Operator’s Manual

Hydronic Surface Heater

E 3000

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Manufacturer

Wacker Neuson Production Americas LLC

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Original instructions

This Operator's Manual presents the original instructions. The original language of this Operator's Manual is American English.

Foreword

This heater is designed and approved for use as a construction heater in accordance with Standard ANSI Z83.7–CSGA 2.14. CHECK WITH YOUR LOCAL FIRE SAFETY AUTHORITY IF YOU HAVE QUESTIONS ABOUT APPLICATIONS.

Other standards govern the use of fuel gases and heat producing products in specific applications. Your local authority can advise you about these.

THE INSTALLATION OF THE UNIT SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF THE AUTHORITIES HAVING JURISDICTION.

WARNING

Risk of personal injury or machine damage from improper use.

- ▶ Before using the machine, read and understand all instructions and follow them carefully.
- ▶ The manufacturer is not responsible for damages to goods or persons due to improper use of this machine.

WARNING

Failure to comply with the precautions and instructions provided with this machine can result in death, serious injury, and property loss or damage from fire, explosion, burns, asphyxiation, carbon monoxide poisoning, and/or electric shock.

- ▶ Before using the machine, read and understand all precautions and instructions that have been provided. Follow them carefully.
- ▶ Only persons who can understand and follow the precautions and instructions should use or service this machine.
- ▶ Contact the manufacturer if you need assistance with operating the machine or need replacement manuals or labels.

WARNING

Work site fire, burn, inhalation, and explosion hazards.

- ▶ Keep solid combustibles, such as building materials, paper, or cardboard at a safe distance away from the machine as recommended by the instructions.
- ▶ Never use this machine in spaces which do or may contain volatile or airborne combustibles, or products such as gasoline, solvents, paint thinner, dust particles, or unknown chemicals.

WARNING

Not for use in homes or recreational vehicles. Installing this machine in a home or RV may result in fire, explosion, property damage, personal injury, or death.

- ▶ Operate the machine only for applications specified in *Machine Description and Intended Use*.

Foreword

SAVE THESE INSTRUCTIONS—This manual contains important instructions for the machine models below. These instructions have been written expressly by Wacker Neuson Production Americas LLC and must be followed during installation, operation, and maintenance of the machines.

Machine	Item Number	Revision
E 3000	0620158	225 and higher
E 3000G	0620219	225 and higher
E 3000 LB	0620678	225 and higher
E 3000 LB-G	0620679	225 and higher
E 3000 LB-G	52000004952	100 and higher

Machine documentation

- From this point forward in this documentation, Wacker Neuson Production Americas LLC will be referred to as Wacker Neuson.
- Keep a copy of the Operator's Manual with the machine at all times.
- Use the separate Parts Book supplied with the machine to order replacement parts.
- Refer to the separate Repair Manual for detailed instructions on servicing and repairing the machine.
- If you are missing any of these documents, please contact Wacker Neuson to order a replacement or visit www.wackerneuson.com.
- When ordering parts or requesting service information, be prepared to provide the machine model number, item number, revision number, and serial number.

Expectations for information in this manual

- This manual provides information and procedures to safely operate and maintain the above Wacker Neuson model(s). For your own safety and to reduce the risk of injury, carefully read, understand, and observe all instructions described in this manual.
- Wacker Neuson expressly reserves the right to make technical modifications, even without notice, which improve the performance or safety standards of its machines.
- The information contained in this manual is based on machines manufactured up until the time of publication. Wacker Neuson reserves the right to change any portion of this information without notice.

CALIFORNIA Proposition 65 Warning

Engine exhaust, some of its constituents, and certain vehicle components, contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Laws pertaining to spark arresters

NOTICE: State Health Safety Codes and Public Resources Codes specify that in certain locations spark arresters be used on internal combustion engines that use hydrocarbon fuels. A spark arrester is a device designed to prevent accidental discharge of sparks or flames from the engine exhaust. Spark arresters are qualified and rated by the United States Forest Service for this purpose. In order to

comply with local laws regarding spark arresters, consult the engine distributor or the local Health and Safety Administrator.

Manufacturer's approval

This manual contains references to *approved* parts, attachments, and modifications. The following definitions apply:

- **Approved parts or attachments** are those either manufactured or provided by Wacker Neuson.
- **Approved modifications** are those performed by an authorized Wacker Neuson service center according to written instructions published by Wacker Neuson.
- **Unapproved parts, attachments, and modifications** are those that do not meet the approved criteria.

Unapproved parts, attachments, or modifications may have the following consequences:

- Serious injury hazards to the operator and persons in the work area
- Permanent damage to the machine which will not be covered under warranty

Contact your Wacker Neuson dealer immediately if you have questions about approved or unapproved parts, attachments, or modifications.

Foreword

1 Safety Information

1.1 Signal Words Used in this Manual

This manual contains DANGER, WARNING, CAUTION, *NOTICE,* and NOTE signal words which must be followed to reduce the possibility of personal injury, damage to the equipment, or improper service.

This is the safety alert symbol. It is used to alert you to potential personal hazards.

- ▶ Obey all safety messages that follow this symbol.

DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

- ▶ To avoid death or serious injury from this type of hazard, obey all safety messages that follow this signal word.

WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

- ▶ To avoid possible death or serious injury from this type of hazard, obey all safety messages that follow this signal word.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

- ▶ To avoid possible minor or moderate injury from this type of hazard, obey all safety messages that follow this signal word.

NOTICE: Used without the safety alert symbol, NOTICE indicates a situation which, if not avoided, could result in property damage.

Note: *A Note contains additional information important to a procedure.*

1.2 Machine Description and Intended Use

This machine is a hydronic surface heater. The Wacker Neuson Hydronic Surface Heaters consist of trailer-mounted enclosures that house an optional diesel generator, a hydronic heater, electric motors, fixed pump(s) and plumbing, a diesel (or gas) burner, a fuel tank, and a hose handling system.

The hydronic heating system utilizes a burner that indirectly warms the Heat Transfer Fluid (HTF). The warmed HTF is continuously circulated through a vented, closed loop hose system. A positive displacement pump pushes the warmed HTF through the hose system, thereby radiating and transferring the heat to the required application area.

An insulated blanket may be laid over the hoses to increase efficiency. The low HTF level protection device shuts down the machine if the HTF level drops below minimum operational capacity.

This machine is intended to be used as a surface heater in order to thaw frozen ground, to cure concrete, or to prevent frost and freezing. In addition, when used with other Wacker Neuson accessories, this machine can be used to heat air.

This machine has been designed and built strictly for the intended use(s) described above. Using the machine for any other purpose could permanently damage the machine or seriously injure the operator or other persons in the area. Machine damage caused by misuse is not covered under warranty.

The following are some examples of misuse:

- Using the machine to heat anything other than what is stated above
- Using the machine to pump anything other than the factory recommended Heat Transfer Fluid
- Using the generator (if equipped) to power anything other than the machine itself or Wacker Neuson accessory machines, as instructed in the Operator's Manual
- Using the machine as a ladder, support, or work surface
- Using the machine to carry or transport passengers or equipment
- Using the machine to tow other machines
- Operating the generator (if equipped) in a manner that is inconsistent with all federal, state, and local codes and regulations
- Operating the machine outside of factory specifications
- Operating the machine in a manner inconsistent with all warnings found on the machine and in the Operator’s Manual

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This machine has been designed and built in accordance with the latest global safety standards. It has been carefully engineered to eliminate hazards as far as practicable and to increase operator safety through protective guards and labeling. However, some risks may remain even after protective measures have been taken. They are called residual risks. On this machine, they may include exposure to:

- Heat, noise, and exhaust from the engine or hydronic heater
- Burns from the HTF or radiant heat from the hoses

- Fire hazards from improper refueling techniques
- Fuel and its fumes
- Personal injury from improper lifting of the trailer tongue
- Tripping hazards from the hoses

To protect yourself and others, make sure you thoroughly read and understand the safety information presented in this manual before operating the machine.

1.3 Safety Guidelines for Operating the Machine

Operator training

Before operating the machine:

- Read and understand the operating instructions contained in all manuals delivered with the machine.
- Familiarize yourself with the location and proper use of all controls and safety devices.
- Contact Wacker Neuson for additional training if necessary.

When operating this machine:

- Do not allow improperly trained people to operate the machine. People operating the machine must be familiar with the potential risks and hazards associated with it.

Operator qualifications

Only trained personnel are permitted to start, operate, and shut down the machine. They also must meet the following qualifications:

- have received instruction on how to properly use the machine
- are familiar with required safety devices

The machine must not be accessed or operated by:

- children
- people impaired by alcohol or drugs

Machine condition

Only operate the machine when:

- All safety devices and guards are in place and in working order.
- All controls operate correctly.
- The machine is set up correctly according to the instructions in the Operator's Manual.
- The machine is clean.
- The machine's labels are legible.

When operating the machine:

- Do not modify or defeat the safety devices.
- Do not use worn electrical cords.
- Do not use faulty fuel supplies.

Safe operating practices

When operating this machine:

- Remain aware of the machine's moving parts. Keep hands, feet, and loose clothing away from the machine's moving parts.

When operating this machine:

- Do not operate a machine in need of repair.

Personal Protective Equipment (PPE)

Wear the following Personal Protective Equipment (PPE) while operating this machine:

- Close-fitting work clothes that do not hinder movement
- Safety glasses with side shields
- Hearing protection
- Safety-toed footwear

Work space

When operating the machine:

- Position the machine on a firm, noncombustible, level surface, and chock the wheels.
- Position the machine on the job site so that neither it nor the operator are standing in water.
- Keep the area immediately surrounding and underneath the machine clean, neat, and free of debris and combustible materials.
- Keep the area above the machine clear of debris that could fall on the machine.
- Store the machine properly when it is not being used.
- Keep unauthorized personnel, children, and pets away from the machine.

When operating the machine:

- Never operate the machine in areas that contain flammable objects, fuels, or products that produce flammable vapors.

1.4 Safety Guidelines for Lifting the Machine

When lifting the machine:

- Make sure slings, chains, hooks, ramps, jacks, forklifts, cranes, hoists, and any other type of lifting device used is attached securely and has enough weight-bearing capacity to lift or hold the machine safely. See section *Technical Data* for machine weight.
- Remain aware of the location of other people when lifting the machine.
- Only use the lifting points and tie-downs described in the Operator's Manual.
- Make sure the transporting vehicle has sufficient load capacity and platform size to safely transport the machine.

To reduce the possibility of injury:

- Do not stand under the machine while it is being lifted or moved.
- Do not get onto the machine while it is being lifted or moved.

1.5 Safety Guidelines for Operating Combustion Burners

When using the machine:

- Clean up any spilled fuel immediately.
- Replace the fuel tank cap after refueling the machine.
- Refill the fuel tank in a well-ventilated area.
- Shut down the generator, if equipped, when refueling.

When using the machine:

DANGER
Exhaust gas from the burner contains carbon monoxide, a deadly poison. Exposure to carbon monoxide can kill you in minutes.

- ▶ Never run the machine indoors or in an enclosed area unless the machine is vented properly.

When refueling the machine:

- Do not fill or drain the fuel tank near an open flame or while the machine is running.
- Do not smoke when refueling the machine.
- Do not use gasoline, crankcase oil, or any oil containing gasoline.

1.6 Safety Guidelines for Operating Gensets

DANGER

- **Carbon monoxide.** Using a generator indoors CAN KILL YOU IN MINUTES. Generator exhaust contains carbon monoxide (CO). This is a poison you cannot see or smell. If you can smell the generator exhaust, you are breathing CO. But even if you cannot smell the exhaust, you could be breathing CO.

WARNING

Electrocution hazard. Generators present special hazards during operation and servicing. These include the risk of electrocution or severe electrical shock. Failure to follow the safety information below can result in severe injury or death.

- Read and follow the safety instructions in this Operator's Manual.
- Contact the genset manufacturer for additional information regarding the genset.

WARNING

Internal combustion engines present special hazards during operation and fueling. Failure to follow the warnings and safety instructions could result in severe injury or death.

- Read and follow the safety instructions in this Operator's Manual.
- Contact the genset manufacturer for additional information regarding the genset.

WARNING

Most used oil contains small amounts of materials that can cause cancer and other health problems if inhaled, ingested, or left in contact with skin for prolonged periods of time.

- Take steps to avoid inhaling or ingesting used engine oil.
- Wash skin thoroughly after exposure to used engine oil.

This machine is built with user safety in mind; however, like any electrical device it can present serious hazards if improperly operated and serviced. Follow instructions carefully. Should questions arise during operation or service of this equipment, contact your Wacker Neuson dealer.

General precautions

- Keep a multi-class, type ABC or equivalent fire extinguisher at hand when using the genset. Refer to NFPA No. 10 for further information regarding fire extinguishers.
- Do not use evaporative starting fluids. They are highly explosive.
- Do not store items such as excess oil, oil rags, tools within the genset compartment. Items stored within the genset compartment are a fire hazard and can restrict cooling air.
- Wash thoroughly after handling used engine oil.

Before operating the genset

- Know how to start, operate, and stop the genset before starting it.
- Obtain the proper training for operating the genset. Do not allow untrained personnel to operate or service the genset.
- Check the fuel lines and the fuel tank for leaks and cracks before starting the engine.
- Clean the genset of any spilled fuel.

Running the genset

- Do not start the engine if fuel has spilled or a fuel odor is present.
- Keep the area around the exhaust pipe free of flammable materials.
- Do not smoke while operating the genset.
- Keep sparks, flames, electrical arcs, and other sources of ignition far away from the genset.
- Do not touch the engine or muffler while the engine is running or immediately after it has been turned off.
- Do not operate the genset with the maintenance covers off.
- Do not overload the genset. The total amperage of the tools and equipment attached to the genset must not exceed the load rating of the genset.
- Do not operate the genset with wet hands.
- Do not remove the radiator cap when the genset is running or is hot.

Refueling safety

When adding fuel to the fuel tank:

- Do not smoke.
- Do not refuel a hot or running engine.

When adding fuel to the fuel tank:

- Keep sparks, flames, electrical arcs, and other sources of ignition far away from the genset.
- Refill the fuel tank only in a well-ventilated area.
- Reinstall the fuel tank cap after refueling.

Maintenance safety

- Only a trained technician should attempt to repair the genset.
- Test procedures which require that the generator be running must be performed using extreme caution.
- Make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat, and use tools with insulated handles when servicing the genset.
- Engine antifreeze is toxic to humans and animals. Clean up spills and dispose of used engine antifreeze in accordance with local environmental regulations.
- Make sure all fasteners are secure and torqued properly.

1.7 Service Safety

Service training

Before servicing or maintaining the machine:

- Read and understand the instructions contained in all manuals delivered with the machine.
- Familiarize yourself with the location and proper use of all controls and safety devices.
- Only trained personnel shall troubleshoot or repair problems occurring with the machine.
- Contact Wacker Neuson for additional training if necessary.

When servicing or maintaining this machine:

- Do not allow improperly trained people to service or maintain the machine. Personnel servicing or maintaining the machine must be familiar with the associated potential risks and hazards.

Precautions

Follow the precautions below when servicing or maintaining the machine.

- Read and understand the service procedures before performing any service to the machine.
- All adjustments and repairs must be completed before operating the machine. Do not operate the machine with a known problem or deficiency.
- All repairs and adjustments shall be completed by a qualified technician.
- Turn off the machine before performing maintenance or making repairs.
- Remain aware of the machine's moving parts. Keep hands, feet, and loose clothing away from the machine's moving parts.
- Reinstall the safety devices and guards after repair and maintenance procedures are complete.

Machine modifications

When servicing or maintaining the machine:

- Use only accessories/attachments that are approved by Wacker Neuson.

When servicing or maintaining the machine:

- Do not defeat safety devices.
- Do not modify the machine without the express written approval of Wacker Neuson.

Replacing parts and labels

- Replace worn or damaged components.
- Replace all missing and hard-to-read labels.
- When replacing electrical components, use components that are identical in rating and performance to the original components.
- When replacement parts are required for this machine, use only Wacker Neuson replacement parts or those parts equivalent to the original in all types of specifications, such as physical dimensions, type, strength, and material.

Cleaning

When cleaning and servicing the machine:

- Keep the machine clean and free of debris such as leaves, paper, cartons, etc.
- Keep the labels legible.

When cleaning the machine:

- Do not clean the machine while it is running.
- Never use gasoline or other types of fuels or flammable solvents to clean the machine. Fumes from fuels and solvents can become explosive.

Personal Protective Equipment (PPE)

Wear the following Personal Protective Equipment (PPE) while servicing or maintaining this machine:

- Close-fitting work clothes that do not hinder movement
- Safety glasses with side shields
- Hearing protection
- Safety-toed footwear

In addition, before servicing or maintaining the machine:

- Tie back long hair.
- Remove all jewelry (including rings).

Maintenance guidelines

When maintaining the machine:

- Keep the fuel lines in good condition and properly connected.
- Allow the burner to cool before maintaining the machine.
- Allow the Heat Transfer Fluid (HTF) to cool before maintaining the machine.
- Keep all electrical cords away from heat, oil, vibrating surfaces, and sharp edges.

1.8 Safety Guidelines for Towing the Machine

WARNING
Risk of severe injury or death. Improper trailer condition and towing technique can lead to an accident.

- ▶ Obey the trailer manufacturer's instructions and the instructions below to reduce the risk of an accident.

When towing the machine:

- Do not tow the machine if the towing vehicle's hitch or the trailer's coupler are damaged.
- Do not tow the machine if any of the trailer's lug nuts are missing.
- Do not tow the machine if the trailer's tires have less than 1.5 mm (1/16 inch) of tread.
- Do not tow the machine unless the trailer's brakes are functioning properly.
- Do not exceed the trailer manufacturer's speed limitations.

When towing the machine:

- Only tow the machine when the trailer's lug nuts are properly torqued.
- Only tow the machine when the trailer's tires are properly inflated.
- Only tow the machine when all trailer lights are functioning correctly.
- Only tow the machine when the trailer's safety chains are connected to the towing vehicle in a crisscross pattern.
- Maintain extra distance between the towing vehicle and other vehicles.
- Avoid soft shoulders, curbs, and sudden lane changes
- Abide by all licensing requirements for your area.

If you have not driven a towing vehicle with trailer before, practice turning, stopping, and backing up the towing vehicle with trailer in an area away from traffic. Only drive the towing vehicle with trailer when you are confident in your ability to do so.

1.9 Reporting Safety Defects

If you believe your trailer has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Wacker Neuson.

If NHTSA receives similar complaints, it may open an investigation; and if it finds that a safety defect exists in a group of trailers, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Wacker Neuson.

