Generator

Maintenance and Operation

Manual

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INTRODUCTION

CONGRATULATIONS on selecting a NORAM generator set. You have chosen a high quality, state-of-the-art unit built to out most rigorous standards. We are proud of what we have accomplished in this unit, and by following the instructions in this manual and performing maintenance at the suggested intervals; it will reward you with many years of service.

This manual divides the generator set into several major component groups: Engine, Generator, 12V electrical system, A.C. electrical system, Cabinet/enclosure, and Trailer. **Please observe all WARNING and CAUTIONS in this manual and on the equipment. Failure to do so may result in serious injury, property damage, or death.** In addition, you have received operating and maintenance manuals from the engine and generator manufacturers. *In the event of conflict between this manual and the manufacturers' manuals, always use their manual.* Since this manual is not specific to any one unit, suggested maintenance intervals are at the minimum interval normally seen by that type of component. Longer intervals may be allowed. If technical assistance is needed, please consult the factory. We maintain a 24 hour, 7 day a week, customer assistance line for your immediate help at 1-800-933-2677.

Always exercise safety precautions to avoid personal injuries or property damage whenever operating a generator set (or working nearby). The following is a short list of some items to pay particular attention to:

WARNING: This equipment uses high voltage circuits capable of causing serious injury or death. Take extreme caution when troubleshooting or repairing any electrical circuit or downline loads. Keep hands and clothing away from moving parts. Never attempt to make adjustments or repairs while unit is running, unless instructed to do so.

WARNING: Unit should be grounded with a mechanical earth ground. We recommend that you connect into the sire or building ground whenever possible. If a grounding rod is to be used, make sure it is installed to NEC specifications.

Lug panels are designed to be both safe and convenient. **DO NOT** disable the door safety switch or any other safety device on the unit. The door switch disengages the engines fuel solenoid or electronic governor, causing the engine to stop, BUT it does not disable the generator outputs. Voltage will remain at the terminal outputs for a few seconds while the engine slows down. WAIT for the engine to come to a complete stop before attempting to connect/disconnect wiring. Some units have shunt trip, but engine will still run.

INTRODUCTION (cont.'d)

CAUTION: Use of ETHER or other starting fluids can cause **SERIOUS ENGINE DAMAGE** or personal injury. Some engines are equipped with an air intake glow plug that will ignite the starting fluid on contact, presenting a serious risk to the operator. All of our generator sets come with glow plugs or auto excess fuel devices for cold weather operation (-5 to -20 deg. F, dependent on engine). Use the correct oil weight and consult the engine manufacturer's operators manual for suggestions on cold weather operation.

Always use the proper trailer hitch and safety chains for towing generator sets. Make sure both the hitch and ball are rated for the weight of the trailer, and they are both of the same size. On units equipped with ring hitches, make sure the receiver is locked closed before towing. Swivel jacks should be rotated 90 deg. Before towing, or hitch failure may occur should the jack strike the ground.

Always maintain proper fluid levels in the engine. All engines are shipped with low oil pressure and high water temperature shutdowns as standard. Low coolant level and low oil level protection are optional. Diesel engines can run for a long time on low fluid levels, causing increased operating temperatures and wear. Check these levels before every start.

Tires should be checked regularly for proper inflation and general condition. Towing at low pressures causes excessive wear and possible tire failure.

Make sure all wiring connections are secure before operation. Plugging in wet or dirty extension cords causes arcing and corrosion in the receptacles. Check for frayed or damaged cords that could cause shorts. Check ground faults with a proper tester on a regular basis. Check cycle circuit breakers periodically to ensure proper operation.

MAJOR COMPONENTS

ENGINE:

Several different brands and types of engine are supplied in NORAM generator sets. All were selected and outfitted to give maximum reliability and service ability in the field. Refer to the engine manufacturers' operations manual supplied with this unit for specific information on these engines. Some items, such as electronic governors, also have their own manual. Refer to these when making adjustments or troubleshooting. Contact the factory if you need assistance. All units are supplied with low oil pressure and high water temperature switches. Units equipped with a distribution panel have a door mounted safety switch operating a relay to protect against electrical shock. The engine will crank and start with the switch open, but will stop when the key is releases. Check that this switch is closed before troubleshooting the shutdown system.

