IUOE National Training Fund

National HAZMAT Program

Student Guide

2-HR GENERATOR SAFETY AWARENESS

FIXED GENERATORS • PORTABLE GENERATORS • DISASTER GENERATOR USE

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FIXED INDUSTRIAL GENERATORS

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Test Yourself

- How often do you inspect the generator?
- How often do you test run the generator?
- How long should you test run the generator?
- Name two relevant OSHA standards.
- Name two safety hazards when testing a generator.
- For fixed generators, what is the ready position?
- Which of the following have relevance in the inspection and test run of a generator?
  a) Personal protective equipment.
  b) Asbestos precautions.
  c) Hearing protection.
  d) Lock-out/ Tag-out procedures.
  e) Cleanliness.
  f) Log books.

Objectives

KNOWLEDGE

- Understand each step of a prestart checklist.
- Understand the operations and safe parameters of a fixed generator during a test run.

SKILLS

- Complete each step of a prestart checklist.
- Conduct a safe test run.
- Place the fixed generator back into the ready position.

ATTITUDES

- Be aware of the importance of weekly inspections and test runs.
- Contribute to a culture of safe work practices.
- Cite relevant OSHA standards and other safety considerations.

Figure 1-1

Figure 1-2

Figure 1-3

Generators come in all shapes and sizes.

I. Background and Rationale

Frequency

Engineers and building operators should inspect and test run the back-up generator system once a week for a *minimum* of thirty (30) minutes.

Think about what that means:
→ (1) Inspect and (2) test run (3) once per week for (4) thirty minutes

What are some of the reasons ALL of these are so important?

Reasons

Back-up generators should always be in a state of readiness because of the critical functions they support. These test-runs are necessary to ensure the reliability of the emergency power system. Back-up generators should always be in a state of readiness because of the critical functions they support. The following are a few of the reasons:

- System readiness.
- Disasters/power outages are unpredictable.
- Required by code.
- Life support.
- Communications.
- Security.
- Safety.
- Continuity of Operations (COOP).

Safety Considerations

Before a test run of a generator is conducted, workers need to be aware of proper prestart safety procedures.

What do you think some of those procedures need to be?

What OSHA standards do you think apply?

Some Relevant OSHA Safety Standards

- 29 CFR 1910 Subpart S – Safety-related Work Practices.
- 1910.331 – Scope.
- 1910.333 – Selection and use of work practices.
- 1910.334 – Use of equipment.
- 1910.335 – Safeguards for personnel protection.
- 29 CFR 1910.95: Occupational Noise Exposure.
- 29 CFR 1910.133: Eye and Face Protection.
- 29 CFR 1910.147: Lock Out / Tag Out.

Figure 1-4


Figure 1-5

Figure 1-6

II. Prestart Check

NOTE: Manufacturer procedures should always be followed when conducting prestart and test runs.

Sample Checklist

The following few pages provide a sample of a basic generator prestart and test run operational check list and should be expanded upon depending on the needs of your facilities.

Building: _____ Generator Number: _____

Maintenance and Inspection Procedure for Emergency Generators

- ☐ Clean Around The Generators Area
- ☐ Clean Generator
- ☐ Check Battery and Rack for Corrosion
- ☐ Check Battery Water Level
- ☐ Check Charge Operation and Rate
- ☐ Check Engine Radiator Level
- ☐ Check Engine Oil
- ☐ Check Hoses and Clamps for Leaks
- ☐ Check Belts
- ☐ Check for Leaks around Generator
- ☐ Check Fuel Tank Level
- ☐ Test Run Generator:

Oil Pressure:	
Generator Temperature:	
Volts:	
Meter Hours Start Time:	
Meter Hours Stop Time:	

- ☐ Set Controls for Generator to Start in an Emergency

List Repairs/ Maintenance Required

Checked By: _____ Date: _____

Figure 1-7

Prestart Check: Review the generator log book

- Note the readinf where the hour meter stopped. Is the reading on the generator the same?
- Are there any maintenance repairs logged?
- Any unusual comments from the last test run?
- Any fuel deliveries?
- Anything that may affect the running of the generator at this time?

Prestart Check: Turn off the generator

- **Never do a prestart check with the generator in the ready position.** In order to begin your prestart checklist you need to first make sure the generator does not come on while you are checking the various components.