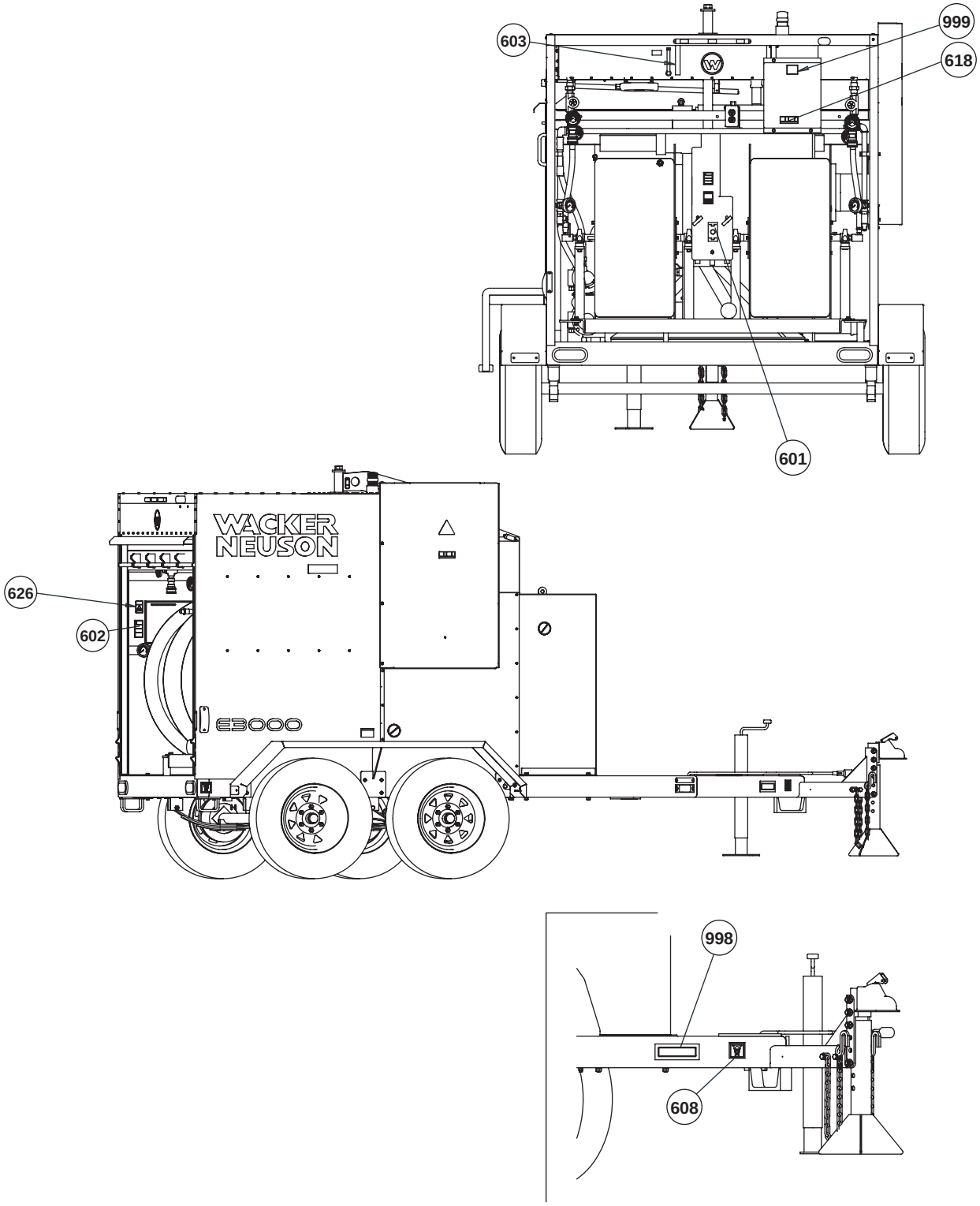
To contact NHTSA, you may either contact the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153), go to http://www.safercar.gov; or write to:

Administrator
NHTSA
1200 New Jersey Avenue S.E.
Washington, DC 20590

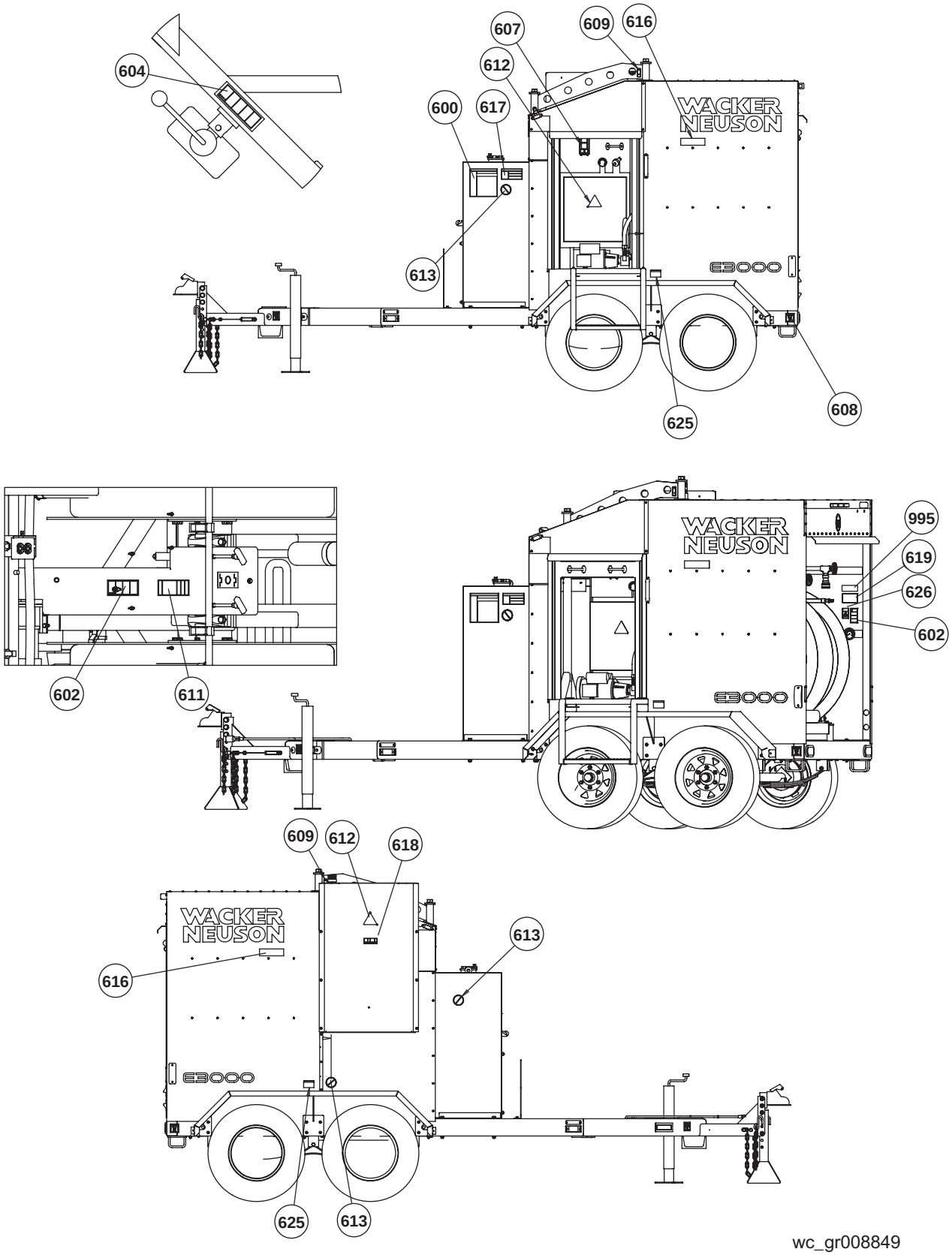
You can also obtain other information about your motor vehicle safety from http://www.safercar.gov

2 Labels

2.1 Label Locations



wc_gr008850


604
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995
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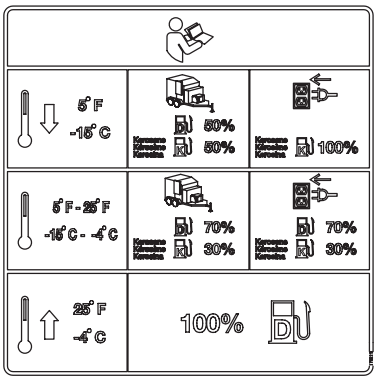
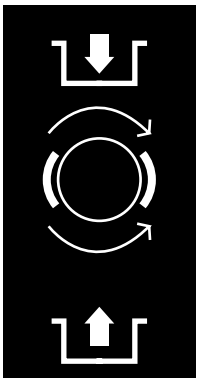
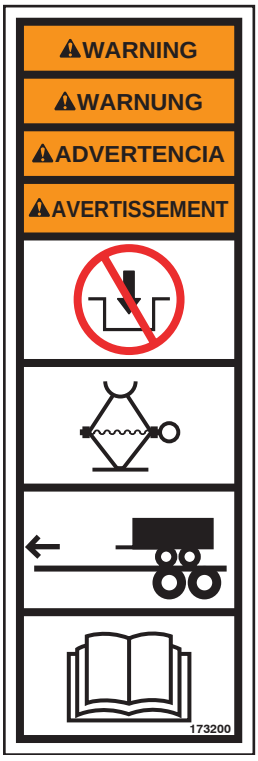
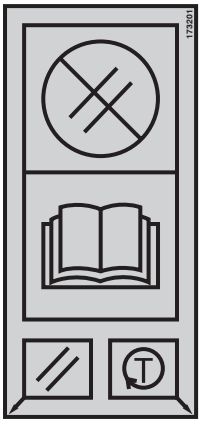
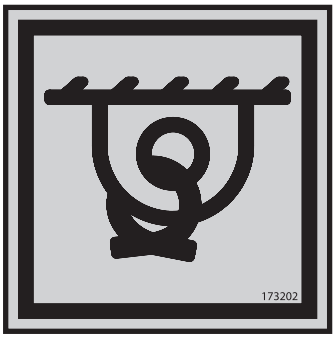
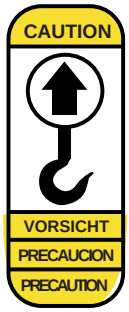
613
625
613
WACKER NEUSON
E3000

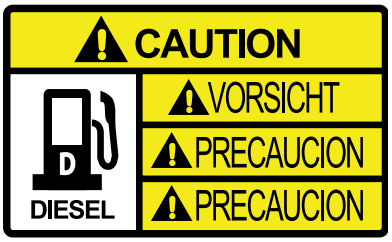
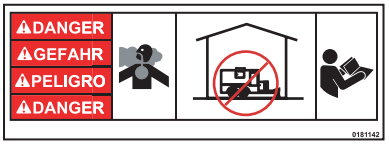
wc_gr008849

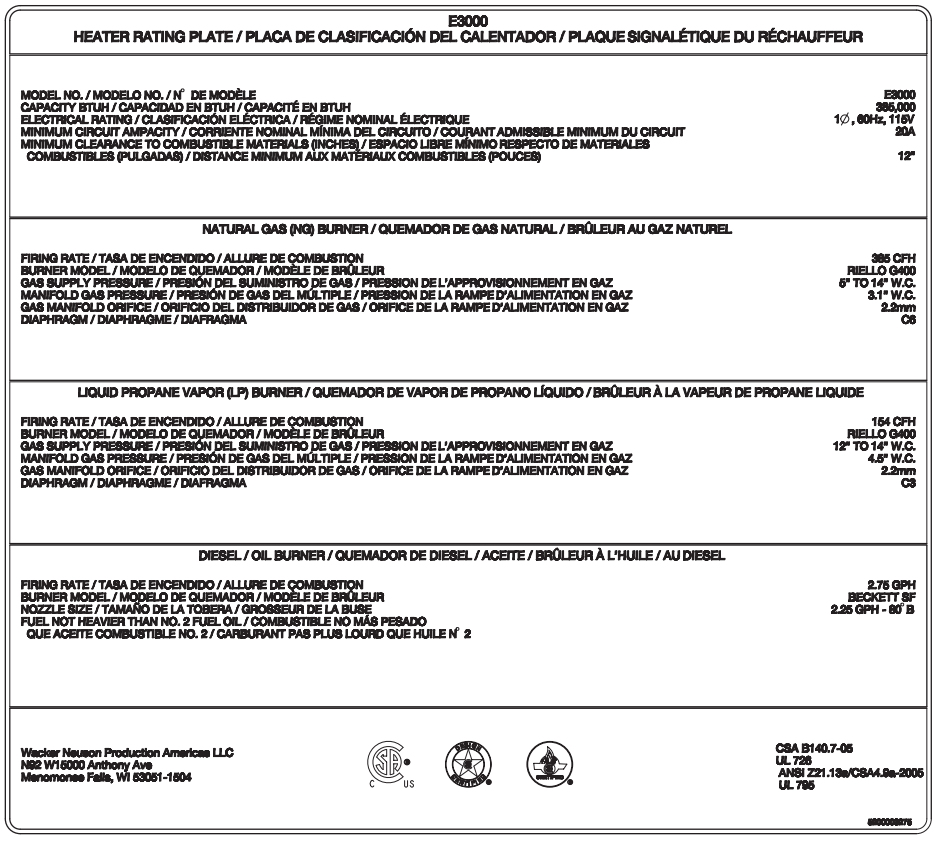
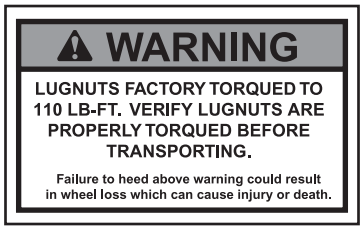
2.2 Label Meanings

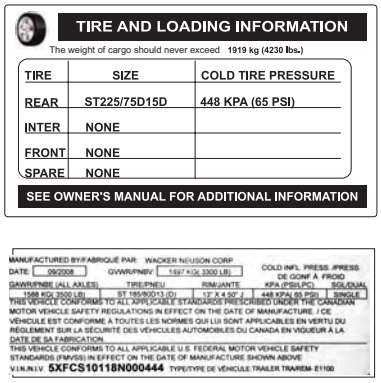
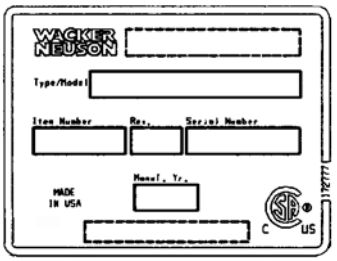
Ref.	Label	Definition
600		For machines powered by the generator: / For machines powered by the power utility: Use a 50-50 blend of #2 diesel and #1 diesel plus additives, or a 50-50 blend of #2 diesel and K1 kerosene plus additives when temperatures are below 5°F (-15°C). / Use 100% #1 diesel plus additives or 100% K1 kerosene plus additives when temperatures are below 5°F (-15°C). Use a 70-30 blend of #2 diesel and #1 diesel plus additives or a 70-30 blend of #2 diesel and K1 kerosene plus additives when temperatures are in the range 5 to 25°F (-15 to -4°C). Use a winter-blend diesel when temperatures are above 25°F (-4°C). wc_gr008377
601		Turn the handle clockwise to engage the hose reel brake. Turn the handle counterclockwise to release the hose reel brake.
602		WARNING! Hot surface hazard. Wear safety gloves. Wear eye protection.

Ref.	Label	Definition
603		Heat Transfer Fluid level. This label indicates the minimum and maximum level for the Heat Transfer Fluid. This label is located adjacent to a sight gauge on the Heat Transfer Fluid reservoir.
604		WARNING! Do not engage trailer jack while transporting the machine. Refer to the Operator's Manual for further instructions.
607		Do not reset. Refer to Operator's Manual.

Ref.	Label	Definition
608		Tie-down location marker.
609		NOTICE! Lift point. Attach lifting device in this location.
611		WARNING! Hand entanglement hazard. Moving parts can crush and cut. Do not operate with guard removed.
612		CAUTION! Hot surface hazard!

Ref.	Label	Definition
613		Not a step.
616		Weight/mass label: This label indicates the total weight of the machine, including the trailer and a full fuel tank.
617		CAUTION This machine uses diesel fuel.
618		DANGER Asphyxiation hazard. Using a Hydronic Surface Heater indoors CAN KILL YOU IN MINUTES. Generator and burner exhaust contains carbon monoxide. This is a poison you cannot see or smell. Never use inside an enclosed area even if doors and windows are open. Only use outside away from windows, doors, and vents. Read manual before use.

Ref.	Label	Definition
619		
	Machine rating label: This label indicates rating information for the machine.	
625		WARNING! Lugnuts factory torqued to 110 ft.lbs. Verify lugnuts are properly torqued before transporting. Failure to heed above warning could result in wheel loss which can cause injury or death.
—		Magnetic placards that display the numeric hazardous material code for diesel fuel are included with each machine. These placards must be placed on three sides of the machine during transport if the fuel tank contains any amount of fuel or fuel residue.

Ref.	Label	Definition
626		CAUTION! Pressurized contents. Do not open when hot!
995		WARNING! Never operate in an explosive environment or near flammable vapors, fuels or combustibles. Explosion or fire may occur. Risk of severe injury or death.
998		(on trailer) Tire and loading information label: This label indicates tire and loading information for the trailer. (on trailer) VIN label. This label displays vehicle identification numbers and other related information.
999		A nameplate listing the model number, item number, revision number, and serial number is attached to each unit. Please record the information found on this plate so it will be available should the nameplate become lost or damaged. When ordering parts or requesting service information, you will always be asked to specify the model number, item number, revision number, and serial number of the unit.

3 Lifting and Transporting

3.1 Lifting the Machine

Requirements

- Properly rated lifting equipment (crane or hoist). See Chapter *Technical Data*.
- Machine stopped. See topic *Stopping the Machine*.
- All doors and access covers closed and secured.

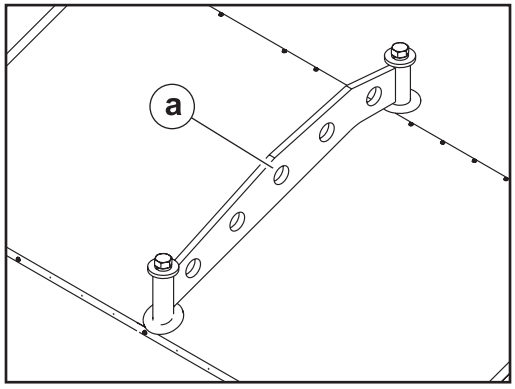
WARNING
Crushing hazard. You may be crushed if the lifting devices fail.

- ▶ Never stand under, or get onto, the machine while it is being lifted or moved.
- ▶ Use only the designated lifting points to lift the machine.

Procedure

Follow the procedure below to lift the machine.

1. Attach the lifting equipment to one of the lifting eyes **(a)** on the machine using hooks, shackles, and chains.



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2. Lift the machine a small distance.

WARNING
Crushing hazard. An unstable machine may cause the lifting devices to fail. You may be crushed if the lifting devices fail.

- ▶ Check for stability before continuing.

3. Check for stability. If necessary, lower the machine, reposition the lifting device, and lift the machine a small distance again.
4. Continue lifting the machine as necessary.

3.2 Preparing the Machine for Transport on a Truck or Trailer

Requirements

- Machine stopped.
- Flatbed truck or trailer capable of supporting the machine's weight.
- Chains, hooks, or straps capable of supporting the machine's weight.

WARNING
Crushing hazard. Improperly securing the machine can lead to a crushing hazard.
▶ Use only the designated tie-down points to secure the machine to a truck or trailer.

Checklist

Before transporting the machine, check the following items:

Machine

- ☐ Check that all accessories are securely stored within the machine.
- ☐ Check that all doors and access panels of the machine are closed.
- ☐ Check that all electrical supplies are disconnected from the machine.
- ☐ For machines with external fuel supplies, check that all fuel supplies are disconnected from the machine.
- ☐ For machines with generators, check that the generator is shut down.

Loading and transporting equipment

- ☐ Check that the transport vehicle or trailer can support the weight of the machine.
- ☐ Check that the transport vehicle or trailer is wide enough to support the machine.
- ☐ Check that the wheels of the transport vehicle or trailer are chocked during the loading process.
- ☐ Check that the transport vehicle or trailer is clean and free of grease, oil, ice, and other loose material.
- ☐ If the machine is mounted to a trailer, check that the jackstand or other transport block (piece of wood or other similar material) is available to support the trailer tongue during transporting. Do not use the machine's trailer jack to support the trailer tongue during transporting.
- ☐ Check that any ramps used in the loading process:
  - Can support the weight of the machine
  - Are clean and free of grease, oil, ice, and other loose material.
  - Are securely connected to the transport vehicle or trailer.
  - Are of sufficient length to keep the loading angle 15° or less.

In addition:

- ☐ Check that the loading area is flat and the ground is stable.
- ☐ Check the overall height of the machine once loaded. Plan your travel route so there will be adequate clearance for overpasses, road signs, buildings, etc.
- ☐ Check local regulations regarding transporting and obey these regulations.

3.3 Transporting the Machine on a Truck or Trailer

Requirements

- Machine stopped. See topic *Stopping the Machine*.
- All doors and access covers closed and secured.

WARNING
Crushing hazard. Improperly securing the machine can lead to a crushing hazard.

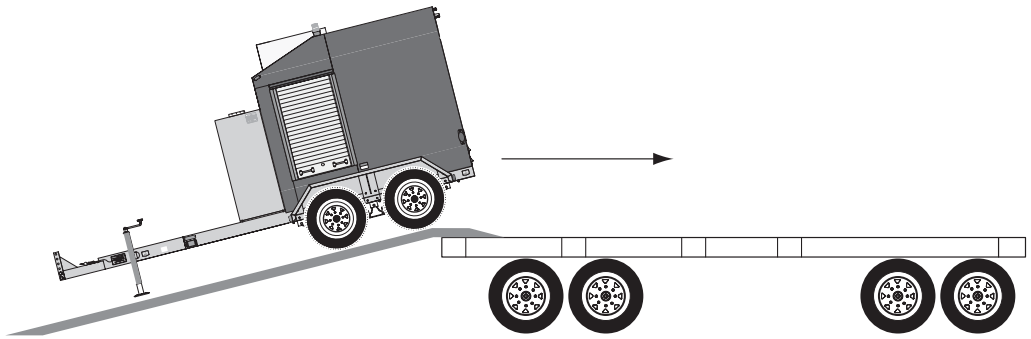
► Use only the designated tie-down points to secure the machine.

NOTICE: Do not run chains or straps across painted surfaces. Chains or straps may damage your machine.

Move the machine

1. Move the machine onto the flat bed using properly rated ramps or docks.

NOTICE: The flat bed must be at least 98 inches wide.



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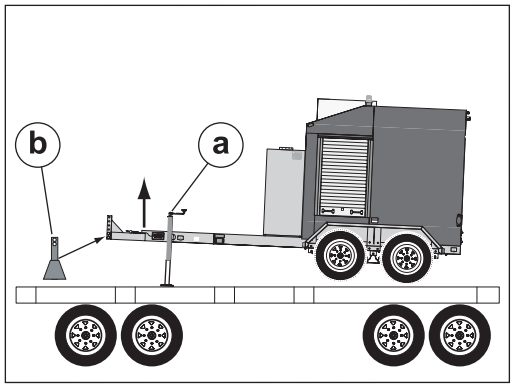
Support the tongue

2. Raise the tongue using the trailer jack **(a)**.
3. Install the tongue support **(b)** using two 5/8 inch bolts.



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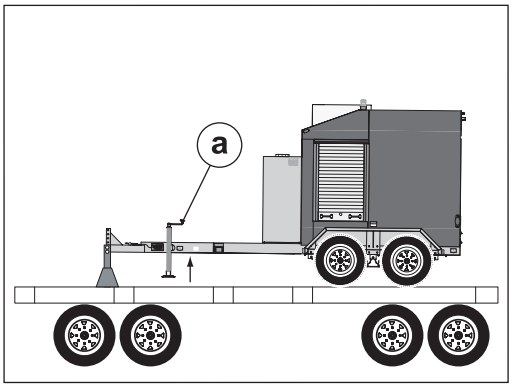

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NOTICE: If the supplied tongue support is missing, use any mechanism capable of supporting the tongue weight.