GENERATOR:

Newage generators are supplied in all NORAM gen-sets. 40kW and larger machines are supplied PMG equipped. This small Permanent Magnet Generator provides more constant power to the field rotor, giving a 50% boost in motor starting capability. The MX series AVR that accompanies the PMG equipped units also has built in over-excitation protection. The AVR will sense when the generator is overloaded and cut power from the exciter, which shuts down the output of the generator. This will automatically reset when the generator set comes to a complete stop.

ENCLOSURE:

All units are built using heavy gauge cold rolled steel. Sound attenuated units feature 12 gauge cabinet construction. Skids are built from 3/16" and ¼" steel, then hot dipped galvanized for maximum durability. Floors are constructed from 11 gauge galvanized steel, along with the sub-floor that protects the fuel tank. All foam insulation is faced to give long life and prevent residue build-up.

ELECTRICAL SYSTEM:

The control panel is divided into two parts. The upper panel contains all the engine instrumentation and output metering; while the lower panel contains the receptacles, circuit breakers, and power distribution terminals. The wiring diagram that accompanies this manual details this unit's component. The panels are joined together and hinged at the bottom for easy inspection. DO NOT alter the electrical system in any way without factory consultation. Failure to do so will void warranty and may result in serious injury or death. Standby units are equipped with a single control panel either mounted above the generator housing or as part of an auto-transfer switch. These components have their own operating instructions furnished with the unit.

RECEIVING, UNLOADING AND INSPECTION PROCEDURES

NORAM Gen-Sets are shipped fully assembled and ready to place into operation. Also, remove any excess packing materials so that the generator can be properly inspected.

NORAM Generators feature a lifting eye for unloading from a shipper. The unit can be lifted by using a suitable sling, chain or hook passed through the lifting eye. A lifting device with a minimum capacity of 2 tons or 4,000 pounds should be used. A forklift may be used to lift the unit if the forks are of adequate length to support the unit. Exercise extreme caution when using a forklift to avoid damage to the underside of the unit.

CAUTION: Exercise extreme caution during the unloading process. Keep all non-essential personnel clear of the lifting are at all times.

Always inspect Gen-Sets immediately for shipping damage. Note any damages on the shipping documents. Never sign shipping documents before inspection. Follow the inspection check list below before putting unit into operation.

( ) Check unit for obvious structural damage.

( ) Check tires for damage and proper inflation and check lug bolts for tightness.

( ) Check engine/generator compartment for obvious damages.

( ) Check any exposed wiring for abrasions.

( ) Check running lights for cracked lenses and damaged lamps.

SET-UP AND STARTING

1) Spot unit on level ground. All NORAM generator sets have the fuel pickup lines near the drain plug locations, which is also opposite of the fuel filler cap. If the ground is not level, place the unit with the drain at the lowest point ("downhill") to maximize the runtime. On trailer-equipped units, chock the tires to prevent rolling.

2) THIS UNIT MUST BE GROUNDED! Even though the galvanized skid precedes a better ground than a painted one, NEC code requires ALL generators be attached either to the site ground or a ground rod.

3) **Make all electrical connections to the distribution panel BEFORE starting the engine.** Refer to distribution panel wiring diagram inside door for correct connections. Make sure all connections are tight. Turn off circuit breakers to items you do not want powered on start-up.

4) Check all fluid levels. Inspect floor signs of leaks or spills. Check fan and other moving parts for debris or other items before starting.

5) If control panel is equipped with a glow lamp indicator, turn key to left for pre-heat. Hold until red indicator light goes out, or until element glows bright orange. To start, turn key to the right. If engine does not start in 30 minutes, wait 30 seconds before trying again. Repeat twice, and then refer to troubleshooting section before continuing.

6) Check instruments to see that the engine is performing normally. The AC (does not mean air conditioner) gauges may not work until the main circuit breaker is in the "ON" position. Frequency should be at 60 Hz on units equipped with an electronic governor and 63 Hz on standard units with no load.

7) **NEVER MOVE VOLTAGE SELECTORS SWITCH WHILE ENGINE IS RUNNING, EVEN UNDER NO LOAD**. Damage to the switch or AVR **WILL** result.

