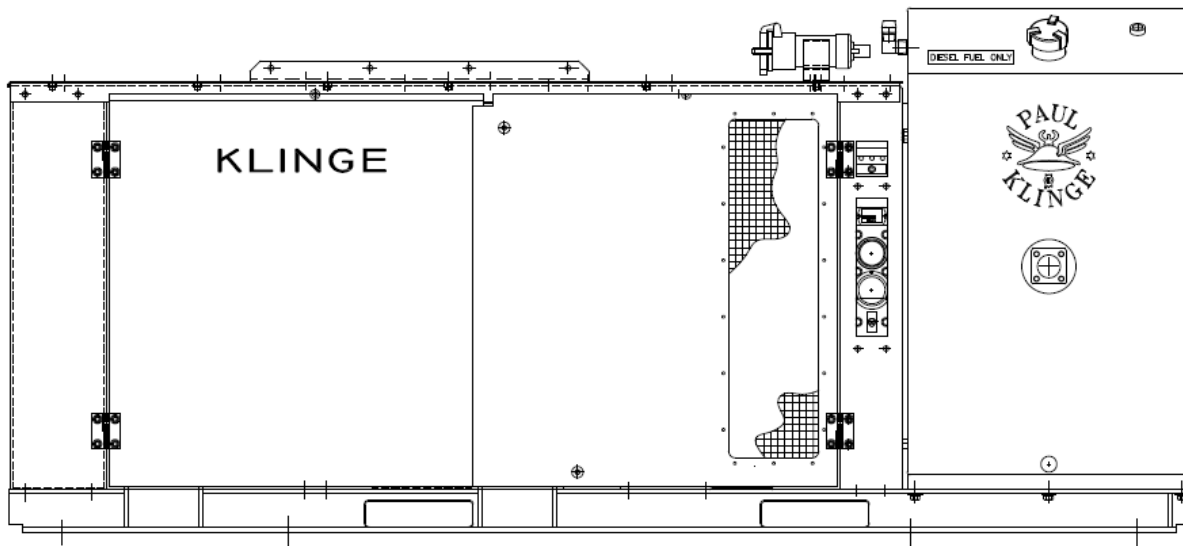


KLINGE

MODEL NMG-115

OPERATION, SERVICE AND PARTS MANUAL



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MANUFACTURED BY KLINGE CORPORATION

REVISION RECORD

Rev	Description	Date	Approved
B	Added Battery Protection Device - see pages 7, 16, 33	2016/05/26	BES
C	15kVA was 15kW (2 places) page 9	2016/06/17	BES
D	Added Servicing Schedule page 20	2016/08/24	BES
E	Updated drawings in Section 6, changes to Service and Maintenance Parts table page 42	2017/06/30	BES
F	Updated safety section based on updated Risk Assessment Review	2017/11/21	JCF
G	Updated cover, revised manual part number (was K35-05850-08-10), add Service and Spare Parts information (pg 6)	2018/03/15	BES
H	Revision to German version	2018/06/11	BES
J	Updated Section 3.9 & Section 6 Engine/Alternator drawing	2021/10/04	BES
K	Corrected Temp gauge and oil press gauge, updated electrical diagram, updated Section 6	2022/03/16	BES
L	Updated Electrical Schematic, updated assembly drawings pgs 24 - 35	2023/01/16	BES

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Service Request

Requests for Service should be directed to the Klinge Service Team. The below link should be used to place all requests for service and will afford the quickest response time.

<https://klingecorp.com/request-service/>

This form will help us determine model and age of the equipment, location, basic details about the issue, who to contact and how to best handle the issues with the equipment. A service ticket number will be provided in a response email once the form is received and processed. If the equipment is out of warranty, charges may apply for extensive technical support.

Additionally, our Service Department can be reached via email at technical@klingecorp.com.

Spare Parts Request

Requests for Spare Parts should be directed to our Parts Department via email at spares@klingecorp.com. Please have available at the time of the request the Serial Number of the equipment to ensure that the proper part is provided.

Use of this Manual

The use of this manual is intended for the safe operation of the equipment described. It is therefore reasoned that persons who have the occasion to use this manual have a knowledge of mechanical and electrical systems and components addressed by its' contents. However, efforts have been made to enable persons less familiar with these systems to use this manual.

The equipment may be installed in a number of configurations. Each may have optional items and differing external details provided by third parties. The specific electrical diagram is posted on the unit as decals.

Suggestions as to improvement in content and format are welcome and should be addressed to engineering@klingecorp.com. Corrections and improvements will be included on dated revisions – the latest of which will be available upon request.

SECTION 1 - SPECIFICATIONS

GENERAL

The NMG-115-10 (Nose Mount Generator Set) was specifically designed to meet the rigorous demands of ocean, over-the-road, and rail transport of 20' and 40' refrigerated containers. The NMG-115-10 can be mounted quickly in the nose of a container, using only four bolts.

CONSTRUCTION

Welded aluminum frame
Aluminum doors and closures
Stainless steel hardware

ENGINE

ISUZU 4LE2PV liquid cooled Diesel.
Four Cylinder; 2.2L; 4 Stroke; Direct Injected; Naturally Aspirated; Glow plug Assisted Start.
37.6 BHP (28.0 kW) @ 1800 RPM Rated Output / 32.1BHP (23.9 kW) @ 1800 RPM Cont.

ALTERNATOR

15 kW / 18.75 kVA MARATHON ELECTRIC - LIMA MAC REEFER, specifically designed for starting 3 phase AC electrical motors.

Single bearing, 10 Lead, 1800 RPM, Y 480 / 240 Volts, 0.8 Power Factor lagging.
Class F-Stator / H-Rotor Insulation, 104°F / 40°C Ambient, 10 Leads, Self-Excited and Inherently Regulated providing 4% voltage regulation without external Voltage Regulator or Transformers, with automatic Volts / Hertz operation capability.

The Air Intake is labyrinth baffled to minimize particle and moisture penetration.

NOTE: The output voltage is not adjustable but is directly related to the engine's speed.
Normal readings at 1800 RPM (60 Hz) are between 460 and 500 V.

TEMPERATURE OPERATING RANGE

From -20°F to +125°F (-30°C to +50°C)

WEIGHT

- 1315 lbs (596 kg) without fuel
- 1665 lbs (755 kg) with full fuel tank

MOUNTING

Mounting clip in back, 4 bolts in front

FUEL SUPPLY

The generator set has an incorporated fuel tank with a capacity of 50 US gallons (190 L) that can provide approximately 50 hours of operation under full load.

POWER SUPPLY

- STANDARD: 15 kVA - 480 V AC / 3 phase / 60 Hz
25 A Power circuit breaker
CEE 17 - 32 A power receptacle
- OPTIONAL: 15 – kVA 230 VAC / 3 phase / 60 Hz
50A power circuit breaker
50 or 60A power receptacle

CONTROLS

- Two toggle switches, ON-OFF and START-PEHEAT
- Low oil pressure switch 1 Pole > 14 PSI (1 kg/cm²) OPEN
- High coolant temperature switch 1 Pole < 221°F (105°C) OPEN
- Electronic TIMER emergency stop unit and LED indicators for cause of shut down
- Engine oil pressure and coolant temperature gauges
- Hour meter
- Ammeter for battery charging control
- AC volt meter for power output control with green band between 420 and 500 V
- 25 A circuit breaker for the DC 12 V system

ELECTRICAL STARTING SYSTEM

- Battery: 12V, Group 31 – 925 CCA @ 0°F (-18°C) with a reserve capacity of 175 minutes.
- Battery charging alternator: 20 or 35 A, 14 V DC
- Starter motor: 2.0 kW, 12V gear reduction type
- Glow plug assisted start with control resistor

FUEL SYSTEM

- The fuel system is self-bleeding and self-priming.
- Electrical 12 V fuel supply pump mounted on the engine.
- Large capacity 10 micron fuel filter with water separator and incorporated 12V-200 W heater to prevent wax build-up in cold weather.

The fuel heater is controlled by a thermostat that starts operating at 45°F (7°C) and stops at 75° F (24°C) as long the electrical control system is “ON”.

- High pressure Bosch / Zexel in line PFR type injection pumps controlled by a variable speed < 5% mechanical governor.

Each cylinder has its own Injection Pump.

LUBRICATION SYSTEM

- Full pressure system with trochoid type oil pump, driven from the crankshaft.
- Oil pan made out pressed stamped steel, full sump, with a capacity of 8.9 U.S. quarts (8.4 liter).
- Full flow, spin-on oil filter, replaceable paper element type.

COOLING SYSTEM

- Pressurized liquid (50/50 water / glycol mixture) forced circulation by centrifugal pump.
- Thermostat, wax pellet type, opening at 170°F (76.5°C).
- Cooling fan suction type, plastic 6 blades, 15.75" (400mm) diameter.
- Heavy duty 4 row, 3 pass copper / brass radiator.
- High coolant temperature switch, normal open, single pole, closing at 221° (105°C).

COMBUSTION AIR CLEANING SYSTEM

- One high performance single stage Cyclopac® air filter with extended life dry cartridge and automatic dust and water expelling Vacuator™ valve.
- Air cleaner restriction indicator for maximum filter life.

SECTION 2 - SAFETY PRECAUTIONS

Safety Glasses should be worn at all times when operating or servicing the Generator Set.

ROTATING HAZARDS

1. Keep your hands, clothing, and tools clear of the alternator belt when the generator set is running.
2. If it is necessary to run the generator with a removed cover, be very careful with tools or meters being used in that area to avoid contacting the rotor.

BATTERY HAZARDS

Few people realize just how dangerous a battery can be.

The electrolyte in a lead acid battery is dilute sulfuric acid (H₂SO₄). During charge or discharge functions of a battery, a chemical change takes place within the individual cells that cause the bubbling we see through the filler hole. This gas bubbling is hydrogen and oxygen, and it is **EXPLOSIVE**. If during this gassing action, a means of ignition is present, an explosion could occur. A defective battery may suddenly explode even while standing idle. Added to this danger, consider a fall-out of highly corrosive sulfuric acid caused by the explosion.

PRECAUTIONS

1. Always wear eye protection when servicing batteries. If electrolyte is splashed on the skin or in the eyes, flush immediately under running water. Obtain medical help as soon as possible.
2. When charging batteries, do not remove the vent caps.
3. When disconnecting or reconnecting the generator-set battery make sure the ON/OFF switch is in the **OFF** position to prevent an arc, which could cause the battery to explode. Disconnect the ground cable first, preferably at a point away from the battery. Reconnect the ground cable last, again away from the battery if possible.
4. **DO NOT** check a battery by "**sparking**" across the posts. Eye injury from the arc or explosion may occur.

NOISE HAZARD

When servicing or operating the Generator Set in a running condition, personal protective hearing equipment should be worn when exposure is longer than 8 hours.

ELECTRICAL HAZARDS

HIGH VOLTAGE

When servicing or repairing a generator set, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with an operating generator. Lethal voltage potentials can exist on connections that are in the exciter control box.

Special attention should be given to the Main Power Plug and Receptacle when disconnecting from each other. When disconnecting these two items ensure that the power circuit breaker has been turned to the off position. Do not pull at the cable but rather with a firm grip on the housing, grab the plug and receptacle and pull apart. If the cable is used rather than the housing the risk exists that the wires within the housing could become dislodged and lead to a future electrical hazard.

PRECAUTIONS

1. When working on high voltage circuits on the generator sets, **DO NOT** make any rapid moves. If a tool drops, **DO NOT** grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
2. Make sure of your footing. If you slip, you will instinctively grab for support. This can be lethal around a generator set. Work on rubber mats or dry wood if possible.
3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed energized conductors are within reach.
4. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.

IMMEDIATE ACTION must be initiated after a person has received an electrical shock.

Obtain expert medical assistance if available.

Remove immediately the source of shock by either shutting it down or removing the victim from the source. If it is not possible to shut off the generator set, the wire should be cut with an insulated tool (e.g. a wooden handled axe or cable cutters with heavy insulated handles), or a rescuer wearing insulated gloves. Whichever method is used, **DO NOT** look at the wire while it is being cut. The ensuing flash can cause blindness. Remember that insulated gloves **MUST BE** insulated and not just rubber gloves manufactured for protection from liquids. If the victim has to be removed from live circuitry, pull him off with a non-conductible material. Use his coat, a rope, a piece of dry wood or loop your belt around his leg or arm and pull him off. **DO NOT TOUCH THE PERSON**, you could receive a shock from current flowing through his body.

After separating the victim from the power source, check immediately for respiration and presence of pulse. If a pulse is present, respiration might be restored by mouth-to-mouth resuscitation.

LOW VOLTAGE

Control circuits utilized by the generator set are low voltage (12 volts D.C.). This voltage potential is not considered dangerous, but the large amount of current available (over 300 amps) can cause severe burns if shorted to ground.

1. Disconnect the negative terminal of the battery if possible when working on the generator set. Disconnect the cable end that is away from the battery.
2. **DO NOT** wear jewelry, watches, or rings. These items can short out and cause severe burns to the wearer.

GENERAL SAFETY PRECAUTIONS

1. To prevent against a possible personnel burn injury the following precautions should be followed:
 - a. Do not touch the muffler, exhaust pipe or exhaust manifold while the unit is in operation or immediately after stopping the unit. The unit should be allowed to cool to an acceptable level prior to performing service in these areas.
 - b. Do not touch the radiator cap or attempt to add coolant to the engine while the unit is in operation or immediately after stopping the unit. The unit should be allowed to cool to an acceptable level prior to opening the radiator cap.
2. Use extreme caution if holes are drilled into the generator set. Holes drilled into an electrical wire can cause fire, explosion, or shock hazard.
3. Ensure all mounting screws are tight and are the correct length.
4. Keep tools and equipment clean and in good working condition. Accidents occur when you attempt procedures without the proper tools.

SAFETY DO'S AND DON'TS

DON' T

DON'T allow inexperienced personnel to work on the generator or electrical equipment.

DON'T remove guards or protective devices.

DON'T wear loose clothing or jewelry in the vicinity of moving parts. These can get in machinery, with disastrous results.

DON'T wear jewelry while working on electrical equipment. If your hair is long, wear a head covering. Hair caught in a drill press, fan belt or other moving part can cause serious injury.

DON'T stand on a wet floor while working on electrical equipment. Use rubber insulated mats placed on dry wood platforms.

DON'T lunge after a dropped tool. To do so may place you in a position of extreme danger.

DON'T commence any operation until you have taken all the necessary steps to ensure that you are in complete safety.

DO

DO perform your tasks carefully, without undue haste.

DO provide fire extinguishers (rated ABC).

DO provide a First Aid Kit (for burns and abrasions). Obtain medical attention, if necessary.

DO use the correct tools for the job you are doing.

DO make sure that all fasteners are secure.

DO use extreme care while making adjustments on the generator set while it is running.

DO keep your hands away from moving parts.

DO remember - Horseplay is for horses! It has no place around machinery.

DO disconnect batteries before starting work on the generator set.

DO use screwdrivers, pliers, diagonal pliers, etc. with insulated handles.

DO remember to keep one hand in your pocket if it is necessary to work on "live" circuits. To do so will prevent passage of electricity into one hand and out the other, which passes current across the heart.

DO PRACTICE SAFETY. THE LIFE YOU SAVE MIGHT BE YOUR OWN.

SECTION 3 - GENERATOR SET OPERATION

PRE-START INSPECTION

1. Check fuel level - Use diesel fuel SAE No. 2-D, No. 1-D in cold weather, or any other equivalent low sulphur content Diesel Fuel as DIN EN 590; BS 2869 Class A-1; JIS No.2; NATO Code F-54 / F-34 / F-44 and XF-63.
2. Check engine oil level – should be at full mark
Use SAE multi-grade oil 10W-40 API rating CC/CD or higher for normal operation and SAE 5W-20 when operating at temperatures below -4°F (-20°C).
3. Check coolant level – should be between the two marks on the overflow bottle.
4. Check fan belt for tension and integrity.
5. Make sure that the generator's main Circuit Breaker located in the electrical control box door is in "OFF" position (down).

STARTING THE UNIT

1. If engine is cold push the "START – PREHEAT" toggle to the left in "PREHEAT" and hold for 5 to 7 seconds. Ammeter should show DISCHARGE.
2. Push "ON – OFF" switch to "ON" position.
The green LED "SYSTEM ON" and the red LED "LOW OIL PRESSURE" will come on and the electric fuel pump will start to operate.
3. Push the "START - PREHEAT" toggle to the right in "START" position in order to crank the engine. Release the switch as soon as the engine has started.
If engine fails to start after 15 seconds of cranking, reset the system by turning the "ON – OFF" switch to "OFF".

Repeat steps #2 and 3, and if needed in cold weather also step #1.

Keep an interval of 15 – 20 seconds between two successive cranking.

NOTE: If for any reason the engine is not started within eight seconds after the "ON – OFF" switch was put in "ON" the timer located in the control box will shut the system down.

The green LED "SYSTEM ON" will go off and the red LED "LOW OIL PRESSURE" will stay "ON" until the system is reset.

AFTER START CHECK-UP

- AC voltmeter needle should be in the green band indicating $\cong 480$ V
- Ammeter should indicate charging
- Hour meter indicator should be rotating
- Engine oil pressure gauge should indicate 30 PSI or higher

ENGINE PROTECTIONS CONTROLS

There are several safety devices employed to prevent damage to the engine, or the electrical system, should a potentially dangerous situation occur.

The 25 A circuit breaker protects DC components and wiring from a short circuit situation. The breaker will reset periodically until the short circuit is removed.

WHEN A DC CIRCUIT BREAKER IS REPLACED IT MUST BE INSTALLED PROPERLY WITH THE "BAT" TERMINAL CONNECTED TO THE LINE OR BATTERY SIDE OF THE CIRCUIT AND THE "AUX" TERMINAL CONNECTED TO THE LOAD SIDE OF THE CIRCUIT AS INDICATED ON THE BREAKER.

Two safety shutdown devices are used to protect the engine. One is the high temperature switch that actuates at 221°F (105°C). Another is an oil pressure switch that actuates at 14 psi (1kg/cm²).

TIMER – EMERGENCY STOP UNIT

The TIMER Emergency Stop Unit provides the safety monitoring of the engine.

The TIMER is completely encapsulated into a mounting case and it is able to withstand a wide ambient temperature range from -4°F (-20°C) to +140°F (+60°C) as the shock and weather conditions encountered in transport applications.

The TIMER automatically shuts down the engine in case of High Coolant Temperature and Low Oil Pressure.

The TIMER also shuts down the electrical control system if:

- The engine runs out of fuel or stops for any other reason
- The engine is not started within eight seconds after the “ON–OFF” switch is put in “ON”.
This prevents battery drain if the “ON-OFF” switch is accidentally pushed in “ON” position.

LED INDICATORS

The electrical control system is provided with three, high intensity colored (one green and two red) LEDs located at the upper, front of the control box.

- Green LED: “SYSTEM ON”
- Red LED: “LOW OIL PRESSURE”
- Red LED: “HIGH COOLANT TEMPERATURE”

Red LED -LOW OIL PRESSURE- “ON” indicates that the unit is shut down either for low oil pressure, or engine has run out of fuel, or that the ON-OFF switch was accidentally turned ON.

Both red LED – LOW OIL PRESSURE and HIGH COOLANT TEMPERATURE- “ON” indicate that the unit is shut down for high coolant temperature.

ENGINE SPEED (RPM) AND FREQUENCY

The engine must be set to run at 1800 to 1850 rpm corresponding to a frequency of 60 to 62 Hz at full load.

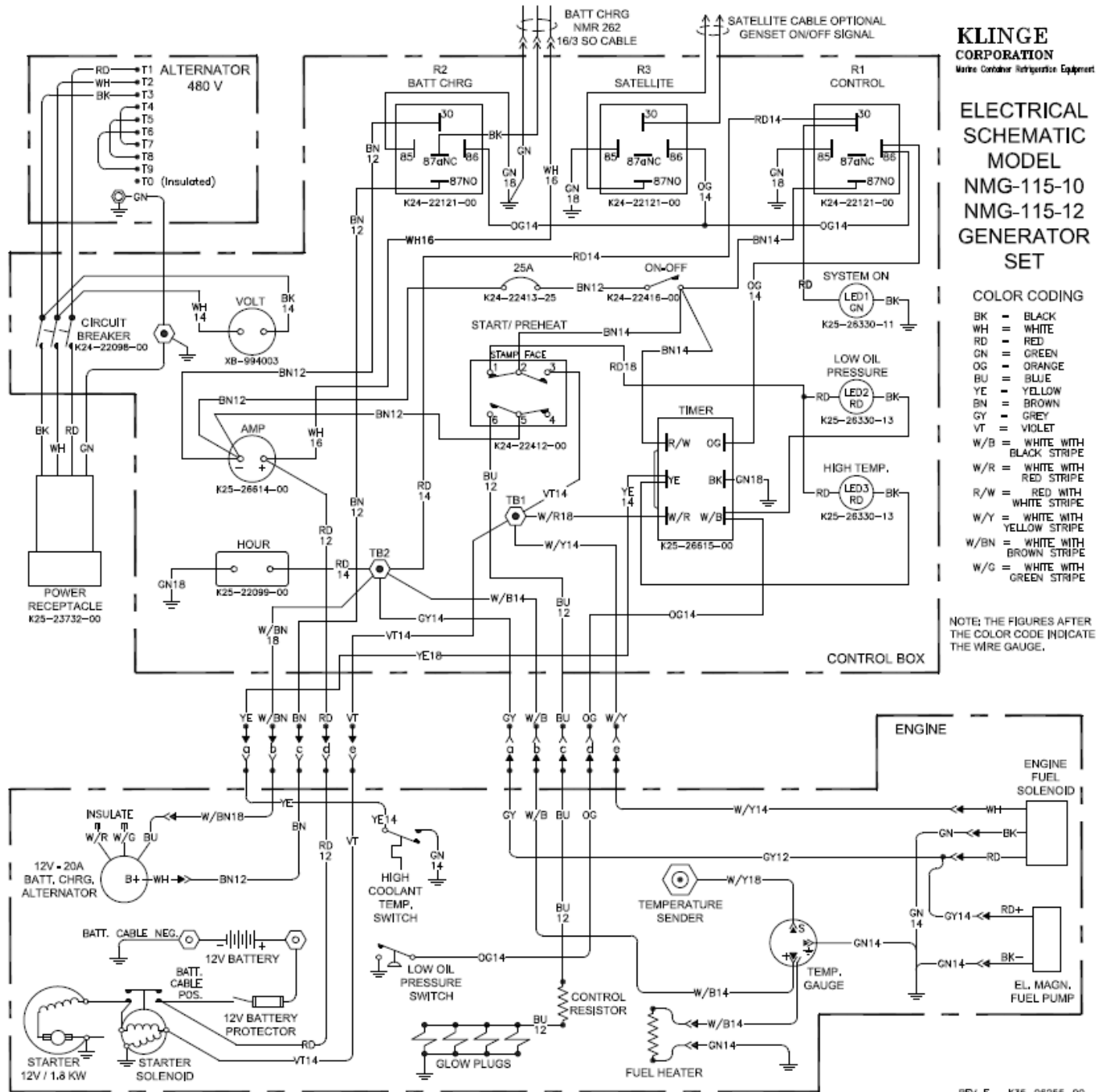
Full load is considered to be when the reefer unit runs in an ambient of + 90 to 100°F (+ 32 to 38° C) and the box temperature is + 32°F (0°C) or above.

NOTES:

1/ AVOID OVER SPEEDING SINCE ALTERNATOR VOLTAGE CAN RISE UP TO 525 – 550 VOLTS AND SEVERE DAMAGES CAN OCCUR.

2/ UNDER NO CONDITION SHOULD THE RPM BE BELOW 1800 RPM (60 Hz).