4. Lower the tongue and retract the trailer jack **(a)** at least two inches from the surface of the truck bed.

This procedure continues on the next page.

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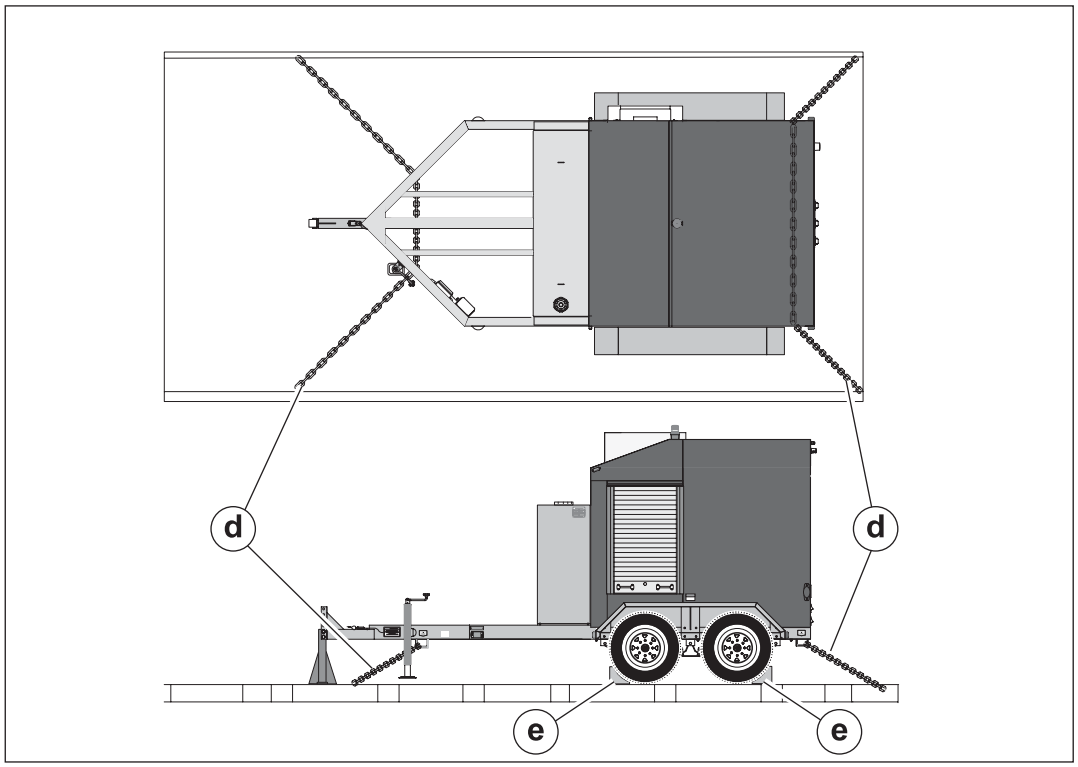
Secure the machine

5. Install properly rated securing mechanisms **(d)** such as chains or straps.
6. Install chocks **(e)** under all four wheels.



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Result The machine is ready to be transported.

3.4 Before Towing Checklist

Before towing the machine, check the licensing requirements for trailers in your area. Also check the following items:

Hitch and coupler

- ☐ Check that the towing vehicle and hitch have a rating equal to or greater than the GVWR of the machine. See *Technical Data*.
- ☐ Check that the hitch of the towing vehicle and coupler of the trailer are compatible.
- ☐ Check the condition of both the coupler and the hitch.
- ☐ Check that all fasteners on the coupler are secure.
- ☐ Check that the coupler has fresh grease applied to it.

Wheels

- ☐ Check that all lug nuts are in place and are properly torqued.
- ☐ Check the tread wear of the tires.
- ☐ Check that the tires are inflated to the proper pressure.

Trailer operation

- ☐ Check that the directional and running lights on the trailer function correctly.
- ☐ Check that the safety chains of the trailer are connected to the towing vehicle using a crisscross pattern.
- ☐ Check that the trailer's breakaway cable is attached to the towing vehicle.
- ☐ Check the operation of the trailer brakes by braking the towing vehicle at a slow speed. Both the vehicle and the trailer must brake smoothly. If the trailer pushes, check the fluid level in the surge brakes or the operation of the electric brakes.
- ☐ Test the function of the breakaway system.

3.5 Towing the Machine

WARNING
Risk of severe injury or death. Improperly torqued lug nuts can lead to loss of wheels. Loss of wheels can cause an accident, severe injury or death.
- ▶ Tighten the lug nuts to the proper torque before towing the machine.

NOTICE: The towing vehicle must be equipped with a Class III or above hitch.

Procedure

Perform the procedure below when towing the machine.

1. Read and follow the towing safety guidelines. See topic *Safety Guidelines for Towing the Machine*.
2. Complete the shut-down procedures. See topic *Stopping and Packing Up the Machine*.
3. Adjust the amount of fuel in the machine to approximately 70% capacity to avoid fuel spillage.
4. Complete the Before Towing Checklist. See topic *Before Towing Checklist*.
5. Connect the machine to the towing vehicle.
6. Rotate the trailer jack to a horizontal position.
7. Tow the machine as needed.

3.6 Testing the Breakaway System (Electric Brakes)

Requirements

- Voltmeter
- Battery charger or backup battery (charged)

When

Test the breakaway system:

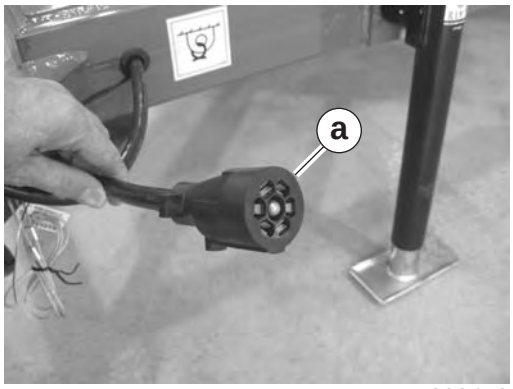
- Before towing
- Monthly if the machine is not in service

Procedure

Perform the following procedure to test the breakaway system.

NOTICE: Disconnect the trailer wiring plug from the tow vehicle before testing. Failure to do so will result in severe damage to the electronic brake control.

1. Connect the machine/trailer to the tow vehicle.
2. Disconnect the trailer wiring plug **(a)** from the tow vehicle.



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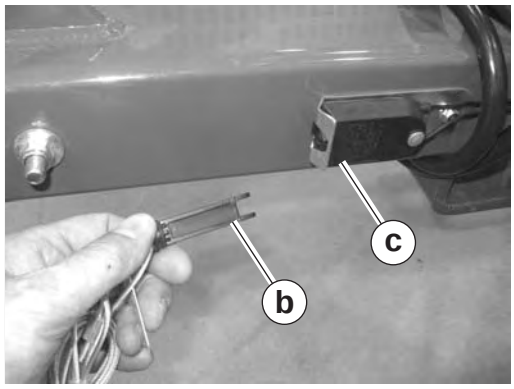

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3. Pull the breakaway pin **(b)** out of the brake switch **(c)** (to activate the brakes) and attempt to tow the machine/trailer at a very slow speed (less than 5 mph (8 km/hr)). When activated, a properly working breakaway system will cause substantial drag on the trailer wheels and may even cause the trailer wheels to lock.
4. Stop the tow vehicle.

WARNING

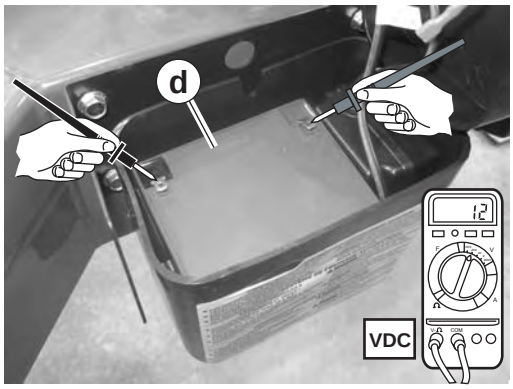
Personal injury hazard. A faulty breakaway system may lead to an accident and personal injury if the machine/trailer breaks away.

- ▶ Do not tow the machine/trailer if the breakaway system is faulty.

This procedure continues on the next page.

Continued from the previous page.

5. If the brakes did not function, check the voltage of the breakaway battery. To do so:
   a. Remove the cover of the battery box.
   b. Remove the wires connected to the breakaway battery **(d)**.
   c. Measure the voltage. If 12–14 VDC is not measured, replace or recharge the breakaway battery.



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6. If 12–14 VDC was measured but the brakes did not function, there is a wiring or mechanical fault with the brakes. Repair any faults before towing.
7. If the brakes function properly:
   a. Reconnect the wires to the breakaway battery.
   b. Reinstall the cover to the battery box.
   a. Reinstall the breakaway pin **(b)** into the brake switch.
   b. Connect the trailer wiring plug to the tow vehicle.

Result The procedure to test the breakaway system is now complete.

3.7 Hazardous Materials Placards

Hazardous materials placards

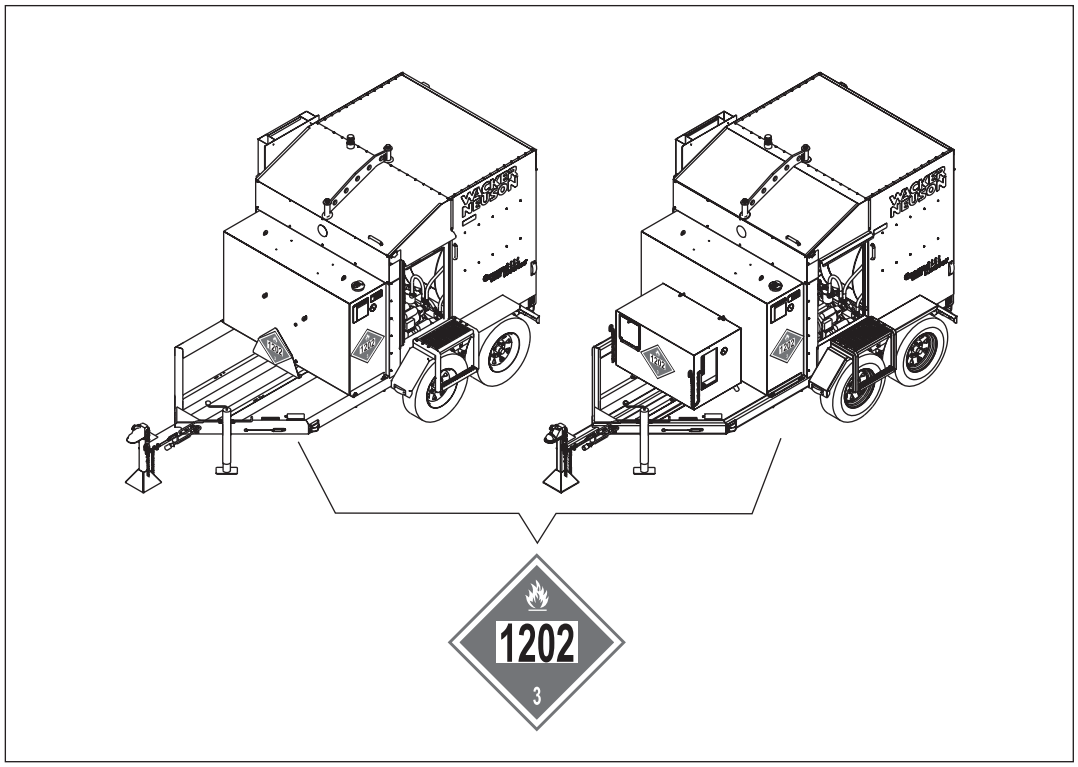
The Pipeline and Hazardous Materials Safety Administration (PHMSA) requires that hazardous materials placards be placed on this machine when transporting it unless the fuel tank has been drained and purged of all fuel and residue.

Before transporting the machine:

1. Drain and purge the fuel tank of all fuel and fuel residue OR place placards that display the numeric hazardous material code for diesel fuel on three sides of the machine.

Note: *The placards are included with the machine.*

2. Consult the Department of Transportation (DOT), or equivalent agency, in the states or countries in which this machine is to be transported, regarding:
   - Driver's licensing requirements for transporting machines that bear hazardous materials placards
   - Other restrictions for use of this machine



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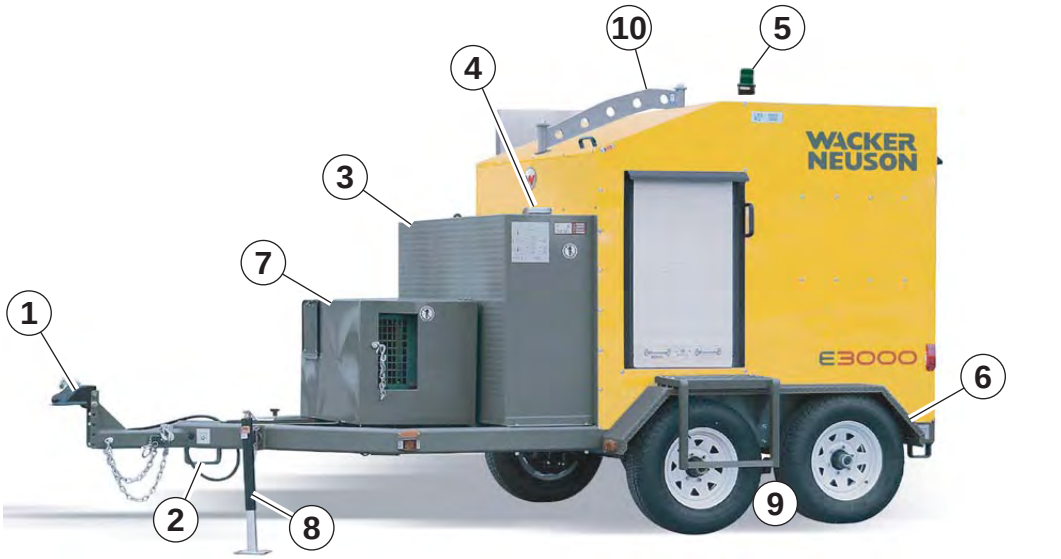
Notes

4 Operation

4.1 External Components



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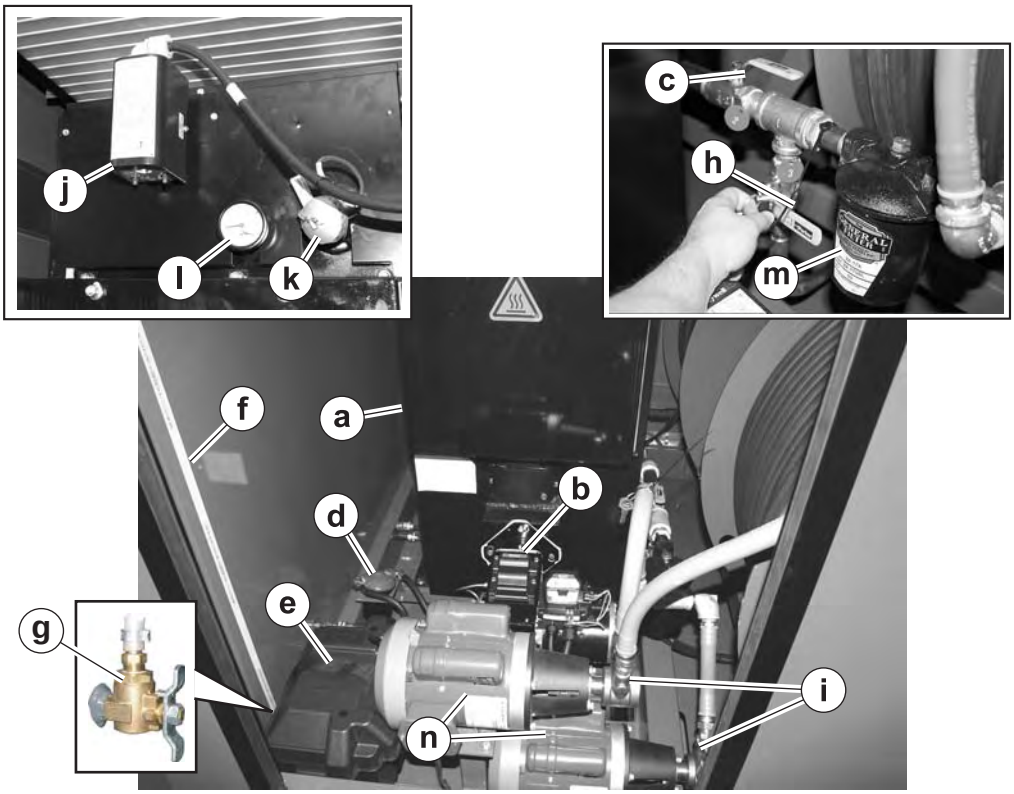
Ref.	Description	Ref.	Description
1	Hitch (ball or pintle)	6	Fender
2	Tie-down	7	Onan genset (option)
3	Fuel tank	8	Jack stand
4	Fuel tank cap	9	Tandem axles
5	Performance monitoring light	10	Lifting bail

4.2 Internal Components



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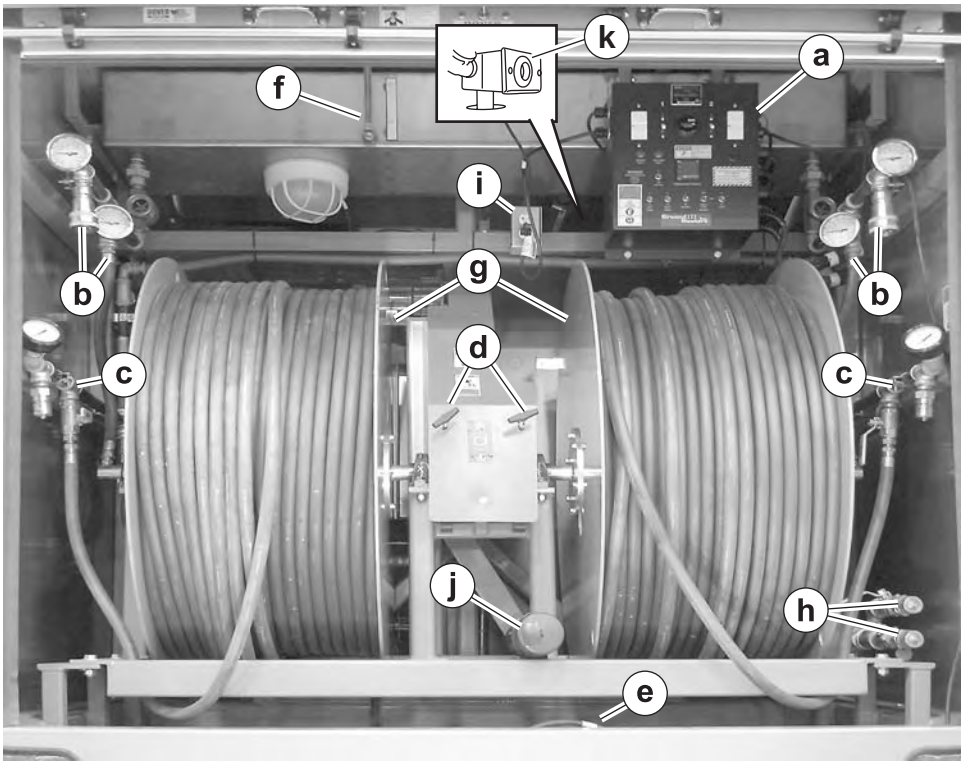
Ref.	Description	Ref.	Description
a	Hydronic heater[1]	h	Fill valve #3
b	Burner (oil burning shown)	i	HTF pumps
c	Suction valve #2	j	Low-level shut-down device
d	Fuel filter	k	Thermocouple
e	Battery	l	Temperature/pressure gauges
f	Fuel sight gauge	m	HTF filter
g	Fuel sight gauge valve	n	Motor (HTF pump)

[1] This hydronic heater operates at zero (atmospheric) pressure and is not subject to regulations applicable to pressurized "boilers".