- Turn the generator from the ready position to the OFF position and tag it!
- **Stay in the moment!** If you are called to do another task put the generator back in the ready (or auto) setting.
- *NEVER EVER* leave to do something else with the generator turned off, it will be rendered useless if there were to be a power failure!

Figure 1-8

Prestart Check: Check and clean the area around the generator

- In outdoor units, trash and debris may have collected or blown in by the wind.
- Look to see that the area around the generator is free of debris. Paper and plastic can be drawn into the fan and lodged or entangled with the fan or against the radiator. This could potentially cause overheating of the engine.
- Look for objects that could be or have already been sucked into the fan.
- Check for rodent nests. Animals can cause a great deal of damage to equipment that sits unused or is outside. Check the area occasionally for nests or signs of rodent activity. Most diesel engines have warm water jacket heaters where animals love to nest.

Figure 1-9

Figure 1-10

Animals could build nests near a generator with a warm water jacket such as those in diesel generators.

This is not a generator, but it does show what happens with a squirrel's nest in a cooling tower fan.

- Mechanical rooms from time to time become storage areas. Make sure that the area around the generator is 1) free of obstacles that may inhibit good air flow around the generator, and 2) free of material that could potentially become a fire hazard or a trip and fall hazard.

Figure 1-11

Prestart Check: Check battery & battery rack for corrosion

- REMEMBER, batteries can be explosive! Make sure you have the proper PPE on before you continue!

What PPE would be recommended in this situation?

- Check the battery and rack for soundness.
- Clean the battery.
- Check the terminals — look for corrosion or poor connections. Poor connections of the battery terminals could prevent the generator from starting in an emergency situation.

Figure 1-12

Figure 1-13

Prestart Check: Check battery water level

- Check to ensure that each cell has water and at the proper level. Carefully remove the caps from each cell of the battery to check for proper water level. If the level is low add distilled water to the cell.

Prestart Check: Check charge operation and rate

- Make sure that the charger is on.
- Ventilate the area.
- Check the charging rate. Batteries will lose their charge from sitting unused for long periods of time. Most generators are equipped with battery chargers to assure that the generator has ample power to start the generator when needed.
- Make sure it is set at the proper voltage.

Figure 1-14

Prestart Check: Check engine radiator coolant level

- Safety First! Practice safe work habits.
- Fluid is the lifeblood of the generator's engine.
- Check the radiator for the proper coolant level.
- Remember to slowly open the radiator cap. Failure to do so could result in the person opening the cap (if the radiator is under pressure) being scalded.

NEVER OPEN THE RADIATOR CAP WHEN THE GENERATOR IS HOT!

- In the fall, check the antifreeze level for proper low temperature settings for your area. Make sure the generator has the proper amount of antifreeze for the winter months.
- Flush the radiator system annually to avoid the buildup of sludge. After a period of time antifreeze can break down and become corrosive. Develop a preventative maintenance schedule for flushing the radiator system.

Prestart Check: Check engine oil

- Check the oil level to see if it is in the safe operational zone. If not, check the manufacture's specifications for the proper oil for that generator. Different generators require different oil viscosities to ensure proper lubrication during heavy load demands.
- Add oil until you reach the proper level and note the addition of oil in the generator log.
- Change the oil annually or after an extended operational period.
- It's cheaper to change the oil than to have the engine replaced.

Figure 1-15

Prestart Check: Check hoses and clamps

Time is an enemy of rubber. Hoses may begin to show signs of dry rotting. Under operating pressures these hoses can burst sending hot fluids flying in all directions and could cause severe burns to individuals in the immediate area. Additionally, the same thing could happen during an emergency call for power while you are not there. If the hoses were to rupture while you were absent from the area, the engine could suffer irreversible damage and the unit could be out of commission for an extended period of time.

Figure 1-16

- Check for sound hose connections.
- Examine each for dry rotting or cracking.
- Check for leaks.

Prestart Check: Check fan belts

Stop! Recheck that the generator cannot come on automatically before you continue. Do not place your hand near the fan or the fan belts until you do so! *Once done, check the fan belts for signs of being worn, cracked, dry rotted or stretched. If so have the belts replaced before continuing.*
On the belts check for:

- Dry rot.
- Cracking.
- Looseness.
- Proper adjustment.
- Worn or frayed areas.

Prestart Check: Check for leaks around generator

- Look for any sign of fluids on the floor under the hoses and connections.
- If it is an outdoor generator check the structure for:
  a. Leaky roof.
  b. Dampers not closing.
  c. Good seals on doors.