WIRING DIAGRAM



KLINGE CORPORATION
 Marine Container Refrigeration Equipment

ELECTRICAL SCHEMATIC MODEL
NMG-115-10
NMG-115-12
GENERATOR SET

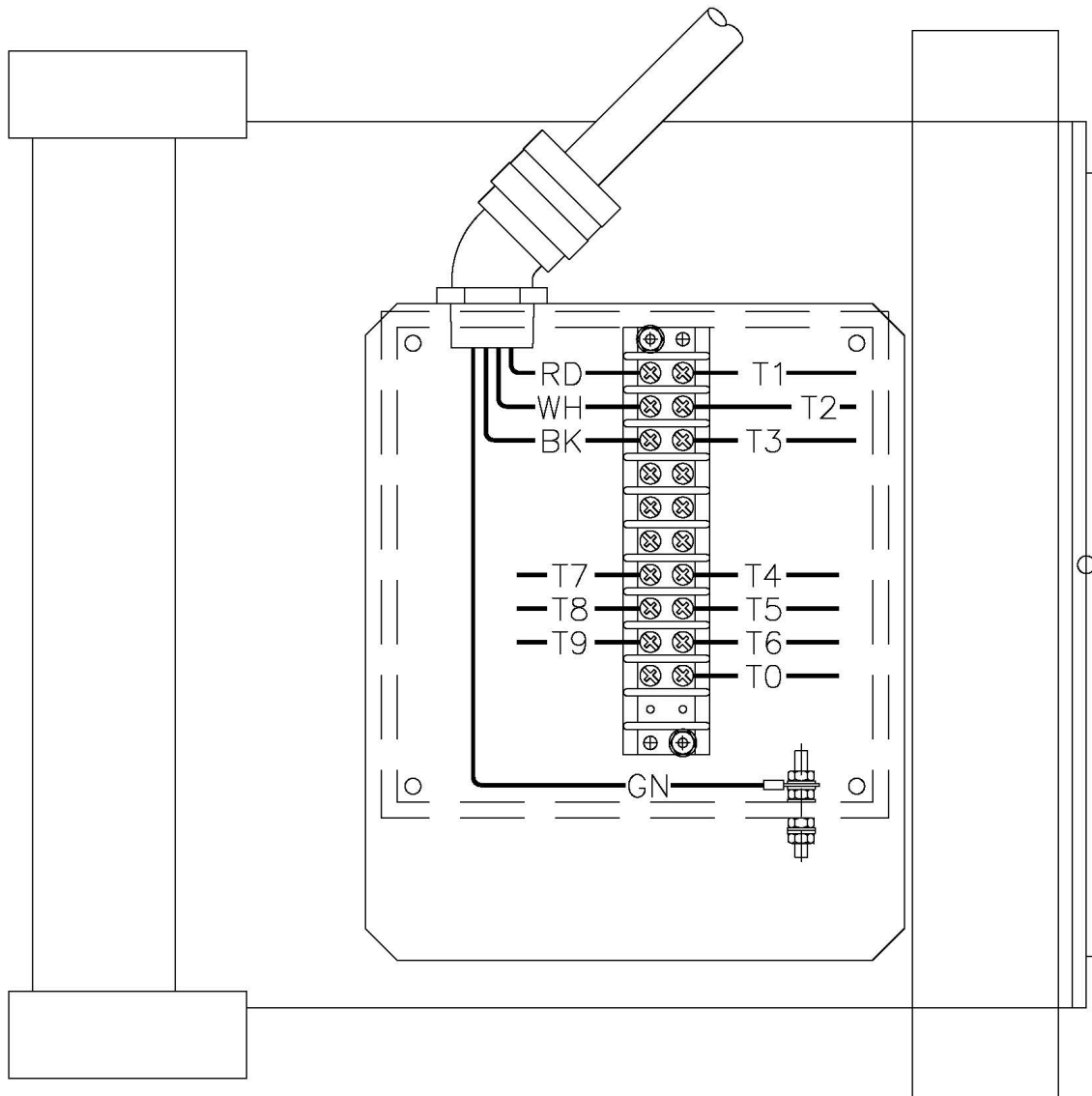
COLOR CODING

- BK = BLACK
- WH = WHITE
- RD = RED
- GN = GREEN
- OG = ORANGE
- BU = BLUE
- YE = YELLOW
- BN = BROWN
- GY = GREY
- VT = VIOLET
- W/B = WHITE WITH BLACK STRIPE
- W/R = WHITE WITH RED STRIPE
- R/W = RED WITH WHITE STRIPE
- W/Y = WHITE WITH YELLOW STRIPE
- W/BN = WHITE WITH BROWN STRIPE
- W/G = WHITE WITH GREEN STRIPE

NOTE: THE FIGURES AFTER THE COLOR CODE INDICATE THE WIRE GAUGE.

REV F K35-08255-00

ALTERNATOR WIRING



TOP VIEW
ALTERNATOR WIRING
INSIDE JUNCTION BOX

SECTION 4 - MAINTENANCE AND COMPONENT INFORMATION

FUEL SYSTEM

The fuel injection pumps and fuel injection nozzles are precisely manufactured and therefore using fuel which contains water or dust particles will result in equipment seizure, costly damages and decreased engine output.

Replace fuel filter element after every 500 hrs of operation.

Use KLINGE XB-998162-2 filter element.

Before starting the unit check for leaks and for water in the filter bowl. Drain if necessary.

Use SAE No.2-D Diesel fuel, 1-D in cold weather.

Following standards are also approved: DIN EN 590; BS 2869 Class A-1; JIS No.2;

NATO Code F-54 / F-34 / F-44 and XF-63.

If not available select a diesel fuel with low sulphur and high cetane value.

DO NOT USE:

- Diesel fuel that has been contaminated with engine oil, this can cause engine damage and can also affect emission control.
- Fuel additives, except “Biocide” type, if required.

COMBUSTION AIR INTAKE SYSTEM

Engine performance and life depends on the intake air condition.

Replace air filter cartridge after every 500 hrs. of operation.

Use KLINGE K26 25091 08 filter cartridges.

After 250 hours of operation, or more often if the generator set is operated in a dusty environment, remove the filter cartridge and from the inside, blow air at a pressure of 45 –70 PSI (3 – 5 kg/cm²) to remove the dust.

Take care to not damage the filter element during the cleaning and to not cause air leakage (sucking) when the air cleaner is reassembled.

LUBRICATION

A correct oil and filter service will ensure good performance and a long engine life.

Change oil and filter after initial 50 hrs. of operation. Afterwards change the oil every 250 hrs and filter every 500 hrs of operation or at least once in a year.

Use SAE multi-grade oil SAE 10W-40 API rating CC / CD or higher and SAE 5W-20 when operating at temperatures below -4°F (-20°C).

Use KLINGE XB-998209 filter element.

Check the oil level before every start, add oil if required up to the FULL mark.

CAUTION: Never mix different brands or different types of oils.

COOLING SYSTEM

Use 50/50 ethylene glycol / water solution. Never exceed 60 / 40 antifreeze water mix.

NOTE: Concentrations over 65% ethylene glycol adversely affects freeze protection, heat transfer rates and silicate stability that may cause water pump leakage.

Replace coolant every two years.

Check the hoses and pump for leaks and the coolant level. With a cool engine, the liquid level should be between the two marks on the expansion tank.

FAN BELT

Check the fan belt for tension and integrity before every starting.
Replace if necessary using KLINGE K26 25145 112 belt.

VALVE CLEARANCE ADJUSTMENT

It is recommended to adjust the valve clearance every 1000 operating hours, or whenever the valve rocker is abnormally noisy. Valve adjustments should also be made if there is an engine malfunction though the fuel system is properly working.

With a cold engine the valve clearance, both intake and exhaust, is 0.0157 inches (0.40) mm.

CAUTION: The rocker arms are made of die-cast aluminum. Therefore, be careful not to tighten the adjusting screw to excess.

INJECTION TIMING ADJUSTMENT

The injection timing needs not to be readjusted.

When an injection pump is removed for any reason, at reassembling take care to not forget to insert the shim on the mounting surface.

CYLINDER COMPRESSION MEASUREMENT

The cylinder compression pressure measurement must be done whenever the engine output is reduced.

Compression pressure: 441 PSI (3.04 MPa)
Test condition: Cranking speed 250 RPM
Coolant temperature 167°F (75°C)

NOTE: Repair the engine and / or replace some parts if compression pressure is lower than 370 PSI (2.55 MPa).

FUEL INJECTION NOZZLES

An injection nozzle test is required any time when the engine output is reduced, and blackish exhaust smoke is present.

Testing should be performed in a specialized shop where the necessary equipment is available.

Tests should be performed to check the static injection starting pressure and the fuel spray conditions.

The injection nozzle opening pressure should be 2560 PSA (17.7 MPa).

BATTERY

Keep the battery fully charged all the time, it is important especially in cold ambient conditions.

Keep the battery posts clean and the battery cables tightened securely.

Always disconnect the battery negative cable when work on the unit is performed.

If distilled water is needed to be added, do it before the unit will be operated, otherwise the water will not mix with the acid and can freeze in cold weather.

STARTER AND BATTERY CHARGING ALTERNATOR

Starter and battery charging alternator servicing consists of:

- Check the carbon brushes and the brush contact.
- Clean the alternator slip ring.

Avoid spraying water or steam on the alternator and on the starter, as it may cause damage.

SERVICING SCHEDULE

	Daily or Weekly	Initial 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Every 2000 Hours
GENERATOR SET (NMG-115)						
Check Fuel Level / add if needed	X					
Check sediment bowl on fuel filter (Drain water and clean if needed)		X	X			
Replace Fuel Filter				X		
Replace Air Filter Insert (More frequent may be required based on operating area)				X		
Check Oil Level / add if needed	X					
Replace Oil Filter		X		X (Min Yearly)		
Replace Oil		X	X (Min Yearly)			
Check for fluid leaks	X	X				
Check radiator coolant level/ add if needed	X					
Inspect and if needed clean radiator fins			X			
Flush radiator and replace coolant and hoses						X
Inspect and adjust cooling fan V-belt		X	X			
Replace V-belt						X
Inspect and clean Vacuumator valve (Air Filter)			X			
Check engine for unusual noises or exhaust smoke	X		X			
Ensure battery terminals are tight			X			
Check main circuit breaker plastic boot			X			
Inspect unit and generator set for damaged, loose, or broken parts, missing bolts			X			
Check condition of mounting bolts		X	X			
Check condition of engine and alternator mounts (replace if necessary)		X			X	

- In addition to the above checklist the normal Pre-Trip Inspection Form should also be completed every 2 months.

PTI FORM

It is important that a Pre-Trip Inspection (PTI) be completed prior to each shipment.

The NMG-115 PTI form can be found on Klinge's website at: <http://www.Klingecorp.com/pti/>

SECTION 5 - TROUBLE SHOOTING

The following trouble shooting chart is by no means complete, but covers the more general type problems, which would most likely occur if a breakdown is experienced.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION SUGGESTED
Engine starter will not energize	Loose or corroded battery terminals	Clean terminals and tighten
	Battery voltage too low	Recharge or replace battery
	Faulty START / PREHEAT switch	Replace
	Faulty ON / OFF switch	Replace
	Faulty starter solenoid	Replace
	Faulty starter motor	Replace
	Circuit breaker open	Replace if it does not reset
Starter turns but engine does not ignite	Faulty control relay R1	Replace
	Faulty emergency stop timer	Replace
	Faulty engine fuel solenoid	Replace
	Control rack is stuck in stop position	Remedy
	Engine too hot and protection system will not allow to operate	Allow engine to cool will not allow starter
	Faulty coolant temperature switch	Replace switch
	Faulty electrical fuel pump	Replace
	No fuel	Add fuel to tank
	Clogged fuel filter element	Replace
Engine starts but stalls immediately	Air in the fuel system	Remedy and bleed the system
	Defective oil pressure switch - Low oil pressure LED stays ON	Replace switch
	Oil level to low	Add oil
Engine stops with high engine temperature indication	Coolant temperature too high	Check cooler for air flow restriction and clean or remove restriction
	Coolant level too low	Add coolant
	Defective high temperature switch	Replace switch
	Thermostat malfunction	Replace

	Fan belt slippage or broken	Adjust tension or replace
Black exhaust	Clogged air filter	Clean the filter cartridge or replace
	Improper fuel – low cetane grade	Replace fuel
	Nozzle damage	Repair or replace nozzle
White smoke	Water mixed in fuel	Replace fuel and clean fuel filter
	Low compression pressure	Check compression
	Low coolant temperature	Check thermostat and replace if needed
Unstable engine running (Hunting)	Defective governor spring	Replace
	Incorrect valve adjustment	Adjust valve clearance
No voltage at power receptacle but AC voltmeter needle is in the green band	Main circuit breaker is on OFF position	Turn main circuit breaker ON
	Defective main circuit breaker	Replace
Problem: No AC voltage	No residual magnetism in the alternator exciter field	Restore magnetism by flashing field See 5.2 Restoring residual magnetism
	Open in main stator windings	Check for continuity in windings See 5.3 Checking main stator windings
	* Open or short in rotating diodes	Check rotating diodes and replace if needed
	* Open in alternator field	Check for continuity. If field coils are open, replace the rotor or repair it
	* Shorted exciter armature	Check for short and replace if faulty. Use a Kelvin type bridge to measure this resistance
	* Shorted leads between exciter armature and generator field	Test and repair
NOTE: * Designate rotating parts. The rear alternator cover (bearing carrier) must be removed in order to perform the test. For instructions how to perform the tests see “ALTERNATOR MANUAL” at the end of this Manual.		
Low voltage	Low speed	Check engine speed or system for overload
	Excess load	Reduce load. The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg
	High resistance connections – Connections will be warm or hot	Make better connections, electrically and mechanically
	Shorted field	Test field coils for possible short. Use an Ohmmeter or resistance bridge. Repair or replace rotor if alternator field

		coils are shorted
Fluctuating voltage	Irregular engine speed	Check engine for malfunction
	Loose terminal or load connections	Tighten connections
	Defective bearing causing uneven gap	Replace alternator bearing
Overheating	Generator overloaded	Reduce load. Check with ammeter and compare with alternator nameplate rating
	Unbalanced load	The load on each leg should be as evenly balanced as possible and should not exceed the rated current on each leg
	Dry bearing	Replace bearing
	Clogged vent ducts	Clean air passages

SECTION 6 - SERVICE PARTS

LIST OF CONTENTS

Final Assembly NMG-115-10

Final Assembly NMG-115-12

Kit Battery Disconnect

Engine / Alternator Assembly

Fuel System Components

Electrical Box Assembly

Door Electrical Box

Isuzu Engine Repair Illustrations

Marathon Electric Alternator Manual

QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
1	360-14361-00	1	FRAME ASSEMBLY NMG-115-10 COMPLETE	1	360-14363-00	40	PANEL ASSEMBLY TANK END NMG-115-10
4	XB-993076	2	SHOCK MOUNT	1	360-14491-00	41	PANEL ALTERNATOR END WELDED & PAINTED WHITE NMG-115-10
4	K21-16486-04	3	WASHER FLAT SS 1/2-13 X 3.5	1	060-14512-00	42	POST FRAME FRONT WELDED & PAINTED WHITE
4	K21-16220-00	4	SCREW HEX SS 1/2-13 X 3.5	1	360-14530-00	43	POST ASSEMBLY FRAME REAR NMG-115-10
8	K21-16195-00	5	WASHER FLAT SS 1/2-1.06 O.D.	1	360-14399-00	44	ANGLE ASSEMBLY TOP FRONT NMG-115-10
4	K21-14921-11	6	NUT LOCK SS 1/2-13	1	360-14480-00	45	ANGLE ASSEMBLY TOP REAR NMG-115-10
1	360-14355-01	7	ENGINE ALTERNATOR ASSEMBLY NMG-115-10 ISUZU / LIMA	1	060-14492-00	46	ANGLE DIAGONAL SUPPORT TOP PLATE NMG-115-10
1	K21-16180-00	8	RECEPTACLE SS SIZE 17 SCREW	15	K21-50492-03	47	WASHER INSULATING PVC 1/4 (0.62 O.D. X 0.020 THICK)
14	K21-14069-00	9	WASHER LOCK SS 3/8 HEAVY 18-8	15	K21-14921-05	48	NUT LOCK SS 1/4-20
14	K21-14073-00	10	WASHER FLAT SS 3/8 0.44 I.D. 1.00 O.D. 0.083 THICK	6	K21-14642-00	49	SCREW HEX SS 1/4-20 X 1/2"
1	360-14489-00	11	FAN SHROUD ASSEMBLY NMG-115-10	1	360-14374 00	50	BOX ASSEMBLY ELECTRICAL FULLY WIRED NMG-115-10
1	XB-340015	12	RADIATOR A ROW / 3 PASS	1	360-14475-00	51	DOOR ASSEMBLY LEFT - ALTERNATOR END NMG-115-10
1	XB-205126	13	BRACKET ASSEMBLY RADIATOR HOLD-DOWN	1	360-14477-00	52	DOOR ASSEMBLY RIGHT - ENGINE END NMG-115-10
1	XB-340024	14	HOSE RADIATOR INLET	2	K29-17880-01	53	HINGE SLIP SS 9/32 HOLE SOCKET LEFT HAND
1	XB-340025-01	15	HOSE RADIATOR OUTLET NMG-115-10	2	K29-17879-01	54	HINGE SLIP SS 9/32 HOLE SOCKET RIGHT HAND
5	XB-998038	16	CLAMP HOSE SS RANGE 1-2"	4	060-09113-00	55	INSULATOR HINGE
2	XB-993011-03	17	RUBBER NEOPRENE 3/16 X 3 X 9"	1	360-14494-00	56	PANEL ASSEMBLY TOP NMG-115-10
1	XB-993000-05	18	RUBBER NEOPRENE 1/8 X 1 X 12"	2	060-14492-00	57	RETAINER POWER CABLE NMG-115-10
86 IN.	XB-998090	19	TUBE PVC CLEAR 5/16 I.D.	4	K2B-10691-00	58	STRAP 15" LONG NO HOOKS
		20		8	K29-18490-00	59	HOOK STRAP SS Ø0.125 WIRE
6	K21-15649-03	21	CLAMP CUSHIONED SS 1/2 I.D.	1	360-14495-00	60	PANEL ASSEMBLY REAR NMG-115-10
1	060-14473-00	22	HOLDER RADIATOR OUTLET HOSE	1	360-14504-00	61	FUEL SYSTEM COMPONENTS NMG-115-10
2	K21-13549-00	23	RIVET ALUM. 1/8 (18-25)	1	K25-25912-00	62	BATTERY 12 VOLT 3/8 TOP STUDS WITH NUTS - 950 CCA
3	K21-10186-00	24	WASHER LOCK SPG SS 1/4 HEAVY 18-8	1	360-14506-01	64	BATTERY CABLE POSITIVE (+) NMG-115-10
31	K21-10189-00	25	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8	1	360-14506-02	65	BATTERY CABLE NEGATIVE (-) NMG-115-10
1	060-14394-00	26	POST RADIATOR FRAME FRONT NMG-115-10	1	060-14493-00	66	ANGLE SS BATTERY HOLD-DOWN
1	360-14529-00	27	POST ASSEMBLY RADIATOR FRAME REAR NMG-115-10	2	XB-209049	67	ROD BATTERY HOLD-DOWN
1	360-14398-00	28	ANGLE ASSEMBLY RADIATOR TOP SUPPORT NMG-115-10	2	XB-993011-02	68	RUBBER NEOPRENE 3/16 X 3 X 12"
1	360-11014-00	29	CLIP ASSEMBLY RETAINING SPARE PARTS BOX	1	XB-993011-22	69	RUBBER NEOPRENE 3/16 X 2 X 8.5"
87	K21-14072-00	30	WASHER FLAT SS 5/16 0.38 I.D. 0.88 O.D. 0.083 THICK	1	K21-16548-08	70	CLAMP CABLE CS VINYL COATED 0.81 I.D. 0.406 MTG. HOLE
84	K21-50492-04	31	WASHER INSULATING PVC 5/16 (0.88 O.D. X 0.020 THICK)	1	K21-15649-08	71	CLAMP CUSHIONED SS 3/4" I.D. 0.28 MTG. HOLE
28	K21-14921-07	32	NUT LOCK SS 5/16-18	7	K21-14730-00	72	SCREW HEX SS 5/16-18 X 1.25"
48	K21-14059-00	33	SCREW HEX SS 5/16-18 X 1.00"	1	K35-06266-00	73	LABEL 15KVA 480V 60HZ 3Ø
2	K21-16395-04	34	SCREW FLAT SS 5/16-18 X 1.00" SLOT	1	K23-07799-00	74	
1	360-14500-00	35	TANK ASSEMBLY FUEL NMG-115-10	1		75	CLAMP HOSE 7/16 OD 0.075 SS WIRE
14	K21-14972-00	36	SCREW HEX SS 3/8-16 X 1.25"				
6	K21-50492-05	37	WASHER INSULATING PVC 3/8 (1.00 O.D. X 0.020 THICK)				
29	K21-14761-00	38	WASHER LOCK SS 5/16 HEAVY 18-8				
18	K21-14057-00	39	SCREW HEX SS 1/4-20 X 3/4"				

NOTES:
 1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS.
 2. INSTALL ITEM #81 (FUEL SYSTEM COMPONENTS) USING THE HARDWARE AND INSTRUCTIONS FROM 360-14504-00.
 3. IF ITEM #15 (RADIATOR HOSE) DOES NOT COME WITH CONDUIT INSTALL ON IT USE 060-15603-00 (SLEEVING)

DATE	CHK NO	DR	CHK	DATE	CHK NO	DR	CHK
8/14/14	14-361	JH	BES	3/6/17	17-140	SKM	BES
4/09/15	15-060	DBE	BES	5/25/17	17-284	DBE	BES
7/16/15	15-171	DBE	BES	2/22/2024	22-142	DBE	BES
5/23/16	16-227	DBE	BES				
8/20/16	16-280	DBE	BES				

REVISION RECORD

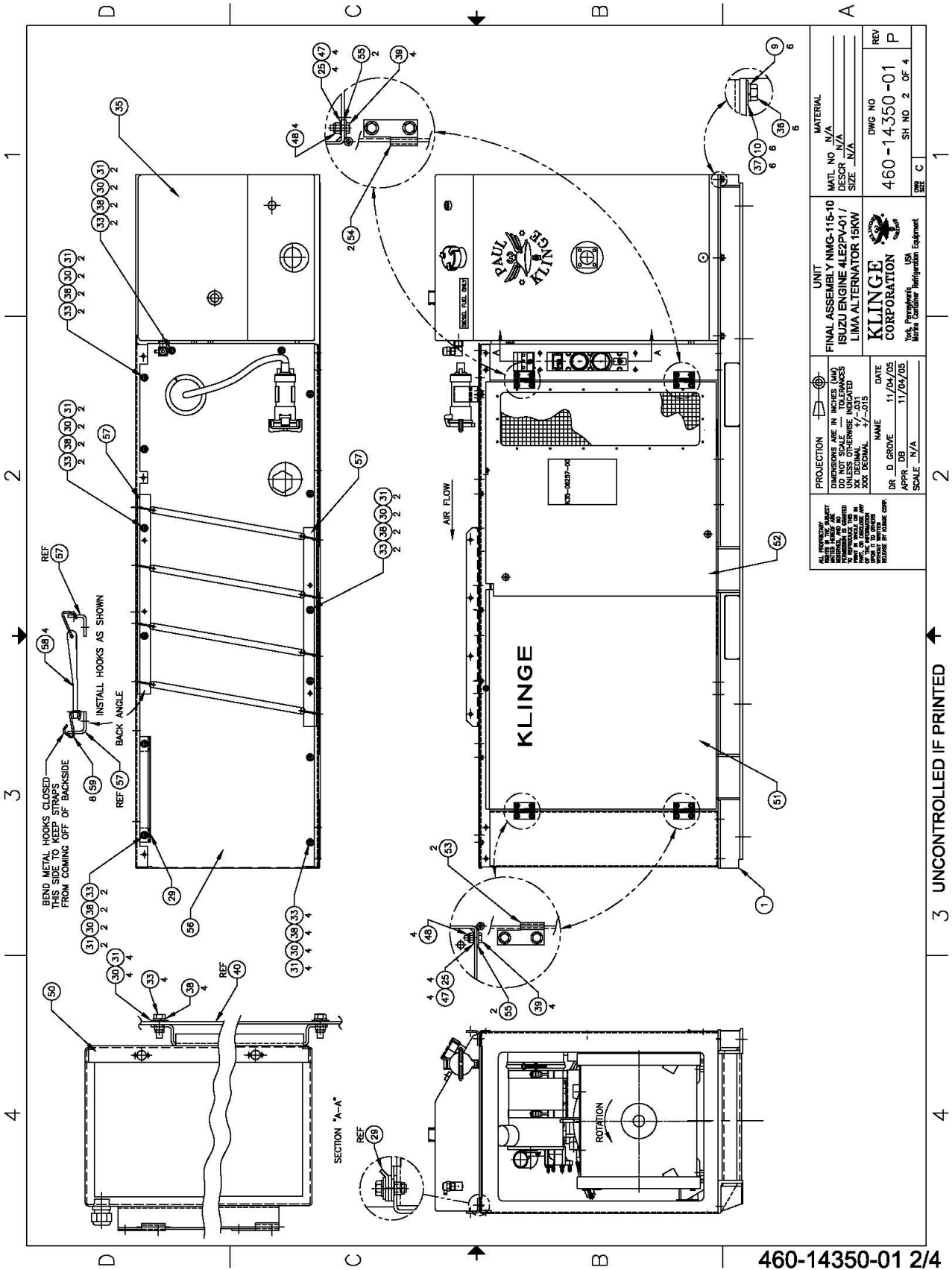
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L	ITEM # 63				ITEM #62 WAS K25-25912-01, REMOVED
M	3/17/17	17-161	DBE	BES	SWAPPED 2 CABLES TO CONTROL BOX SHEET 4
N	5/25/17	17-284	DBE	BES	ITEM #3 WAS XB-998077
P	2/22/2024	22-142	DBE	BES	REMOVED ITEM #20 K23-1028-00 DRIT 2 SEE SHIT