4.3 Rear Components



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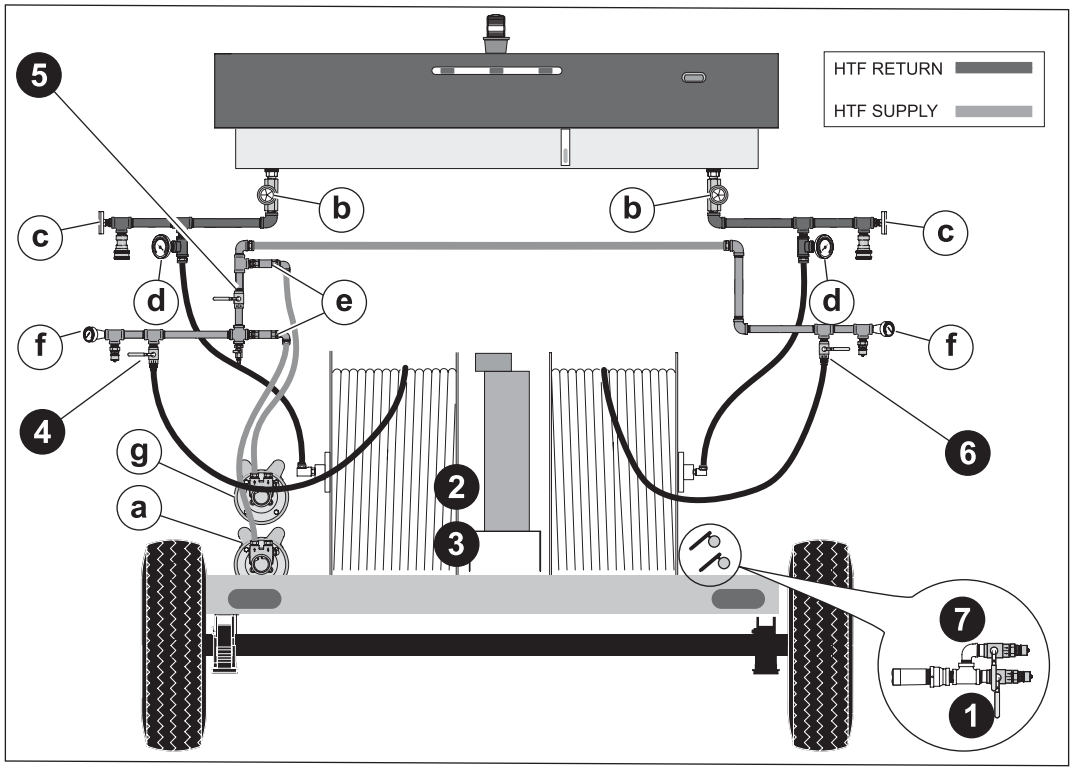
Ref.	Description	Ref.	Description
a	Control panel	g	Hose reels and hose
b	Heat Transfer Fluid (HTF) return plumbing	h	Pump Pack supply connections
c	HTF supply plumbing	i	Duplex receptacle
d	Hose reel brake T-handle	j	Operator’s Manual holder
e	Rewind system foot control pedal	k	Thermal switch (snap switch)
f	HTF expansion tank sightglass	—	—

4.4 Pumps, Gauges, and Valves



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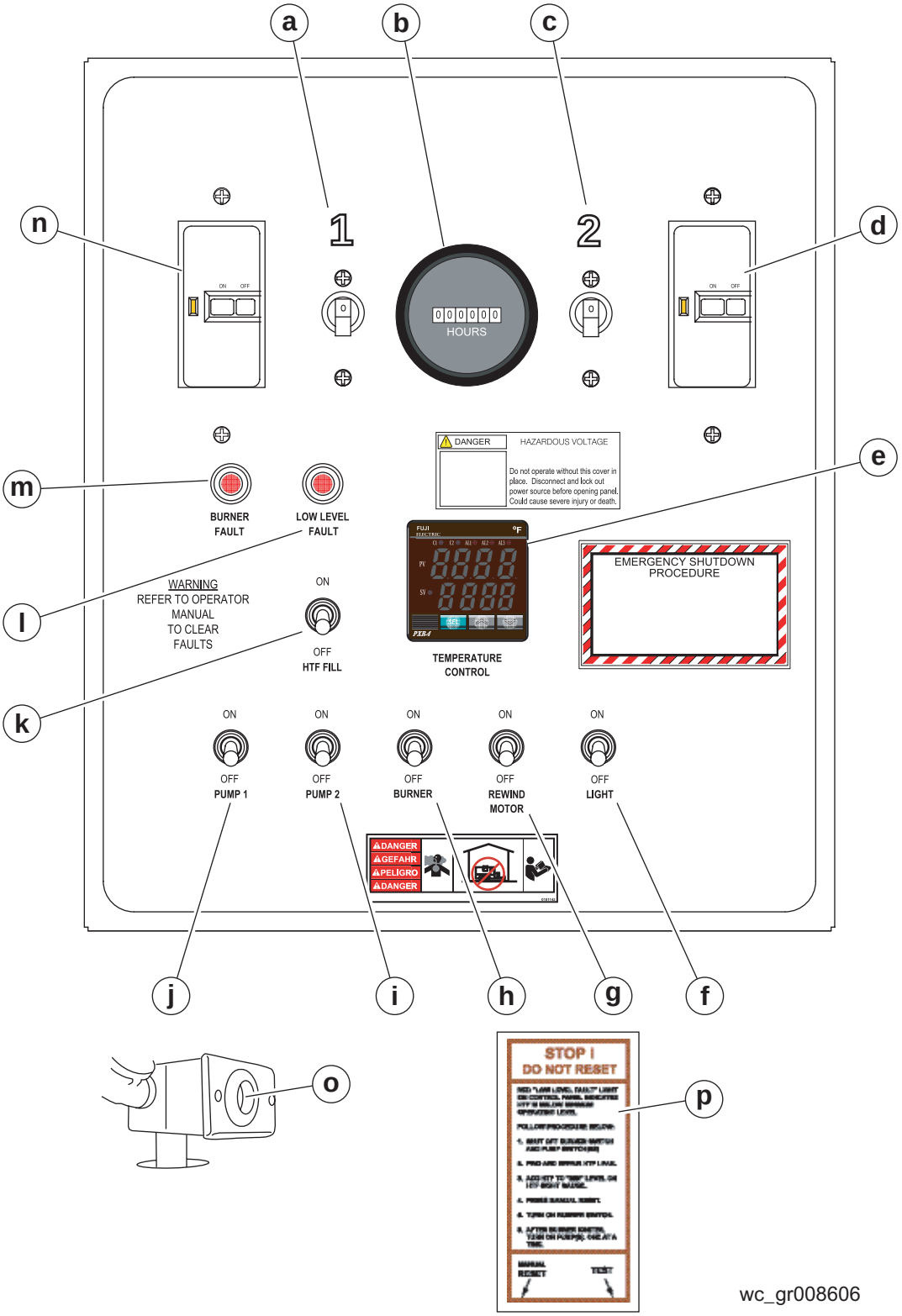
Pumps and Gauges

Ref.	Description
a	Left pump
b	Return flow indicator
c	Accessory HTF return thermometer
d	Main HTF return thermometer
e	Check valves
f	Pump pressure gauge
g	Right pump

Valves

Valve #	Description
1	Pump Pack supply and drain valve
2	Pump suction valve (behind hose reel)
3	HTF fill valve (behind hose reel)
4	Left hose reel supply valve
5	Cross connect valve
6	Right hose reel supply valve
7	Pump Pack supply valve

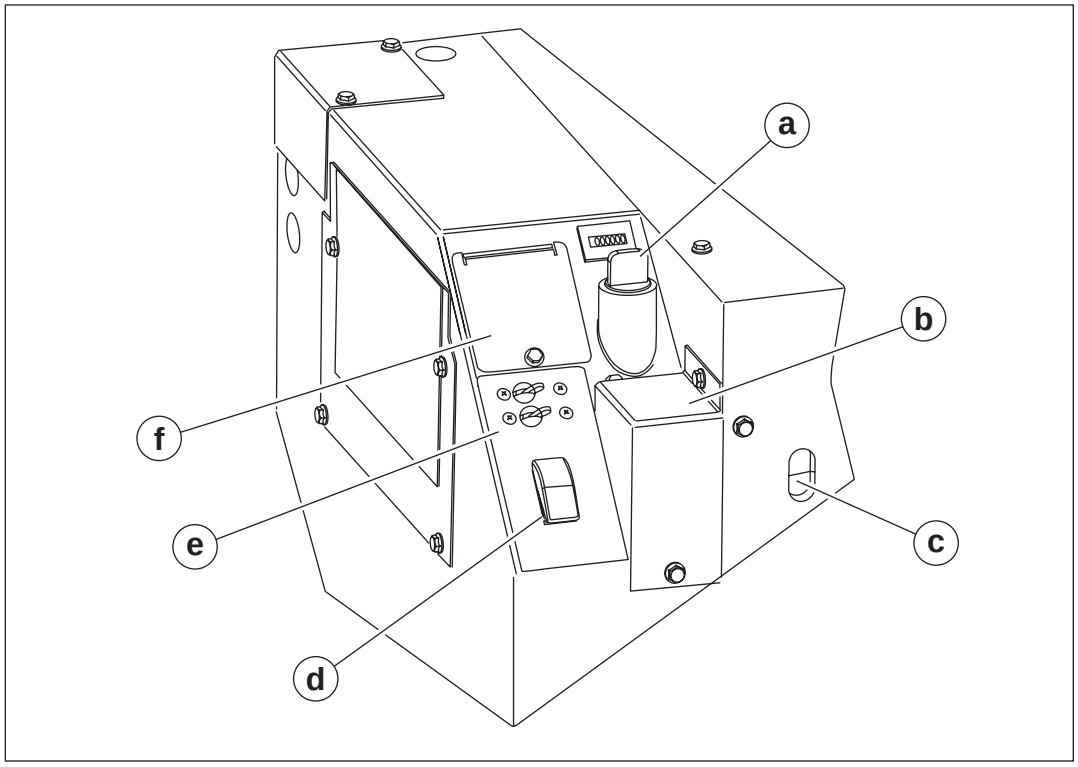
4.5 Control Panel



4.6 Control Panel Components

Ref	Description	Function
a	Main breaker 1	Controls power to electrical circuit 1.
b	Hour meter	Meters usage of the machine.
c	Main breaker 2	Controls power to the pump circuit (20A)
d	Circuit 2 GFCI	Provides protection for the operator.
e	Temperature control	■ Allows the user to control the HTF target application temperature. ■ Shows the actual temperature of the HTF.
f	Cab light ON-OFF switch	Switches electric power ON and OFF to the cab light.
g	Hose rewind ON-OFF (right and left) switch	Controls power to the hose rewind motor. This switch has two ON modes—one each in the up and down positions. OFF mode is in the middle position.
h	Burner ON-OFF switch	Switches electric power ON and OFF to the burner.
i	Pump 2 ON-OFF switch	Switches electric power ON and OFF to Pump 2.
j	Pump 1 ON-OFF switch	Switches electric power ON and OFF to Pump 1.
k	HTF fill switch	This momentary switch bypasses the low-level shut-down device and provides power to the pumps. It is used when filling the HTF reservoir after a low level fault.
l	Low level fault indicator	Illuminates to indicate a low HTF level condition.
m	Burner fault indicator	Illuminates to indicate a burner fault condition.
n	Circuit 1 GFCI	Provides protection for the operator.
o	Thermal switch (snap switch)	Disconnects power to the burner circuit in the event of an over-temperature condition. This switch opens at 70°C. This switch must be manually reset.
p	HTF low-level reset switch (module is located inside the auxiliary control panel)	Pressing this switch resets the low-level shut-down device.

4.7 Genset Control Panel



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Ref	Description
a	Oil fill cap and dipstick
b	Coolant recovery access panel
c	Coolant level sightglass
d	Control switch and status light
e	Line circuit breakers
f	Coolant fill access panel

4.8 Preparing the Machine for First Use

Preparing for first use

To prepare your machine for first use:

1. Make sure all loose packaging materials have been removed from the machine.
2. Check the machine and its components for damage. If there is visible damage, do not operate the machine! Contact your Wacker Neuson dealer immediately for assistance.
3. Take inventory of all items included with the machine and verify that all loose components and fasteners are accounted for.
4. Attach component parts not already attached.
5. Add fluids as needed and applicable, including fuel, engine oil, and battery acid.
6. Move the machine to its operating location.

4.9 Breaking in the Genset

Background

New gensets require a break-in period for the engine. If you are the first owner of this machine, or the genset's engine has just been rebuilt, break in the engine as stated below.

Procedure

1. Check that the engine oil level is correct. Check that the engine oil viscosity is appropriate for the temperature conditions. Change the oil if it is not appropriate for the temperature conditions.
2. Operate the genset at approximately 1/2 rated power for the first two hours.
3. Operate the genset at approximately 3/4 rated power for two more hours.
4. Check the engine oil level every four hours (or twice daily) during the first 24 hours of operation.
5. Change the engine oil and filter after the first 50 hours of operation.

4.10 General Sequence of Operation

Follow the sequence of operation below. Refer to the specific topic for details.

Task	When/Where	See Topic
1. Check HTF level.	Before leaving for the job site. Or, when at the job site before daily operation.	4.11 / 4.15
2. Check fuel level.		4.13 / 4.15
3. Position the machine.	At the job site.	4.14
4. Perform pre-starting checks.		4.15
5. Connect power.		4.16
6. Start the generator (if equipped)		4.17
7. Power up the machine.		4.18
8. Run the machine.		—
a. Preheat the HTF (if necessary).		4.19
b. Initiate HTF flow.		4.20
c. Unwind and position the hoses.		4.22 / 4.23
d. Monitor the operating parameters.		4.24
e. Rewind the hoses.		4.25
9. Shut down and pack up the machine.		4.26

4.11 Checking the HTF Level

When

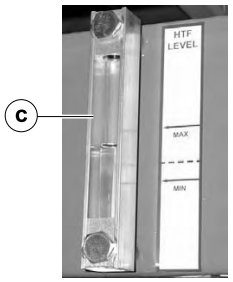
- Before leaving for the job site, or
- Before beginning operation at the job site

Prerequisites

- The machine is level.
- The machine is cool.

Procedure

The Heat Transfer Fluid (HTF) level must be between the marks on the sightglass **(c)**.



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If low

If the HTF level is low, HTF must be added. Filling the HTF reservoir requires electric power to the machine and knowledge of the machine's operation. Familiarize yourself with the function of the machine's controls, then see topic *Filling the HTF Reservoir* for detailed instructions.

4.12 Recommended Fuel

Low ambient temperatures cause diesel fuels to gel. Gelled fuels will cause burner ignition failure and/or burner fuel pump damage. Always use the proper fuel for the conditions.

Fuel Blend Guide		
Lowest expected ambient temperature °F (°C)	**Generator-powered**	**Shore-powered**
Below 5 (-15)	50-50 blend of #2 diesel and #1 diesel, plus additives OR 50-50 blend #2 diesel and K1 kerosene, plus additives	100% #1 diesel plus additives OR 100% K1 kerosene, plus additives
5 to 25 (-15 to -4)	70-30 blend of #2 diesel and #1 diesel, plus additives OR 70-30 blend of #2 diesel and K1 kerosene, plus additives	
Above 25 (-4)	Winter-blend diesel	

NOTICE: Do not use B20 or any other type of biodiesel fuel in this machine.

CAUTION
Fire hazard.

- ▶ Do not use gasoline, crankcase oil, or any oil containing gasoline.

4.13 Refueling the Machine

Requirements

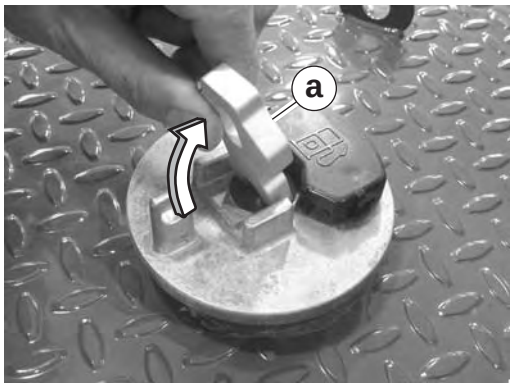
- Machine shut down
- Machine level with the ground
- Diesel fuel supply

Procedure

Perform the procedure below to refuel the machine.

Note: *On models with generators, it is not necessary to fill the generator's fuel tank. Both the burner and the generator use the machine's fuel tank.*

1. Lift the lever **(a)** on the fuel cap.



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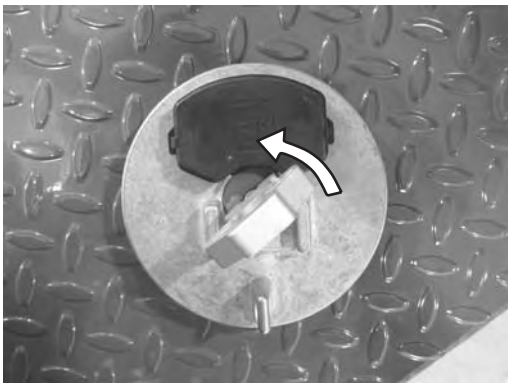

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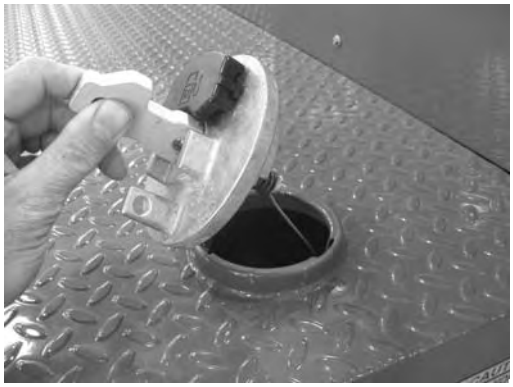
2. Rotate the lever counterclockwise until it stops.
3. Remove the fuel cap from the tank.



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4. Fill the tank with the appropriate grade of fuel for the weather conditions until the gauge **(b)** reads full. Leave room within the tank for possible fuel expansion.

CAUTION

Fire and health hazard. Fuel expands when heated. Expanding fuel in a overly-full tank can lead to spills and leaks.

- ▶ Do not overfill the fuel tank.

5. Reinstall the fuel cap.

Result

The procedure to refuel the machine is now complete.

4.14 Positioning the Machine

DANGER
Asphyxiation hazard.
Exhaust gas from the burner contains carbon monoxide, a deadly poison you cannot see or smell. Exposure to carbon monoxide can kill you in minutes.
- ▶ Position the machine so that burner exhaust will not enter any nearby structures.

WARNING
Fire hazard. Do not move the machine while it is running.
- ▶ Shut down the machine before moving or repositioning it.

WARNING
Fire hazard. Machines positioned on a hill or an incline may slide, break away or roll over.
- ▶ Do not position the machine on a hill or an incline.

WARNING
Explosion and fire hazard. Risk of severe injury or death.
- ▶ Do not operate the machine near flammable vapors, fuels, or combustibles.

CO Alarms

Because this machine produces carbon monoxide (CO), Wacker Neuson recommends that CO alarms be installed in all structures in close proximity to the machine. CO alarms provide an extra measure of protection against this poison that you cannot see or smell.

Install battery-operated CO alarms or plug-in CO alarms with battery backup, according to the manufacturer's instructions. CO alarms should be certified to the requirements of the latest safety standards (UL 2034, IAS 6-96, or CSA 6.19.01). Test the CO alarm batteries monthly.

Requirements

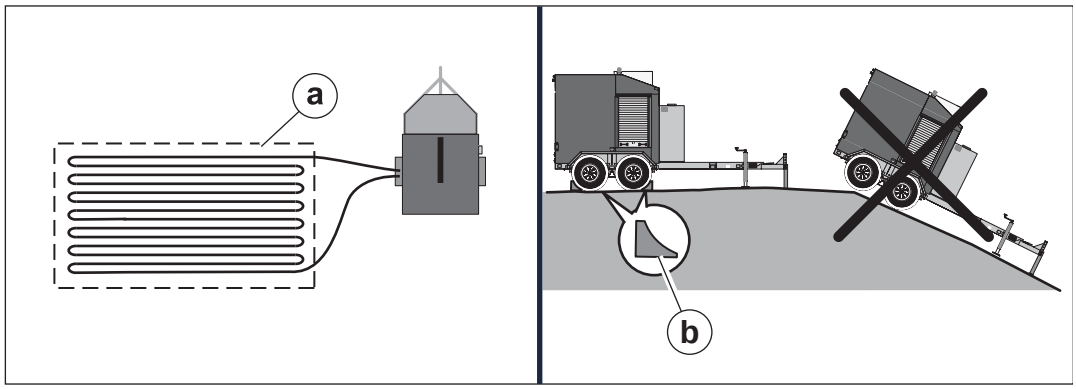
Position the machine:
- so that burner exhaust will not enter nearby structures.
- so that the machine does not block traffic.
- so that the machine is not close to any combustible material or flammable vapor.
- so that all of the machine's access doors/panels may be accessed.
- so that HTF hoses do not pose tripping hazards, and so the HTF hoses cannot be damaged by machines or other equipment on the job site.

This procedure continues on the next page.

Continued from the previous page.

Procedure Perform the following procedure to position the machine.

1. Place the machine near the application area **(a)** on solid, stable, and level ground.



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2. For machines with trailers, install chocks **(b)** under the wheels.

Result The machine is now properly positioned.

4.15 Pre-Starting Checks

Requirements

- Machine properly positioned
- Power connected to the machine

Checks

Before starting the machine, check the following items:

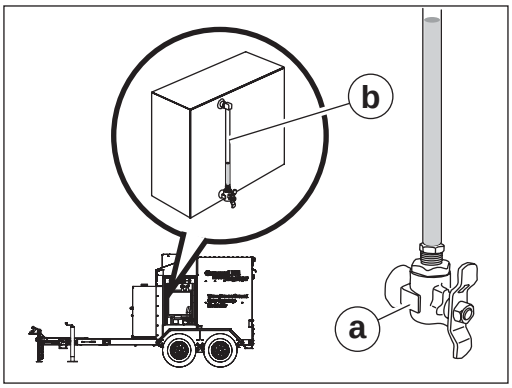
Fuel System

Fuel sight gauge valve **(a)**

▶ Check that the fuel sight gauge valve is open.

Fuel sight gauge **(b)**

▶ Check that the fuel tank is full.