Prestart Check: Check fuel tank level

- Check and ensure that the fuel tank is topped off monthly.
- Make sure that the vent line is free of obstructions.
- Make sure that the fill and vent lines are of the same size.

Prestart Check: Check fuel system

If your generator has fuel separators, drain them down to ensure that there is no water and/ or sediment in them prior to starting the engine.

Prestart Check: Check warning controls or lights

If your generator has warning lights, test each light to ensure it is in working condition.

Figure 1-17

Example of a bird's nest in the underground fuel tanks vent.

Figure 1-18

III. Test Run

Test Run: Before you start

Remove all tags from the control panel.

Test Run: Start generator

After all of the different systems of the generator have been checked, start and begin the test run of the generator.

Don the proper hearing protection when running a generator.

Figure 1-19

Test Run: Check the exhaust stack at start up

It should run clean after a few seconds.

Figure 1-20

Figure 1-21

Figure 1-22

Test Run: Check the following systems

- Oil Pressure.
- Water Temperature.
- Volts.
- Meter Hours Start Time.

→ *If possible test run your generator under load conditions.*

Review the generator's user manual for optimal readings on the gauges and sensors. Ensure the generator's oil pressure, water temperature and volts are within the manufacturer's operating range.

Safety First! Review proper PPE for hearing protection.

Test Run: Safety reminder

Remember when running your generator you are generating electricity!

Test Run: Transfer switches

Transfer switches when installed should transfer from commercial power to the generated power source.

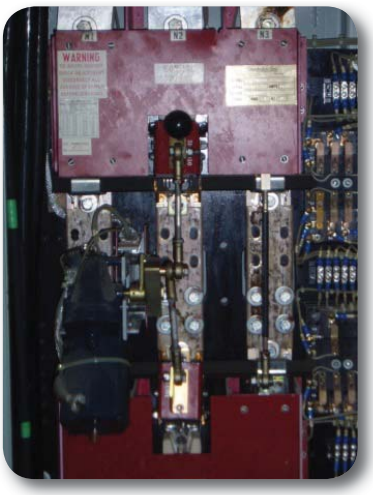

Figure 1-23

Test Run: Transfer switches (Accident)

- The lugs on this transfer switch became loose from expansion and contraction. Once the lugs start to become loose, the cables will heat up due to a poor connection. Periodically, preventive maintenance on these lugs has to be performed. "ALWAYS REMEMBER TO

FOLLOW STRICT SAFETY PROCEDURES TO ENSURE THAT THE POWER SOURCE IS OFF AND DRAINED!!!"

Figure 1-24

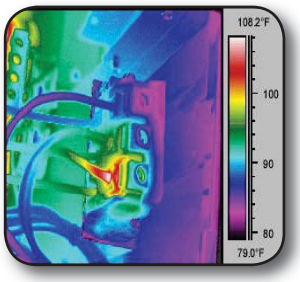

Figure 1-25

- Melted wires (due to lack of preventive maintenance).

Figure 1-26

Figure 1-27

- Burnt lugs (due to lack of preventive maintenance).

Figure 1-28

Figure 1-29

Test Run: Completing the generator test run

- Cool down period: Once the generator has gone through a test run under simulated load conditions, the generator will enter the next phase, the cool down time. Some generators have a built in tier for cool down periods after a test run.
- Log in any changes or unusual events and findings during the test run.

Test Run: Reset the generator control switch

When the test run is completed, always make sure that the generator is in the ready position in the event of a power disruption or failure.

- Set generator controls back to "ready to start" so it will be ready in an emergency.
- Remove any tag that you may have placed at the control panel.

In Review: We Covered

Background and Rationale

- Importance of weekly inspections and test runs.

Important Safety Considerations

- Relevant OSHA standards and other safety considerations.
- How to contribute to a culture of safe work practices.

Prestart Checklist

- What is involved in each step of a prestart checklist.

Conducting a Test Run

- How to conduct a safe test run.
- The operations and safe parameters of a fixed generator during a test run.
- Placing the fixed generator back into the ready position.

PORTABLE GENERATOR SAFETY

Topics We Will Cover

I. Portable Generator Modes and Types
II. Hazards Associated with Portable Generators:
- Shocks and Electrocution.
- Carbon Monoxide.
- Fire Hazards.
- Noise and Vibration.