UNIT: **KLINGE CORPORATION**
 11/24/05
 11/24/05
 11/24/05
 11/24/05

FINAL ASSEMBLY NMG-115-10
 ISUZU ENGINE ALE2PV-01 /
 LIMA ALTERNATOR 15KW

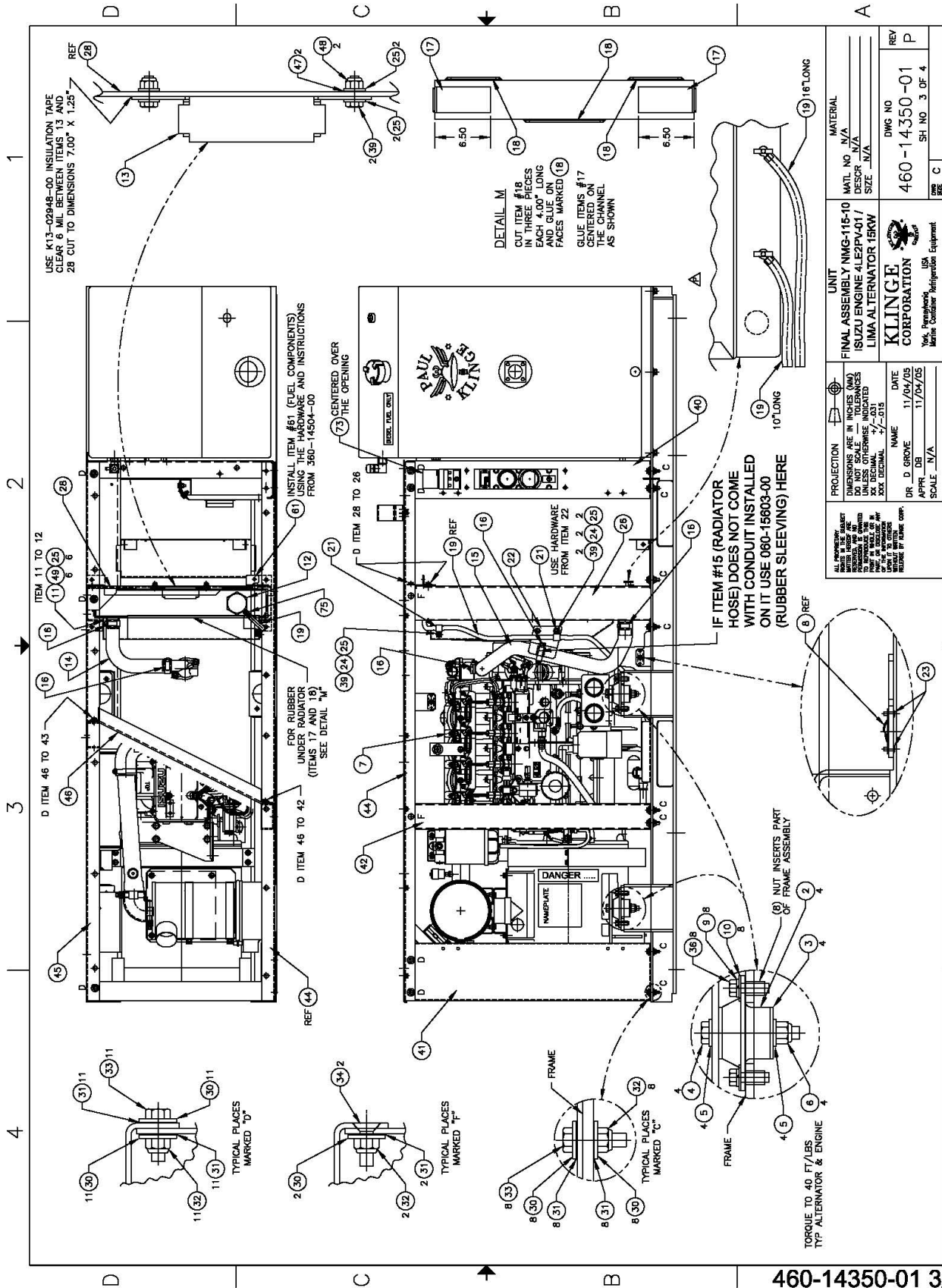
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 SHI NO 1 OF 4

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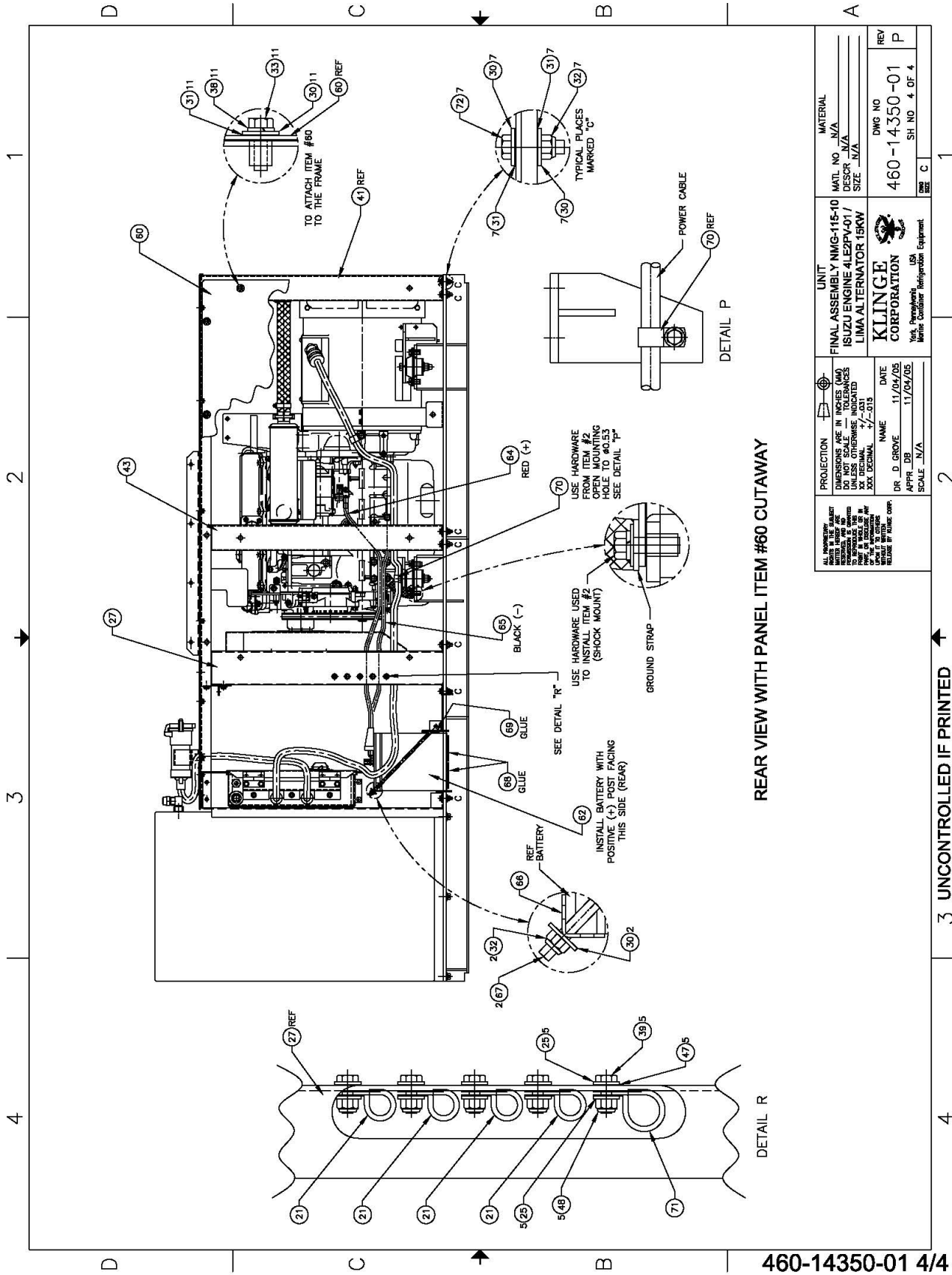


ALL DIMENSIONS ARE IN INCHES (MM) UNLESS OTHERWISE INDICATED. DIMENSIONS ARE TO CENTER UNLESS OTHERWISE INDICATED. DIMENSIONS TO CENTER UNLESS OTHERWISE INDICATED. DIMENSIONS TO CENTER UNLESS OTHERWISE INDICATED. DIMENSIONS TO CENTER UNLESS OTHERWISE INDICATED.	PROJECTION 	UNIT FINAL ASSEMBLY NMG-115-10 ISUZU ENGINE 4LE2PV-01/ LIMA ALTERNATOR 15KW	MATERIAL MATL NO N/A DESCR N/A SIZE N/A
	NAME DR D GROVE	DATE 11/04/05	DWG NO 460-14350-01
	APPR DB SCALE N/A	NAME DR D GROVE	SH NO 2 OF 4
	SCALE N/A	NAME DR D GROVE	REV P

460-14350-01 2/4



460-14350-01 3/4



REAR VIEW WITH PANEL ITEM #60 CUTAWAY

460-14350-01 4/4

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (AMA) UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: FRACTIONS DECIMALS XX .015 XX .015 XX .015 XX .015		PROJECTION FIRST ANGLE DIMENSIONS ARE IN INCHES (AMA) DO NOT SCALE TOLERANCES FRACTIONS DECIMALS XX .015 XX .015 XX .015 XX .015	UNIT FINAL ASSEMBLY NMG-115-10 ISUZU ENGINE 4LE2PV-01 / LIMA ALTERNATOR 18KW KLINGE CORPORATION USA Y&A Products, Inc. Marine Container Refrigeration Equipment	MATERIAL MATL NO N/A DESC N/A SIZE N/A DWG NO 460-14350-01 SH NO 4 OF 4 REV P
NAME DR D GROVE APPR DB SCALE N/A		DATE 11/04/05 11/04/05	DR D GROVE APPR DB SCALE N/A	DWG NO 460-14350-01 SH NO 4 OF 4 REV P

QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
1	360-14361-12	1	FRAME ASSEMBLY NMG-115-12 COMPLETE	1	360-14363-00	40	PANEL ASSEMBLY TANK END NMG-115-10
4	XB-999076	2	SHOCK MOUNT	1	360-14491-00	41	PANEL ALTERNATOR END WELDED & PAINTED WHITE NMG-115-10
4	K21-16486-04	3	WASHER SNUBBING	1	060-14512-00	42	POST FRAME FRONT WELDED & PAINTED WHITE
4	K21-16220-00	4	SCREW HEX SS 1/2-13 X 3.5	1	360-14530-00	43	POST ASSEMBLY FRAME REAR NMG-115-10
8	K21-16195-00	5	WASHER FLAT SS 1/2-1.06 O.D.	1	360-14378-12	44	ANGLE ASSEMBLY TOP FRONT NMG-115-12
4	K21-14921-11	6	NUT LOCK SS 1/2-13	1	360-14480-00	45	ANGLE ASSEMBLY TOP REAR NMG-115-10
1	360-14355-01	7	ENGINE ALTERNATOR ASSEMBLY NMG-115-10 ISUZU / LIMA	1	060-14492-00	46	ANGLE DIAGONAL SUPPORT TOP PLATE NMG-115-10
1	360-11014-00	8	CLIP ASSEMBLY RETAINING SPARE PARTS BOX	15	K21-50492-03	47	WASHER INSULATING PVC 1/4 (0.62 O.D. X 0.020 THICK)
14	K21-14069-00	9	WASHER LOCK SS 3/8 HEAVY 18-8	15	K21-14921-05	48	NUT LOCK SS 1/4-20
14	K21-14073-00	10	WASHER FLAT SS 3/8 0.44 I.D. 1.00 O.D. 0.083 THICK	6	K21-14642-00	49	SCREW HEX SS 1/4-20 X 1/2"
1	360-14489-00	11	FAN SHROUD ASSEMBLY NMG-115-10	1	360-14374 00	50	BOX ASSEMBLY ELECTRICAL FULLY WIRED NMG-115-10
1	XB-340015	12	RADIATOR 4 ROW / 3 PASS	1	360-14475-00	51	DOOR ASSEMBLY LEFT - ALTERNATOR END NMG-115-10
1	XB-205126	13	BRACKET ASSEMBLY RADIATOR HOLD-DOWN	1	360-14477-12	52	DOOR ASSEMBLY RIGHT - ENGINE END NMG-115-12
1	XB-340024	14	HOSE RADIATOR INLET	2	K29-17880-01	53	HINGE SLIP SS 9/32 HOLE SOCKET LEFT HAND
1	XB-340025-01	15	HOSE RADIATOR OUTLET	2	K29-17879-01	54	HINGE SLIP SS 9/32 HOLE SOCKET RIGHT HAND
5	K21-18426-02	16	CLAMP HOSE SS HD RANGE 1.2" - 2.1"	4	060-09113-00	55	INSULATOR HINGE
2	XB-993011-03	17	RUBBER NEOPRENE 3/16 X 3 X 9"	1	360-14484-00	56	PANEL ASSEMBLY TOP NMG-115-10
1	XB-993000-05	18	RUBBER NEOPRENE 1/8 X 1 X 12"	2	060-14492-00	57	RETAINER POWER CABLE NMG-115-10
66 IN.	XB-998090	19	TUBE PVC CLEAR 5/16 I.D.	4	K29-18490-00	58	STRAP 15" LONG NO HOOKS
		20		8	360-14495-00	59	HOOK STRAP SS #0.125 WIRE
6	K21-15649-03	21	CLAMP CUSHIONED SS 1/2 I.D.	1	360-14504-00	60	PANEL ASSEMBLY REAR NMG-115-10
1	060-14473-00	22	HOLDER RADIATOR OUTLET HOSE	1	K25-25912-00	62	BATTERY 12 VOLT 3/8 TOP STUDS WITH NUTS - 950 CCA
1		23					
3	K21-10186-00	24	WASHER LOCK SPG SS 1/4 HEAVY 18-8	1	360-14506-01	64	BATTERY CABLE POSITIVE (+) NMG-115-10
31	K21-10189-00	25	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8	1	360-14506-02	65	BATTERY CABLE NEGATIVE (-) NMG-115-10
1	060-14394-00	26	POST RADIATOR FRAME FRONT NMG-115-10	1	060-14493-00	66	ANGLE SS BATTERY HOLD-DOWN
1	360-14529-00	27	POST ASSEMBLY RADIATOR FRAME REAR NMG-115-10	2	XB-209049	67	ROD BATTERY HOLD-DOWN
1	360-14398-00	28	ANGLE ASSEMBLY RADIATOR TOP SUPPORT NMG-115-10	2	XB-993011-02	68	RUBBER NEOPRENE 3/16 X 3 X 12"
		29		1	XB-993011-22	69	RUBBER NEOPRENE 3/16 X 2 X 8.5"
87	K21-14072-00	30	WASHER FLAT SS 5/16 0.38 I.D. 0.88 O.D. 0.083 THICK	1	K21-16548-09	70	CLAMP CABLE CS VINYL COATED 0.81 I.D. 0.406 MTG. HOLE
85	K21-50492-04	31	WASHER INSULATING PVC 5/16 (0.88 O.D. X 0.020 THICK)	1	K21-15649-08	71	CLAMP CUSHIONED SS 3/4" I.D. 0.28 MTG. HOLE
31	K21-14921-07	32	NUT LOCK SS 5/16-18	9	K21-14730-00	72	SCREW HEX SS 5/16-18 X 1.25"
47	K21-14059-00	33	SCREW HEX SS 5/16-18 X 1.00"	1	K35-06286-00	73	LABEL 15KVA 480V 60HZ 3Ø
2	K21-16395-04	34	SCREW FLAT SS 5/16-18 X 1.00" SLOT	1	K35-06653-00	74	LABEL INSTRUCTION PICTORIAL NMR/NMG
1	360-14500-00	35	TANK ASSEMBLY FUEL NMG-115-10	1	K23-07799-00	75	CLAMP HOSE 7/16 OD 0.075 SS WIRE
14	K21-14972-00	36	SCREW HEX SS 3/8-16 X 1.25"				
6	K21-50492-05	37	WASHER INSULATING PVC 3/8 (1.00 O.D. X 0.020 THICK)				
29	K21-14761-00	38	WASHER LOCK SS 5/16 HEAVY 18-8				
18	K21-14057-00	39	SCREW HEX SS 1/4-20 X 3/4"				

NOTES:
 1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS
 2. INSTALL ITEM #81 (FUEL SYSTEM COMPONENTS) USING THE HARDWARE AND INSTRUCTIONS FROM 360-14504-00.
 3. IF ITEM #15 (RADIATOR HOSE) DOES NOT COME WITH CONDUIT INSTALL ON IT USE 060-15603-00 (SLEEVEING)

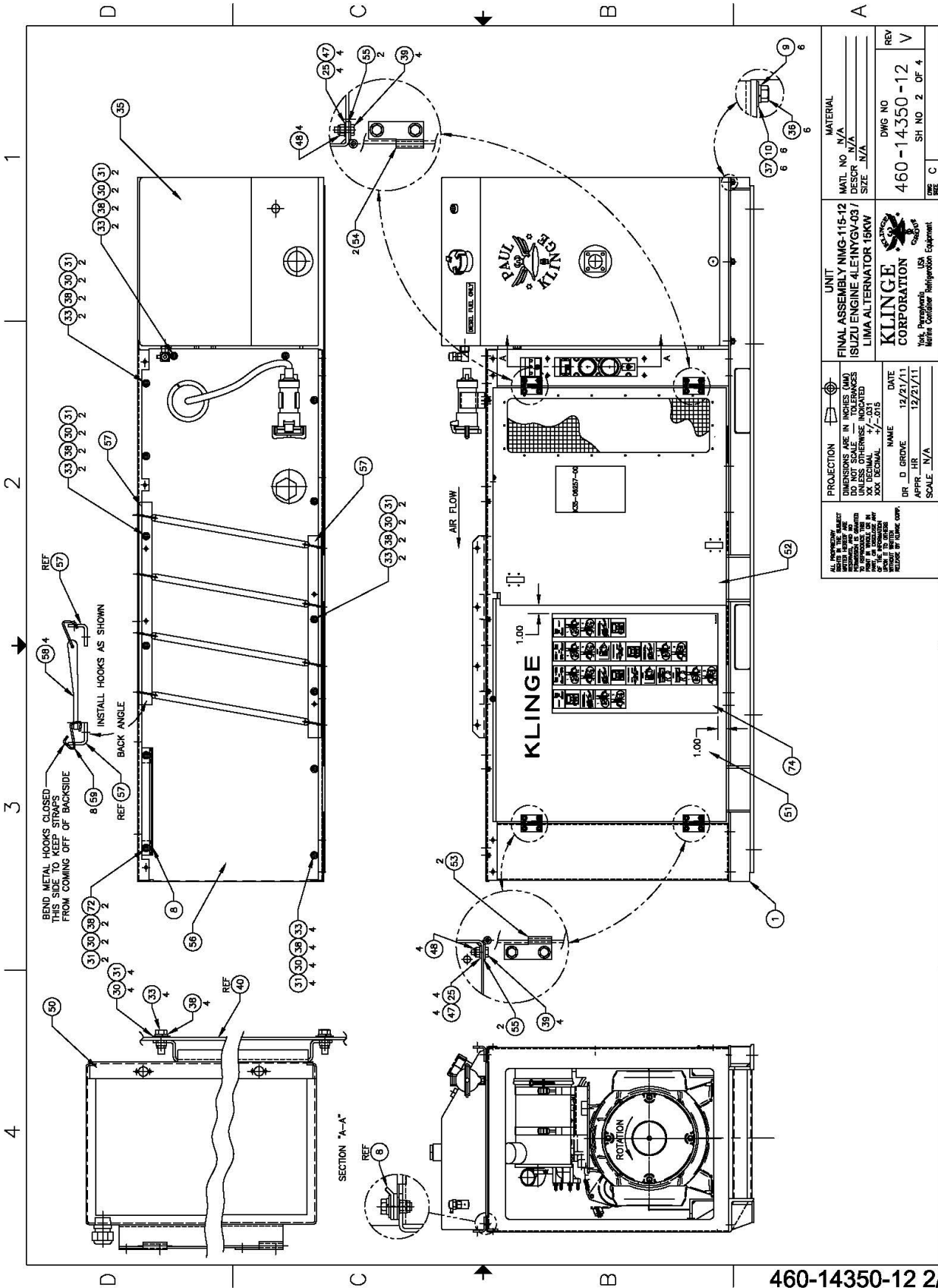
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K	3/9/17	17-140	SKM	BES	SHEET#3 AND ADDED AT TWO PLACES IN SHEET#4, UPDATED DETAIL D & BOM P 10/09/20	20-325	CHK	BES	ITEM #23 WAS K23-13415-06
L	3/17/17	17-294	DBG	BES	ITEM #22 WAS K20-29812-00, REMOVED	21-132	DBG	BES	K15-03103-00 WAS K15-02946-00 SFT 3
M	5/25/17	17-294	DBG	BES	ITEM #22 WAS K20-29812-00, REMOVED	21-132	DBG	BES	DETAIL MARKED "3" WAS MARKED "3" SFT 4
N	3/17/17	17-294	DBG	BES	SWAPPED 2 CABLES TO CONTROL BOX SHEET 4	22-054	DBG	BES	UPDATED ALTERNATOR PICTORIAL
					ITEM #3 WAS XB-998077	22-142	DBG	BES	REMOVED ITEM #20, K23-10280-00 QTY 2
					ITEM #70 WAS XB-998077, ADDED ITEM #74. SEE SHEET 2	22-142	DBG	BES	SEE SHEET 3

460-14350-12 1/4

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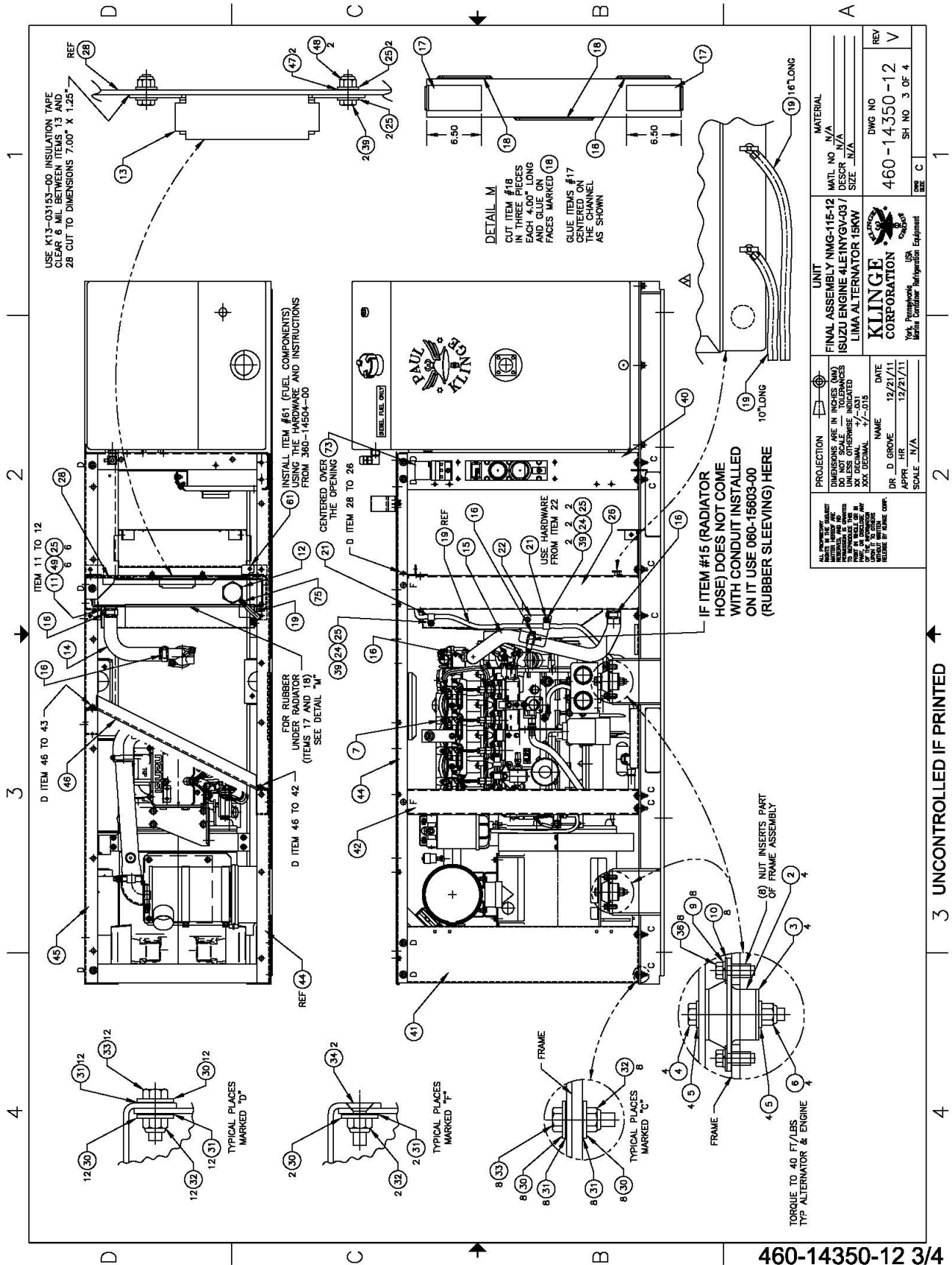
K35-NMG115-10
Rev. L, January 2023