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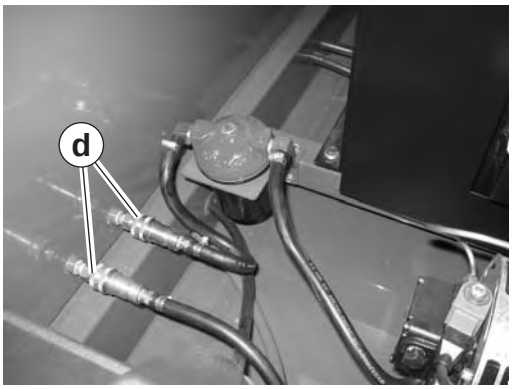
Quick connects **(d)**

▶ Check that the quick-connect couplings are secure.



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Heat Transfer Fluid (HTF) System

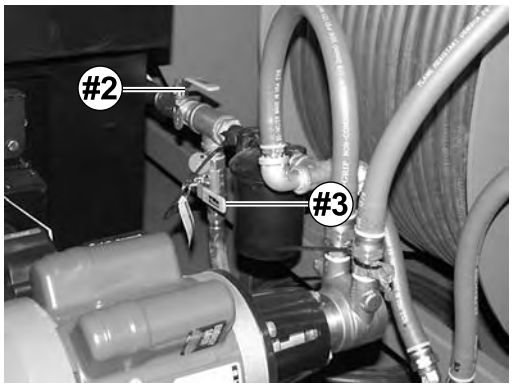
Suction valve **(#2)**

- Check that suction valve **(#2)** is open.

HTF fill valve **(#3)**

- Check that HTF fill valve **(#3)** is closed and locked with the locking pin.

NOTICE: The HTF fill valve must remain closed and locked during normal operation. An open HTF fill valve will cause HTF leakage.



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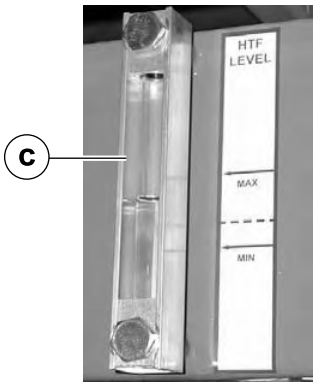
HTF sight gauge **(c)**

- Check that the HTF level is within the operating range.

NOTICE: Starting the machine with low HTF will damage the pumps.



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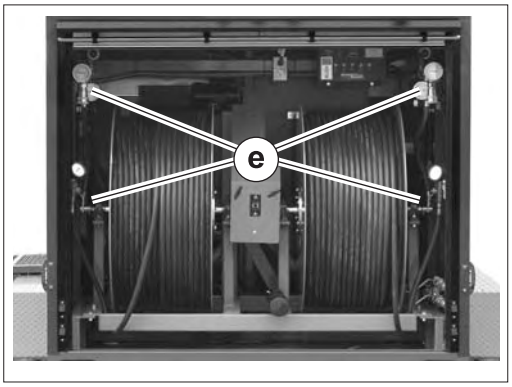
HTF Hose connections **(e)**

- Check that all HTF hose quick-connects are secure.



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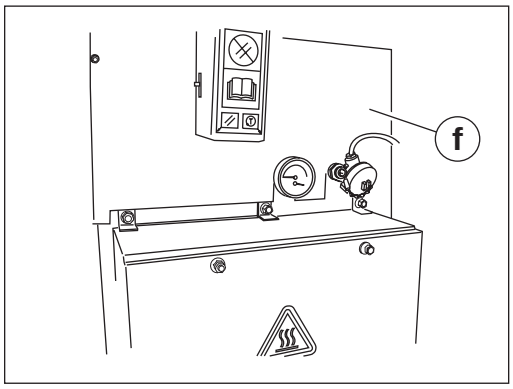
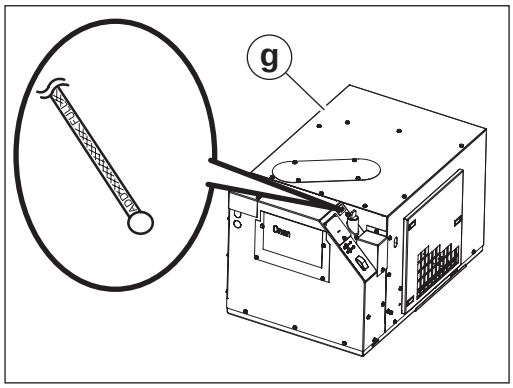
Hydronic heater **(f)** ▶ Inspect for signs of exhaust leaks. See topic *Inspecting/ Replacing the Rope Gasket.*	 wc_gr008603
Genset **(g) (if equipped)** ▶ Check oil level. See topic *Checking the Engine Oil*. ▶ Inspect for signs of fuel and exhaust leaks.	 wc_gr008141

Result The machine is ready to have power applied.

4.16 Connecting Power to the Machine

Prerequisites

- Power source
- Machine properly positioned

WARNING
Fire hazard and electric shock hazard. The use of undersized extension cords can lead to fire and electric shock. Fire and electric shock can cause severe injury.

▶ Do not use undersized extension cords.

Extension cords

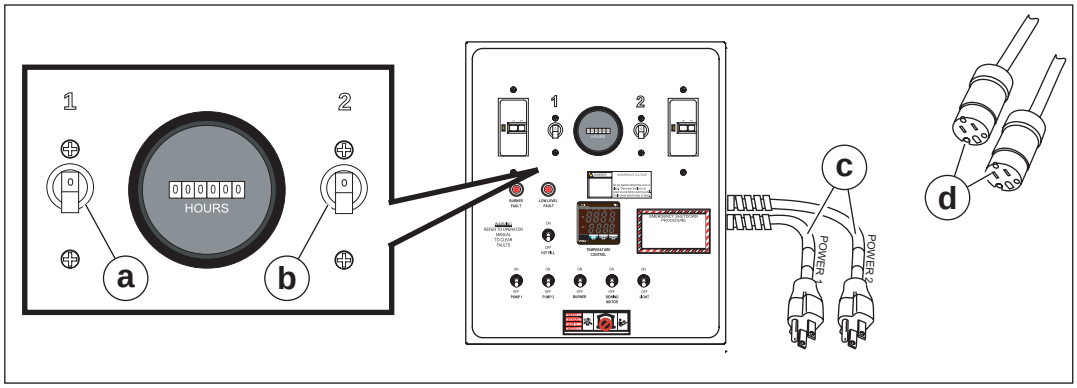
Restrictions for extension cords:

- Use only 3-wire type extension cords with heavy-duty plugs.
- The maximum length of extension cord usage per circuit is 30 m (100 ft).
- Use 12-gauge extension cords for lengths up to 15 m (50 ft).
- Use 10-gauge extension cords for lengths up to 30 m (100 ft).

Procedure

Follow the procedure below to connect power to the machine.

1. Move both circuit breaker switches **(a** and **b)** to the OFF position.



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2. Connect the main power cords **(c)** to a properly-rated power source or to the generator **(d)** if included.

Result

Power has now been connected.

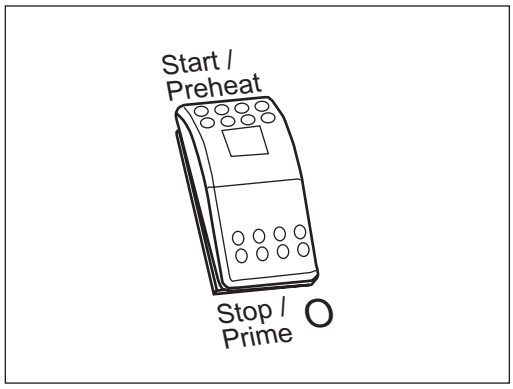
4.17 Starting and Stopping the Generator

Background Only general starting and stopping procedures for the generator are included in this manual. See the generator manufacturer's operation manual for detailed procedures.

Starting Perform the procedure below to start the generator.

1. Move the circuit breaker switches on the genset to the OFF position.
2. Prime the fuel system if needed. The fuel system will need to be primed if:
   - Fuel system has run dry
   - Fuel system has been drained
   - The fuel filter has been changed
   - The genset has not been run for several weeks

▶ To prime the fuel system: Press and hold the control switch in the "Stop / Prime" position. The fuel pump will start two seconds after the control switch is initially placed in the "Stop / Prime" position. Continue holding the control switch for at least one minute.



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3. Press and hold the control switch in the "Start / Preheat" position. The genset will first preheat (for up to 15 seconds depending on how cold it is). Then, the starter will engage and the engine will start.

NOTICE: Do not crank the engine for more than 30 seconds at a time. Wait at least two minutes before cranking the engine again.

Stopping Perform the procedure below to stop the genset.

1. Move the generator circuit breakers to the OFF position.
2. Allow the genset to run two minutes to cool down.
3. Press the control switch to the "Stop / Prime" position.

4.18 Applying Power to the Machine

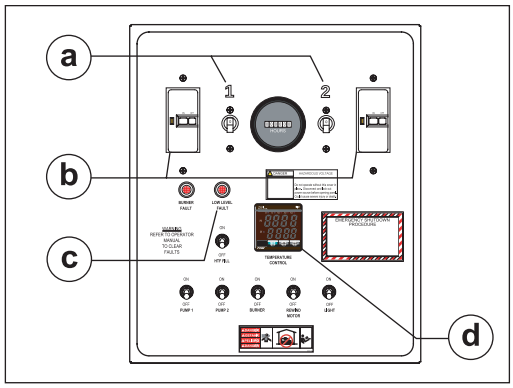
Requirements

- Pre-starting checks have been completed
- Power connected to the machine

Procedure

Follow the procedure below to apply power to the machine.

1. Move both circuit breaker switches **(a)** to the ON position.



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2. Check that the indicator lights of both GFCIs **(b)** are off. Press the **“RESET”** button of the GFCI if its indicator light is ON.
3. Check that the low-level-fault indicator light **(c)** is OFF. If this light is ON, add Heat Transfer Fluid (HTF) to the reservoir. See topic *Filling the HTF Reservoir.*
4. Check that the displays of the temperature controller **(d)** illuminate. If the displays of the temperature controller do not illuminate, there is a problem with the GFCI 1 or with the wiring to the temperature controller. Disconnect the main power supply and rectify the problem before continuing.

Result

The machine is ready for operation.

4.19 Preheating the HTF

NOTICE: Starting the machine with frozen or partially frozen Heat Transfer Fluid (HTF) will permanently damage the pumps. Preheat the HTF when ambient air temperature is below -26°C (-15°F).

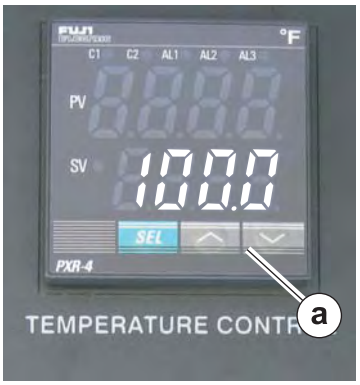
Requirements

- HTF reservoir full
- Machine powered up

Procedure

Follow the procedure below to preheat the HTF.

1. Use the up and down arrows **(a)** on the temperature controller to set the HTF temperature to 100°F (40°C). This is the set point temperature.



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2. Move the burner ON-OFF switch **(b)** to the ON position. The following sequence occurs:
   a. The burner motor starts after a 5-second delay.
   b. The burner fires after a 15-second delay.
   c. The burner will operate, with little or no visible exhaust smoke, until the HTF reaches the set point temperature, at which time, the burner will stop firing.
   d. The burner will re-fire if the set point temperature is increased or the temperature of the HTF falls below 100°F (40°C).

Note: *The temperature of the HTF is displayed* **(b)** *in red.*

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Result

When the temperature controller displays “100.0” **(b)** the HTF is preheated.

4.20 Initiating HTF Flow

Requirements

- Heat Transfer Fluid (HTF) preheated. See topic *Preheating the HTF.*
- Gloves

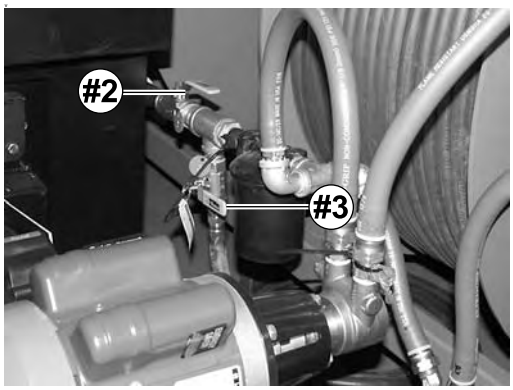
CAUTION
Burn hazard. The hoses and components of the plumbing system may be very hot. Hot hoses and hot plumbing components may cause burns.
▶ Wear gloves when handling hot hoses or hot plumbing components.

Note: *If you are using accessories, see Chapter "Accessories".*

Procedure

Follow the procedure below to initiate HTF flow.

1. Close and lock valve #3. This is the fill valve.



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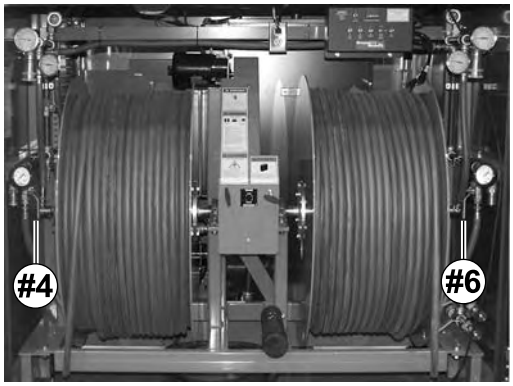
2. Open valve #2. This is the suction valve.
3. Open valve #4 and valve #6. These are the hose reel supply valves.



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4. Move the left pump ON-OFF switch **(d)** to the ON position.

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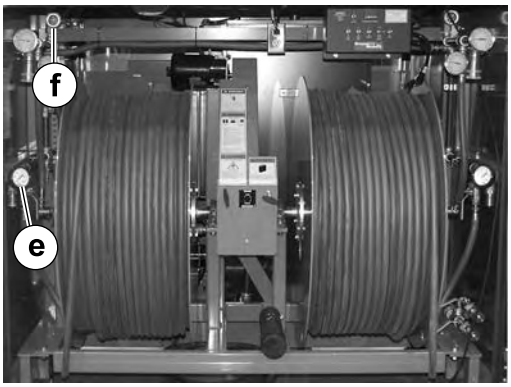

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5. Check the pump pressure gauge **(e)**. The following should occur:
   - During the first minute of operation, the pressure should build to as high as 170 psi.

NOTICE: If the HTF reaches 170 psi (11.7 bar) after only a second or two of operation, there is a problem. Shut down the machine and rectify the problem before continuing.

   - Once flow is established, pressure should be: 125–140 psi (8.6–9.6 bar).
   - When the HTF is warm, operating pressure should be: 90–110 psi (6.2–7.6 bar).

6. Check the HTF flow indicator **(f)**. The flow indicator should be spinning. If it is not, there is a problem. Shut down the machine and rectify the problem before continuing.
7. Repeat steps 4–6 for the right pump.

Result HTF is now flowing.

4.21 Setting the Operating Temperature

Operating temperature

Once the HTF is preheated, set the temperature controller to the operating temperature. Use the chart below as a guide.

Operation type	Recommended Temperature Setting
Ground thawing	80°C (180°F)
Concrete curing	7°C (20°F) above the desired temperature of the concrete
Air heating	80°C (180°F)

4.22 Unwinding and Positioning the Hoses

Requirements

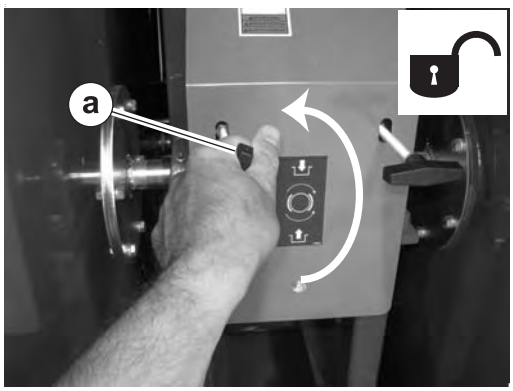
- HTF preheated if applicable
- HTF flow initiated

CAUTION
Burn hazard. The hoses and components of the plumbing system may be very hot. Hot hoses and hot plumbing components may cause burns.
▶ Wear gloves when handling hot hoses and plumbing components.

Procedure

Follow the procedure below to unwind and position the hoses.

1. Rotate the T-handle **(a)** counter-clockwise to unlock it.



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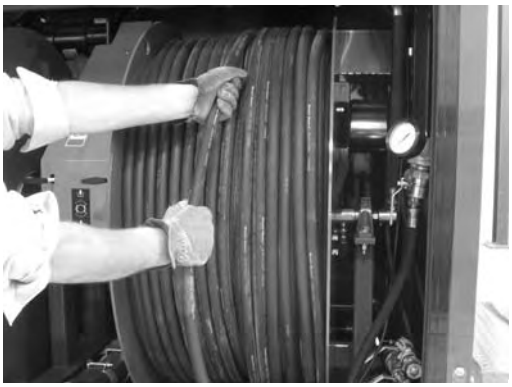
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2. Pull the hose **(b)** off the reel by hand and place it in the application area. See topic *Hose Spacing Guidelines* for hose spacing recommendations based on application.

Result

The hose is now positioned and the machine is operating.

NOTICE: The machine must be periodically monitored during operation to ensure system efficiency. See topic *Monitoring the Operating Parameters*.

4.23 Hose Spacing Guidelines

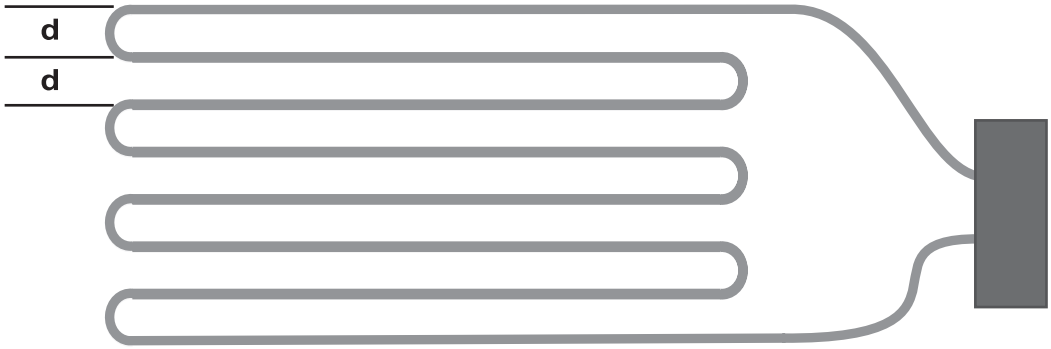
Background

When laying hose in the application area, the space between individual lines of hose significantly affects the progress of the application. Although it is impossible to predict the ambient conditions for each job site, Wacker Neuson Corporation recommends observing the following guidelines to maximize efficiency.

Hose spacing diagram

Refer to the diagram and table below when placing hoses in the application area.

Note: *Adjustments may be necessary to achieve maximum efficiency.*



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Application	Distance (d)	Description
Frost prevention	91.5 cm (36 in.)	Prevents frost in the application area.
Concrete curing	61 cm (24 in.)	Allows concrete to cure.
Excavation thaw	61 cm (24 in.)	Partially thaws the ground for excavation.
Compaction thaw	45.7 cm (18 in.)	Completely thaws the ground for compaction.
Accelerated thaw	30.5 cm (12 in)	Up to 50% faster than compaction thaw.

Note: To increase heat penetration, cover the hoses with a plastic vapor barrier and two layers of insulated blankets. For concrete curing, cover the concrete with plastic, place the hoses on top of the plastic, then cover the hoses with two layers of insulated blankets.

Note: *The hoses may be positioned vertically along concrete framing walls for curing applications. Contact Wacker Neuson Application Support for more information.*

4.24 Monitoring the Operating Parameters

Background Monitor the machine while it is operating to ensure safe and efficient operation.

Parameters Monitor the following parameters every 8–24 hours.

Parameter	Notes
Fuel level	Add fuel as needed.
HTF level	Add HTF as needed.
HTF operating pressure	Operating pressure: 90–110 psi. If operating pressure is higher than 110 psi, check for kinked hoses. If operating pressure is less that 90 psi, check HTF level.
HTF return temperature	The HTF return temperature tells you how much heat is being transferred. It can also tell you when a thawing process is complete, as very little heat will be transferred at that point. Consult Wacker Neuson Product Support for detailed information.
Strobe light	Flashing strobe signifies that all systems are OK.

4.25 Rewinding the Hoses

Requirements

- All accessories off, if applicable
- Machine turned on

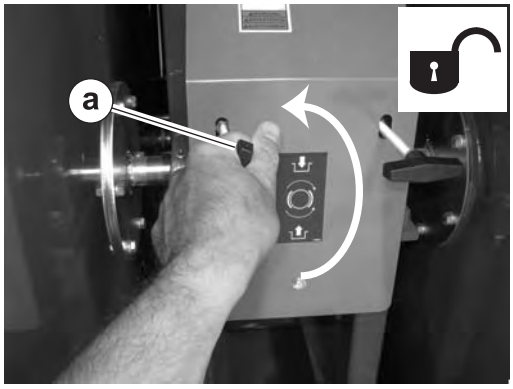
CAUTION
Burn hazard. The hoses and components of the plumbing system may be very hot. Hot hoses and hot plumbing components may cause burns.
▶ Wear gloves when handling hot hoses and plumbing components.