III. Sizing an Emergency Generator

Test Yourself

- Name one of the most valuable things you can do to understand safe and proper use (and maintenance) of your generator.
- Under what conditions would you use a) an independent portable generator system and b) an integrated portable generator system?
- Assume you will use a portable generator to power a building or residence during a power failure. Before turning the generator on, what very important thing should you do first?
- Why is a double-pole, double-throw transfer switch so important for safety?
- When using extension cords with a generator, what is a common cause of a spark or fire hazard?
- With portable generators, explain why carbon monoxide poisoning is a hazard.
- Name two symptoms of carbon monoxide poisoning.
- List five items in a home or residence a portable generator should be able to power.

Objectives

EXPOSURE

- Be exposed to topics associated with portable generator hazards such as proper setup, use of cords, proper grounding, water hazards, fire hazards, dangers from hot engines, fuel storage, noise and vibration.

KNOWLEDGE

- Understand the difference between independent and integrated portable generator systems.
- Understand the purpose and design of a double-pole, double-throw transfer switch.
- Understand the cause of carbon monoxide poisoning and its symptoms.

SKILLS

- Be able to identify and prioritize power requirements for emergency generator use.
- Complete a power calculation worksheet.

ATTITUDES

- Be aware of the need for proper setup with regards to shocks and electrocution.
- Contribute to a culture of safe generator practices.

Safety Notes

If you plan on using an emergency generator, it is essential that you take precautions for your safety and for the safety of utility employees working to restore power.

Before starting your generator, carefully read, understand and follow the manufacturer's instructions.

Key Points of Generator Safety

- All electrical connections must comply with the National Electric Code.
- Do not overload generator with too many appliances.
- After losing main power, turn off main breaker or pull main fuse block.
- Generators that are directly connected to existing wiring systems must use a double-pole, double-throw (DPDT) transfer switch.
- Generator must be properly grounded.
- You may be liable for damage or injury to people and property that may result from an improperly installed or operated emergency generator.

Portable Generator Modes and Types

Available as portable or stationary units, generators come in many sizes and configurations:

Engine-driven generators

Figure 2-1

PTO-driven generators

Figure 2-2

- Factors such as availability, storage, volatility and safety should be considered for each fuel type. In general, smaller units (less than 7,000 watts) tend to be gasoline powered, while the larger units usually run on diesel fuel, liquid propane or natural gas.
- Power take-off (PTO) generators use an attachment on farm tractors or construction equipment such as bulldozers and front-end loaders.

Generator Modes

The two safe modes for supplying power from an emergency generator are:

- independent portable operation.
- integrated system operation.

Generator Modes: Independent Portable Operation

- A generator that operates as an independent, stand-alone unit NOT connected to any existing wiring system.
- Cords plugged into the generator delivering power to selected electrical equipment and appliances.
- Useful when temporary or remote power is needed.
- Commonly used during cleanup and recovery efforts following disasters such as hurricanes, tornadoes, etc.

Generator Modes: Integrated System Generators

An emergency generator that is connected to an existing wiring system of a home or business. This system uses a double-pole, double-throw (DPDT) "transfer switch" to safely isolate the generator from the utility power lines.

Transfer Switch Explained:

The DPDT transfer switch has three positions:

- Utility power on, Generator power off;
- Both off; and
- Generator power on, Utility power off.