460-14350-12 2/4

PROJECTION DIMENSIONS ARE IN INCHES (MM) DO NOT SCALE DRAWINGS UNLESS OTHERWISE INDICATED XX DECIMAL 1/100 XXX DECIMAL 1/1000	NAME DR. D. GROVE APPR. HR SCALE N/A	DATE 12/21/11 12/21/11	UNIT FINAL ASSEMBLY NMG-115-12 ISUZU ENGINE 4LE1IN9V-03 / LIMA ALTERNATOR 18KW	KLUNGE CORPORATION York, Pennsylvania, USA Marine Refrigeration Equipment	MATERIAL MATL NO. N/A DESCR. N/A SIZE N/A	DWG NO. 460-14350-12	REV
							C

3 UNCONTROLLED IF PRINTED



460-14350-12 3/4

UNIT: FINAL ASSEMBLY NMG-115-12, ISUZU ENGINE 4LE1NYGV-03, LIMA ALTERNATOR 15KW

MATERIAL: MATL NO. N/A, DESC. N/A, SIZE N/A

DWG NO: 460-14350-12

REV: V

SHI NO: 3 OF 4

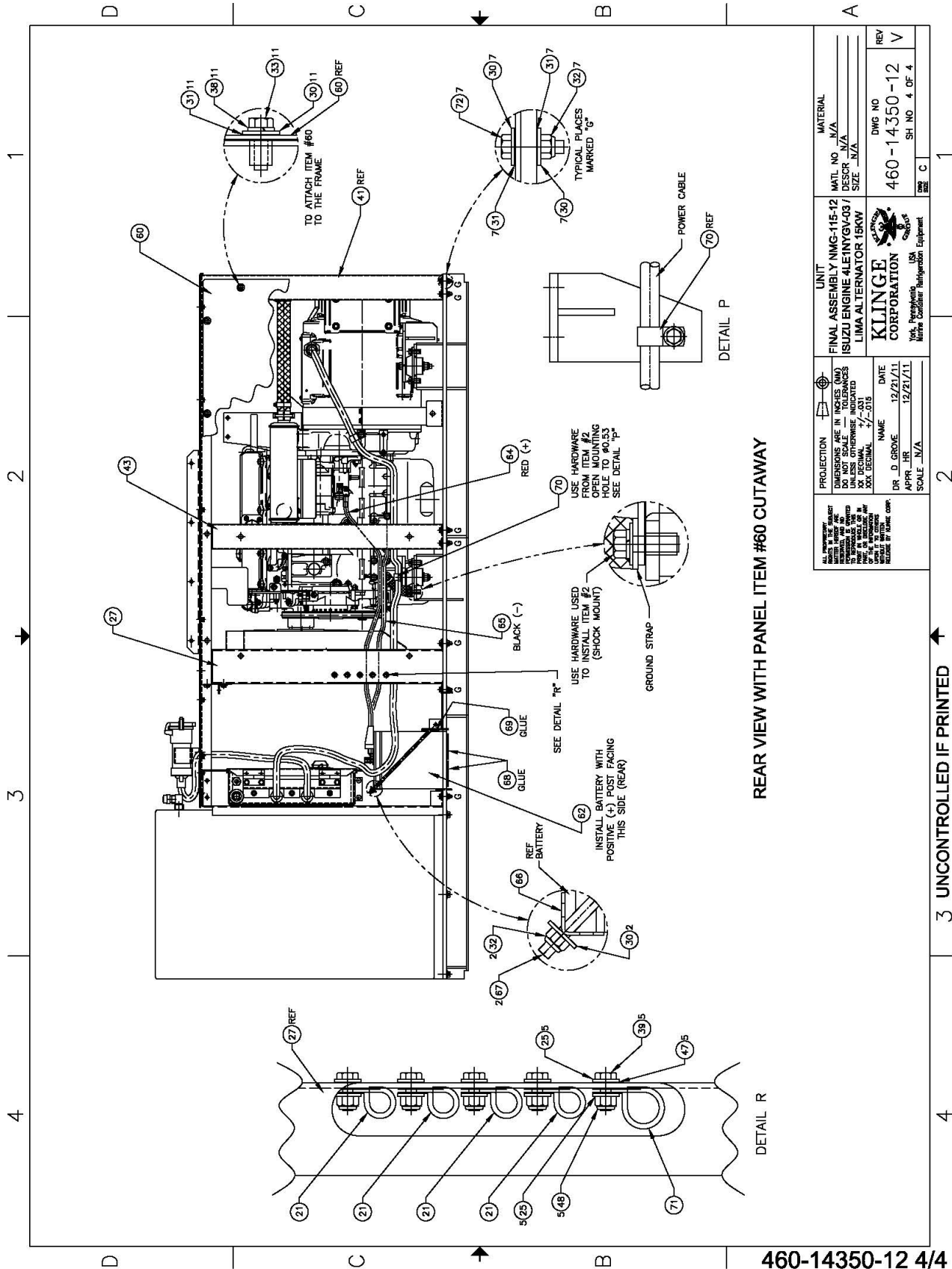
KLINGE CORPORATION

York, Pennsylvania, U.S.A.

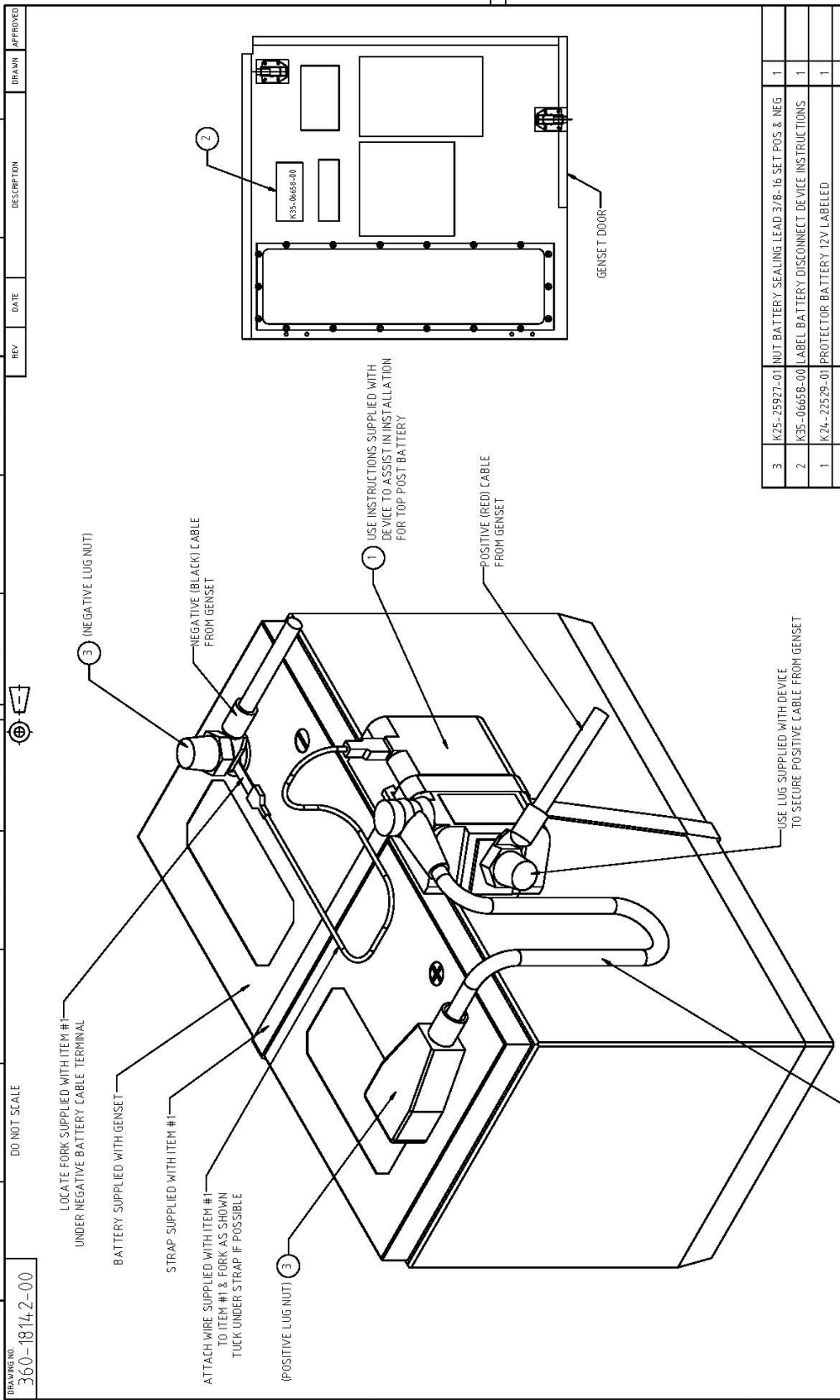
Martin Marietta Performance Equipment

PROJECTION	DATE
DIMENSIONS ARE IN INCHES (MM)	12/21/11
DO NOT SCALE DRAWINGS	12/21/11
TOLERANCES UNLESS SPECIFIED	
XX DECIMAL .XX	
XXX DECIMAL .XXX	
FRAMES	
NAME	
DR. D. GROVE	
APPR. HR.	
SCALE	N/A

UNCONTROLLED IF PRINTED



1	2	3	4	5	6	7	8	9	10	11	12				
DRAWING NO. 360-18142-00											REV.	DATE	DESCRIPTION	DRAWN	APPROVED



ITEM NO.	PART NO.	DESCRIPTION	QTY/BULK QTY
3	K25-25972-01	NUT BATTERY SEALING LEAD 3/8-16 SET POS & NEG	1
2	K35-06658-00	LABEL BATTERY DISCONNECT DEVICE INSTRUCTIONS	1
1	K24-22529-01	PROTECTOR BATTERY 12V LABELED	1

		MATERIAL N/A NUMBER N/A DESCR. N/A SIZE N/A FINISH N/A NO PERMISSIONS IN DIMENSIONS UNLESS OTHERWISE INDICATED TOLERANCES UNLESS OTHERWISE INDICATED X = +/- .10 (OR +/- .040) XX = +/- .05 (OR +/- .030) XXX = +/- .02 XXXX = +/- .015
ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED SUBJECT MATTER RESERVED AND NO PERMISSIONS TO REPRODUCE THIS PRINT IN WHOLE OR IN PART WITHOUT THE WRITTEN PERMISSION OF KLINGE GROUP DRAWN N BOWERS 2/15/16 APPROVED B STABLEY 2/16/16		NAME DATE DRAWN N BOWERS 2/15/16 APPROVED B STABLEY 2/16/16
TITLE KIT BATTERY DISCONNECT		SHEET NO. 360-18142-00 SHEET SIZE A2 REV. 1

360-18142-00

QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
1	360-14515-01	1	ENGINE DIESEL ISUZU 4LE2PV-01 MODIFIED FOR NMG-115-10 USE	1	360-14381-00	31	SUPPORT OVERFLOW BOTTLE ASSEMBLY NMG-115-10
1	XB-997878	2	ALTERNATOR LIMA MAC 480V / 60Hz SAE #5 C 107 G .36	6	K21-50226-20	32	SCREW HEX SS M10 X 1.5 X 20
1	XB-997879	3	BAFFLE AIR EXHAUST ALTERNATOR	1	XB-999093	33	BOTTLE OVERFLOW COOLANT
8	XB-992659-16	4	SCREW CAP SOCKET M8 X 16MM DIN 912 CLS 12.9	1	XB-999094	34	CAP OVERFLOW BOTTLE
8	XB-992749	5	WASHER FLAT M8 HIGH STRENGTH PLATED STEEL	1	360-14390-01	35	SUPPORT ASSEMBLY MUFFLER & FUEL FILTER
6	XB-992610-30	6	BOLT HEX HD M10 X 30MM DIN 933 8.8 PLATED	1	K21-50225-20	36	SCREW HEX SS M8 X 1.25 X 20
23	K21-50421-10	7	WASHER LOCK SPG M10 SS 18-8 DIN 127B	2	K21-14761-00	37	WASHER LOCK SPG SS 5/16 HEAVY 18-8
23	K21-50401-10	8	WASHER FLAT SS M10 10.5 X 20 X 2 18-8	2	K21-14072-00	38	WASHER FLAT SS 5/16 0.38 I.D. X 0.88 O.D. X 0.083 THK
2	K21-16249-10	9	NUT HEX SS M10 X 1.5	1	XB-999090	39	MUFFLER MODIFIED FROM XB-999090-01
1	360-13800-00	10	CRADLE LIMA ALTERNATOR WELDMENT BLACK	1	K21-14360-00	40	SCREW HEX SS 5/16-18 X 3/4" LG
4	K21-50227-45	11	SCREW HEX SS M12 X 1.75 X 45 18-8	1	K21-16320-00	41	CLAMP EXHAUST CS 1-1/2"
4	K21-16583-12	12	NUT LOCK SS M12 X 1.75 NYLON INSERT	1	060-14519-00	42	PIPE EXHAUST NMG-115-10
8	K21-50401-12	13	WASHER FLAT SS M12 13 X 24 X 2.3-2.7 18-8 DIN 125	28 IN.	XB-995029	43	SLEEVING FIBERGLASS 1.50" I.D.
1	360-14353-00	14	MOUNT ASSEMBLY ENGINE RIGHT NMG-115-10	2	K21 12930 00	44	CLAMP HOSE 1.06-2
1	360-14354-00	15	MOUNT ASSEMBLY ENGINE LEFT NMG-115-10	1	360-14384-00	45	SUPPORT ASSEMBLY AIR FILTER & ALTERNATOR COVER NMG-115-10
1	XB-340013	16	BRACKET PRESSURE & TEMPERATURE GAUGES	4	K21-50492-03	46	WASHER INSULATING PVC 1/4 X 0.62 O.D.
1	XB-994020	17	GAUGE OIL PRESSURE	1	K26-25091-02	47	FILTER AIR (K26-25091-00) 1 STAGE MODIFIED
1	XB-994130	18	GAUGE TEMPERATURE	1	K26-25095-04	48	HOOD AIR INLET PLASTIC STYLE E FITS 2.50 O.D. AIR FILTER INLET
1	XB-216562-10	19	HOSE OIL PRESSURE GAUGE	1	K26-24666-00	49	INDICATOR AIR RESTRICTION 20" H2O
1	XB-540076-20	20	WIRE HARNESS ENGINE ISUZU W. 20 AMP BATT. CHARGER ALTERN.	1	K28-10838-00	50	ELBOW NEOPRENE 90° 2-1/4" SMALL RADIUS
1	K25-26761-32	21	CONNECTOR STRAIGHT PLASTIC M32 12.4-20MM	1	K21-16639-00	51	SCR PAN BR5 M4 X 10 SLOT DIN 85A
1	K25-13609-00	22	RING SEAL CS 1.00" O.D.	1	360-14385-00	52	PIPE ASSEMBLY AIR INTAKE NMG-115-10
4	K21-50224-20	23	SCREW HEX SS M6 X 1 X 20mm FULL THREAD	1	060-14520-00	53	ELBOW RUBBER 2" I.D. X 90° AIR INTAKE NMG-115-10
1	360-14507-00	24	CABLE ASSEMBLY POWER ALTERNATOR TO CONTROL BOX	4	XB-999057	54	CLAMP HOSE SS 1.56 - 2.50 RANGE
1	K21-16548-09	25	CLAMP CABLE PARKER CL-14 0.81 I.D.	0.05	XB-999062	55	MUFFLER SEAL ACUSTA-SEAL
2	K21-13579-00	26		1	K35-05899-00	56	LABEL DANGER HIGH VOLTAGE
10	K21-10186-00	27	SCREW HEX SS 1/4-20 X 5/8	4	K21-14057-00	57	SCREW HEX SS 1/4-20 X 3/4
10	K21-10189-00	28	WASHER LOCK SPG SS 1/4 HEAVY 18-8	1	K25-26621-08	58	STRAP GROUND 8" LONG 3/8" MOUNTING HOLE
1	XB-998070-02	29	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8	1	K35-06365-02	59	LABEL USE 50/50 SOLUTION ETHYLENE GLYCOL/WATER
1	XB-998070-02	30	FITTING ELBOW BRASS 1/8 FPT X 7/16-20	9	K21-50226-25	60	SCREW HEX SS M10 X 25

NOTES:
 1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS.
 2. ITEM #20 (ENGINE WIRE HARNESS) NOT SHOWN ON DRAWING. FOR WIRE HOOK-UP USE 360-14351-00.
 3. USE EXISTING NYLON CLAMP TO GUIDE BLUE WIRE CONNECTED TO CONTROL RESISTOR.
 4. USE ITEM #51 (XB-992986-10) M4 BRASS SCREW TO ATTACH BLUE WIRE CONNECTING CONTROL RESISTOR WITH GLOW PLUGS LINE.
 5. ATTACH TO ITEM #35 (SUPPORT ASSEMBLY MUFFLER & FUEL FILTER) ITEMS 13, 19, 20, & 21 FROM 360-14504-00 (FUEL SYSTEM COMPONENTS).
 6. GROUND HERE ON EXISTING M8 SCREW 4 GREEN WIRES FROM ITEM #20 (WIRE HARNESS).
 7. ATTACH ITEM #20 (WIRE HARNESS) HERE WITH EXISTING CLAMP.
 8. IF ENGINE USES 35 AMP BATTERY CHARGER ALTERNATOR USE WIRE HARNESS XB-940076-35.

DATE	CHG NO	CHK	REV	DATE	CHG NO	CHK	REV
J 2/13/17	17-080	SKM	BES	20220413	22-054	DBG	BES
K 5/25/17	17-284	DBG	BES				
L 20210802	21-277	DBG	BES				
M 20211004	21-300	DBG	BES				

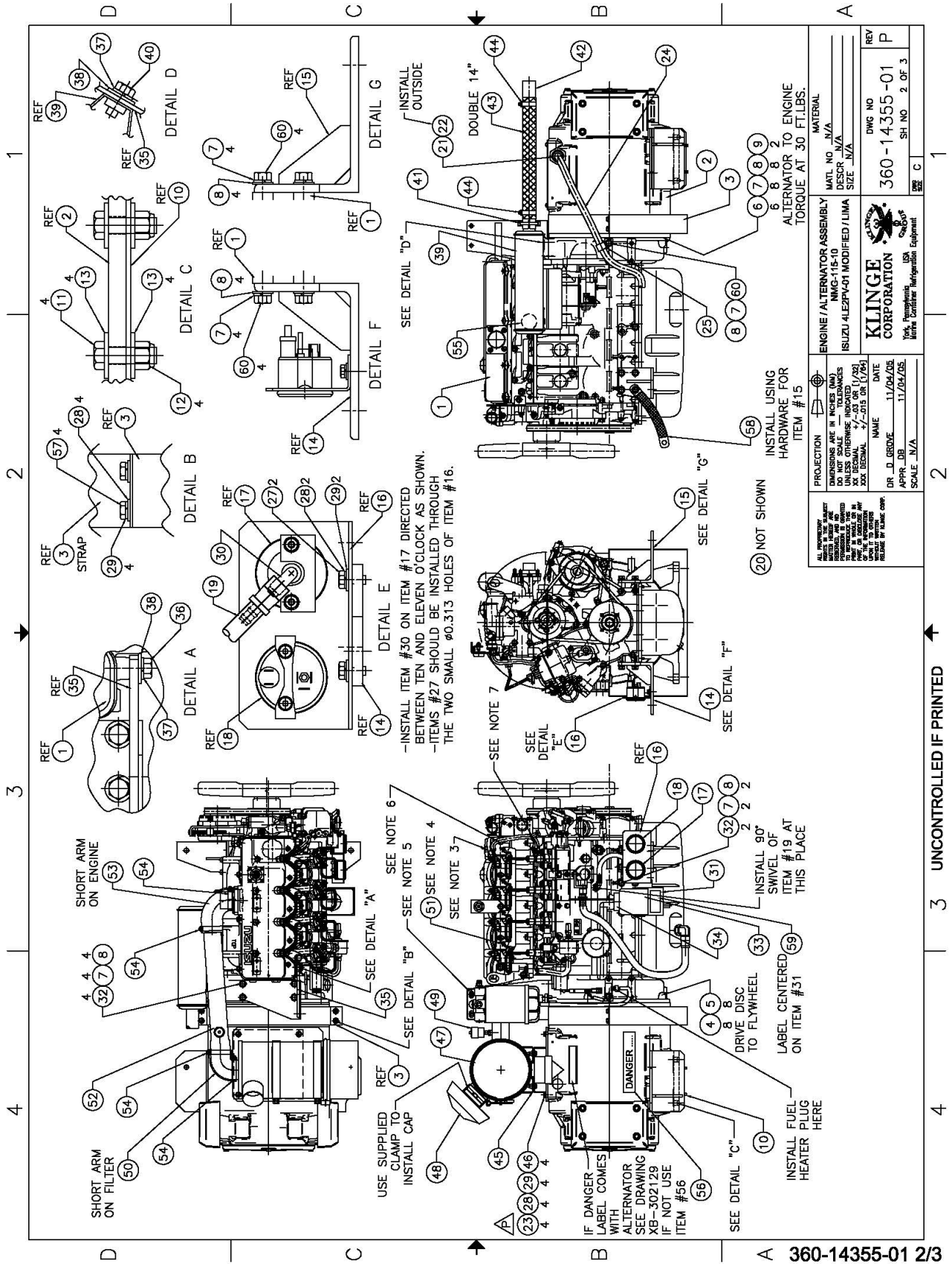
REVISION RECORD	DATE	CHG NO	DR	CHK	REVISION RECORD
ITEM #1 WAS XB-992986-10					ITEM #12 WAS K21-15894-00, ITEM #13 WAS K21-16254-00, ITEM #21 WAS K21-14921-13, ITEM #13 WAS K21-16254-00, REMOVED ITEM #21 WAS XB-994098-03, REMOVED ITEM #23 K25-11013-00, REMOVED ITEM #21 WAS K21-16433-00, UPDATED ALTERNATOR PICTORIALY
ITEM #25 WAS XB-998077					ITEM #23 SHEET 2, ITEM #57 QTY WAS 8
ITEM #40 WAS K21-14730-00 DETAIL D SRT 2					
ITEM #40 WAS K21-14730-00 DETAIL D SRT 2					