8) To stop units, turn key switch to the off position. On units equipped with a turbocharger, run the engine at no load for two minutes before stopping engine to prevent overheating and damage to the turbocharger's bearings.

OPERATION

ELECTRICAL SYSTEM: This electrical system consists of two circuits: the engine's 12 or 24V DC electrical system and the starter battery, and the generators AC electrical circuit.

ENGINE CIRCUIT:

1. Engine fuel control solenoid (speed control solenoid on units with electronic governor)

2. Safety shutdown system

3. Starting system

4. Charging system

5. Instrumentation (Gauges, indicator lights, lamps, ect.)

GENERATOR CIRCUITS:

1. Generator

2. Control panel, upper (metering)

3. Control panel, lower (circuit breakers, receptacles, distribution)

ENGINE:

1. Refer to engine wiring diagram. When the key is in the ON position, power is supplied from key switch terminal #2 (K2) to the door switch relay (R). If the distribution door is closed, power goes to the oil switch. If there is oil pressure, then power is supplied to the water switch. If the engine is not overheated, then power is supplied on mechanically governed units to the fuel control solenoid. On units with electronic governors, the power goes to red terminal (+) of the governor.

2. To bypass this system for starting, K5 provides power to the governor with the key in the "crank" position. This circuit engages just before the starter, so if the key is turned slowly an audible "click" can be heard as the fuel solenoid pulls in. On mechanically governed units, the solenoid will stay in. On electronically governed units, the actuator will only pull in momentarily. When then key is released to the ON position, K2 powers the circuit as above. If the engine has not yet built up oil pressure, the engine will stop. Simply restart the unit, usually 1 to 3 times is normal, depending on the ambient temperature. For faster starting in cold weather, make sure the engine has the correct oil weight.

3. The starting system is shown in the following wiring diagram. Some larger engines, with high solenoid currents, will require the optional starter relay to prolong key switch life.

4. All NORAM gen-sets use battery charging alternators with built in voltage regulators. No periodic adjustment is necessary and minimal of external wiring is all that is required. The voltage of the alternator at the output terminal should be greater than the battery voltage. The purple exciter wire energizes the field on startup, so if the alternator is not charging make sure the exciter has 12V with the key in the ON position.

5. The instruments are shown in diagram 1. When troubleshooting, an open circuit on the red, black, or signal wires will give a reading of zero or minimum. Check first for power to the gauge, then for ground continuity. If those are good, check continuity through the wire, to the sending unit. Lastly, check the sending unit for good grounding.

TOWING INSTRUCTIONS

Please observe the following instructions when towing a generator:

1) Attach the generator to the towing vehicle using the front leveling jack.

2) Lock the hitch and insure that it is connected securely.

CAUTION: **If the hitch is not secured properly, the trailer could separate from the towing vehicle and cause equipment damage or personal injury.**

3) Connect the taillight wiring harness to the towing vehicle. Check the taillights for proper operation.

4) Position the leveling jack to its traveling position by pulling the pin and rotating 90 degrees.

5) Check the wheels to insure that the lug bolts are tight. Make sure tires are inflated to 35 PSI (MAX).

6) Make sure all doors are latched.

7) Remove wheel chocks, if required.

NOTE: The maximum highway towing speed recommended by NORAM is 55 MPH. Off road towing speed is not to exceed 10 MPH. Excessive speeds or improper use could cause severe damage and will void manufacturer's warranty.

MAINTENANCE / TROUBLESHOOTING

GENERATOR

Refer to the Newage handbook for all generator troubleshooting. Before troubleshooting a generator problem, disconnect all external connections to the generator and connect the terminals as in one of the diagrams pictured inside the lid of the terminal box (or readings will be in error). Run the unit to see if the problem may have been caused by an external fault. Call the factory for information on warranty or for help locating the nearest qualified service center.

UPPER CONTROL PANEL

The upper control panel contains:

1. Voltmeter
2. Ammeter
3. Frequency meter
4. Phase selector switch for meters
5. Voltage trimmer for AC output

The voltmeter measures line to neutral voltage on three phase units and both line to line and line to neutral on single phase units. Most meters are scaled for 300 Volts, to allow for more accurate reading on 480 volt systems (277V line to neutral).