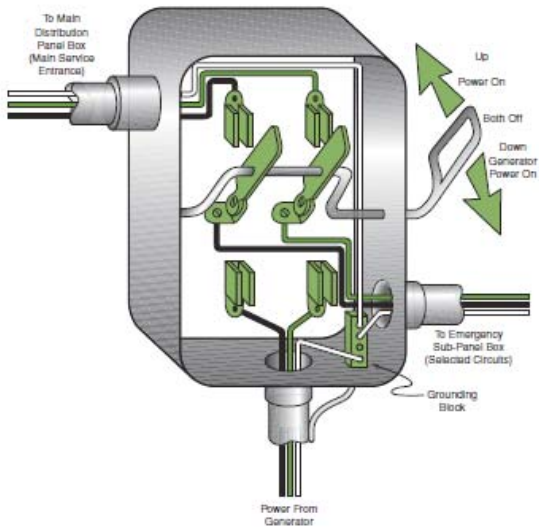

Figure 2-3

Portable

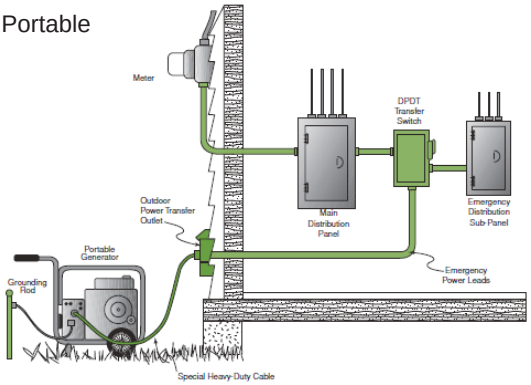

Figure 2-4

Permanent

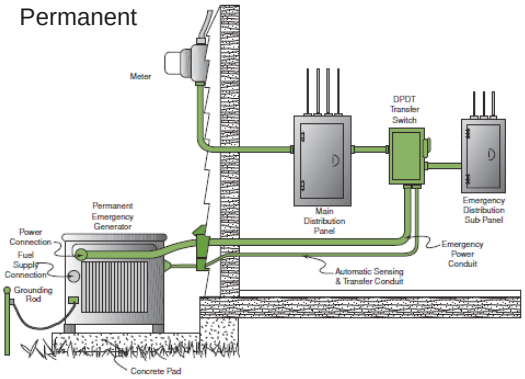

Figure 2-5

An integrated system must use a DPDT transfer switch.

PORTABLE: Shown above, a special heavy-duty cable from the generator is plugged into a specially designed outdoor power transfer outlet. (Note: this is different from a typical outdoor electrical outlet found on most homes.) This outlet feeds the DPDT transfer switch which, in turn, connects power to selected circuits in the emergency sub-panel box.

PERMANENT: Shown above is a permanent outdoor generator installation, with the unit housed inside a weather-resistant, protective enclosure. The DPDT transfer switch has been installed between the main panel box and a separate emergency sub-panel box used to redirect generator power to selected circuits. The electric devices you have determined to be necessary in an emergency are wired into the emergency sub-panel.

Hazards Associated with Portable Generators: Shocks and Electrocution

Shocks and Electrocution: Proper setup

- The electricity created by generators has the same hazards as normal utility-supplied electricity.
- Additional shock and electrocution hazards occur because many generator users often bypass the safety devices (such as circuit breakers) that are built into electrical systems.
- Never attach a generator directly to the electrical system of a structure (home, office, trailer, etc.) unless a qualified electrician has properly installed the generator with a transfer switch.
- Attaching a generator directly to the building's electrical system without a properly installed transfer switch can energize wiring systems for great distances. This creates a risk of electrocution for utility workers and others in the area.

- Power off and do not use any electrical equipment that has strange odors or begins smoking.

Shocks and Electrocution: Use of cords

- Always plug electrical appliances directly into the generator using the manufacturer's supplied cords or extension cords that are grounded (3-pronged).
- Inspect the cords to make sure they are fully intact and not damaged, cut or abraded.
- Never use frayed or damaged extension cords. Ensure the cords are appropriately rated in watts or amps for the intended use.
- Do not use underrated cords; replace them with appropriately rated cords that use heavier gauge wires.
- Do not overload a generator; this can lead to overheating which can create a fire hazard.

Shocks and Electrocution: Grounding

- Use ground fault circuit interrupters (GFCIs), especially where electrical equipment is used in or around wet or damp locations. GFCIs shut off power when an electrical current is detected outside normal paths. GFCIs and extension cords with built-in GFCI protection can be purchased at hardware stores, do-it-yourself centers, and other locations that sell electrical equipment. Regardless of GFCI use, electrical equipment used in wet and damp locations must be listed and approved for those conditions.
- Make sure a generator is properly grounded and the grounding connections are tight.
- Consult the manufacturer's instructions for proper grounding methods.

Shocks and Electrocution: Water hazards

- Keep a generator dry; do not use it in the rain or wet conditions.
- If needed, protect a generator with a canopy.
- Never manipulate a generator's electrical components if you are wet or standing in water.
- Do not use electrical equipment that has been submerged in water.
- Equipment must be thoroughly dried out and properly evaluated before using.

Hazards Associated with Portable Generators: Carbon Monoxide Poisoning

Carbon Monoxide: The Hazard

- Many people have died from CO poisoning because their generator was not adequately ventilated.
- Carbon monoxide (CO) is a colorless, odorless, toxic gas.
- Symptoms of CO poisoning: dizziness, headaches, nausea, tiredness—get to fresh air immediately and seek medical attention.

- Do not re-enter the area until it is determined to be safe by trained and properly equipped personnel.