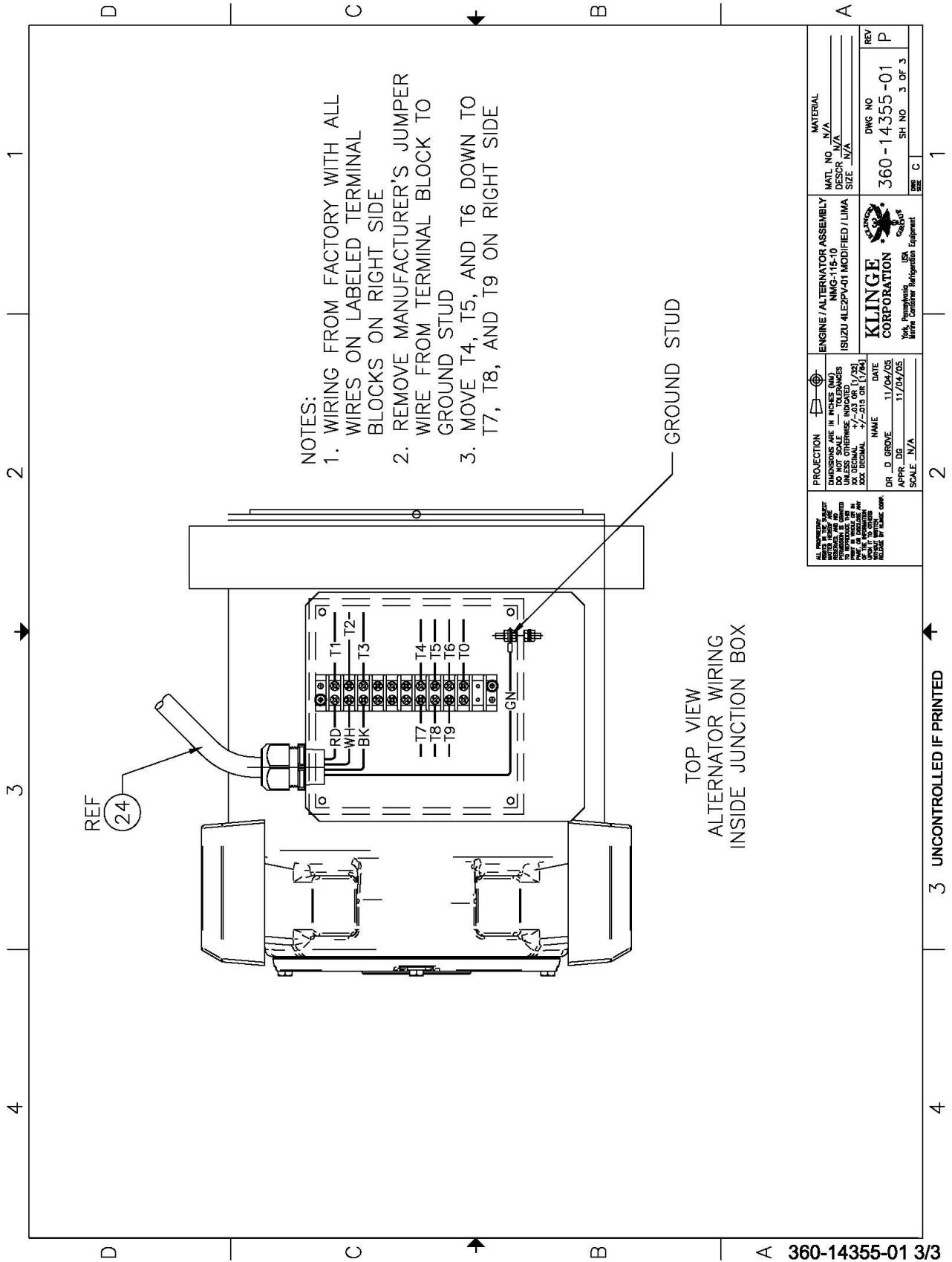
ALL DIMENSIONS ARE IN INCHES (MM) UNLESS OTHERWISE NOTED OR IN BOX. DECIMALS: 1/16" OR 0.03125" OR 0.015625" OR 0.0078125"	PROJECTION	ENGINE / ALTERNATOR ASSEMBLY
DO NOT SCALE - TOLERANCES	1st ANGLE	NMG-115-10
USE DIMENSIONAL LINES	ISUZU 4LE2PV-01 MODIFIED / LIMA	
DATE	NAME	DATE
11/04/05	DR. D. GROVE	11/04/05
SCALE: N/A	SCALE: N/A	

KLINGE CORPORATION
 K35, 115, 125
 Parts, Components, Refurbishment Equipment

MATL NO N/A
 DESCR N/A
 SIZE N/A

DWG NO 360-14355-01
 SH NO 1 OF 3

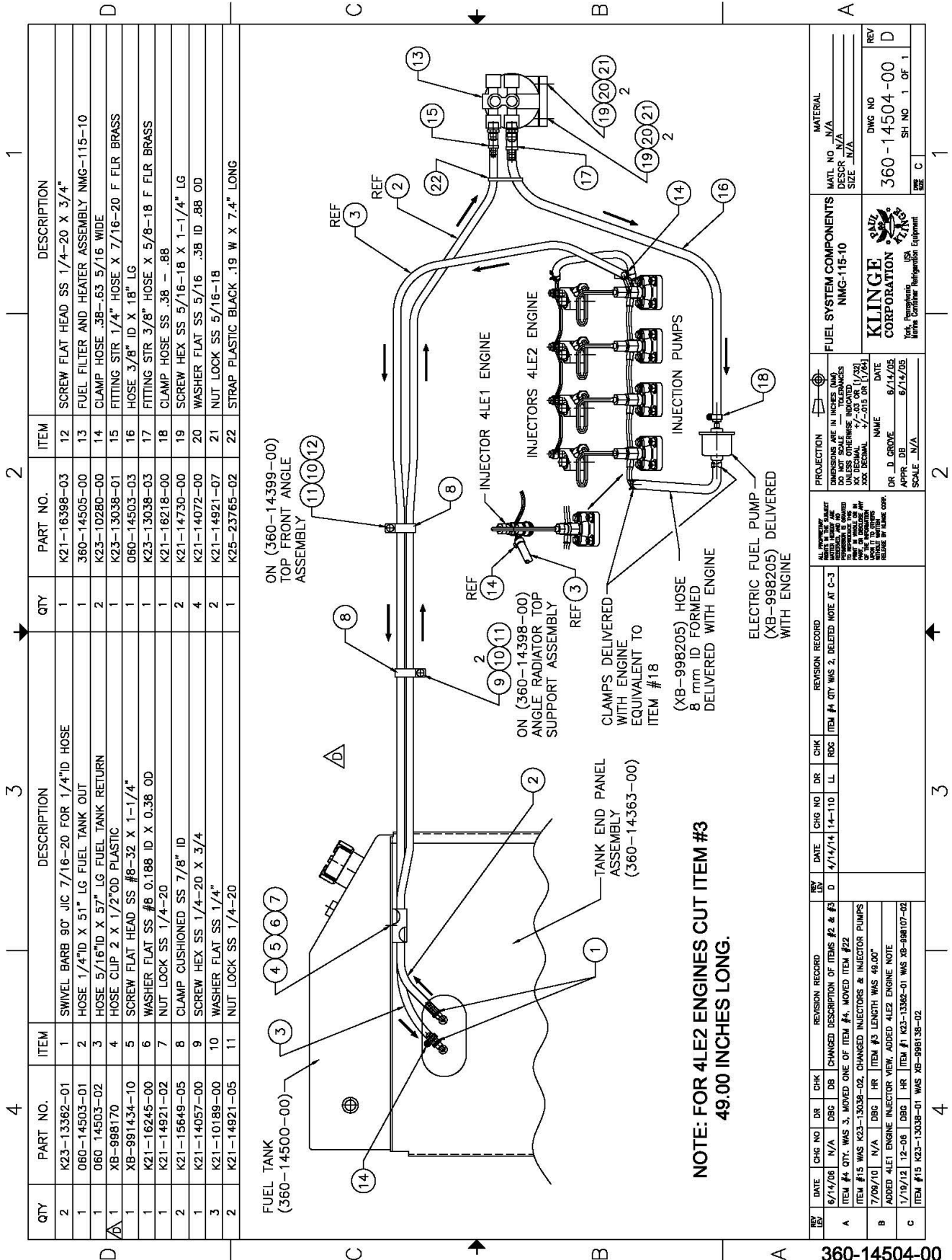




NOTES:

1. WIRING FROM FACTORY WITH ALL WIRES ON LABELED TERMINAL BLOCKS ON RIGHT SIDE
2. REMOVE MANUFACTURER'S JUMPER WIRE FROM TERMINAL BLOCK TO GROUND STUD
3. MOVE T4, T5, AND T6 DOWN TO T7, T8, AND T9 ON RIGHT SIDE

ALL DIMENSIONS ARE IN INCHES (MM) UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES (MM) UNLESS OTHERWISE SPECIFIED. DO NOT SCALE DIMENSIONS. XX DECIMAL +/- .015 OR 1/32 XX DECIMAL +/- .015 OR 1/32	PROJECTION FIRST ANGLE	ENGINE / ALTERNATOR ASSEMBLY NMG-115-10 (SUZUKI 4LEPP/01 MODIFIED / LIMA)	MATERIAL MATL NO. N/A DESCR. N/A SIZE N/A
	DR. D. GROVE APPR. DG SCALE N/A	NAME DATE 11/04/05	DWG. NO. 360-14355-01
KLINKE CORPORATION York, Pennsylvania, USA Marine / Commercial Refrigeration Equipment		SHEET NO. 3 OF 3	



QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
2	K23-13362-01	1	SWIVEL BARB 90° JIC 7/16-20 FOR 1/4" ID HOSE	1	K21-16398-03	12	SCREW FLAT HEAD SS 1/4-20 X 3/4"
1	080-14503-01	2	HOSE 1/4" ID X 51" LG FUEL TANK OUT	1	360-14505-00	13	FUEL FILTER AND HEATER ASSEMBLY NMG-115-10
1	080-14503-02	3	HOSE 5/16" ID X 57" LG FUEL TANK RETURN	2	K23-10280-00	14	CLAMP HOSE .38-.63 5/16 WIDE
1	XB-998170	4	HOSE CLIP 2 X 1/2" OD PLASTIC	1	K23-13038-01	15	FITTING STR 1/4" HOSE X 7/16-20 F FLR BRASS
1	XB-991434-10	5	SCREW FLAT HEAD SS #8-32 X 1-1/4"	1	060-14503-03	16	HOSE 3/8" ID X 18" LG
1	K21-16245-00	6	WASHER FLAT SS #8 0.188 ID X 0.38 OD	1	K23-13038-03	17	FITTING STR 3/8" HOSE X 5/8-18 F FLR BRASS
1	K21-14921-02	7	NUT LOCK SS 1/4-20	1	K21-16218-00	18	CLAMP HOSE SS .38 - .88
2	K21-15649-05	8	CLAMP CUSHIONED SS 7/8" ID	2	K21-14730-00	19	SCREW HEX SS 5/16-18 X 1-1/4" LG
1	K21-14057-00	9	SCREW HEX SS 1/4-20 X 3/4	4	K21-14072-00	20	WASHER FLAT SS 5/16 .38 ID .88 OD
3	K21-10189-00	10	WASHER FLAT SS 1/4"	2	K21-14921-07	21	NUT LOCK SS 5/16-18
2	K21-14921-05	11	NUT LOCK SS 1/4-20	1	K25-23765-02	22	STRAP PLASTIC BLACK .19 W X 7.4" LONG

REV	DATE	CHG NO	DR	CHK	DB	DESCRIPTION OF ITEMS #2 & #3	REVISION RECORD	DATE	CHK	DR	U.L.	REVISION RECORD	DATE	CHK	DR	U.L.
6/14/06	N/A	N/A	DRG	DRG	DB	CHANGED DESCRIPTION OF ITEMS #2 & #3		4/14/14	14-110	L.L.		ITEM #4 QTY WAS 2, DELETED NOTE AT C-3				
7/09/10	N/A	N/A	DRG	HR	HR	ITEM #15 WAS K23-13038-02, CHANGED INJECTORS & INJECTOR PUMPS										
1/19/12	12-06	DRG	HR	HR	HR	ADDED 4LE1 ENGINE INJECTOR VIEW, ADDED 4LE2 ENGINE NOTE										
						ITEM #15 K23-13038-01 WAS XB-998170-02										

PROJECTION	FUEL SYSTEM COMPONENTS	MATERIAL
1ST ANGLE	NMG-115-10	MATL NO N/A DESCR N/A SIZE N/A
KLINGBE CORPORATION York, Pennsylvania USA Marine Condition Refrigeration Equipment		
DR: D. GROVE	DATE: 6/12/05	DWG NO: 360-14504-00
APPR: DB	DATE: 6/12/05	SH NO: 1 OF 1
SCALE: N/A		REV: C

4		3		2		1	
QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
1	360-14365-00	1	BOX ELECT NMG-115-10 WELD & PAINT WHIT	1	K25-22099-00	29	HOURMETER
1	060-11754-01	2	SUPPORT HINGE ELECTRICAL BOX	2	K21-14921-01	30	NUT LOCK SS #6-32
13	K21-14057-00	3	SCREW HEX SS 1/4-20 X 3/4	2	K21-15697-00	31	SCREW PAN SS #6-32 X 1/2
13	K21-10189-00	4	WASHER FLAT SS 1/4	1	XB-994003	32	VOLTMETER 0-600 VAC
13	K21-50492-03	5	WASHER INSULATOR 1/4	1	K25-26614-00	33	AMMETER -50 0 +50 AMP
4	K21-14921-05	6	NUT LK SS 1/4-20	1	K25-26615-00	34	TIMER TEMP & OIL PRESSURE SHUTDOWN
2	K29-17879-01	7	HINGE SLIP SS 9/32 HOLES SOCKET	9	K21-10188-00	35	WASHER LOCK SPG SS 1/4
2	060 09113-00	8	INSULATOR HINGE	4	K21-50492-02	36	WASHER INSULATOR #10
1	360-11755-11	9	CHANNEL ELECT BOX WITH NUT INSERTS WHITE	12	K21-12574-00	37	WASHER FLAT SS #10
1	360-14372-00	10	DOOR ASSEMBLY ELECT BOX NMG-115-10	2	XB-992103	38	NUT HEX SS #10-32 THIN
2	XB-994000-02	11	CABLE GRIP 3/4"	4	K21-14921-03	39	NUT LOCK SS #10-32
2	K25-22534-02	12	RING SEAL SS 3/4 CND	1	K25-21619-02	40	BLOCK TERMINAL 6-32 2 POLE
2	K25-05700-00	13	NUT LOCK 3/4 PLATED STEEL	2	K21-16504-04	41	SCREW SELF SEALING PAN SS #8-32 X 3/4
1	K25-26129-03	14	CONNECTOR STRAIGHT PLASTIC SHT 1/2	2	K21-16245-00	42	WASHER FLAT SS #8
1	K25-26147-01	15	RING SEAL PLASTIC 1/2	2	K21-14921-02	43	NUT LOCK SS #8-32
1	K25-26340-02	16	NUT LOCK PLASTIC 1/2	3	K24-22121-00	44	RELAY SPDT 12 VDC COIL 30 A
1	K28-10936-10	17	PLUG SEAL POLY FLUSH 0.69" HOLE	5	K21-15742-00	45	SCREW PAN SS #10-32 X 1/2
2	K21-14682-00	18	RECPT FASTENER #12 SCR RIVET TY SS	5	K21-08206-00	46	WASHER LOCK SPG SS #10
4	K21-15910-02	19	RIVET SST 1/8 DOME HD	1	K24-22413-25	47	CIRCUIT BREAKER 25 A 12 VDC
1	K35-06539-00	20	LABEL GROUND SYMBOL	3	K21-16505-05	48	SCREW SELF SEALING PAN SS #10-32 X 1
1	K24-22416-00	21	SWITCH ON/ OFF			49	
1	K35-06253-01	22	LABEL ON-OFF ELECTRICAL BOX	1	XB-993011-20	50	RUBBER NEOPRENE 1/4 X 2 X 12"
1	K24-22412-00	23	SWITCH PREHEAT/ START (SEE DETAIL "E" SHT 2/2)	2	K24-17239-00	51	BOOT TOGGLE SWITCH
1	K35-06253-03	24	LABEL PREHEAT/ START	9	K21-16445-09	52	NUT INSERT LF CBRSS 1/4-20
1	K25-26330-11	25	LAMP INDICATOR GREEN 12 VDC	2	K28-11067-15	53	CAPLUG VINYL RED 0.187 ID X 0.50 H
2	K25-26330-13	26	LAMP INDICATOR RED 12 VDC	2	K28-05007-00	54	CAP/ PLUG SEAL #5 C = 0.409
3	K28-10995-010	27	RING "O" EPDM .25 ID X .06 SECT	1	K35-06267-00	55	LABELS R1, R2, R3, SAT, AND BATT (SET OF FIVE)
1	K35-06253-02	28	LABEL SYS ON/ LOW OIL PRESS/ HIGH TEMP	1	K21-15797-04	56	WASHER LOCK EXT INT SS #10

REV	DATE	CHG NO	DR	CHK	REVISION RECORD	REV	DATE	CHG NO	DR	CHK	REVISION RECORD
L	8/03/14	14-463	DBE	BES	ITEM #17 (K21-12574-00) QTY 12 WAS QTY 14	T	6/21/17	17-349	DBE	BES	ITEM #12 QTY WAS 3, ITEM #13 QTY WAS 3
M	3/23/15	15-071	DBE	BES	ITEM #20 (K21-50492-02) QTY 4 WAS QTY 5	U	REMOVED ITEM #17 (06-98400-00), REMOVED ITEM #18 (K25-26114-03) QTY 2.5 FT				
N	6/20/17	16-260	DBE	BES	ITEM #1 (K21-15797-04) QTY 1 SEE DETAIL D SHEET 2	V	3/15/18	18-062	DBE	BES	ITEM #53 WAS XB-993011
P	6/28/18	18-268	DBE	BES	ITEM #20 (K21-16478-07) QTY 4		9/26/18	18-362	DBE	BES	ADDED ITEM #17
R	7/11/16	16-278	DBE	BES	ADDED ITEM #20 SEE SHT 2 INSIDE BOX						

ALL DIMENSIONS UNLESS OTHERWISE INDICATED ARE IN INCHES. TOLERANCES UNLESS OTHERWISE INDICATED ARE: FRACTIONAL 1/16" DECIMAL 0.015" ANGLES 1/2°

PROJECTION: FIRST ANGLE

DO NOT SCALE DIMENSIONS UNLESS OTHERWISE INDICATED

DATE: 6/29/05

DR: J. GROVE

APPR: J.B.

SCALE: N/A

MATERIAL: N/A

BOX ELECTRICAL ASSEMBLY

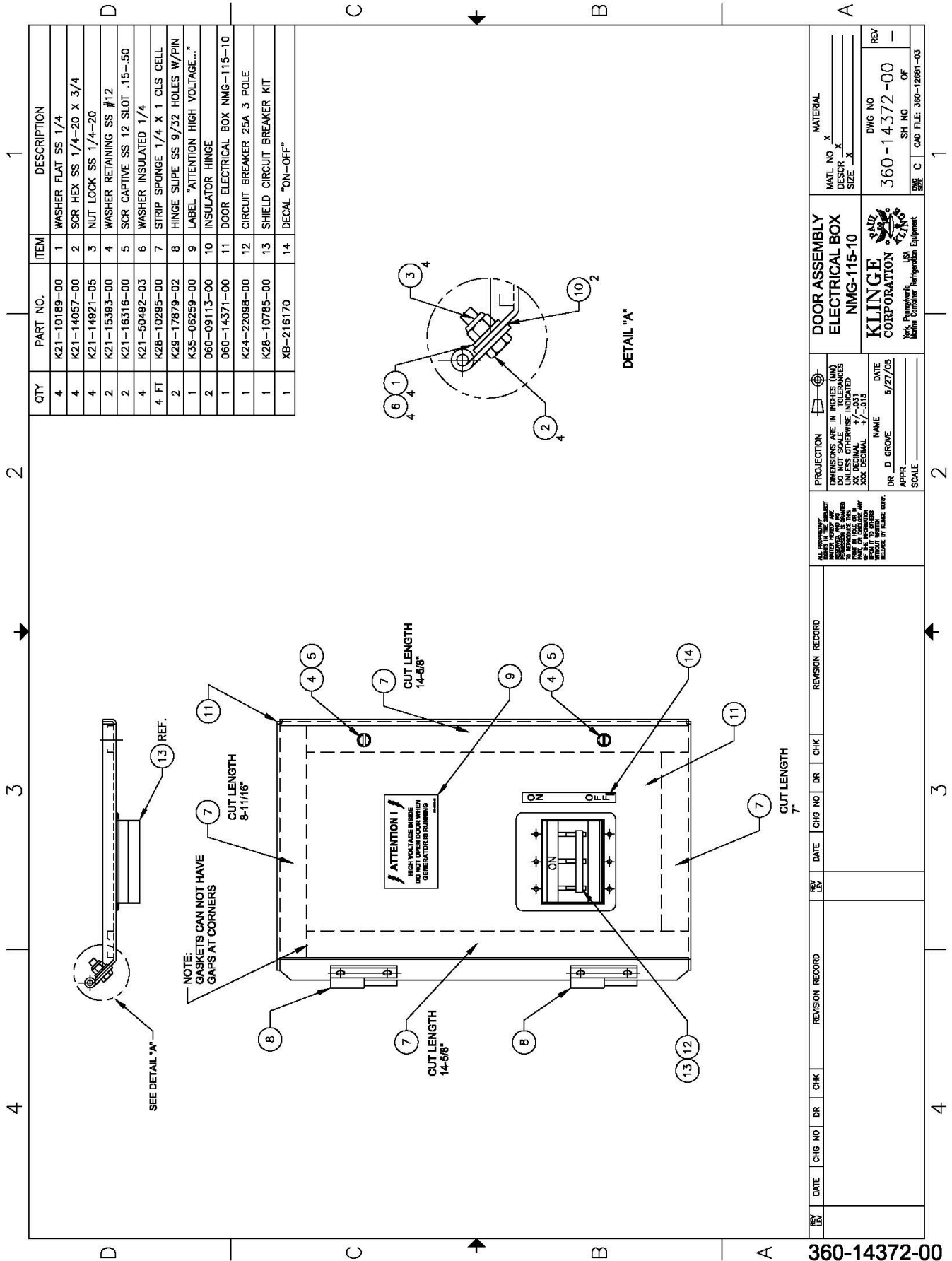
KLINGE CORPORATION
York, Pennsylvania, USA
Marine Conditioner Refrigeration Equipment

DWG NO: 360-14370-00

SH. NO. 1 OF 2

360-14370-00 1/2

UNCONTROLLED IF PRINTED



QTY	PART NO.	ITEM	DESCRIPTION
4	K21-10189-00	1	WASHER FLAT SS 1/4
4	K21-14057-00	2	SCR HEX SS 1/4-20 X 3/4
4	K21-14921-05	3	NUT LOCK SS 1/4-20
2	K21-15393-00	4	WASHER RETAINING SS #12
2	K21-16316-00	5	SCR CAPTIVE SS 12 SLOT .15-.50
4	K21-50492-03	6	WASHER INSULATED 1/4
4 FT	K28-10295-00	7	STRIP SPONGE 1/4 X 1 CLS CELL
2	K29-17879-02	8	HINGE SLIPE SS 9/32 HOLES W/PIN
1	K35-06259-00	9	LABEL "ATTENTION HIGH VOLTAGE..."
2	060-09113-00	10	INSULATOR HINGE
1	060-14371-00	11	DOOR ELECTRICAL BOX NMG-115-10
1	K24-22098-00	12	CIRCUIT BREAKER 25A 3 POLE
1	K28-10785-00	13	SHIELD CIRCUIT BREAKER KIT
1	XB-216170	14	DECAL "ON-OFF"

PROJECTION DIMENSIONS ARE IN INCHES (MM) DIMENSIONS IN PARENTHESES ARE UNLESS OTHERWISE INDICATED XX DECIMAL +/- .01 XXX DECIMAL +/- .015		MATERIAL MATL NO. X DESCR. X SIZE X	
NAME DR. D. GROVE APPR.		DOOR ASSEMBLY ELECTRICAL BOX NMG-115-10	
DATE 6/27/05		DWG NO 360-14372-00	
SCALE		SH NO OF	
DR. D. GROVE APPR.		KLINGE CORPORATION York, Pennsylvania, USA Marine Turbines, Refrigeration Equipment	
REVISION RECORD		REV. C CAD FILE: 360-12691-03	

REV	DATE	CHG NO	DR	CHK	REVISION RECORD

360-14372-00

NMG-115-10 / BRG-540 / COG-340

GENERAL

The engine models used on the generator sets are ISUZU 4LE1PV (indirect injected) or 4LE2PV (direct injected) depending on the specific application of the unit.

Because the manufacturer can change part numbers any time without prior notice, to be sure to receive the correct part, when ordering please indicate:

- Model and Serial Number of the engine,
- Figure number from the attached “Illustration Index”,
- where the part is located,
- a description of the part, and
- the number attached to it

NOTE: The Engine ID No. can also be used for identifying the correct needed part.

The Engine ID No. can be found on the bottom of the emission label located underneath injector #3.

The power alternator is a Marathon Electric LIMA MAC Reefer model 260MSL1361.

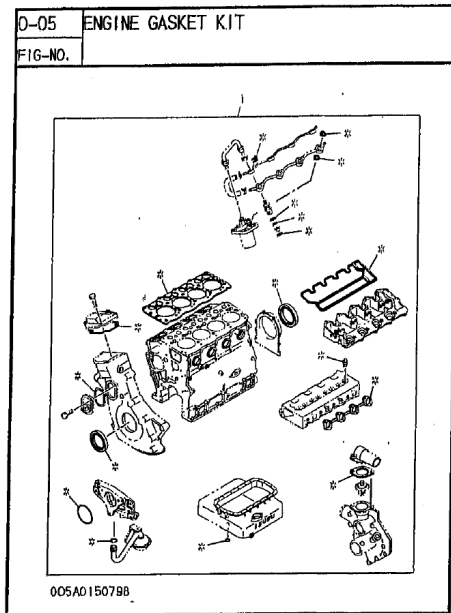
Because the manufacturer can change part numbers any time without prior notice, to be sure to receive the correct part, when ordering please indicate the alternator serial number.