All ammeters are amp CT powered units, with scaling and CT sizing appropriate to the maximum generator output. Replace only with units of the same 400:5 ratios. NOTE: Correct wiring is important for accurate readings. If inaccurate readings are suspected, check the units to see if they are properly grounded, and that CT's not reading in the current switch position are "grounded out" (BOTH wires grounded).

Frequency meters are all 120-139VAC units. If rewiring a 480 volt unit, do not wire line to neutral or meter will be damaged. Use a hand-held digital meter of good quality to calibrate. The phase selector switch is diagrammed in the drawing below. Incorrect wiring can instantly ruin a meter, so pay attention to terminal numbers when wiring. **Do not ground the ammeter or CT's to the same terminal as the frequency meters or the inductance in the CT's will "spike" the frequency meter when the switch position is changed eventually causing failure.**

The VOLTS trimmer is a 1 Kohm variable resistor, tied to the generator AVR. Turning the screw clockwise will increase the output voltage of the generator. The range of adjustment is set using the VOLTS trimmer on the AVR. Refer to the Newage handbook for details.

LOWER CONTROL PANEL

The lower control panel is made up of the following components (some optional):

1. Circuit breakers
2. Receptacles
3. Distribution panel (terminal board)
4. Voltage selector switch (optional)
5. Excitation breaker (PMG units only)

The wiring diagram for this unit is in the rear of this manual. Circuit breakers are both magnetic and thermal tripped and of high quality. Replace ONLY with a breaker of the same size and rating. Receptacles are widely varied, but all are grounded using a conductor, not just attached to the panel. Reinstall ground wires for maximum protection and corrosion protection. Always reinstall wiring to the correct polarity terminals. This is especially important on ground fault receptacles (GFI or GFCI).

Heavy duty selector switches are used in this unit. Note that our switches are used at their UL rated currents, not the higher thermal current (Ith). This switch may be one size larger than an equivalent unit from a competitor. We recommend replacing with the same size provided for maximum reliability.

On PMG units, an excitation breaker is provided. This cuts power to the exciter, resulting in collapse of the main rotor field voltage and loss of output. This can be used on start-up to prevent starting under load. The AVR in these units provides over-excitation protection. If the unit is overloaded, the AVR will cut power output (usually within 10 to 15 seconds). To reset, bring engine to a complete stop and restart. The AVR will automatically reset.

(6 Diagrams goes here)

NORAM Industries/Controls, Inc.
Product Specifications

NORAM Generator-Set Digital Control Panel

Displays

Display	Function Displayed	Display Type
AC Voltage	Generator Output Storage	Scrolling Ø 1-2, Ø2-3, Ø3-1
AC Current	System Load Current	Scrolling Ø 1-2, Ø2-3, Ø3-1
Frequency	Generator Output Frequency	Constant Display
Battery voltage	Engine Battery DC Voltage	Constant Display
Oil Pressure	Engine Oil Pressure	Constant Display
Water Temperature	Engine Water Temperature	Constant Display
Fuel Level	Engine Fuel Supply Level	Constant Display
Running Time	Total Engine Running Time	Accessed By Toggle Switch
Shutdown Set Points	Preset Values for Shutdowns	Accessed By Toggle Switch
Custom Message	User Instructions for Malfunction	Displayed Upon Fault

Pre-Alarm Functions

Pre-Alarm	Cause of Pre-Alarm	Control Functions
Low Oil Pressure	Engine oil pressure approaching shutdown level	LCD Display of Pre-Alarm
High Water Temp.	Engine water temp. approaching shutdown level	LCD Display of Pre-Alarm
Low DC Voltage	Engine battery voltage is low	LCD Display of Pre-Alarm
High DC Voltage	Engine battery voltage is high	LCD Display of Pre-Alarm
Low Fuel Level	Fuel level is approaching shutdown level	LCD Display of Pre-Alarm
Over Current	Load current is approaching shutdown level	LCD Display of Pre-Alarm
Over Frequency	Frequency is approaching shutdown level	LCD Display of Pre-Alarm
Under Frequency	Frequency is approaching shutdown level	LCD Display of Pre-Alarm
Sender Fault	Sender is malfunctioning	LCD Display of Pre-Alarm