Carbon Monoxide: Proper ventilation

- Never use a generator indoors or in enclosed spaces such as garages, crawl spaces, and basements.
- Make sure a generator has 3 to 4 feet of clear space on all sides and above it to ensure adequate ventilation. Open windows and doors may NOT prevent CO from building up when a generator is located in an enclosed space.
- Do not use a generator outdoors if its placement near doors, windows, and vents could allow CO to enter and build up in occupied spaces.

Figure 2-6

Carbon Monoxide: Detectors are critical

Carbon Monoxide: Is it okay to extend the exhaust pipe?

- What does your manufacturer recommend?
- Flexible exhaust extensions are available in many auto parts stores.
- Care should be taken to limit the length of the extension to minimize exhaust back pressure.

Figure 2-7

Hazards Associated with Portable Generators: Fire Hazards

Fire Hazards: Danger from hot engine

- Generators become hot while running and remain hot for long periods after they are stopped.
- Generator fuels (gasoline, kerosene, etc.) can ignite when spilled on hot engine parts.
- Before refueling, shut down the generator and allow it to cool.

Fire Hazards: Fuel storage

- Gasoline and other generator fuels should be stored and transported in approved containers that are properly designed and marked for their contents, and vented.
- Keep fuel containers away from flame producing and heat generating devices (such as the generator itself, water heaters, cigarettes, lighters, and matches).
- Do not smoke around fuel containers.
- Escaping vapors or vapors from spilled materials can travel long distances to ignition sources.
- Do not store generator fuels in your home.
- Store fuels away from living areas.

Hazards Associated with Portable Generators: Noise and Vibration Hazards

Noise and Vibration Hazards

- Generator engines vibrate and create noise.
- Excessive noise and vibration could cause hearing loss and fatigue that may affect job performance.
- Keep portable generators as far away as possible from work areas and gathering spaces. Wear hearing protection if this is not possible.

Sizing an Emergency Generator: Prioritizing Needs and Load Planning

Sizing an Emergency Generator: Prioritize your needs

- Make a list of all critical items you feel must operate in an emergency.
- Limit the load on your generator. Higher loads use more fuel. Add the wattages of essential appliances, including "starting wattage" for items that use electric motors.
- Use low-watt light bulbs that provide a safe level of light. This reserves power for additional equipment or appliances.
- Nameplate information on motors or appliances can help you determine their kilowatt rating: Power (watts) = Current (amps) x Voltage (volts).

Sizing an Emergency Generator: Load planning

- Electrical appliances have either resistive load or inductive load.
- Resistive Load: Electric appliances (electric stoves, electric space heaters, radios, light bulbs, televisions) that have the same starting and operating wattages.
- Inductive Load: Electric appliances (power tools, refrigerators, freezers, pumps) that use electric motors requiring two to four times the operating wattage for start-up.

Sizing an Emergency Generator: Load planning example

- Remember, safety first! Try not to overload the capacity of your generator!
- First prioritize the most critical equipment like lights and heat. Then slowly add devices and appliances to stay under the unit capacity.

Load Planning Exercise

Determine your own electrical needs by completing this load calculation worksheet.

Wattage Worksheet

When selecting a generator there are a few important features to consider:

Wattage ■ Engine ■ Run Time ■ Starting ■ Mobility

This worksheet will focus on determining your running and starting watt needs. The size of the generator you need depends on your power requirements. Generally, a higher-wattage generator lets you power more items at once.

1 Select the items you wish to power at the same time. Using the chart on the opposite page, fill in the running watts and starting watt requirements on the "Your Power Needs" worksheet.

2 Add the **Running Watts** of the items you wish to power. Enter this number in the **Total Running Watts** column.

3 Select the one individual item with the highest number of starting watts. Take this one number, add it to your **Total Running Watts**, and enter it in the **Total Starting Watts** box.

EXAMPLE

TOOL OR APPLIANCE	RUNNING WATTS	ADDITIONAL STARTING WATTS
1. Refrigerator/Freezer	700	2200
2. 1/2 HP Furnace Fan	800	2350
3. Television	500	0
4. Window AC	1200	1800
5. Sump Pump – 1/2 HP	1050	2200
6.		
7.		

HIGHEST STARTING WATTS

4250

4250 TOTAL RUNNING WATTS

\+ 2350 HIGHEST STARTING WATTS

= 6600 TOTAL STARTING WATTS NEEDED

With this example you need a generator that produces at least 4250 total running watts and 6600 total starting watts.