LIST OF FREQUENTLY USED SERVICE AND MAINTENANCE PARTS

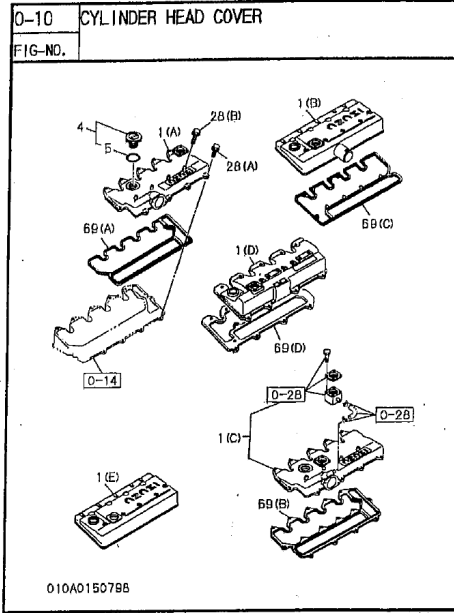
DESCRIPTION	PART NO.
<u>ENGINE</u>	
Oil Filter	XB-998209
Primary fuel filter element	K26-25180-02
Bowl with heater, primary fuel filter	K26-25180-03
Bowl O-ring & seal service kit, primary fuel filter	K26-25180-04
Fuel pump electrical	K26-25179-00
V-belt (fan & alternator) 855 mm long 4LE1PV & 4LE2PV engines	K26-25145-112
Air filter cartridge	K26-25091-08
Hose radiator inlet (top tank)	XB-340024
Hose radiator outlet (bottom tank)	XB-340025-01
Temperature gauge	XB-994130
Temperature sender	K26-25178-00
High temperature switch	XB-998207
Oil pressure gauge	XB-994020
Hose oil pressure gauge	XB-216562-10
Stop solenoid	XB-998206
Starter motor	XB-998203
*Alternator battery charging 20A (permanent magnet)	XB-998204-20
*Alternator battery charging 35A	XB-998204-35
Glow plug 4LE1PV engine	XB-998213
Glow plug 4LE2PV engine	XB-998213-02
Control resistor, glow plugs 4LE1PV and 4LE2PV engines	XB-998214
Gasket exhaust flange	XB-998217
<u>POWER ALTERNATOR</u>	
Rectifier assembly	XB-997880
Bearing	XB-997881

*Either 20A or 35A battery charging alternator is acceptable as replacement on this engine.

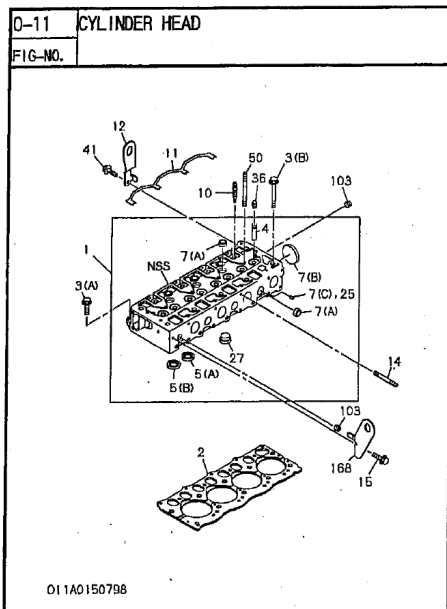
ILLUSTRATION INDEX



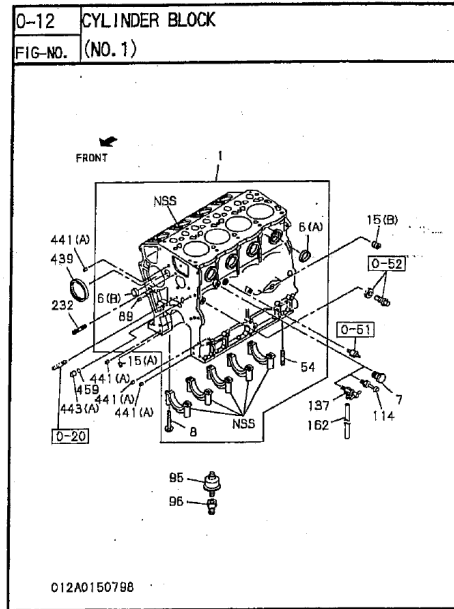
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P -6

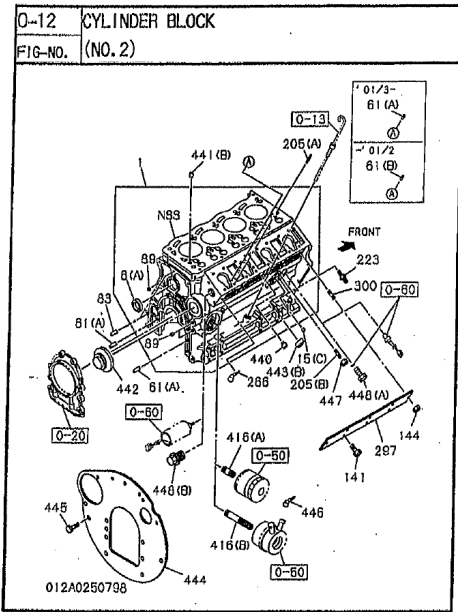


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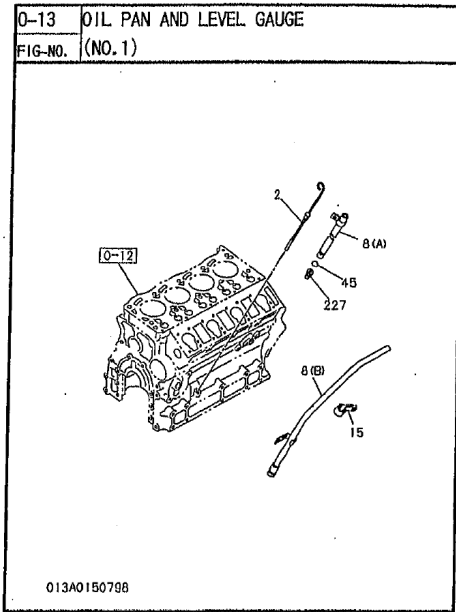


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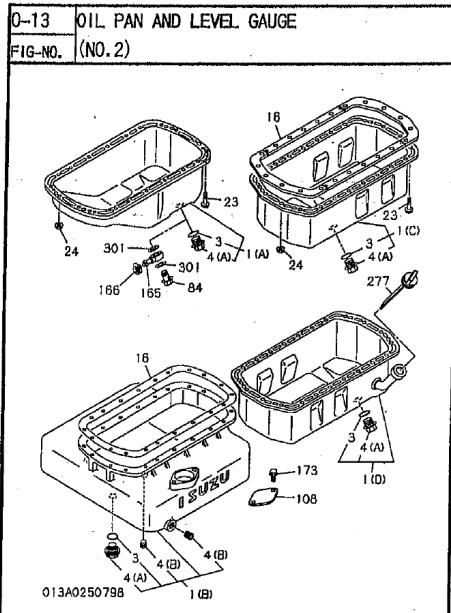
ILLUSTRATION INDEX



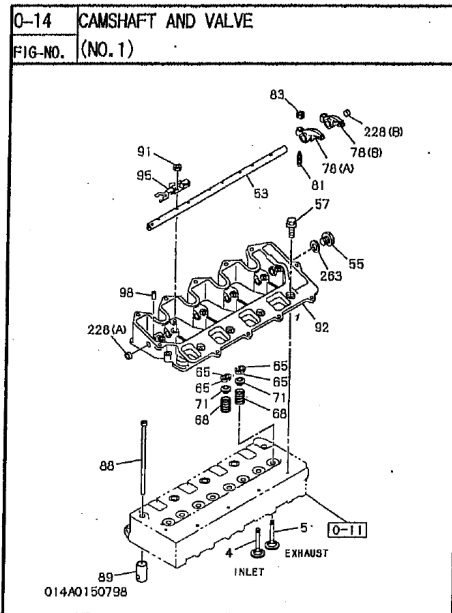
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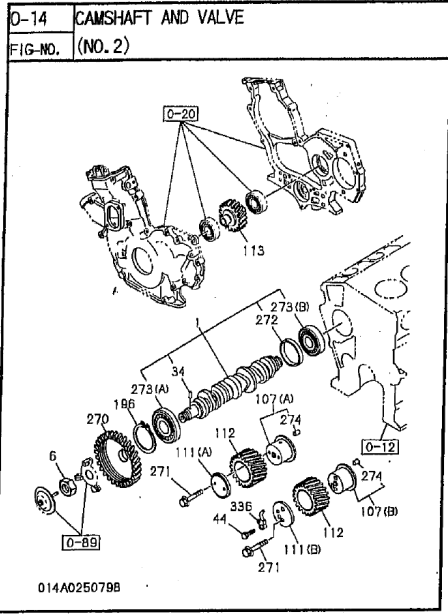


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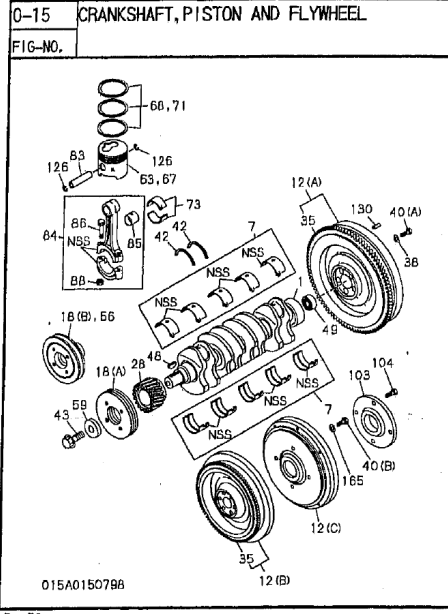


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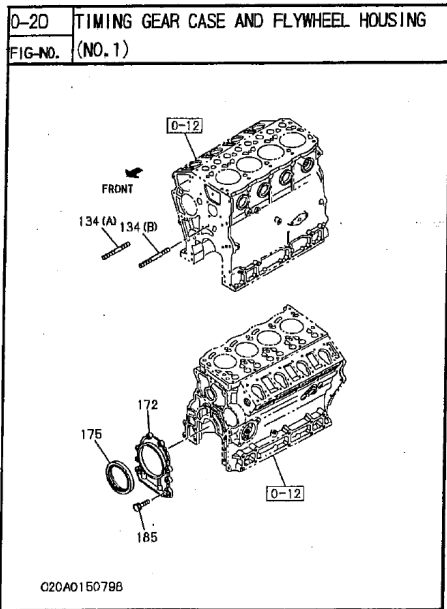
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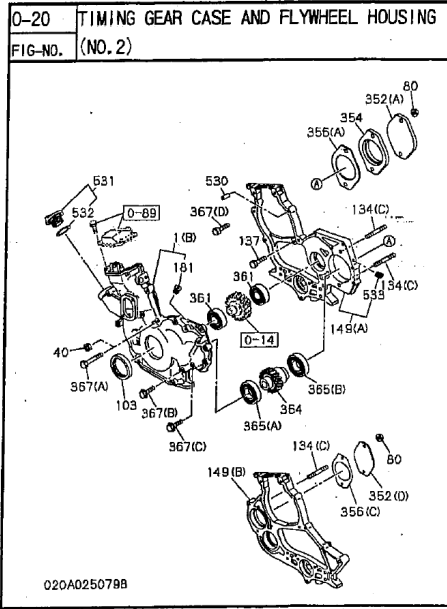
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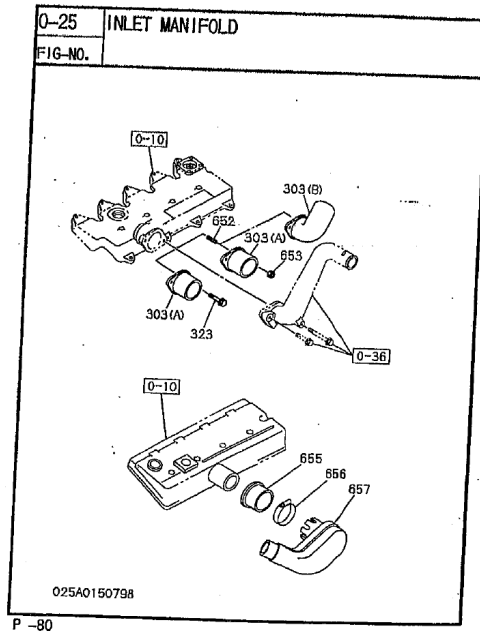
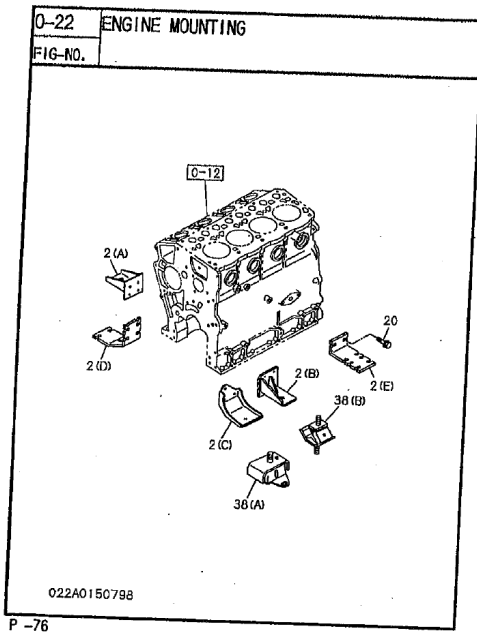
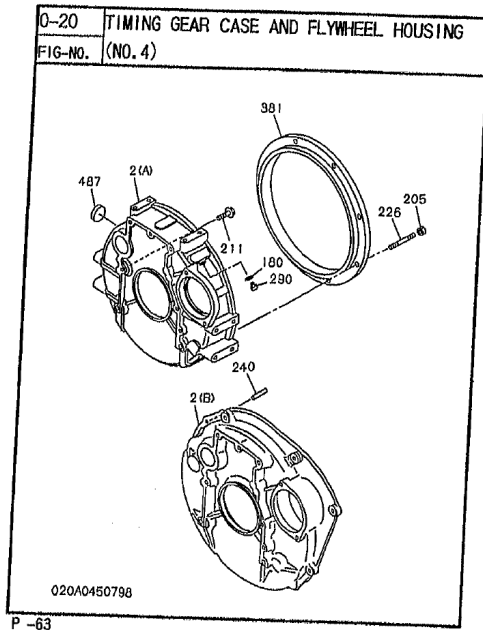
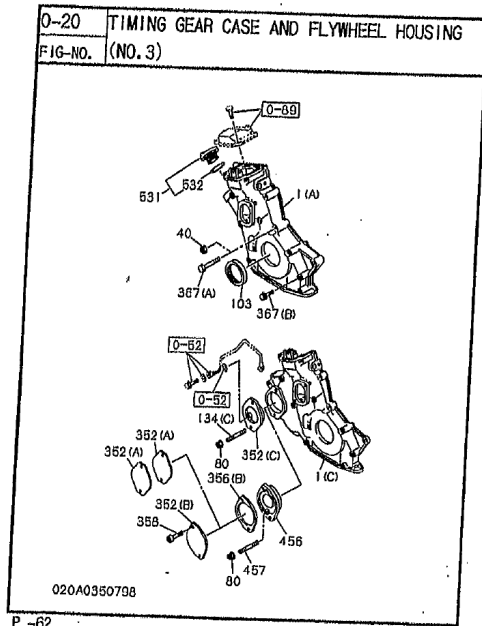
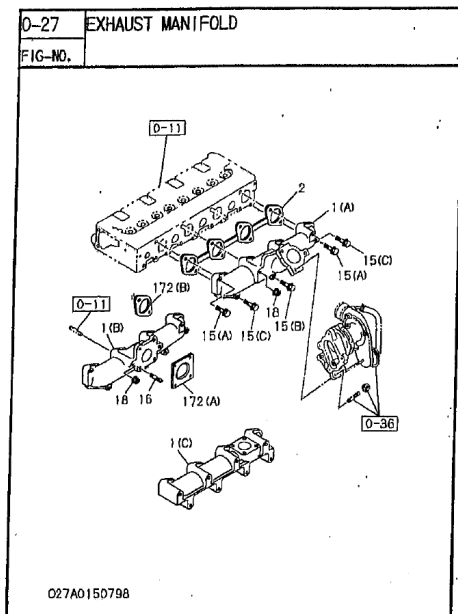
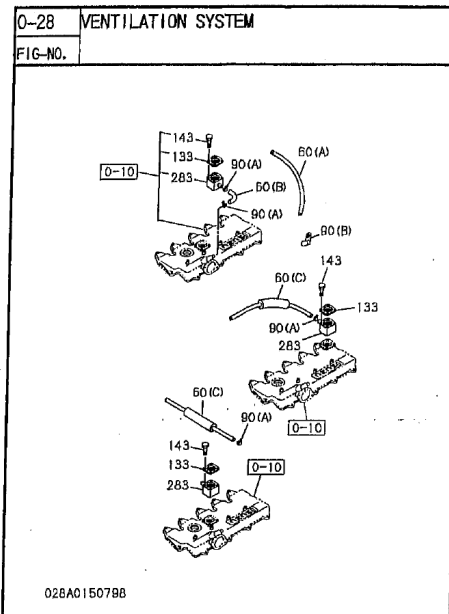


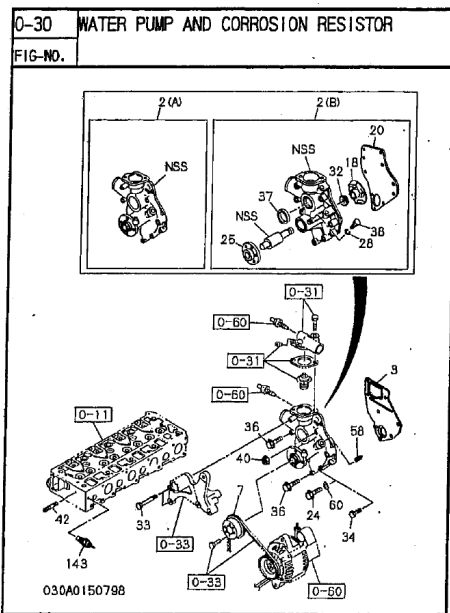
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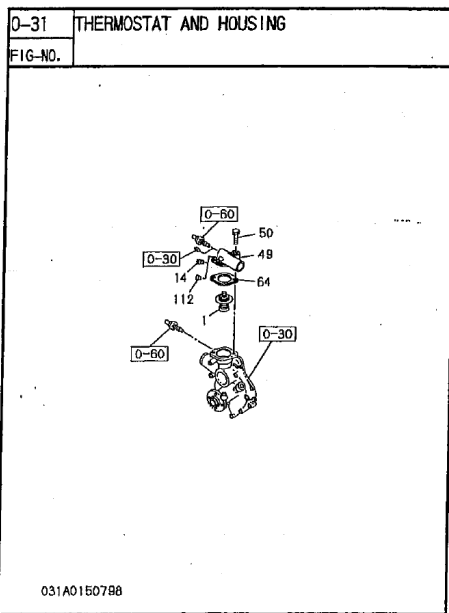
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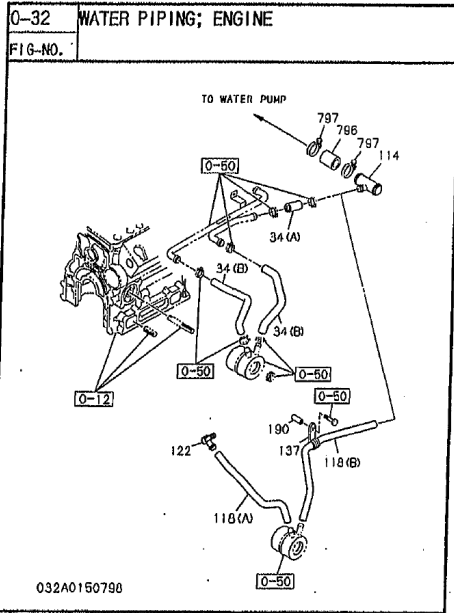


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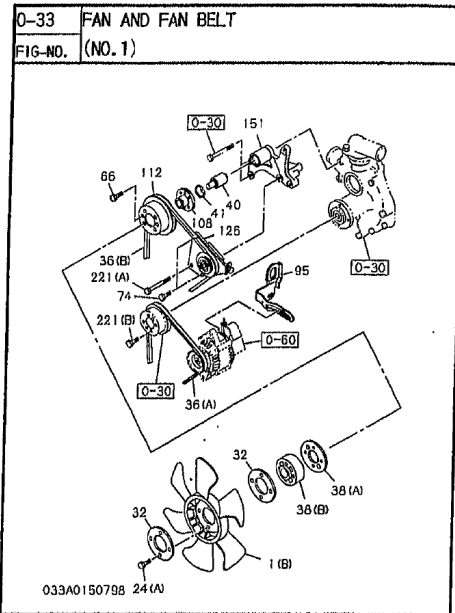


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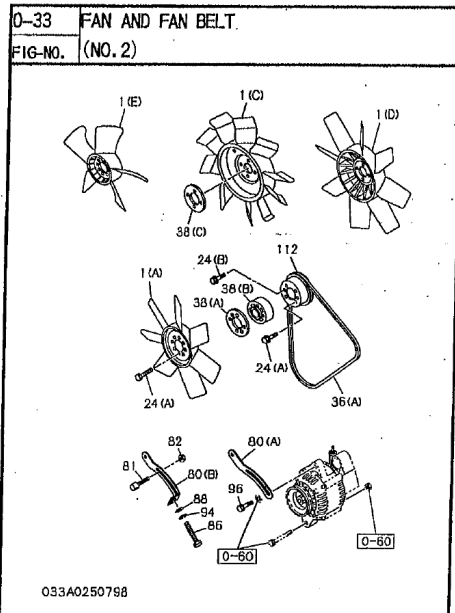
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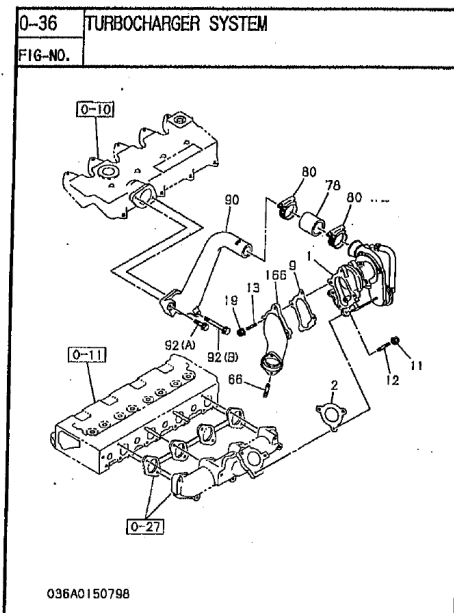
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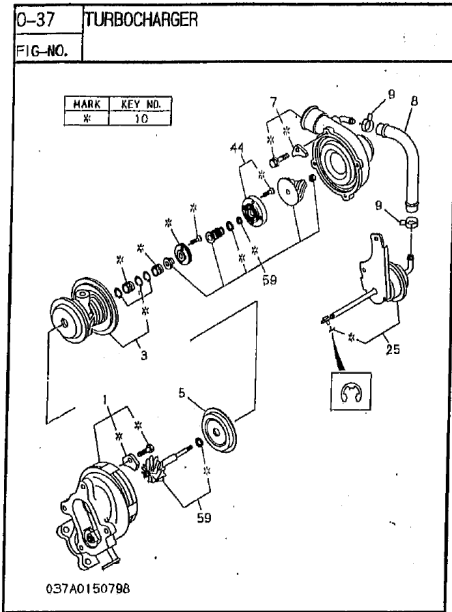


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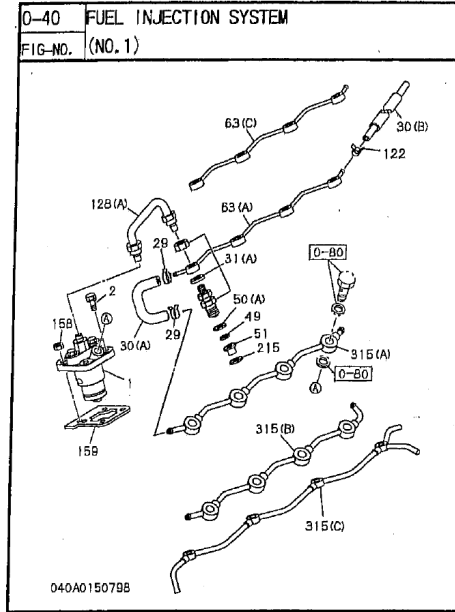