Shutdown Functions

Shutdown	Cause of Shutdown	Control Function
Low Oil Pressure	Engine oil pressure is low	Display of Fault, Engine Shutdown, Breaker Trip
High Water Temp.	Engine water temp is high	Display of Fault, Engine Shutdown, Breaker Trip
Over Crank	Cranking period is too long	Display of Fault, Engine Shutdown, Breaker Trip
Over Speed	Engine speed is too high	Display of Fault, Engine Shutdown, Breaker Trip
Under Speed	Engine speed is too low	Display of Fault, Engine Shutdown, Breaker Trip
Over Frequency	Frequency is too high	Display of Fault, Engine Shutdown, Breaker Trip
Under Frequency	Frequency is too low	Display of Fault, Engine Shutdown, Breaker Trip
Over Voltage	Output voltage is too high	Display of Fault, Engine Shutdown, Breaker Trip
Under Voltage	Output voltage is too low	Display of Fault, Engine Shutdown, Breaker Trip
Over Current	Load current is too high	Display of Fault, Engine Shutdown, Breaker Trip
Emergency Stop	Initiated by operator	Display of Fault, Engine Shutdown, Breaker Trip

ENGINE & ENGINEERING TERMS

Analog Device – A device that operates with variables, such as voltages or pressures, represented as continuously measured quantities.

Automatic Transfer Switch – A switch designed to sense the loss of one power source and automatically transfer the load to another source of power.

Batteries (parallel connected) – Two or more batteries whose terminals are connected positive-to-positive and negative-to-negative, with the load connected across the positive and negative leads. The available current is equal to the sum of the individual battery current ratings and the voltage is the voltage rating of one battery. Only batteries of equal voltage rating may be connected in this manner.

Battery – A device that transforms chemical energy into electric energy in a cell with positive and negative electrodes in an electrolyte. Technically two or more cells connected in series, but in common usage often applied to single cells.

Battery Warmer – Heater used in cold climates to maintain battery electrolyte temperature.

Block Heater – Coolant heating device which may be mounted in the engine black and immersed in engine coolant, (immersion type heater) or mounted externally and connected to the engine's coolant passages by means of piping or hoses (tank type heater).

Critical Silencer – An exhaust silencer that is applied in sensitive noise control areas.

Decibel (dB) - One tenth on a bel. The number of decibels denoting the ratio of the two amounts of power being ten times the logarithm to the base 10 of this ratio. A unit of measure of noise level in which the faintest sound we can hear, called the threshold of hearing, is 0 dB, and the loudest sound the human can tolerate, called the threshold of pain, is 140 dB.

Engine Rating – The value of engine power output assigned by the manufacturer to indicate the maximum power level at which the engine should be applied in a given application.

Engine Speed – The rotating velocity of the engine flywheel, measured in revolutions per minute (rpm).

Equipment Grounding – The bonding of all exposed metallic parts of electrical equipment to a grounding electrode. This includes metallic parts such as generator frames, engines of engine generator sets, mounting bases, electrical conduit and enclosures.

Four-cycle Engine (also four stroke cycle) – A reciprocating internal combustion engine that requires four piston strokes to compete a power cycle (intake, compression, combustion and exhaust).

Governor, Electric – A governor that senses prime mover speed by means of magnetic pick-up or by sensing the frequency of the electric-set generator. The governor then uses an electrical controller to determine the correct fuel setting to maintain prime mover speed.

Governor, Isochronous – A governor that can be adjusted to zero droop so that steady-state speed is the same at all loads.

Liquid-Cooled Engine – An engine that is cooled by means of liquid coolant circulated about the heated parts of the engine. The coolant is then passed through a radiator or heat exchanger where it in turn is cooled and then re-circulated to the engine.

Naturally Aspirated – Engine combustion air flow system not assisted by artificial means such as a supercharger or turbocharger.

Parallel Operation – Two or more generators, or other power sources, of the same phase, voltage and frequency characteristics supplying the same load.

Paralleling – The procedure used to connect two or more generators to a common load.

Permanent Magnet Generator (PMG) – A generator that has a permanent magnet field, usually rotating. The generator is usually synchronous.

Rated Speed – Engine speed in revolutions per minute (RPM) at which the engine is designed to operate.

Residential Silencer – An exhaust muffler used to produce the silencing level usually associated with residential areas.