YOUR POWER NEEDS

TOOL OR APPLIANCE	RUNNING WATTS	ADDITIONAL STARTING WATTS
1.		
2.		
3.		
4.		
5.		
6.		
7.		

[ ] TOTAL RUNNING WATTS

\+ [ ] HIGHEST STARTING WATTS

= [ ] TOTAL STARTING WATTS NEEDED

I need a generator that produces at least _____ total running watts and _____ total starting watts.

FREQUENTLY ASKED QUESTIONS

How many watts does it take to power basic items in an average size house?
In a typical home, essential items will average 5000 – 7500 watts of power to run.

What is the difference between running watts and starting watts?
Running, or rated watts are the continuous watts needed to keep items running. Starting watts are extra watts needed for two to three seconds to start motor-driven products like a refrigerator or circular saw, this is the maximum wattage the generator can produce.

Why is only one starting watt item used to calculate your total starting watt requirement?
Unlike running watts, starting watts are only needed during the first few seconds of operation. In most cases, only one item will start or cycle at the same time, therefore this is the most accurate estimate.

What if I can't determine the running or the starting watt requirement for a tool or appliance?
If the running watts are not on the tool or appliance, you may estimate using the following equation: **WATTS=VOLTS x AMPS**. Only motor-driven items will require starting watts. The starting watts required may be estimated at 1-2x the running/rated watts.

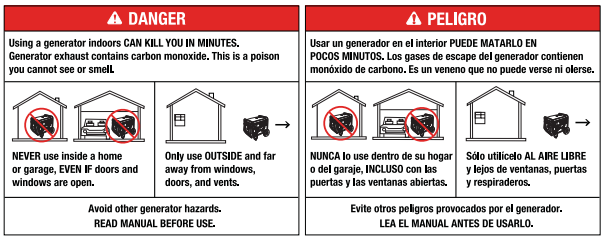

Figure 2-8

Wattage Worksheet

TOOL OR APPLIANCE	ESTIMATED RUNNING WATTS	ADDITIONAL STARTING WATTS
Recreational Use		
Tailgating/Camping:		
Electric Grill	1650	0
AM/FM Radio	100	0
Box Fan – 20"	200	0
Outdoor Light String	250	0
Cell Phone Battery Charger	25	0
Inflator Pump	50	150
Storm / Emergency Use		
Essentials:		
Light Bulb – 60 Watt	60	0
Light Bulb – 75 Watt	75	0
Refrigerator/ Freezer	700	2200
Sump Pump – 1/3 HP	800	1300
Sump Pump – 1/2 HP	1050	2200
Water Well Pump – 1/3 HP	1000	2200
Electric Water Heater	4000	0
Heating/Cooling:		
Space Heater	1800	0
Humidifier – 13 Gal	175	0
Furnace Fan Blower – 1/2 HP	800	2350
Furnace Fan Blower – 1/3 HP	700	1400
Window AC – 10,000 BTU	1200	1800
Window AC – 12,000 BTU	3250	3950
Central AC – 10,000 BTU	1500	3000
Central AC – 24,000 BTU	3800	4950
Central AC – 40,000 BTU	6000	6700
Heat Pump	4700	4500
Laundry Room:		
Iron	1200	0
Washing Machine	1150	2250
Clothes Dryer – Electric	5400	1350
Clothes Dryer – Gas	700	1800
Kitchen:		
Microwave Oven – 625 Watts	625	0
Microwave Oven – 1000 Watts	1000	0
Coffee Maker	1000	0
Electric Stove – 8" Element	2100	0
Dishwasher – Hot Dry	1500	1500
Food Processor	400	0
Toaster Oven	1200	0
Toaster	850	0
Electric Can Opener	168	0
Family Room:		
VCR	100	0
Stereo Receiver	450	0
Other:		
Security System	500	0
Garage Door Opener – 1/2 HP	875	2350
Curling Iron	1500	0
Hair Dryer – 1250 Watt	1250	0
Jobsite		
DIY/Jobsite:		
Quartz Halogen Work Light, 300	300	0
Quartz Halogen Work Light, 500	500	0
Quartz Halogen Work Light, 1,000	1000	0
Airless Sprayer – 1/3 HP	600	1200
Reciprocating Saw	960	960
Electric Drill – 3/8", 4 Amps	440	600
Electric Drill – 1/2", 5.4 Amps	600	900
Hammer Drill	1000	3000
Circular Saw – 7-1/4"	1400	2300
Miter Saw – 10"	1800	1800
Planer/Jointer – 6"	1800	1800
Table Saw/Radial Arm Saw – 10"	2000	2000
Belt Sander	1200	2400
Air Compressor – 1/4 HP	970	1600
Air Compressor – 1 HP	1600	4500

The above are estimates only. Check your tool or appliance for exact wattage requirements. The wattages listed in our reference guide are based on estimated wattage requirements. For exact wattages, check the data plate or owner's manual on the item you wish to power.