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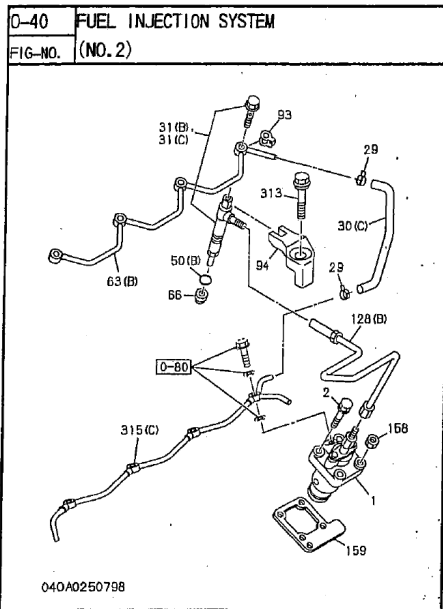
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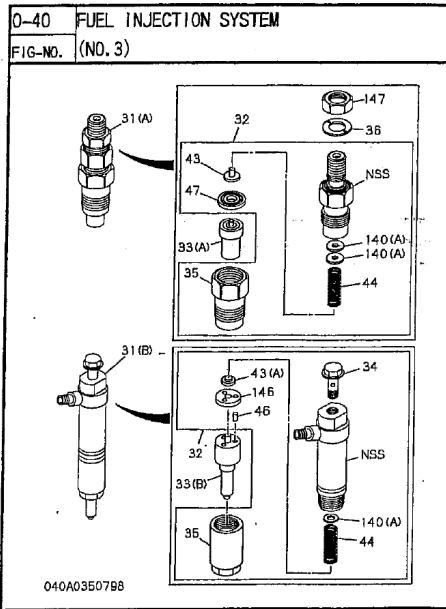
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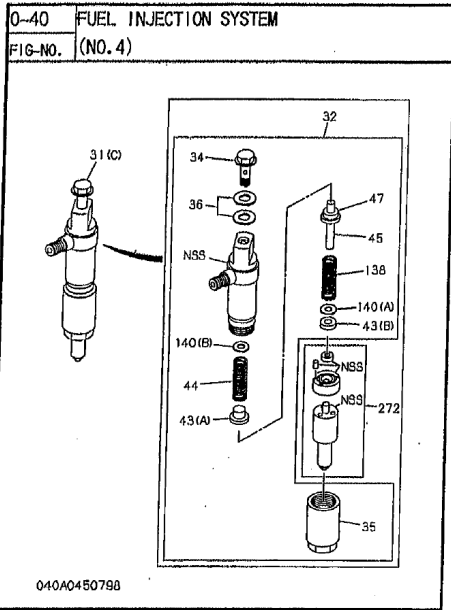


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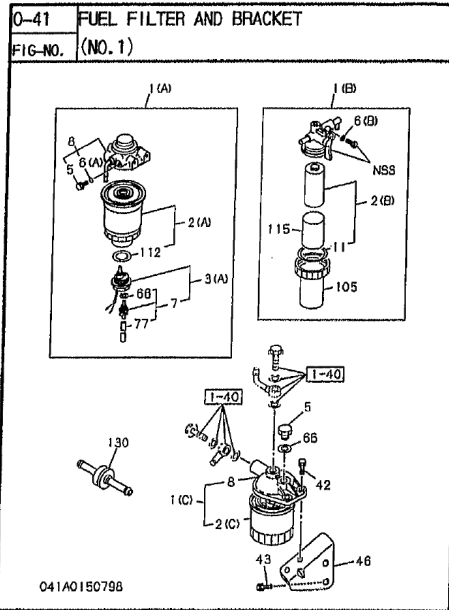


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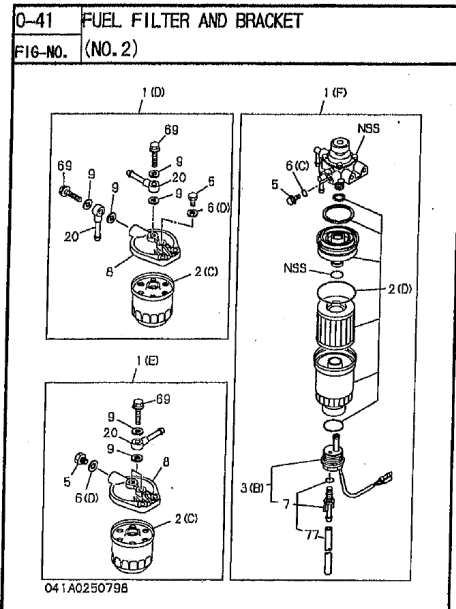
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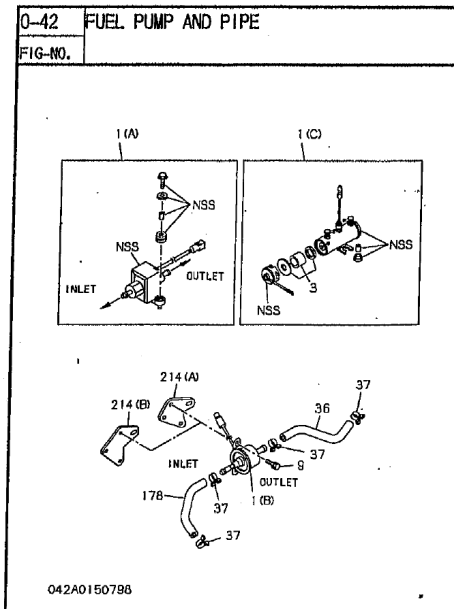
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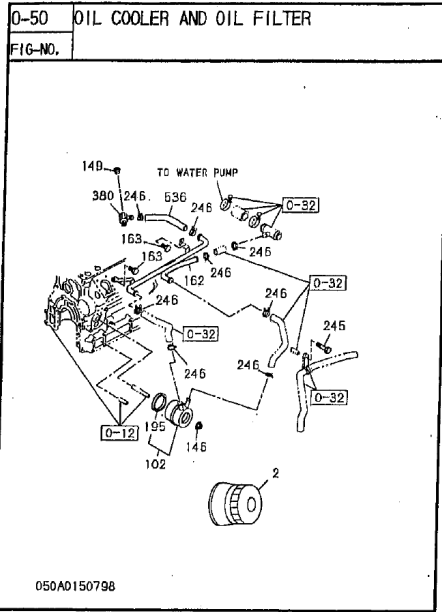


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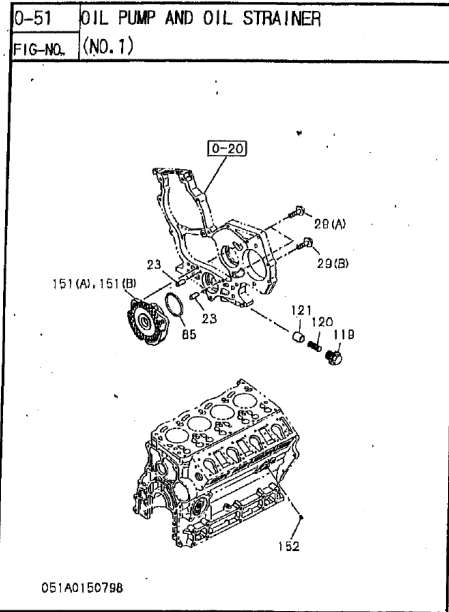


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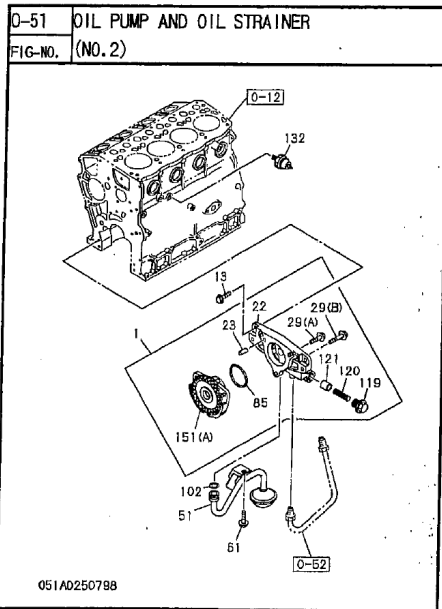
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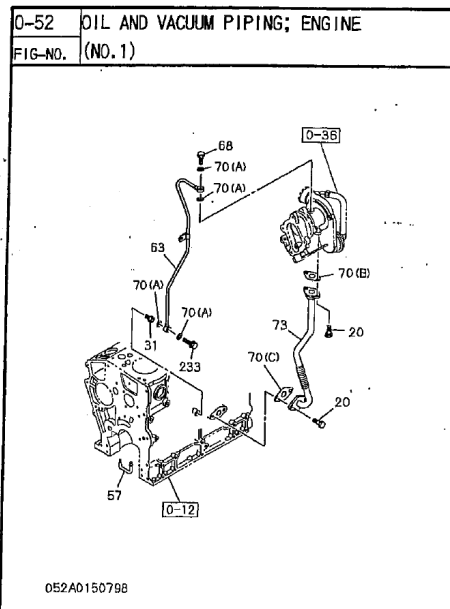
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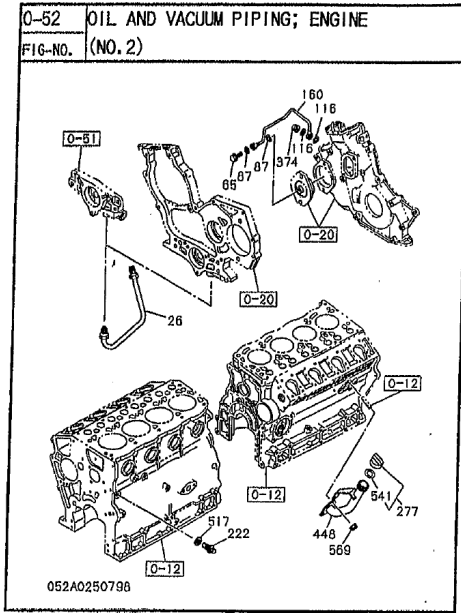


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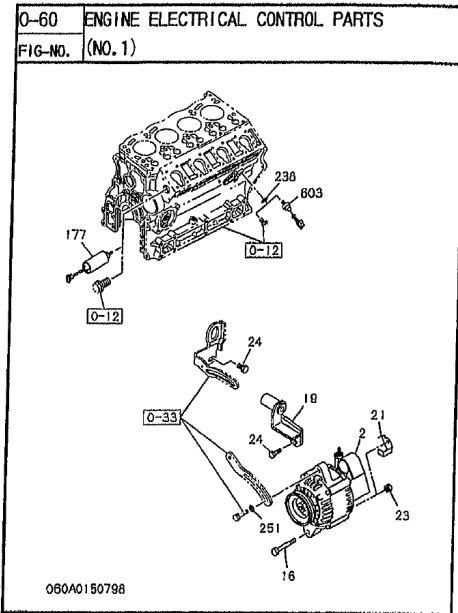


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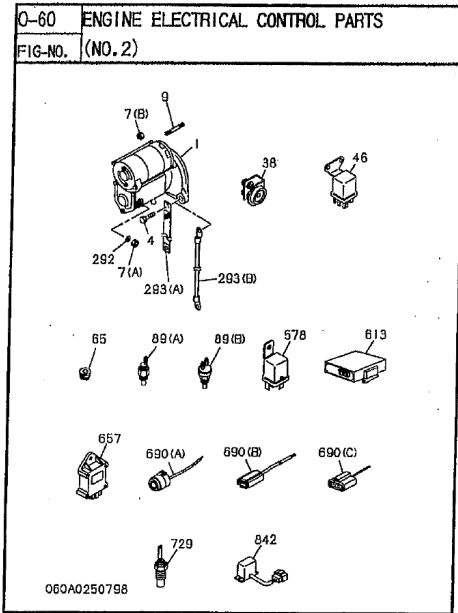
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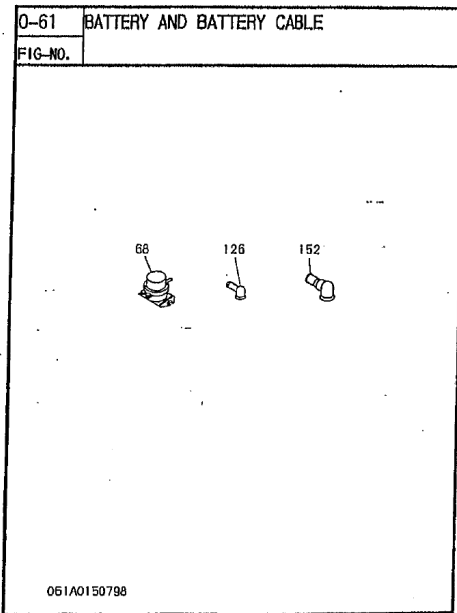
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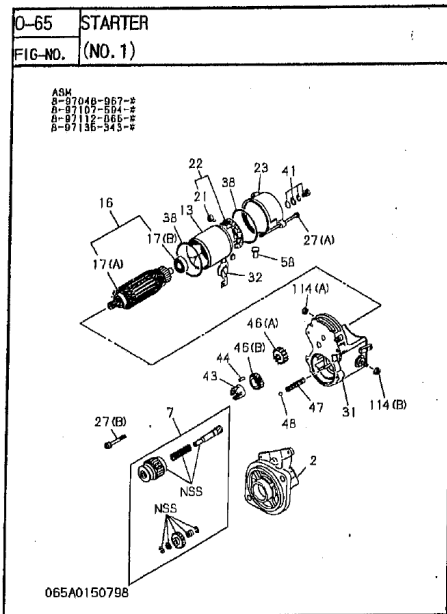


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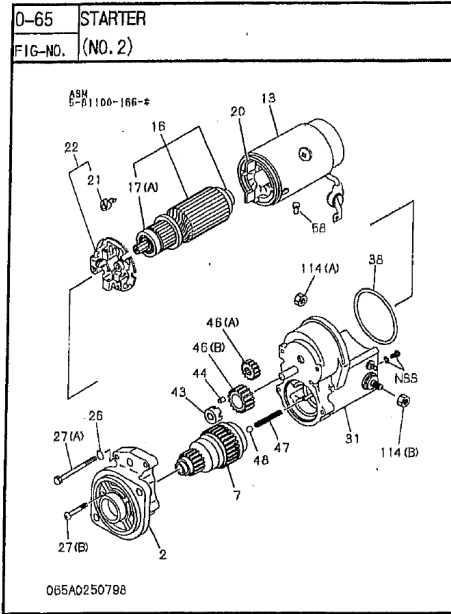


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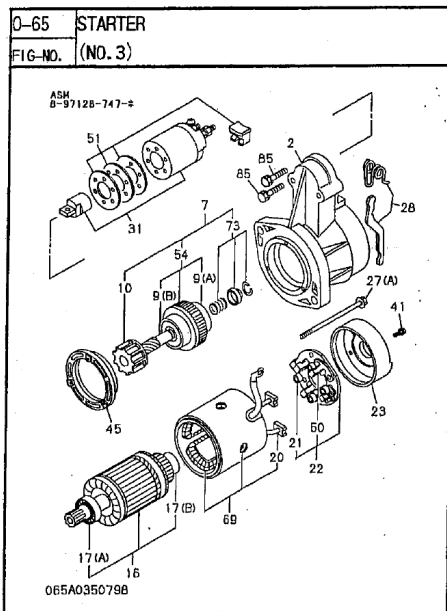
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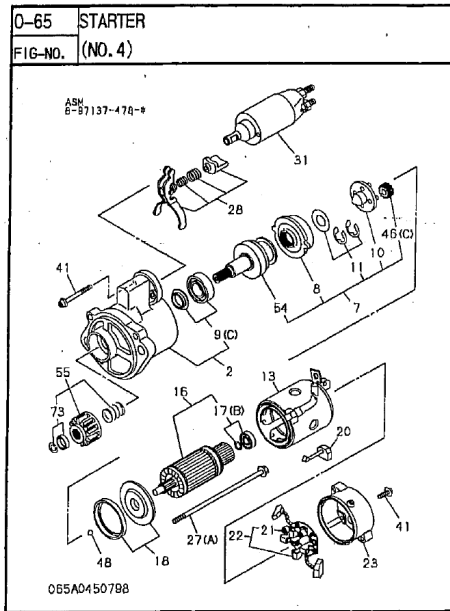
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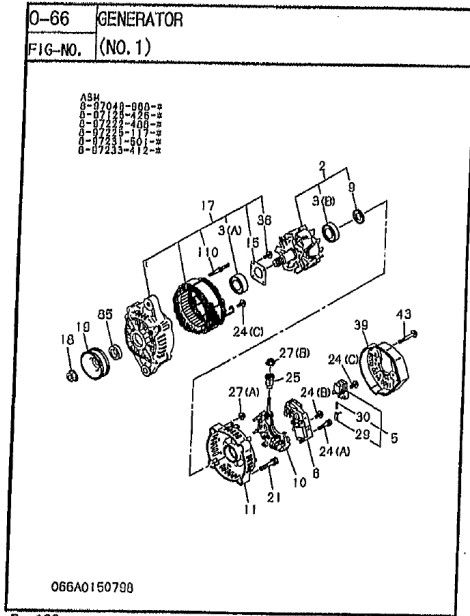


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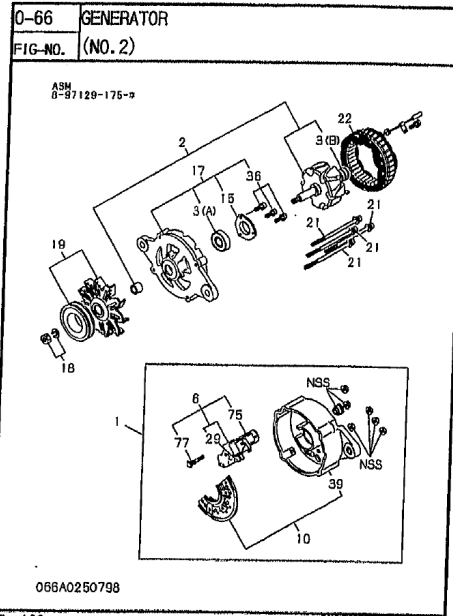


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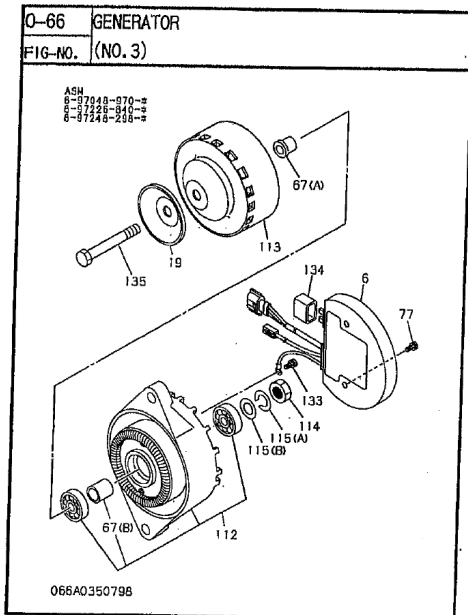
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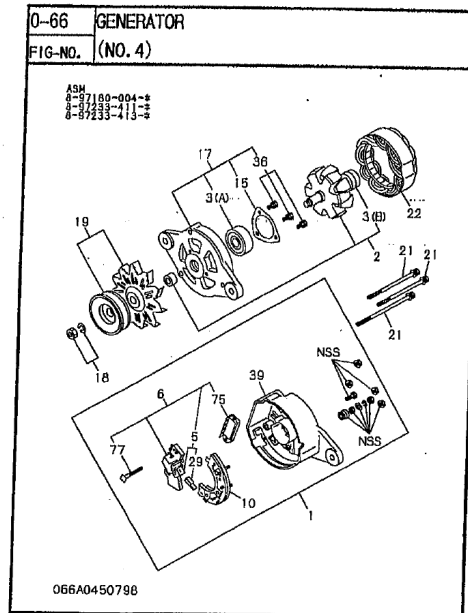
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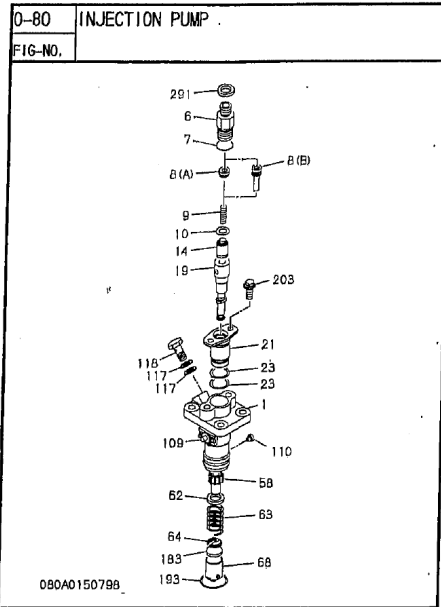


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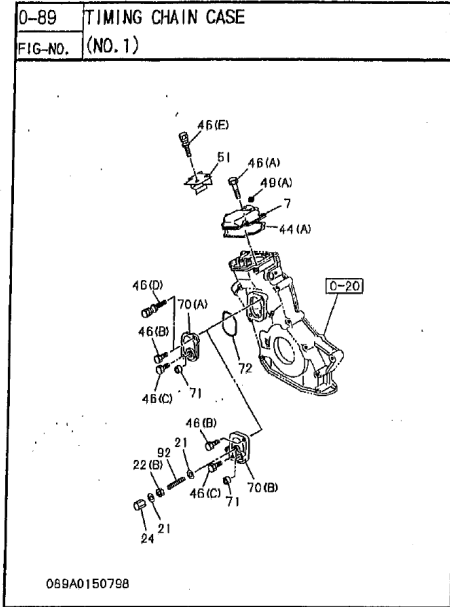


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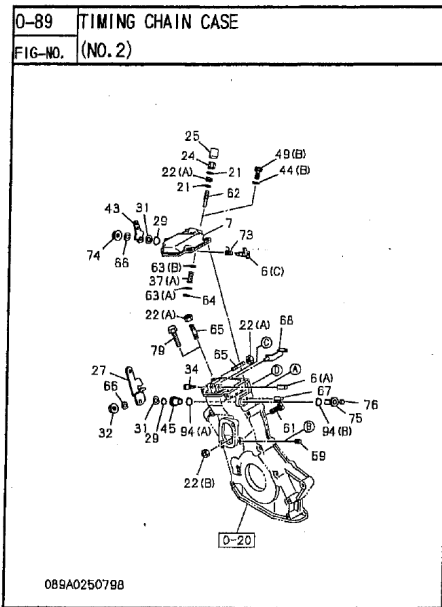
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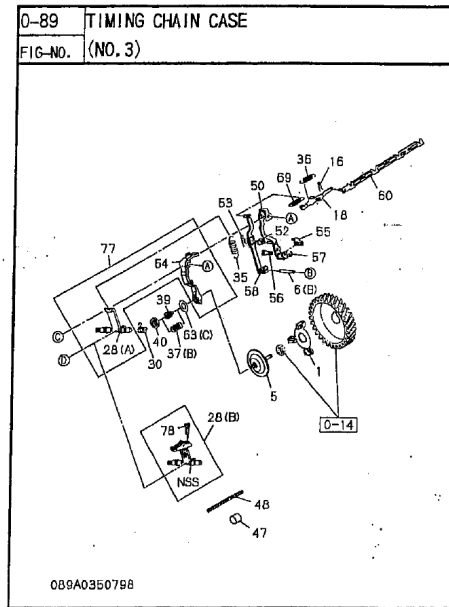
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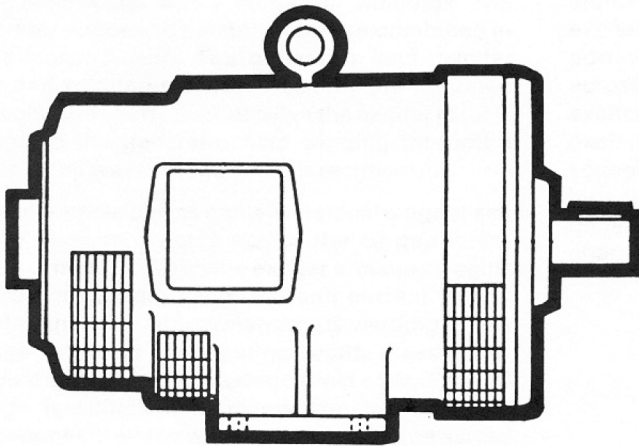


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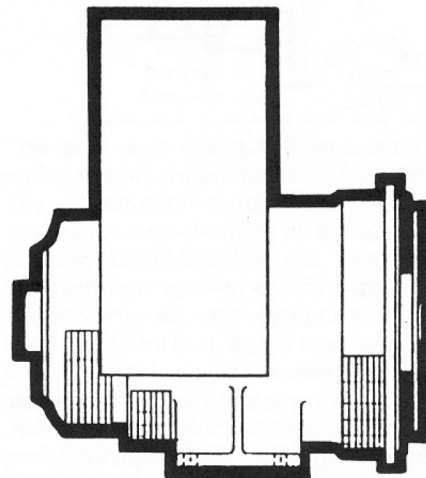
INSTALLATION, OPERATION AND MAINTANENCE MANUAL

TYPE MAC Brushless AC Synchronous, Internally Regulated Alternator Frame 280



Marathon Electric Mfg., Corp.
100 East Randolph Street
P.O. Box 8003
Wausau, WI 54402-8003
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Fax: (715) 675-6361

Making Energy Work For You



SB 349

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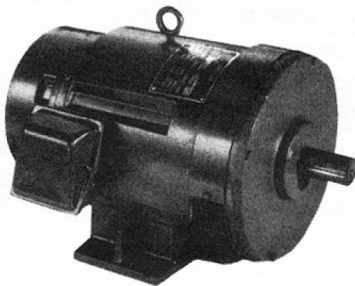
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PRINCIPLE OF OPERATION

The MAC generator is a self-regulated, rotating field synchronous unit with the rotor having a salient pole construction with amortisseur windings. The generator stator and exciter stator are combined in a common housing. The generator field, exciter rotor and rotating rectifier assembly are mounted on a common shaft. The output of the exciter rotor is applied to the generator field winding through a rotating, full wave bridge, silicon rectifier unit.