Spark Arrestor – A device used to prevent sparks from being released with exhaust gases.

Space Heater – Integral heater used to prevent condensation in electrical equipment.

Standby Power Supply – The power supply that is selected to furnish electric energy when the normal power supply is not available.

Synchronous Generator – A synchronous alternating current machine that transforms mechanical power into electrical power. NOTES: (1) A synchronous machine is one in which the speed of normal operation is exactly proportional to the frequency of the system to which it is connected. (2) Unless otherwise stated, it is generally understood that a synchronous generator (or motor) has field poles excited with direct current or permanent magnets.

Trickle Charger – A minimal charging device to maintain starting batteries charged at a continual fixed rate.

Turbocharger – An air pump driven by engine exhausts gases and used to supply engine charge air and at pressure above atmospheric.

Voltage Regulation – The voltage regulation of an engine generator set is the difference between steady state no load and steady state full load output voltage expressed as a percentage of the full load voltage.

Voltage Regulator – A device which automatically controls the voltage output of a generator at its specific value.

RULES OF THUMB

Everyone loves those shortcuts! Rules of thumb are good for a quick estimate or a check to see if a multiplier or decimal place may have been missed. Rules of thumb are strictly shortcuts. They ignore correction factors, round off significant figures, and pay no attention to individual machine performance. Using them for engineering design calculations must be avoided.

Engine Horsepower

Engine net horsepower = 1.5 x kW of generator
Assumes approximately 0.90 generator efficiency.

Motor Starting

Gen-Set maximum across-the-line motor start = 0.5 HP per kW
Ignores differences in generators, motor code letters and types of load.

Total Motor Load

Total motor load a generator can power = 1.14 x kW
Generator kW to power motor load = 0.877 x total motor HP
Assumes approximately 0.85 motor efficiency and 0.8 power factor or better.

Sound Attenuation

Noise level reduces 6dBA each time distance from the generator set is doubled.

Commonly Asked Questions

Question 1: *What size generator will it take to start and run a given HP size motor?*

Answer: 1 Ø HP x 746 = Total HP Watts x 1.5 = KW requirement
3 Ø HP x 746 = Total HP Watts x 2.0 = KW requirement

Question 2: *What size engine (HP) does it take to produce given KW requirements?*

Answer: If KW rating is 6 KW it will take a 12 HP engine @ 1,800 RPM to produce a prime power rating 6 KW.

Math: HP ÷ 2 = KW Prime Power Rating
KW x 2 = HP

Question 3: *How much generator power do you lose when you use a 3Ø generator for a 120/240 Volt 1Ø application?*

Answer: 1/3 of the KW potential.

Question 4: *How much engine HP do you lose because of altitude?*

Answer: Non-Turbo Engines = 3 ½% per 1,000 feet above 1,000 feet
Turbo Engines = 1% per 1,000 feet above 1,000 feet

Question 5: *How much engine HP do you lose because of hot temperature?*

Answer: You lose 1% of engine HP for every 10° F above 85° F.
Note: Same for either N/A or Turbo Engine.

Question 6: *How much fuel does an engine consume per hour? Or, how long will engine run per gallon of fuel?*

Answer: Engine consumes under full load .4 lbs. of fuel per HP of engine per hour of operation.

Diesel Wt.: 7.1 lbs. per gallon *Gasoline Wt.* 6 lbs. per gallon

Example: 10 gallons of diesel (71.0 gallons) will operate a 12 HP engine for 14.7 hours under full load.

Math: .4 lbs. x 12HP = 4.8 lbs. / hour consumption
4.8 lbs. = 68% of gallon of diesel (7.1 lbs.)
10 gallons ÷ .68 = 14.7 hours

Question 7: *What type of oil do you use in warm and/or cold weather conditions?*

Answer:		
	10W30	Cold above 32° F
	5W30	Freezing below 32° F
	15W40	Mild below 72° F
	20W50	Hot above 85° F

Question 8: *What is the % difference between mechanical and electronic regulation?*

Answer:		
	Mechanical	5% no load / full load
	Electronic	¼% no load / full load

Basic Generator Information & Examples

WATTS: The total volume of power potential of electricity measured in KW or KVA.

AMPS: The amount of energy an electrical apparatus consumes (load) to operate efficiently.