CAUTION:
Operating voltage and frequency requirement of all electronic equipment should be checked prior to plugging them into this generator. Damage may result if the equipment is not designed to operate within a +/- 10% voltage variation, and +/- 3 hz frequency variation from the generator name plate ratings.

Figure 2-8

USING GENERATORS DURING AND AFTER DISASTERS

Topics We Will Cover

I. Quantity of fuel; Rationing fuel
II. Power system in the home (What would happen during a flood?)
III. Looting
IV. Quality, condition, and power of the generator
V. Placement when in use
VI. Installing a transfer switch/ Choosing an electrician
VII. Prioritizing what to power
VIII. Maintenance

Test Yourself

- How much fuel do you keep on hand? Do you keep it winterized?
- Have you considered the issues in powering your home after a flood? Tornado? Ice storm?
- Do you know which circuits, devices, equipment, or appliances you will and will not power on a generator?
- Do you know what your generator can handle?
- Do you have proper extension cords? Has your home been wired with a transfer switch?
- Where is the generator to be placed? Have you considered noise or carbon monoxide in this choice of placement?
- What monthly, quarterly, or annual maintenance do you conduct on your generator?

Objectives

EXPOSURE

Be exposed to common topics and frequent sources of frustration associated with the use of portable emergency generators.

Your generator is only as effective as your fuel supply and fuel supplier. How much fuel do you own? Will you be able to purchase fuel?

Figure 3-1

Power Distribution Systems

An integrated system is dependent on the existing wiring in your home or facility. What are some of the things that may damage your existing power distribution system (wiring) in your home?

Not everyone will have a generator, people will steal…

- Generators.
- Fuel.
- Copper wires.
- Extension cords.

Figure 3-2

Figure 3-3

Answer these questions:

- What is the quality and condition of your generator?
- How much power will you generate?
- When was the last time you checked your generator?
- Do you have the proper cords, connections etc.?
- How should I ration this during daytime and nighttime hours, and based upon my available fuel?
- Ration based on need.
- Are you preserving food, using for light?

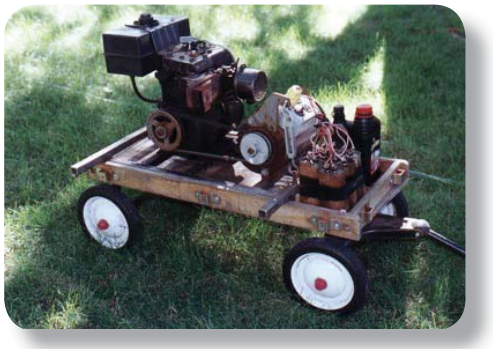

Figure 3-4: Home-made generatotor

Answer these questions:

- How long will you be without power?
- How much fuel do you use?
- What are your necessities?

Figure 3-5

Because of the disaster and changes to your home or yard you may have to re-evaluate the placement of your generator.

- Are you creating a hazard by the placement of your generator?
- What should you consider during a disaster for placement of your generator?

Figure 3-6: Use portable generators OUTSIDE and far away from the building.

You should always use a qualified electrician for integration of generator systems into your home.

Beware of "fly by night" contractors. Beware of storm chasers that move into your area -- some are reputable while others are not. Questions you should ask:

- Are you bonded?
- Are you insured?
- Are you licensed?
- Do you have credentials?
- Are you a qualified electrician?

Figure 3-7

When you activate your generator the electrical devices that were running when the power went out will immediately be a load on your generator. Prepare to turn your generator on by turning everything in your house off.

Figure 3-8

Protect your generator after use and prepare for the next outage by using fuel treatment so your generator will run when you need it next.

- Turn off the fuel and let it run draining the carburetor.
- Drain the fuel bulb if possible.
- Use fuel treatments.

Figure 3-9: Common commercially fuel treatment additives.

GENERATOR
SAFETY AWARENESS

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