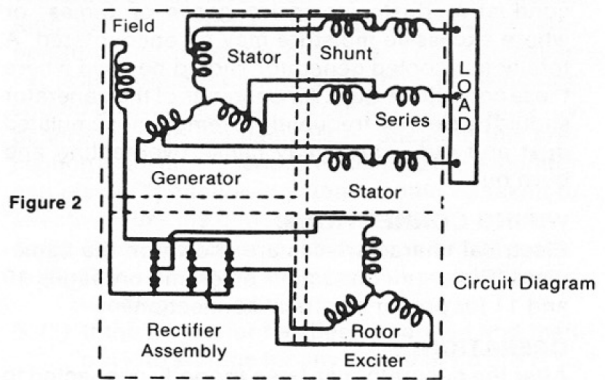
The exciter pole pieces contain residual magnetism, setting up lines of force across the air gap to the exciter armature. When the exciter armature begins to rotate a voltage is induced and current flow is initiated in the exciter armature AC windings. This voltage is fed to the rotating rectifier assembly, rectified and fed to the alternator field coils. This DC voltage is sufficient to magnetize the laminated alternator field which will set up lines of force across the air gap to the alternator stator. As the generator rotor rotates a voltage will be induced and current will flow in the alternator stator windings and to the output circuit.

All connections between the exciter stator windings and the generator stator windings are internally connected within the stator housing. Only the output power leads of the generator unit are brought out to the generator terminal box.



CIRCUIT DIAGRAM

Figure 2 shows the internal schematic diagram of the generator, exciter and rectifier unit. The generator is a three phase unit and the exciter stator and exciter rotor also have three phase windings. A portion of the exciter stator windings is connected across a tap on the generator stator winding. This exciter shunt winding provides the generator field excitation power required for the generator no load voltage. Another portion of the exciter stator windings is connected in series with the output of the generator and provides a compounding excitation characteristic.



The rotor is, in effect, the secondary of a rotating current transformer induction frequency converter. The exciter rotor output voltage is applied to the generator field windings by a three phase full wave rotating silicon rectifier unit. The response time of the excitation system is very fast since the exciter stator carries an alternating current corresponding to the load current which appears immediately on the exciter primary. An increase in load current will cause an immediate increase in the exciter secondary output voltage which is rectified and applied to the generator field windings. The inherent compounding characteristics of the excitation system provide excellent voltage regulation even under heavy overload conditions.

PERFORMANCE DATA

The excitation characteristics of fast exciter response with maximum exciter output makes this generator ideal for motor starting loads that require a very high current at low power factor during the motor starting and acceleration periods. At the same time it offers the rugged, reliable, maintenance-free operation inherent in the brushless type generator. No external controls are needed with a Lima MAC generator.

The performance of a 10 kW Lima MAC synchronous generator is indicated in Figure 3.

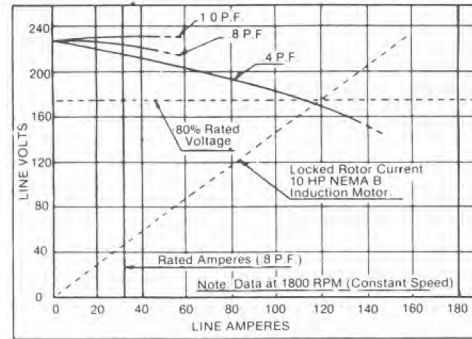


Figure 3

**SECTION I
INSTALLATION AND OPERATION**

UNPACKING:

When unpacking, check for damage in shipping. Report any damage at once to delivering carrier. Read instruction tags shipped with generator.

INSTALLATION:

The generator must be properly aligned and located in a well-ventilated place where the air temperature will not exceed 40°C or 104°F, and should be accessible for cleaning. An open type generator should not be located where there are abrasive or conductive dusts, corrosive gases or fumes, or where excessive moisture may be encountered. A totally fan-cooled generator should be used where these conditions exist. Air openings of the generator should be cleaned frequently to remove accumulated dust and dirt, which may cause overheating and burn out.

WIRING CONNECTIONS:

Electrical characteristics are shown on the nameplate. Refer to connection diagrams on pages 10 and 11 for proper electrical connections.

OPERATION:

After the generator has been properly connected to the driving unit and the load lines connected to the generator's leads according to the wiring diagram, the unit is ready for operation. To connect the coupling discs of a single bearing generator to the driving engine's flywheel it may be necessary to slide the rotor forward a few inches out of the stator, taking care not to slide it so far as to cause the rotor to come out of the bearing entirely and down upon the stator windings, causing damage to the windings.

Ordinarily, a chain hoist is needed to jockey the generator rotor into position.

STANDBY UNITS:

Generators used as an auxiliary power source in case of commercial power failure must be isolated from the commercial line before being placed in operation.

CAUTION: MAKE SURE UNIT IS COMPLETELY SHUT DOWN AND FREE OF ANY POWER SOURCE BEFORE ATTEMPTING ANY REPAIR OR MAINTENANCE ON THE UNIT.

PARALLEL OPERATION:

For parallel operation, both units must be of the same voltage, frequency, and phase. Phase voltages of paralleled units must be synchronized. This generator set utilizes the "dark lamp" method of paralleling.

ROTATION:

The generator can be operated in either direction of rotation.

OVERLOAD:

The load on the generator should be checked with an AC ammeter to see that the ampere rating stamped on the nameplate is not exceeded. Prolonged overload on the generator may cause it to overheat and possibly burn out.

LUBRICATION:

Ball bearings on Lima generators are pre-lubricated and require no further lubrication for the life of the bearing.

SECTION II SERVICE AND MAINTENANCE

PREVENTATIVE MAINTENANCE AND OPERATING PERCAUTIONS:

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions which are compatible with those at which the equipment was designed to operate. Follow the instructions as outlined to insure maximum efficient utilization of the electrical equipment.

COOLING:

Keep all cooling parts clean and make certain sufficient room is left on all sides for a plentiful supply of fresh coolant air flow. **DO NOT EXCEED AIR TEMPERATURE RISE AS SHOWN FOR 50°C ABOVE A 40°C AMBIENT.** This insures that the insulation NEMA Class "F" will not be damaged. **DO NOT EXCEED RATED LOAD**, except as specified for the equipment. **OPERATE AT RATED SPEED.** Failure to operate generators at rated load or speed will cause overheating and possibly damage to windings due to over voltage or current.

BEARING REPLACEMENT:

Factor lubricated shielded bearings will normally provide several years of trouble free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. Should bearing failure occur, bearings can be replaced. **ALWAYS REPLACE WITH THE SAME TYPE BEARING AS INSTALLED AT THE FACTORY. CHECK PARTS LIST FOR PART NUMBER.** Include generator serial number when ordering bearings.

ROTATING DIODE BRIDGE:

The rotating diode bridge can be removed and replaced. Excessive overcurrent, overvoltage, over-speed, or reverse currents can cause damage to the assembly or any of the component parts.

ROTOR DAMAGE:

The damper bars of the generator prevent excessive hunting when AC generators are operated in parallel. Damper bars, because they must have a low electrical resistance and are subjected to extreme centrifugal forces, must be mechanically secure and permanent. Consequently, they are welded to end plates completely covering the field.

All rotors are static and dynamically balanced to a high degree on precision machines to assure minimum vibration. They will, therefore, remain dynamically stable at speed well beyond the synchronous speed of the generator. The rotors on generators

are, however, subjected to extreme centrifugal forces which can increase beyond safe operating limits at excessive overspeed. Therefore, the prime mover should be adequately governed to prevent over-speed.

Damage to the rotor can also occur due to overheating which can be caused by the air flow being restricted from dust or other foreign objects collecting in the air passage.

If a rotor becomes defective, it should be returned to the factory with full nameplate data, because the rotor coils are enclosed in welded squirrel cage winding. To repair a rotor the special tooling and technique of the factory is necessary and essential. The Lima Electric Company, Incorporated, facilities can perform a complete rebuild, or rewind job with greater skill and craftsmanship than can be found in the average motor rewind shop. Should a failure occur, the factory should be notified immediately and steps will be taken to get the generator back into service with the least expense; and more important, to determine the cause of the failure and take steps to prevent a recurrence.

PRECAUTIONS:

GENERATOR WINDINGS (DRYING):

Generators that have been in transit or storage for long periods may be subjected to extreme temperature and moisture changes. This can cause excessive condensation, and the generator windings should be thoroughly dried out before bringing the generator up to full nameplate voltage. If this precaution is not taken, serious damage to the generator can result. The following steps should be taken to effectively dry the generator windings:

- A. (1) Place generator in drying oven or hot room.
- (2) Dry with warm air blower directed through windings.
- B. (1) If the generator has been operated and then put into storage for any period of time, a P.D. George #11127 type air-dry fungus resistant varnish should be reapplied.

Experience has shown that it is necessary to take these precautions in locations such as seaboard installations and other highly humid areas. Some installations will be in atmospheres that are much more corrosive than others. A little precaution along the lines outlined here could eliminate an unnecessary repair job.

Each generator was subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated was impressed between the winding and frame. All machines are insulated with a high safety factor for the class of insulation used. The latest and newest in insulation and baking techniques are used.

The finest insulation job can be very quickly broken down carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a breakdown, making it necessary to return the generator to the factory for repair, and consequent expense and loss of time.

WARNING: HIGH VOLTAGE (DIELECTRIC) TESTING MUST NOT BE PERFORMED TO THE MACHINE WITHOUT FIRST OBSERVING NEMA RULES. THE INSULATION OF THIS GENERATOR WINDING MAY BE SAFELY CHECKED BY USING A MEGGER. A HIGH MEGGER READING INDICATES LOW INSULATION LEAKAGE.

RESTORING RESIDUAL MAGNETISM:

The current necessary to magnetize the alternator field is obtained from the exciter. Initially, upon starting the generator, current flow and voltage are induced into the exciter armature by the magnetic lines of force set up by the residual magnetism of the exciter field poles.

Residual magnetism of the exciter field poles may be lost or weakened by a strong neutralizing magnetic field from any source, or if the generator is not operated for a long period of time.

Should the generator fail to build up voltage after being disassembled for any reason, a momentary short-circuit of any two generator leads should be

sufficient to correct this condition. If not, an alternate method may be used. Apply either an alternating current or a direct current voltage of approximately 20 volts to any to generator leads. Do not make a positive connection but rather touch the leads together until the generator voltage begins to rise and then remove. It is suggested that a 30 ampere fuse be inserted in the circuit to prevent any damage in case the build-up voltage is not removed quickly enough.

Start generator and observe generator build-up. Reflash field if generator output voltage does not build up.

TESTING DIODES WITH AN OHMMETER:

Isolate the rectifier assembly by disconnecting the two leads from the main rotor and three leads from the exciter rotor. Do not unsolder diodes. Test each diode by applying the probes of an ohmmeter to the anode and cathode.

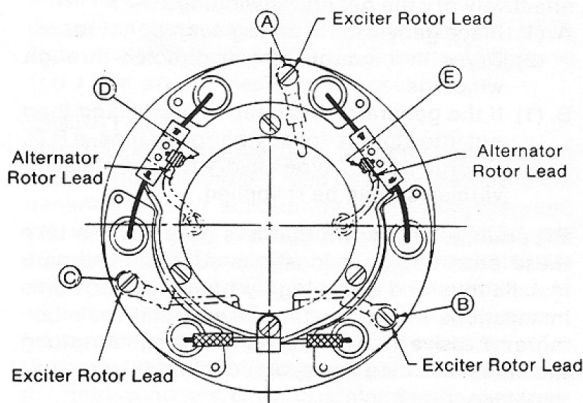
A good diode will produce a meter reading of only a few ohms when the probes are applied in one direction, and a reading of near infinity when the probes are reversed. If both readings are high, or both are low, the diode is defective and must be replaced.

Diode failure after a 25 hour "run-in" period is generally traceable to external causes such as lightning strike, overheating or a reverse current fed into the alternator. To save excessive service time and call-backs, it is a generally accepted practice to replace the entire rectifier assembly where failure can be traced to external causes AFTER THE CAUSE OF DIODE FAILURE IS IDENTIFIED AND CORRECTED.

RECTIFIER REMOVAL PROCEDURE:

Rectifiers may be removed through the bearing cap on the rear of the generator. (See Figure 6, Item B.) First, remove the bearing cap by removing the four bolts shown in Figure 6 as Item A. You can now see both the bearing (Item C) and rectifier assembly (Item D). Use a bearing puller to remove the bearing from the main shaft being careful to locate the puller on the inner race of the bearing to avoid bearing damage. Once the bearing is free it is then necessary to disconnect leads A, B, C and D as shown in Figure 5 assembly drawing. Then remove the three hold-down cap screws which secure the rectifier assembly to its adaptor. Once this procedure is complete the rectifier assembly is free for removal.

Follow the testing procedures outlined in testing diodes and Figure 5.



Rectifier Assembly 778600
Figure 5

After the rectifier assembly has been repaired or replaced, reverse the procedure as stated above, being careful that all lead connections are tight and that set screws are locked with a Lock-Tite compound.

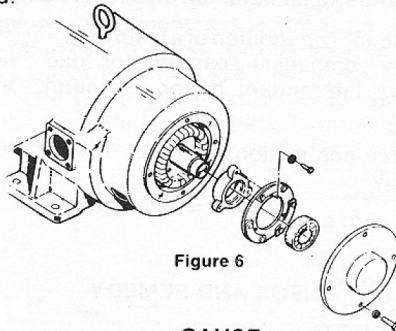


Figure 6

**TROUBLESHOOTING PROCEDURES
AC BRUSHLESS GENERATOR**

As with any machine, trouble may develop in electrical generators. It may be due to long service or neglect of regular maintenance, servicing, and checking. Should trouble develop, the following instructions will be helpful in tracing the cause and making repairs.

SPEED DEVIATIONS:

The generator speed should be maintained at rated nameplate speed. The frequency and voltage of the generator output depends on speed. If the generator runs slower than rated speed, the voltage will drop off.

CAUSE	NO VOLTAGE:	CHECK AND REMEDY
Loss of residual magnetism in exciter field poles.		Flash field, see page 6 "Restoring Residual Magnetism."
Open in stator windings.		Check for continuity in windings. Return to factory for repair if open.
* Open or short in rotating rectifiers.		Check rectifiers per previous instructions, replace if faulty.
Short circuited.		Clear lead to restore voltage build-up.
* Open in alternator field.		Check for continuity and return rotor to factory for repair if field coils are open.
* Shorted exciter armature.		Check for short and replace if faulty. Use a "Kelvin" type bridge to measure this resistance.
* Shorted leads between exciter armature and generator field.		Test and repair.
NOTE: *Designate rotating parts. Generator must be open to test.		

CAUSE	LOW VOLTAGE:	CHECK AND REMEDY
Excessive load.		Reduce load. With 3 phase generators, the load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
Low speed.		Check engine for malfunction or system for overload.
Line loss.		Increase size of line lead wire.
High resistance connections — connection will be warm or hot.		Make better connection electrically and mechanically.
Shorted field.		Test field coils for possible short by checking resistance with an ohmmeter or resistance bridge. Return rotor assembly to factory for repair if alternator field coils are shorted.
Low power factor.		Reduce inductive (motor) load. Some AC motors draw approximately the same current regardless of load. Do not use motors of larger horsepower rating than is necessary to carry the mechanical load.

FLUCTUATING VOLTAGE:

(May be indicated by flickering lights)

CAUSE	CHECK AND REMEDY
Irregular speed of engine.	Check engine for malfunction or load for fluctuation.
Fluctuating speed.	Stabilize load. The addition of a lamp load (resistance load) may compensate partially for load changes caused by intermittent motor operation. Do not overload.
Loose terminal or load connections.	Make better connection mechanically and electrically.
Defective bearing causing uneven air gap.	Replace worn bearing.

HIGH VOLTAGE:

CAUSE	CHECK AND REMEDY
Excessive speed.	Check engine for malfunction.

OVERHEATING:

CAUSE	CHECK AND REMEDY
Generator overloaded.	Reduce load. (Check with ammeter and compare with nameplate rating.)
Clogging ventilating screens.	Clean air passages.
High room temperature	Improve ventilation.
Insufficient circulation.	Provide cross-ventilation.
Low power factor.	Reduce inductive loads or install power factor improvement capacitors.
Unbalanced load.	The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
Dry bearing.	Replace bearing.

MECHANICAL NOISE:

CAUSE	CHECK AND REMEDY
Defective bearing.	Replace bearing.
Rotor scrubbing on stator.	Bad bearing, replace. Bent shaft, return to factory. Loose endbell, tighten; loose drive discs, tighten.
Loose laminations.	Return to factor for repair.
Loose or misaligned coupling.	Tighten or align.

GENERATOR FRAME PRODUCES SHOCK WHEN TOUCHED:

CAUSE	CHECK AND REMEDY
Static charge.	Ground generator frame.
Grounded armature or field coil.	Return to factory for repair.

ELECTRICAL WIRING PROCEDURES — WIRING DIAGRAMS

CAUTION

Wiring of the alternator should be done in accordance with good electrical practices. Follow government, association and industry standards. In some wiring arrangements, groups of terminals are connected together with no further termination. These terminals must be properly insulated to avoid a hazard to personnel and potential equipment damage.

Lima MAC alternators are supplied in 10-lead or 12-lead configurations. From the nameplate information and system voltage requirements, select the appropriate wiring diagram from the information that follows.

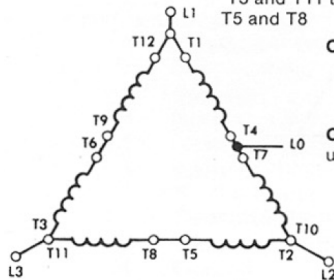
WIRING REFERENCE CHART

Configuration		MAC Type Specific Voltage (60 HZ)	Ref. Diag.
3 Phase	12-Lead Unit, 4-Wire 240 Volt Delta Connected	240V	A
	12-Lead Unit, High Voltage Wye Connected	416V	B
	12-Lead Unit, Low Voltage Wye Connected	208V	C
	10-Lead Unit, High Voltage Wye Connected	480V	D
	10-Lead Unit, Low Voltage Wye Connected	240V	E
1 Phase	12-Lead Unit, Low Voltage Delta	120V	F
	12-Lead Unit, 240 Volt Zigzag	240V	G

DIAGRAM A

12-Lead Unit, 240 Volt, Delta Connected, 3 Phase

Connect together the following six sets of terminations:
 T1 and T12 to form L1 T2 and T10 to form L2
 T3 and T11 to form L3 T4 and T7 to form L0
 T5 and T8



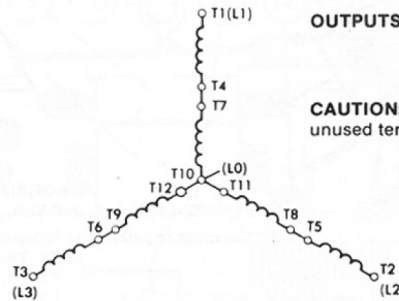
OUTPUTS: 120V, 1Ø 240V, 3Ø
 L1 to L0 L1 to L2
 L2 to L0 L2 to L3
 L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM B

12-Lead Unit, High Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:
 T4 and T7 T5 and T8 T6 and T9
 T10, T11 and T12 to form L0
 T1 is L1 T2 is L2 T3 is L3



OUTPUTS: 240V, 1Ø 416V, 3Ø
 L1 to L0 L1 to L2
 L2 to L0 L2 to L3
 L3 to L0 L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM C

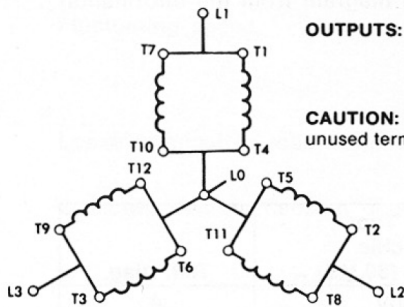
12-Lead Unit, Low Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:

T1 and T7 for form L1 T2 and T8 to form L2

T3 and T9 to form L3

T4, T5, T6, T10, T11 and T12 to form L0



OUTPUTS: 120V, 1Ø 208V, 3Ø
 L1 to L0 L1 to L2
 L2 to L0 L2 to L3
 L3 to L0 L1 to L3

CAUTION: Properly insulate all unused terminations.

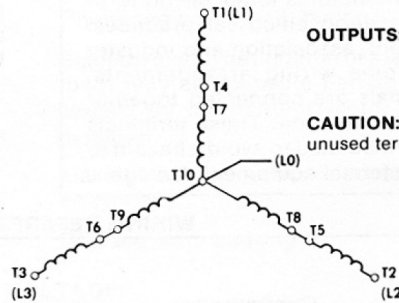
DIAGRAM D

10-Lead Unit, High Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:

T4 and T7 T5 and T8 T6 and T9

T1 is L1 T2 is L2 T3 is L3



OUTPUTS: 277V, 1Ø 480V, 3Ø
 L1 to L0 L1 to L2
 L2 to L0 L2 to L3
 L3 to L0 L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM E

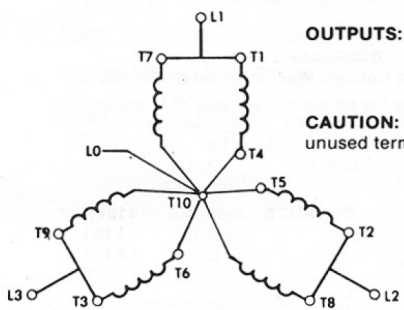
10-Lead Unit, Low Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:

T1 and T7 to form L1 T2 and T8 to form L2

T3 and T9 to form L3

T4, T5, T6 and T10 to form L0



OUTPUTS: 139V, 1Ø 240V, 3Ø
 L1 to L0 L1 to L2
 L2 to L0 L2 to L3
 L3 to L0 L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM F

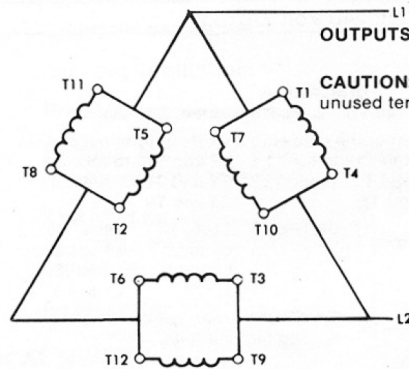
12-Lead Unit, Low Voltage, Delta Connected, 1 Phase

Connect together the following three sets of terminations:

T2, T8, T6, T12 and Insulate

T1, T5, T7, T11 to form L1

T3, T4, T9, T10 to form L2



OUTPUTS: 120V, 1Ø
 L1 to L2

CAUTION: Properly insulate all unused terminations.

DIAGRAM G

12-Lead Unit, 240 Volt, Zigzag, 1 Phase

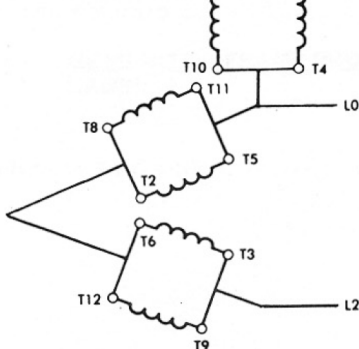
Connect together the following four sets of terminations:

T2, T8, T6, T12 and Insulate

T1, T7, to form L1

T3, T9, to form L2

T4, T10, T5, T11 to form L0



OUTPUTS: 120V, 1Ø 240V, 1Ø
 L1 to L0 L1 to L2
 L2 to L0

CAUTION: Properly insulate all unused terminations.