VOLTS: The constant pressure of electricity produced by a generator that supplies the name plate volts required to operate an electrical apparatus.

Standard Rated Generator Voltages		Voltage Adjustment Settings
120/240 Volts	1Ø Single Phase	Turn clockwise (right)
208Y/120 Volts	3Ø Three Phase 208V 1Ø Single Phase 208V 1Ø Single Phase 120V	Turn counter-clockwise (left)
277/480 Volts	3Ø Three Phase 1Ø Single Phase 480V	Turn clockwise (right)

Note: 208 Volt 1Ø will operate 240 Volt 1Ø electric motors at same efficiencies.

208 Volt 1Ø can be split to produce two (2) 120 Volt 1Ø circuits.

208Y Volt 3Ø can be split to produce two (2) 208 Volt 1Ø circuits and three (3) 120 Volt 1Ø circuits.

Important: Nameplate amp ratings on dual voltage generators and electrical apparatus are calculated by the high voltage listing.

Example: On a 6500 Watt, 1Ø generator with a voltage rating at 120/240 Volts, the amp rating on the nameplate will show the amps at 240 Volts.

Watts ÷ (240 Volts x P.F.)

Note: Most smaller gen-sets (gasoline) have a 1.0 Utility Power Factory (P.F.)

Let's do the math to determine the amps at both voltage ratings:

6500 watts ÷ (240 Volts x 1.0) = 27 amps

6500 watts ÷ (120 Volts x 1.0) = 54 amps

Notes:

- On 3Ø gen-sets, this calculation cannot be used. The 3Ø constant of 1.73 must be multiplied into the denominator (Volts) part of the equation.
- Standard 3Ø Power Factors are at .80.

$$\frac{\textbf{Watts}}{\textbf{(1.73 x 240 Volts) P.F.}}$$

Example:

$$\frac{\textbf{6500 watts}}{\textbf{(1.73 x 240 Volts) x .80}} = \textbf{19.5 amps (3Ø)}$$

KVA/KW Amperage Chart
80% Power Factor

KVA	KW	208V	220V	240V	380V	400V	440V	450V	480V
6.3	5	17.5	16.5	15.2	9.6	9.1	8.3	8.1	7.6
9.4	7.5	26.1	24.7	22.6	14.3	13.6	12.3	12	11.3
12.5	10	34.7	33	30.1	19.2	18.2	16.6	16.2	15.1
18.7	15	50	49.5	45	28.8	27.3	24.9	24.4	22.5
25	20	69.5	66	60.2	38.4	36.4	33.2	32.4	30.1
31.3	25	87	82.5	75.5	48	45.5	41.5	40.5	37.8
37.5	30	104	99	90.3	57.6	54.6	49.8	48.7	45.2
50	40	139	132	120	77	73	66.5	65	60
62.5	50	173	165	152	96	91	83	81	76
75	60	208	198	181	115	109	99.6	97.5	91
93.8	75	261	247	226	143	136	123	120	113
100	80	278	264	240	154	146	133	130	120
125	100	347	330	301	192	182	166	162	150
156	125	433	413	375	240	228	208	205	188
187	150	520	495	450	288	273	249	244	225
219	175	608	577	527	335	318	289	283	264
250	200	694	660	601	384	364	332	324	301
312	250	866	825	751	480	455	415	405	376
375	300	1040	990	903	576	546	498	487	451
438	350	1220	1155	1053	672	637	581	568	527
500	400	1390	1320	1203	770	730	668	650	602
625	500	1735	1650	1504	960	910	820	810	752
750	600	2080	1980	1803	1150	1090	996	975	902
875	700	2430	2310	2104	1344	1274	1162	1136	1052
1000	800	2780	2640	2405	1540	1460	1330	1300	1203
1125	900	3120	2970	2709	1730	1640	1495	1460	1354
1250	1000	3470	3300	3009	1920	1820	1660	1620	1504
1563	1250	4350	4130	3765	2400	2280	2080	2040	1885
1875	1500	5205	4950	4520	2880	2730	2490	2440	2260
2188	1750	-	-	5280	3350	3180	2890	2830	2640
2500	2000	-	-	6020	3840	3640	3320	3240	3015
2812	2250	-	-	6780	4320	4095	3735	3645	3400
3130	2500	-	-	7520	4800	4560	4160	4080	3765
3750	3000	-	-	9040	5760	5460	4950	4880	4525
4375	3500	-	-	10550	6700	6360	5780	5660	5285
5000	4000	-	-	12040	7680	7280	6480	6480	6035