Procedure

Perform the procedure below to rewind the hose.

Note: *Turn the pump ON. Turning the pump on—to circulate warm HTF through the hose—will aid in handling of the hose.*

1. Turn the T-handle **(a)** counterclockwise to unlock the hose reel.



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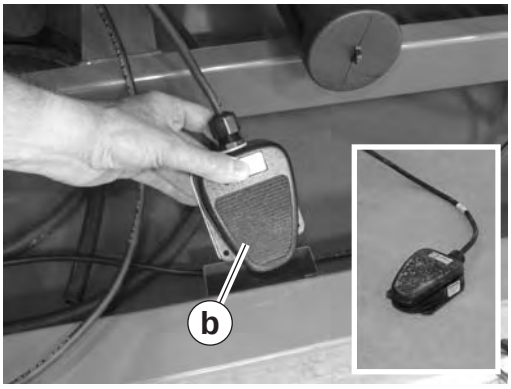

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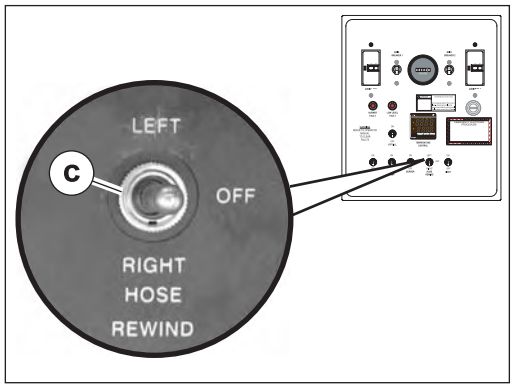
2. Remove the foot pedal **(b)** and place it on a firm, flat, and dry surface.
3. Move the hose rewind ON-OFF switch **(c)** to the RIGHT or LEFT position depending which reel you are working with.

Note: *The rewind motor will start but will not rotate the hose reel until the clutch is engaged.*



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4. Press down on the foot pedal to engage the clutch. The hose reel will rotate.
5. Guide the hose evenly onto the hose reel as it rotates.

This procedure continues on the next page.

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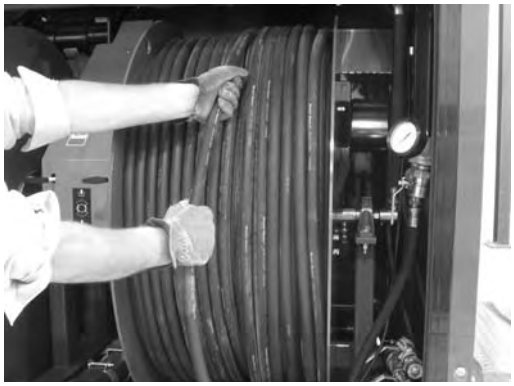
NOTICE: Disengage the clutch before reaching the hose end. Failure to comply may damage the machine.

6. Release the foot pedal to disengage the clutch before reaching the hose end.
7. Manually wind the remainder of the hose onto the reel.



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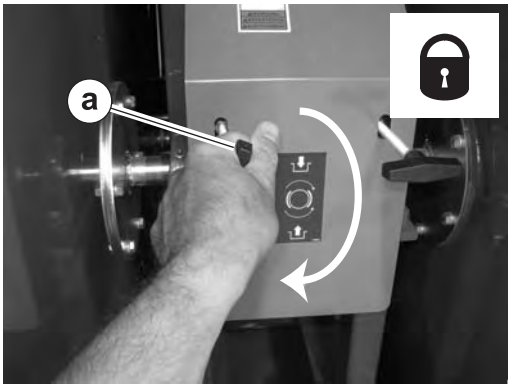

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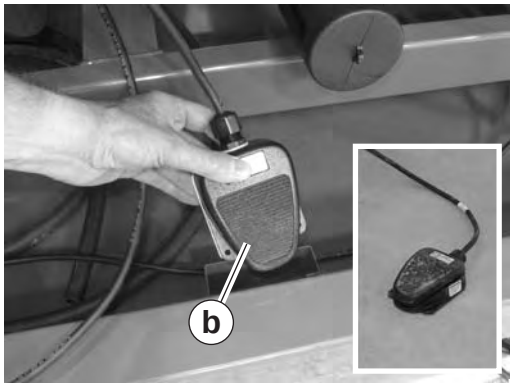
8. Engage the hose reel brake by turning the T-handle **(a)** clockwise.
9. Return the foot pedal **(b)** to its storage location.



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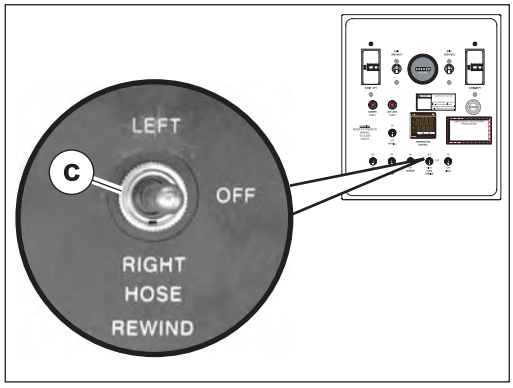

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10. Turn the pump off.
11. Move the hose rewind ON-OFF switch **(c)** to the OFF position.

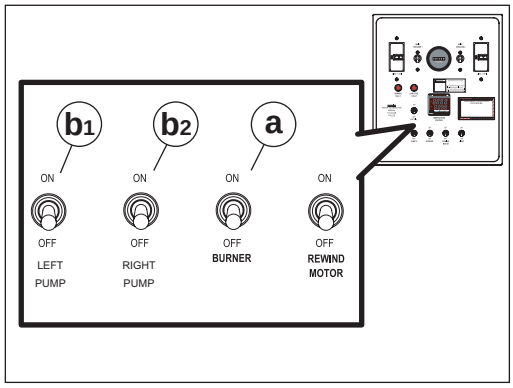
Result The hoses are now wound onto the hose reel and the machine is ready to be shut down. See topic *Shutting Down and Packing Up the Machine.*

4.26 Shutting Down and Packing Up the Machine

Shutting down

Perform the procedure below to shut down the machine.

1. Turn off all accessories if applicable.
2. Rewind the hoses. See topic *Rewinding the Hoses.*
3. Move the burner ON-OFF switch **(a)** to the OFF position.



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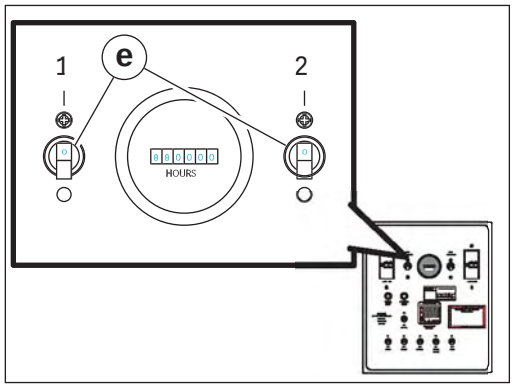
4. Move the pump ON-OFF switches **(b_1 and b_2)** to the OFF position.
5. Move the circuit breaker ON-OFF switches **(e)** to the OFF position.



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The machine is now shut down and ready to be packed up.

Packing up the machine

Perform the following procedure to pack up the machine.

1. Disconnect and store all accessories.
2. Disconnect power from the machine.
3. Close and lock all doors.

Result

The machine is now ready to be stored.

4.27 Resetting a Low HTF Fault

Requirements

- Genuine Wacker Neuson Heat Transfer Fluid, or
- Dowfrost HD 50 Heat Transfer Fluid

NOTICE: Use only factory-recommended Heat Transfer Fluid (HTF). Failure to do so may damage the machine.

Background

The HTF reservoir includes a sensor that will trigger the low-level shut-down device to stop the machine's function if the HTF falls below the minimum operational capacity. During a low HTF level condition the following occurs:

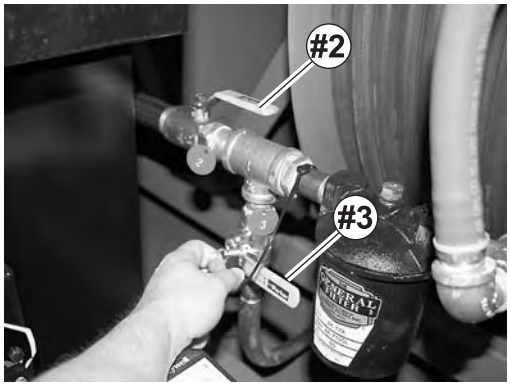
- The control panel low level fault light illuminates
- Power is cut to the burner
- Power is cut to the pumps
- The low-level shut-down device "LOW WATER" light illuminates

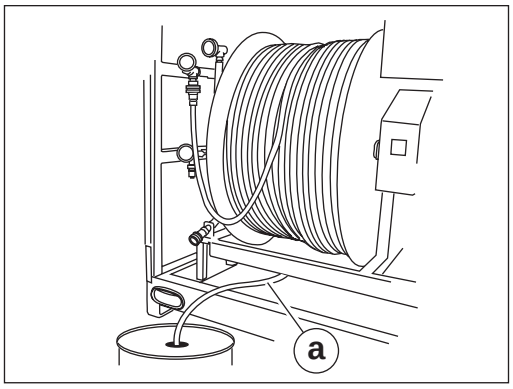
---

Procedure

Follow the procedure below to reset a low HTF fault.

1. Move the burner switch to the OFF position.
2. Move the pump switches to the OFF position.
3. Clean the fill hose.
4. Remove the locking pin, then open valve #3 and close valve #2 simultaneously.





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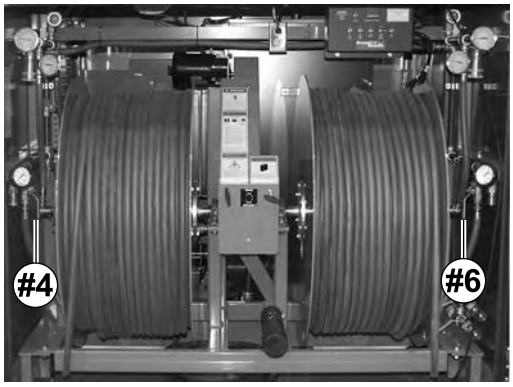
5. Place the open end of the fill hose **(a)** into a container full of HTF.
6. Open valve #6 (right hose reel supply valve).



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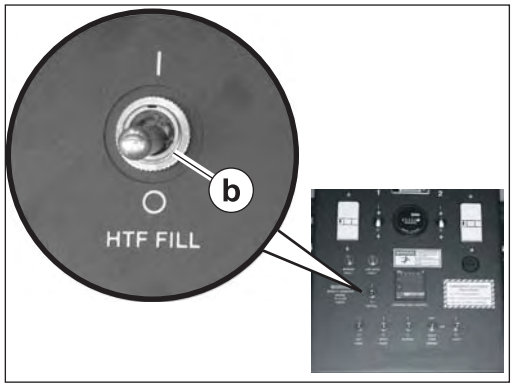
7. Lift and hold the HTF fill switch **(b)** in the ON position (I) and watch the HTF reservoir sightglass **(c)**—release the HTF fill switch when the HTF level is seen in the HTF reservoir sightglass.

NOTICE: Do not overfill the HTF reservoir. Doing so may damage the machine.



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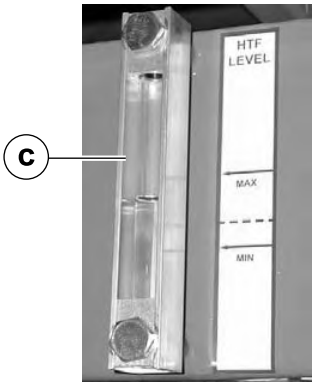

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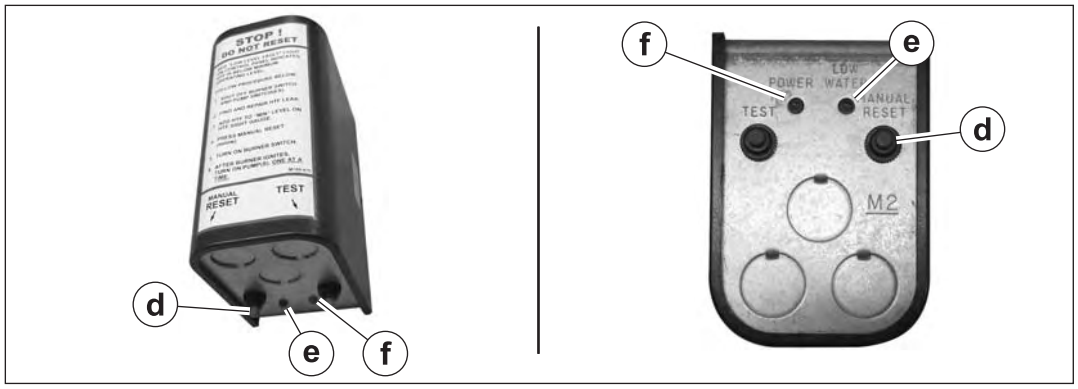
8. Press and release the “RESET” button **(d)** on the low-level shut-down device.



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The following will occur:

- The “POWER” (green) **(f)** and “LOW WATER” (red) **(e)** lights will blink for fifteen seconds while the low-level shut-down device performs a self-diagnostic test.
- After 15 seconds, the “LOW WATER” light will go out—the “POWER” light will stay on.
- The low HTF level indicator will go out.
- Power will be returned to the pumps.
- Power will be returned to the burner.

9. Move the right pump switch to the ON position (I) and continue to fill the HTF reservoir until the HTF level is between the two marks on the HTF reservoir sightglass.

NOTICE: Do not overfill the HTF reservoir. Doing so may damage the machine.

This procedure continues on the next page.

Continued from the previous page.

10. Move valve #3 to the normal position.
11. Remove the fill hose from the HTF container and allow any HTF within the hose to drip back into the container. Cap the fill hose if a cap is provided.
12. Move the fill hose to its storage location under the hose reel.
13. Open valve #2 and close valve #3 simultaneously.

Result

The low HTF level fault has been reset and the HTF reservoir has now been filled.

You may now resume operation of the machine.

4.28 Quick-Connect Coupling Usage and Care

CAUTION
Burn hazard. The hoses and components of the plumbing system may be very hot. Hot hoses and hot plumbing components may cause burns.
▶ Wear gloves when handling hot hoses and hot plumbing components.

Precautions

- Do not join or separate quick-connect couplings when the pressure gauge indicates that the system is pressurized.
- Do not join or separate quick-connect couplings when the HTF temperature is above 48°C (120°F).
- Do not use damaged quick-connect couplings.
- Do not use dirty or contaminated quick-connect couplings.
- Do not lubricate the quick-connect couplings.

Cleaning

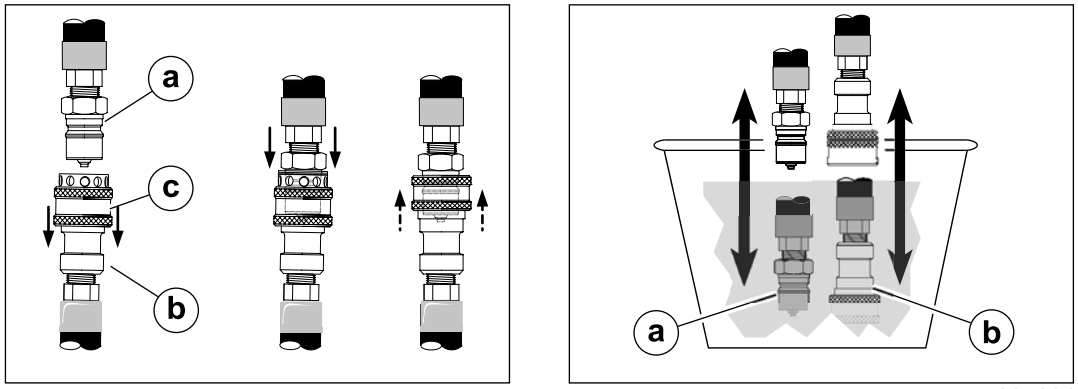
Follow the procedure below to clean the quick-connect couplings. Do so before and after each use.

1. Clean both the male **(a)** and female coupling **(b)** by rinsing each with clean water.
2. When the couplings are clean, inspect seals and gaskets and replace them if necessary.
3. After cleaning the couplings, install caps or protective covers on the couplings to protect them.

Using

Follow the procedures below to use the quick-connect couplings.

1. Pull back and hold the locking collar **(c)** on the female coupling **(b)**.



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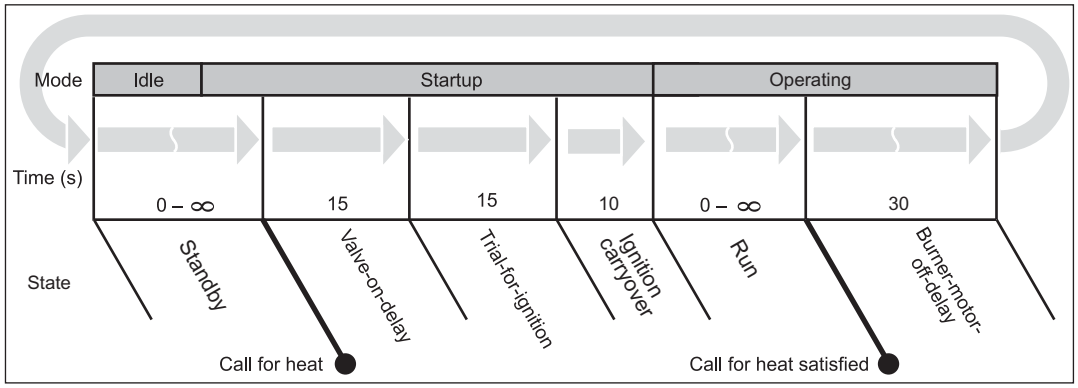
2. Insert the male coupling **(a)** into the female coupling.
3. Release the locking collar. The couplings will lock together.

To release the couplings:

1. Pull back and hold the locking collar **(c)** on the female coupling **(b)**.
2. Pull the male coupling from the female coupling.
3. Release the locking collar.

4.29 Operating States of the Beckett Burner Controller



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Burner states

The burner control has several states that it sequences through during normal operation. These operating states are described below.

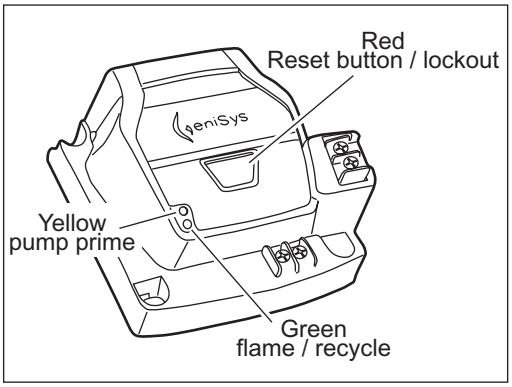
State	Action or Function
Standby	As soon as power is supplied to the burner control, the burner control enters the standby state in which it will remain until there is a call for heat or power is disconnected.
Valve-on delay (pre-time)	When the setpoint of the temperature controller is set to a temperature higher than that of the heat transfer fluid, the output contacts of the temperature controller close, completing a circuit between the two terminals labeled “T” of the burner control. This is the call for heat. The burner control enters the valve-on-delay state. The valve-on-delay state lasts 15 seconds. During this state: ■ Power is sent to the burner motor/fuel pump. ■ Power is sent to the electrodes. ■ If the cad cell detects flame at the end of the valve-on-delay state, the burner control goes into the lockout state.
Trial-for-ignition	The trial-for-ignition state immediately follows the valve-on-delay state. During this state: ■ The fuel shut-off valve is opened (energized). ■ Pressurized fuel atomizes at the burner nozzle. ■ The atomized fuel is ignited by the electrodes. ■ The burner fires and the flame is monitored by the cad cell. ■ If flame is detected, the burner control moves to the ignition carryover state. If flame is not detected within 15 seconds: ■ The burner control enters the lockout state. ■ Power is disconnected from the fuel shut-off valve, electrodes, and the burner motor.

State	Action or Function
Ignition carryover	The ignition carryover state starts as soon as the flame is established. During this state: ■ The fuel shut-off valve is open (energized). ■ Pressurized fuel atomizes at the burner nozzle. ■ The atomized fuel is ignited by the electrodes. ■ The electrodes stay powered for up to 10 seconds after flame is sensed. When the ignition carryover state has elapsed: ■ The ignition transformer is shut off. ■ The burner control enters the run state. If the flame is lost during the ignition carryover state: ■ If the lockout time has not expired, the burner control returns to trial-for-ignition state. ■ If the lockout time has expired, the burner control enters the recycle mode.
Run	The run state starts and continues once the ignition carryover state has elapsed. During this state: ■ The fuel shut-off valve is open (energized). ■ Pressurized fuel atomizes at the burner nozzle. ■ The flame is monitored by the cad cell. When the setpoint is reached (call for heat satisfied), the burner control enters the burner-motor-off delay state. If the flame is lost during the run state: ■ The burner control enters the recycle mode.
Burner-motor-off-delay	The burner-motor-off-delay state starts immediately after the setpoint is reached, i.e., the call for heat has been satisfied. The time of this state is 30 seconds. During this state: ■ The output contacts of the temperature controller open, interrupting the circuit between terminals labeled “T”. ■ The fuel shut-off valve closes (de-energizes). ■ The burner motor runs until the burner-motor-off delay expires, then the burner motor turns off. ■ The burner control returns to the idle mode. If the cad cell detects flame during the burner-motor-off-delay state: ■ The burner control goes into the standby state.