Generator Output Current Ratings

Amps Single Phase			Amps. Three Phase			
@ 120 Volts	@ 240 Volts	Kilowatts	@208 Volts	@ 240 Volts	@ 480 Volts	@ 500 Volts
104	52	10	35	30	15	12
156	78	15	52	45	23	18
208	104	20	69	60	30	24
260	130	25	87	75	33	30
312	156	30	104	90	45	36
416	208	40	139	120	60	48
521	260	50	173	150	75	60
624	312	60	208	180	90	72
780	390	75	260	226	113	90
1041	521	100	347	300	150	120
		125	433	375	188	150
		150	520	451	226	180
		175	607	526	263	211
		200	694	601	300	241
		250	866	751	376	301
		300	1040	902	451	361
		350	1213	1052	526	421
		400	1388	1202	601	481
		500	1732	1502	751	601
		600	2080	1803	902	722
		700	2426	2103	1052	842
		750	2602	2256	1128	902
		900	3123	2706	1353	1083
		1000	3470	3007	1504	1203

Generator Electrical Terms

Ampacity – The current carrying capacity, expressed in amperes, of a wire, cable, or bus bar under stated thermal conditions.

Ampere – The unit of electric current flow. One ampere will flow when one volt is applied across a resistance of one ohm.

Apparent Power – A term used to describe the product of current and voltage, expressed in kilovolt amperes (KVA). The apparent power in KVA multiplied by the power factor (PF) in the real power in kilowatts (KW).

Bonding – A reliable connection to assure electrical conductivity (usually used in grounding circuits).

Circuit Breaker – A mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specific time, and automatically breaking currents under specified abnormal circuit conditions, such as those of short circuit.

Current – The rate of flow of electricity. See ampere.

Efficiency - The ratio (expressed as a percentage) of the useful power output to the total power input.

Electromotive Force (EMF) – The force which causes current to flow in a conductor; in other words, the voltage or potential.

Frequency – The number to complete cycles of an alternating voltage or current per unit of time, expressed in hertz (Hz), cycles per second.

Full Load Current – The maximum current that a circuit or device is designed to carry continuously at rated conditions. Also known as rated current.

Ground – A connection, either international or accidental, between an electric circuit and the earth or some conducting body serving in place of the earth.

Hertz (Hz) – A unit of frequency (formerly cycles per second).

Neutral – The point in an electrical system where the voltages to all line conductors are equal.

Ohm – Unit of electrical resistance. One volt will cause a current of one ampere to flow through a resistance of one ohm.

Parallel Connection – An electrical connection in which the input terminal of one element is connected to the input terminal of another element and the output terminals are similarly connected together, thereby providing two paths for current flow.

Power – Rate of expending energy per unit of time. Mechanical power can be measured in horsepower; electrical power in kilowatts. One horsepower equals 746 watts.

Rated Current – The rated nameplate current of a machine or apparatus is the value of current which it can carry without exceeding the allowable temperature rises.

Rated Power – Horsepower specified by the engine manufacturer for a given application at a given (rated) speed. Also, the stated or nameplate net electric output, which is obtainable from a generator, set when it is functioning at rated conditions.

Rated Voltage – The voltage of electrical apparatus at which it is designed to operate.

Rectifier – A device that changes alternating current into direct current.

Surge – A sudden temporary variation in current, voltage or frequency.

Transformer – A static electric device consisting of a winding, or two or more magnetically coupled windings used to transfer power by electromagnetic induction between circuits at the same frequency, usually with changed values of voltage and current.

Transient – That part of the change in a variable that disappears after transition form one steady state operating condition to another.

Voltage Transient – The maximum change in voltage when a specified load is suddenly applied or removed.

Wye Connection – A method of in connecting the phases of a three phase system to form a configuration resembling the letter Y, such that one end of each of the wingdings is connected to a common point (the neutral point) and the other end to it appropriate line terminal. Same as a star connection.