Lockout

The lockout state is described below.

State	Action or Function
Lockout	The burner will enter the lockout state for the following reasons: ■ Trial for ignition time has expired without flame being established. ■ Cad cell detects flame at the end of the valve-on delay state. ■ Recycle time budget expires. ■ Relay check failure. **Note:** The burner control cannot reset by interrupting the voltage. During the lockout state: ■ The burner will not fire. ■ The red reset button / lockout light on the burner control will flash during a soft lockout condition. ■ The reset button / lockout light will remain on continuously during a hard lockout condition. ■ The burner fault light on the control panel will illuminate. To clear the soft lockout fault so a restart can be attempted, press and release the reset button. **Note:** *After the third attempt to manually clear the lockout fault, the burner control will enter the hard lockout mode. To clear the hard lockout, press and hold the reset button for 15 seconds.*



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Recycle

The recycle mode is described below.

State	Action or Function
Recycle	The burner will enter the recycle mode if the flame is lost while the burner is firing. During the recycle mode: ■ The burner control shuts down the burner. ■ The burner control enters a 60-second delay, then repeats the ignition sequence. ■ The green flame / recycle light on the control panel flashes. ■ The burner control attempts to recycle each time the flame is lost, up to three times. If flame is not established after the third time, the burner control enters the hard lockout state. To clear the hard lockout fault so a restart can be attempted, press and hold the reset button for 15 seconds.

Pump prime The pump prime mode is described below.

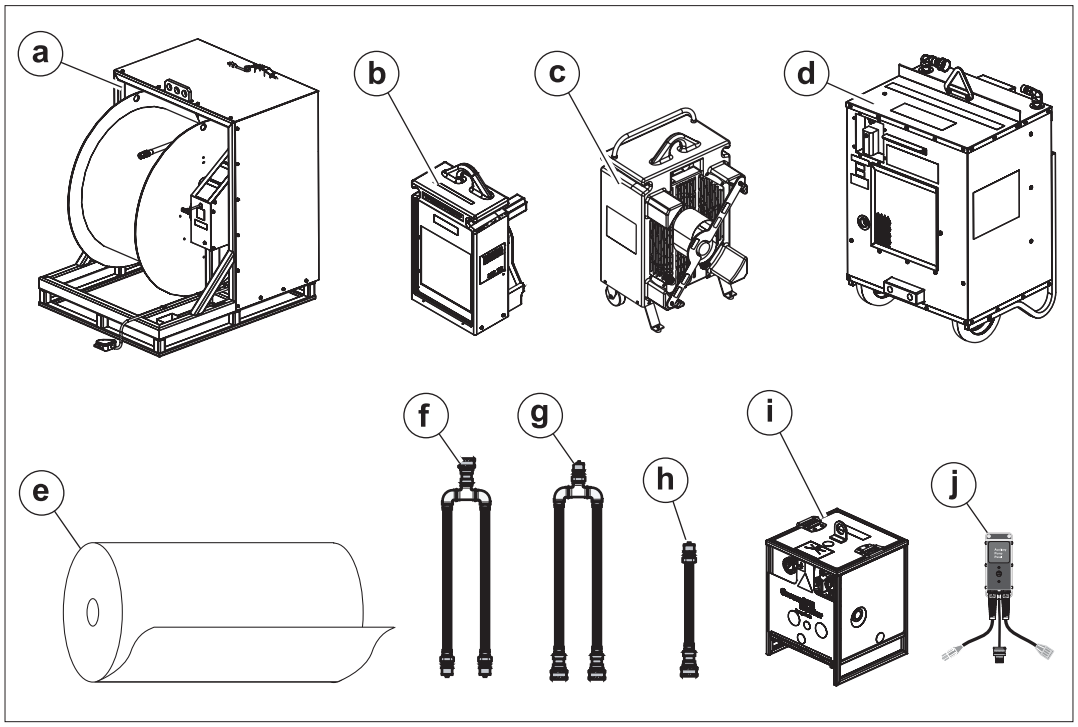
State	Action or Function
Pump prime	During the pump prime mode, the cad cell is disregarded, allowing the technician to prime the pump without having to jumper the cad cell. This mode lasts 4 minutes. During this mode: ■ Power is sent to the burner motor/fuel pump. ■ Power is sent to the electrodes. ■ The cad cell is disregarded. ■ The yellow pump prime light illuminates. To enter the pump prime mode: 1. Prepare the burner for priming. **Do not allow oil to spray into a hot combustion chamber.** ■ Attach a hose over the bleed port fitting. ■ Fully open the pump bleed valve. ■ Use a suitable container to collect the purged oil. 2. Set the temperature controller so there is a call for heat. 3. After the burner starts, press and hold the reset button for 15 seconds until the yellow light turns on, then release the reset button. The yellow light will turn off, the burner control powers down the burner, and the burner will then start up again. At burner startup, press and release the reset button to enter the pump prime mode. The yellow light will turn on. To exit the pump prime mode, do one of the following: ■ Set the temperature controller so there is no longer a call for heat and press the reset button for at least 1 second. The burner control will return to the standby state. ■ Wait four minutes for the pump prime mode to time out. The burner control will return to the standby state. The yellow light will turn off.

Notes

5 Accessories

5.1 Available Accessories

To increase the machine's capabilities and capacities, the following Wacker Neuson accessories are available.



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Ref	Description	Ref.	Description
a	Hose Handling System (HHS3002)	**f**	1-2 Adapter
b	Heat Exchanger (HX 50)	**g**	2-1 Adapter
c	Heat Exchanger (HX 100)	**h**	Accessory hoses (various lengths)
d	Heat Exchanger (HX 200)	**i**	Single (SPP) or Dual Pump Pack (DPP)
e	Insulation blanket	**j**	Auxiliary Pump Panel (APP) (power adapter)

Configurations

These accessories allow the following application configurations:

- Combining your parent machine with Heat XCHANGERS allows it to heat air.
- Combining your parent machine with a DPP and HHS increases the ground heating, thawing, and curing capacities of the parent machine.
- Covering the heat transfer hoses with insulation blankets increases heat retention and penetration.
- The 1–2 and 2–1 adapters and accessory hoses allow the accessories to be properly connected to your parent machine.

For compatibility and configuration information, continue reading.

5.2 Expanding the Surface Heating Capacity

Background

The E 3000 can be combined with Wacker Neuson Hose Handling Systems (HHS 3002) and Dual Pump Packs (DPP) to increase the surface heating capacity. The typical configurations are shown below; however, this does not represent all possible configurations. For more information, contact Wacker Neuson Application Support.

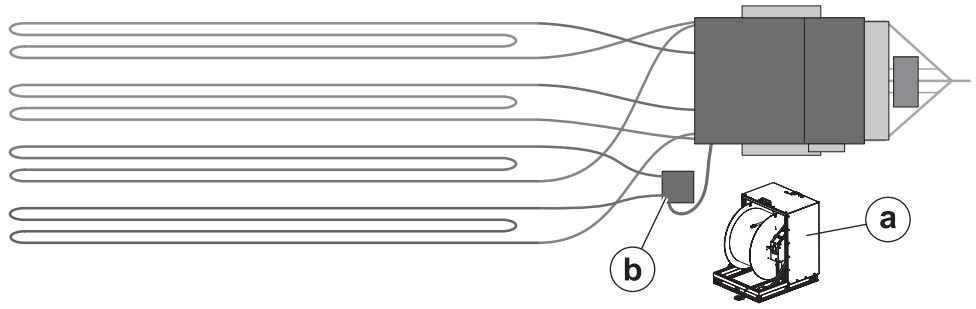
Estimated capacities

The machine is capable of the following when utilizing the expansion configurations illustrated below.

Option Description		**Application**		
		Thaw	**Cure**	**Frost Prevention**
1 1 HHS and 1 DPP	m^2 (ft^2)	550 (6000)	1110 (12,000)	1670 (18,000)
2 2 HHS and 2 DPP	m^2 (ft^2)	Not applicable	1670 (18,000)	2500 (27,000)

Option 1

E 3000 combined with one HHS 3002 **(a)** and one DPP **(b).**



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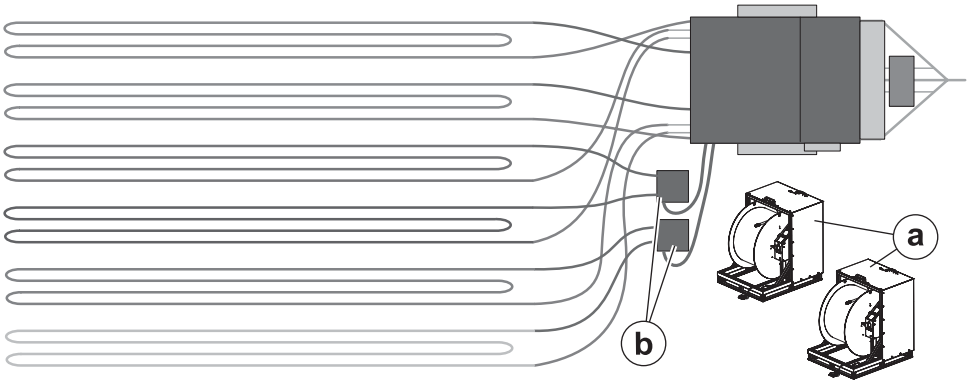
Option 2

E 3000 combined with two HHS 3002's **(a)** and two DPP's **(b).**

Note: *This configuration requires installing an Auxilliary Pump Panel for power protection. See topic "Mounting the Auxiliary Pump Panel."*



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For more information regarding setup of these configurations, continue reading.

5.3 Expanded Operation Using One HHS 3002 and One DPP

Requirements

- Machine stopped
- One HHS 3002 Hose Handling System
- One DPP Dual Pump Pack

Procedure

Perform the procedure below to expand the machine with one Hose Handling System (HHS) and one Dual Pump Pack (DPP).

1. Position the E 3000 near the application area.
2. Position the DPP **(a)** near the application area.
3. Unwind and position the hose **(b)** from the left reel of the E 3000 within the application area.
4. Unwind and position the hose **(c)** from the right reel of the E 3000 within the application area.
5. Unwind and position the hose loop 1 **(d)** from the HHS 3002 **(f)** within the application area.
   a. Connect the male quick-connect to the return port **(g)**.
   b. Connect the female quick-connect to the DPP **(a)**.
6. Unwind and position the hose loop 2 **(e)** from the HHS 3002 **(c)** within the application area. Place the HHS 3002 frame in a safe place.
   a. Connect the male quick-connect to the return port **(h)**.
   b. Connect the female quick-connect to the DPP **(a)**.
7. Connect the leader hose of the DPP to the accessory supply port **(#1)**.
8. Connect the electric cord of the DPP to the Auxiliary Pump Panel. See topic *Mounting the Auxiliary Pump Panel*.

Result

The machine is now ready for expanded operation.

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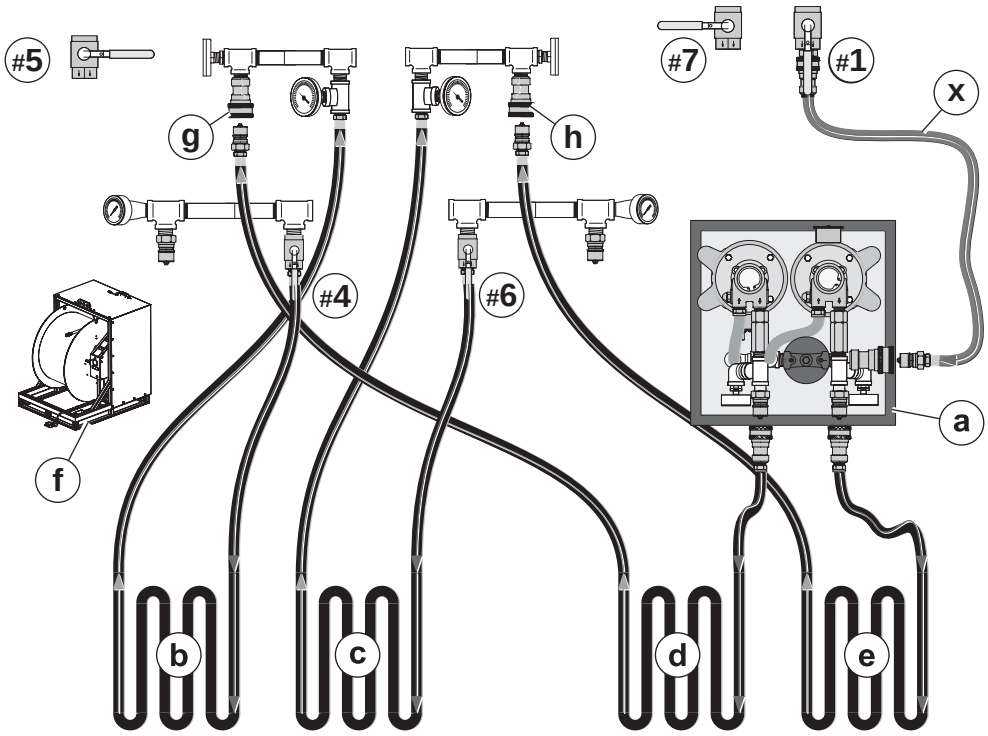

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Ref	Description	Condition
#1	Pump pack supply valve 1	Open after connection
#4	Right HTF supply valve	Open after connection
#5	Cross connect valve	Closed
#6	Left HTF supply valve	Open after connection
#7	Pump pack supply valve 2	Closed (no connections)
a	DPP	Connected to E 3000 and HHS 3002
b	Hose loop from left reel	Placed in application area
c	Hose loop from right reel	Placed in application area
d	HHS 3002 hose loop 1	Placed in application area
e	HHS 3002 hose loop 2	Disconnected from HHS 3002 hose loop 1 and placed in application area
f	HHS 3002 frame	Placed in safe location
g	Return port	Used for HSS 3002 loop 1
h	Return port	Used for HHS 3002 loop 2
x	Leader hose	Used to connect DPP to E 3000

5.4 Expanded Operation Using Two HHS 3002 and Two DPP

Requirements

- Machine stopped
- Two HHS 3002 Hose Handling Systems
- Two DPP Dual Pump Packs
- Two 2-1 adapters

Procedure

Perform the procedure below to expand the machine with two Hose Handling Systems (HHS) and two Dual Pump Packs (DPP).

1. Position the E 3000 near the application area.
2. Position both DPP **(a** and **m)** near the application area.
3. Unwind and position the hose **(b)** from the left reel of the E 3000 within the application area.
4. Unwind and position the hose **(c)** from the right reel of the E 3000 within the application area.
5. Connect one 2-1 adapter **(i)** to return port **(g)**.
6. Connect the other 2-1 adapter **(j)** to return port **(h)**.
7. Unwind and position the hose loop 1 **(d)** from the first HHS 3002 **(f)** within the application area.
   a. Connect the male quick-connect to the 2-1 adapter **(j)**.
   b. Connect the female quick-connect to the DPP **(a)**.
8. Unwind and position the hose loop 2 **(e)** from the HHS 3002 **(f)** within the application area. Place the HHS 3002 frame in a safe place.
   a. Connect the male quick-connect to the 2-1 adapter **(j)**.
   b. Connect the female quick-connect to the DPP **(a)**.
9. Unwind and position the hose loop 1 **(k)** from the second HHS 3002 **(n)** within the application area.
   a. Connect the male quick-connect to the 2-1 adapter **(i)**.
   b. Connect the female quick-connect to the DPP **(m)**.
10. Unwind and position the hose loop 2 **(l)** from the second HHS 3002 **(n)** within the application area. Place the HHS 3002 frame in a safe place.
    a. Connect the male quick-connect to the 2-1 adapter **(i)**.
    b. Connect the female quick-connect to the DPP **(m)**.
11. Connect the leader hose of the DPP **(a)** to the accessory supply port **(#1)**.
12. Connect the leader hose of the DPP **(m)** to the accessory supply port **(#7)**.
13. Connect the electric cord of the first DPP to the Auxiliary Pump Panel. See topic *Mounting the Auxiliary Pump Panel*.
14. Connect the electric cord of the second DPP to the duplex receptacle of the E 3000.

Result

The machine is now ready for expanded operation.

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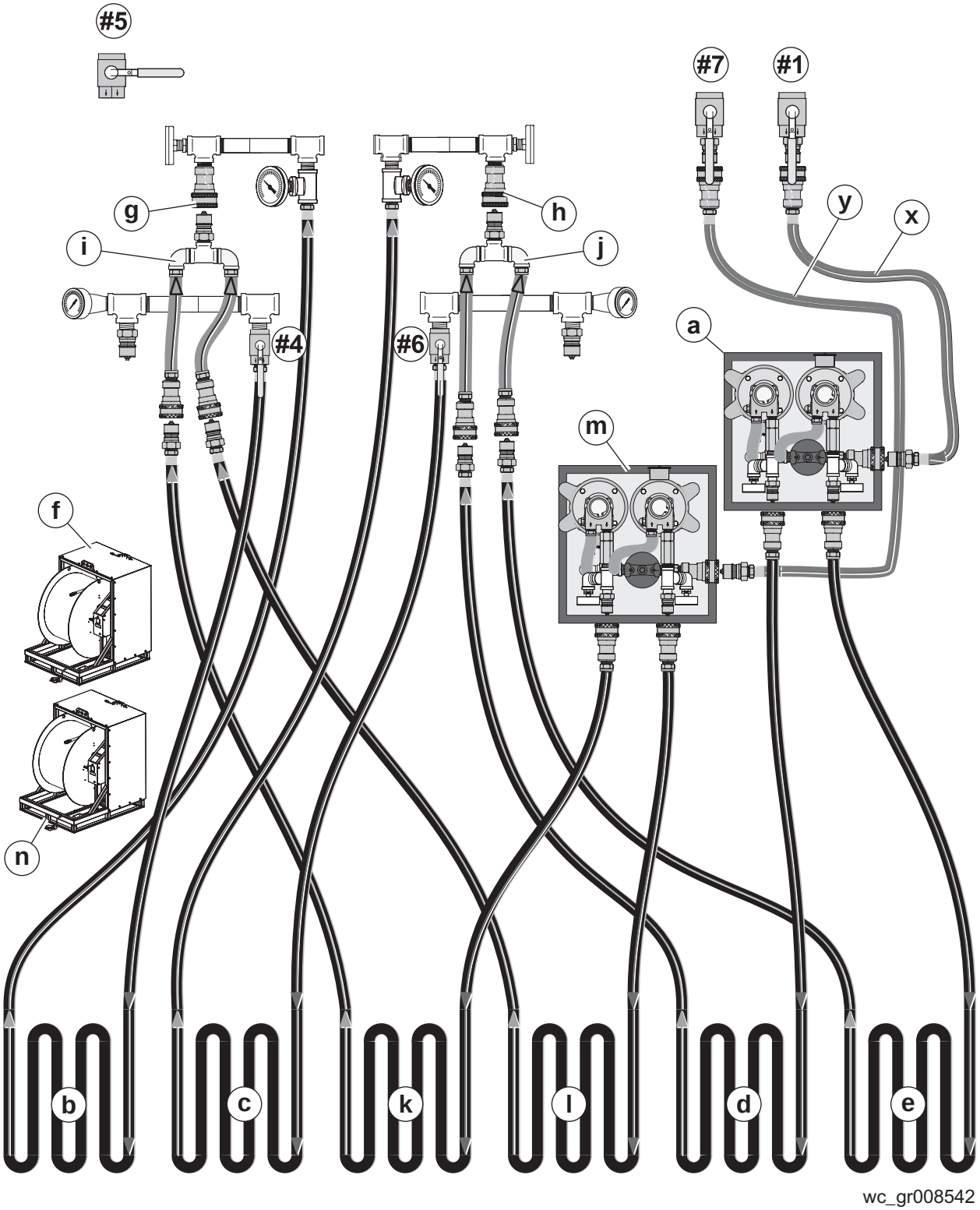

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Ref	Description	Condition
#1	Pump pack supply valve 1	Open after connection
#4	Right HTF supply valve	Open after connection
#5	Cross connect valve	Closed
#6	Left HTF supply valve	Open after connection
#7	Pump pack supply valve 2	Open after connection
a	First DPP	Connected to E 3000 and HHS 3002
b	Hose loop from left reel	Placed in application area
c	Hose loop from right reel	Placed in application area
d	First HHS 3002 hose loop 1	Placed in application area
e	First HHS 3002 hose loop 2	Disconnected from first HHS 3002 hose loop 1 and placed in application area
f	First HHS 3002 frame	Placed in safe location
g	Return port	Used for HSS 3002 loop 1
h	Return port	Used for HHS 3002 loop 2
i / j	2-1 adapter	Connected to return port
k	Second HHS 3002 hose loop 1	Placed in application area
l	Second HHS 3002 hose loop 2	Disconnected from second HHS 3002 hose loop 1 and placed in application area
m	Second DPP	Connected to E 3000 and HHS 3002
n	Second HHS 3002 frame	Placed in safe location
x	First DPP leader hose	Connected to E 3000 and HHS 3002
y	Second DPP leader hose	Connected to E 3000 and HHS 3002

5.5 Mounting and Connecting the Auxiliary Pump Panel

Prerequisites

- Machine shut down
- Power disconnected

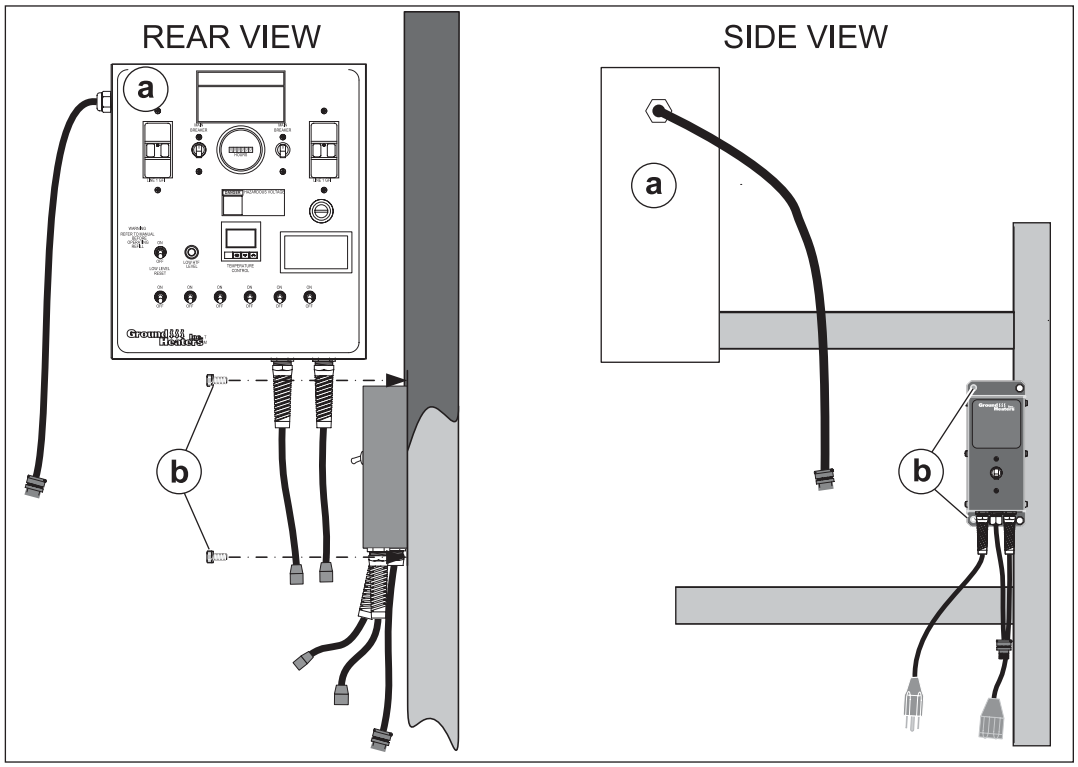
Background

The Wacker Neuson Auxiliary Pump Panel (APP) is an electrical device that communicates with the main machine's systems to provide protection for any additional Pump Packs that are connected to the machine. If the machine experiences a low level fault condition, the APP will cut off power to the external components. This power cut-off protects the pumps from damage.

Guidelines

Follow the guidelines below when mounting the APP. Refer to the diagram below.

- Install inside the machine, near the main control panel **(a)**.
- Install using included hardware **(b)**.



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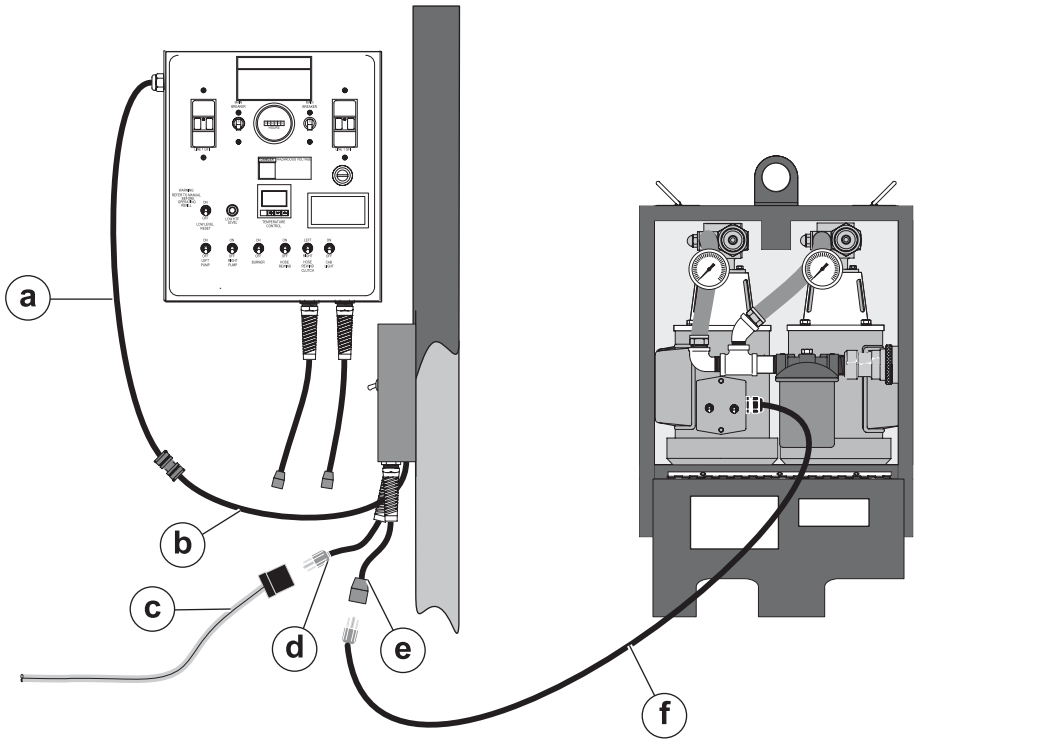
Electrical connections

After mounting, carry out the steps below to complete the electrical connections.

1. Connect the DIN leader **(a)** from the main control panel to the corresponding DIN leader on the APP **(b)**.
2. Connect a properly-rated extension cord **(c)** to the power cord **(d)** on the APP.
3. Connect the Pump Pack power cord **(f)** to the APP power adapter **(e)**.



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Result

The APP is now mounted and connected. Continue with normal operation.

5.6 Using Heat Exchangers to Heat Air

Background

The E 3000 can be combined with Wacker Neuson HX 50, HX 100, or HX 200 Heat Exchangers to convert the heating application from surface to air.

Configuration requirements

In order to connect Heat Exchangers to the machine, additional accessories (Single Pump Packs (SPP), Dual Pump Pack (DPP), or Auxiliary Pump Panel (APP) may be required to support the additional load on the machine's systems. Use the chart below to determine what components may be required.

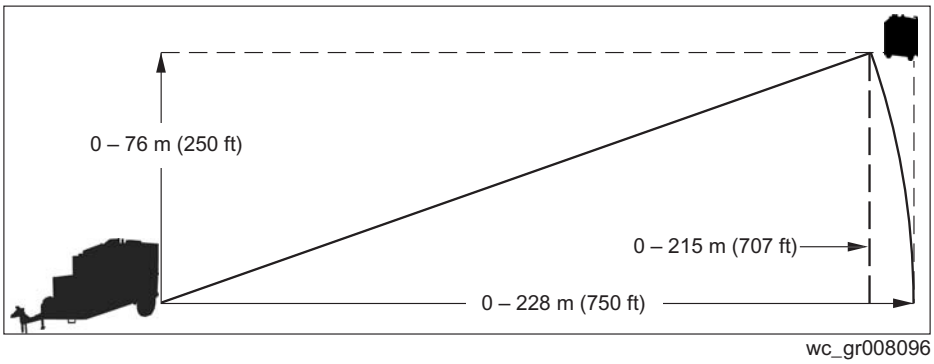
NOTICE: Use care when adding accessories; failure to adhere to these requirements may damage your machine.

Heat Exchanger Model	Qty	Additional components required				
		SPP	DPP	1-2 Adapter	2-1 Adapter	APP
HX 50	1	—	—	—	—	—
	2	—	—	—	—	—
	3	—	—	1	1	—
	4	—	—	1	2	—
	5	1	—	2	3	1
	6	1	—	3	4	1
HX 100	1	—	—	—	—	—
	2	—	—	—	—	—
	3	1	—	1	—	1
HX 200	1	—	—	—	—	—
	2	—	1	—	1	1

Limitations

- Maximum run (horizontal distance from HX to machine): 228 m (750 ft)
- Maximum rise (vertical distance of HX above machine): 76 m (250 ft)
- Maximum run at maximum rise: 215 m (707 ft)

Note: *The farther the HX is positioned from the parent machine, the more heat will be lost through the hose. This may affect HX performance.*



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5.7 Connecting Six HX 50 Heat Exchangers

Requirements

- Six HX 50 Heat Exchangers
- Four 2-1 adapters
- Three 1-2 adapters
- One Single Pump Pack (SPP)
- Auxiliary Pump Pack (APP) (See topic *Mounting the Auxiliary Pump Panel.*)

Connect adapters

Perform the procedure below to connect the Heat Exchanger to the machine.

1. Connect a 2-1 adapter **(x)** to the left return plumbing rack **(LR)**.
2. Connect a 2-1 adapter **(y)** to 2-1 adapter **(x)**.
3. Connect a 1-2 adapter **(z)** to left accessory supply **(LS)**.
4. Connect a 2-1 adapter **(w)** to the right return plumbing rack **(RR)**.
5. Connect a 2-1 adapter **(u)** to 2-1 adapter **(w)**.
6. Connect a 1-2 adapter **(v)** to right accessory supply **(RS)**.

Connect the SPP

1. Position the SPP **(g)** near the machine.
2. Connect hose **(i)** to the supply port of the SPP and to valve #1 of the machine.
3. Connect a 1-2 adapter **(h)** to the outlet port of the SPP.
4. Open valve #1.

Connect the HX hoses

1. Position the Heat Exchangers **(a** thru **f)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
3. Connect Heat Exchanger **(b)** to 1-2 adapter **(z)** and 2-1 adapter **(y)**.
4. Connect Heat Exchanger **(c)** to 1-2 adapter **(v)** and 2-1 adapter **(y)**.
5. Connect Heat Exchanger **(d)** to 1-2 adapter **(v)** and 2-1 adapter **(u)**.
6. Connect Heat Exchanger **(e)** to 1-2 adapter **(h)** and 2-1 adapter **(u)**.
7. Connect Heat Exchanger **(f)** to 1-2 adapter **(h)** and 2-1 adapter **(w)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Connect the SPP power cord to the APP.
4. Open cross-connect valve #5.
5. Close valve #4 and valve #6.

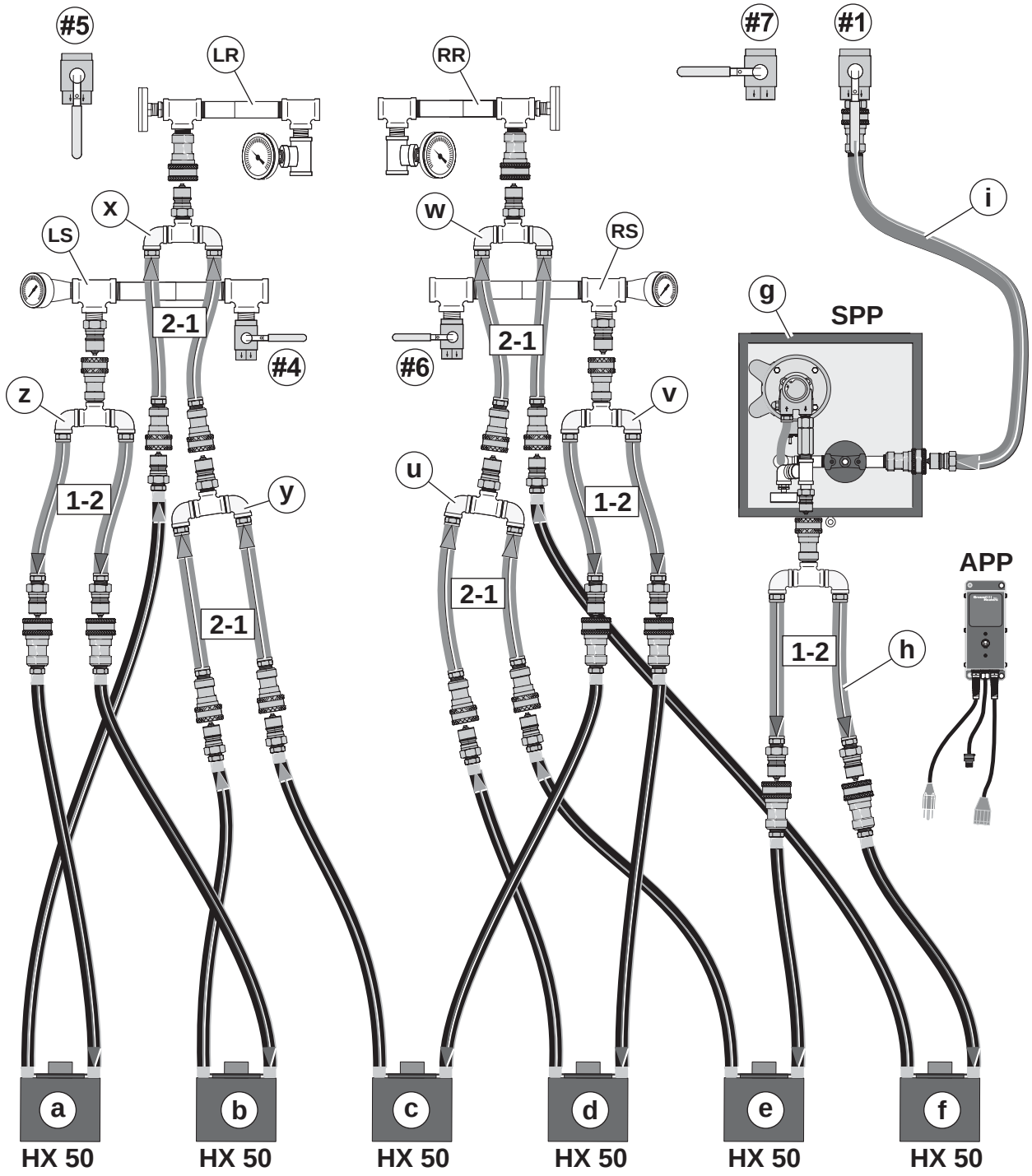
This procedure continues on the next page.

Continued from the previous page.

Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.



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5.8 Connecting Five HX 50 Heat Exchangers

Requirements

- Machine stopped
- Five HX 50 Heat Exchangers
- Three 2-1 adapters
- Two 1-2 adapters
- One Single Pump Pack (SPP)
- Auxiliary Pump Pack (APP) (See topic *Mounting the Auxiliary Pump Panel.*)

Connect adapters

Perform the procedure below to connect the Heat Exchangers to the machine.

1. Connect a 2-1 adapter **(x)** to the left return plumbing rack **(LR)**.
2. Connect a 2-1 adapter **(y)** to 2-1 adapter **(x)**.
3. Connect a 1-2 adapter **(z)** to left accessory supply **(LS)**.
4. Connect a 2-1 adapter **(w)** to the right return plumbing rack **(RR)**.
5. Connect a 1-2 adapter **(v)** to right accessory supply **(RS)**.

Connect the SPP

1. Position the SPP **(g)** near the machine.
2. Connect hose **(i)** to the supply port of the SPP and to valve #1 of the machine.
3. Open valve #1.

Connect the HX hoses

1. Position the Heat Exchangers **(a** thru **e)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
3. Connect Heat Exchanger **(b)** to 1-2 adapter **(z)** and 2-1 adapter **(y)**.
4. Connect Heat Exchanger **(c)** to 1-2 adapter **(v)** and 2-1 adapter **(y)**.
5. Connect Heat Exchanger **(d)** to 1-2 adapter **(v)** and 2-1 adapter **(w)**.
6. Connect Heat Exchanger **(e)** to SPP and 2-1 adapter **(w)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Connect the SPP power cord to the APP.
4. Open cross-connect valve #5.
5. Close valve #4 and valve #6.

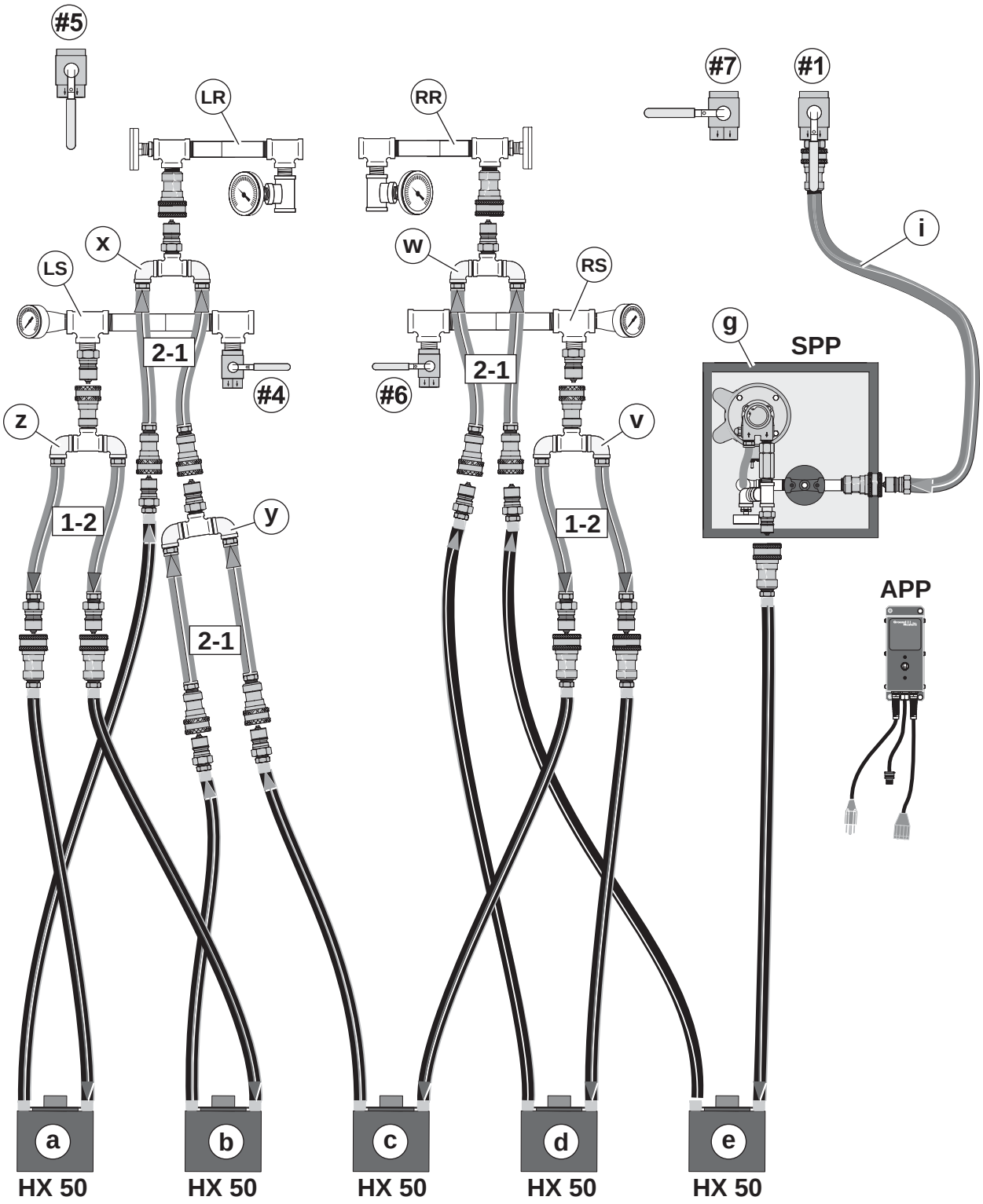
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 80°C.
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.


#5
LR
RR
#7
#1
x
w
i
LS
RS
g
SPP
2-1
2-1
#4
#6
z
v
1-2
1-2
y
APP
2-1
a
b
c
d
e
HX 50
HX 50
HX 50
HX 50
HX 50

wc_gr008557

5.9 Connecting Four HX 50 Heat Exchangers

Requirements

- Machine stopped
- Four HX 50 Heat Exchangers
- Two 2-1 adapters
- Two 1-2 adapters

Connect adapters

Perform the procedure below to connect the Heat Exchangers to the machine.

1. Connect a 2-1 adapter **(x)** to the left return plumbing rack **(LR)**.
2. Connect a 1-2 adapter **(z)** to left accessory supply **(LS)**.
3. Connect a 2-1 adapter **(y)** to the right return plumbing rack **(RR)**.
4. Connect a 1-2 adapter **(v)** to right accessory supply **(RS)**.

Connect the HX hoses

1. Position the Heat Exchangers **(a** thru **d)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
3. Connect Heat Exchanger **(b)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
4. Connect Heat Exchanger **(c)** to 1-2 adapter **(v)** and 2-1 adapter **(y)**.
5. Connect Heat Exchanger **(d)** to 1-2 adapter **(v)** and 2-1 adapter **(y)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Open cross-connect valve #5.
4. Close valve #4 and valve #6.

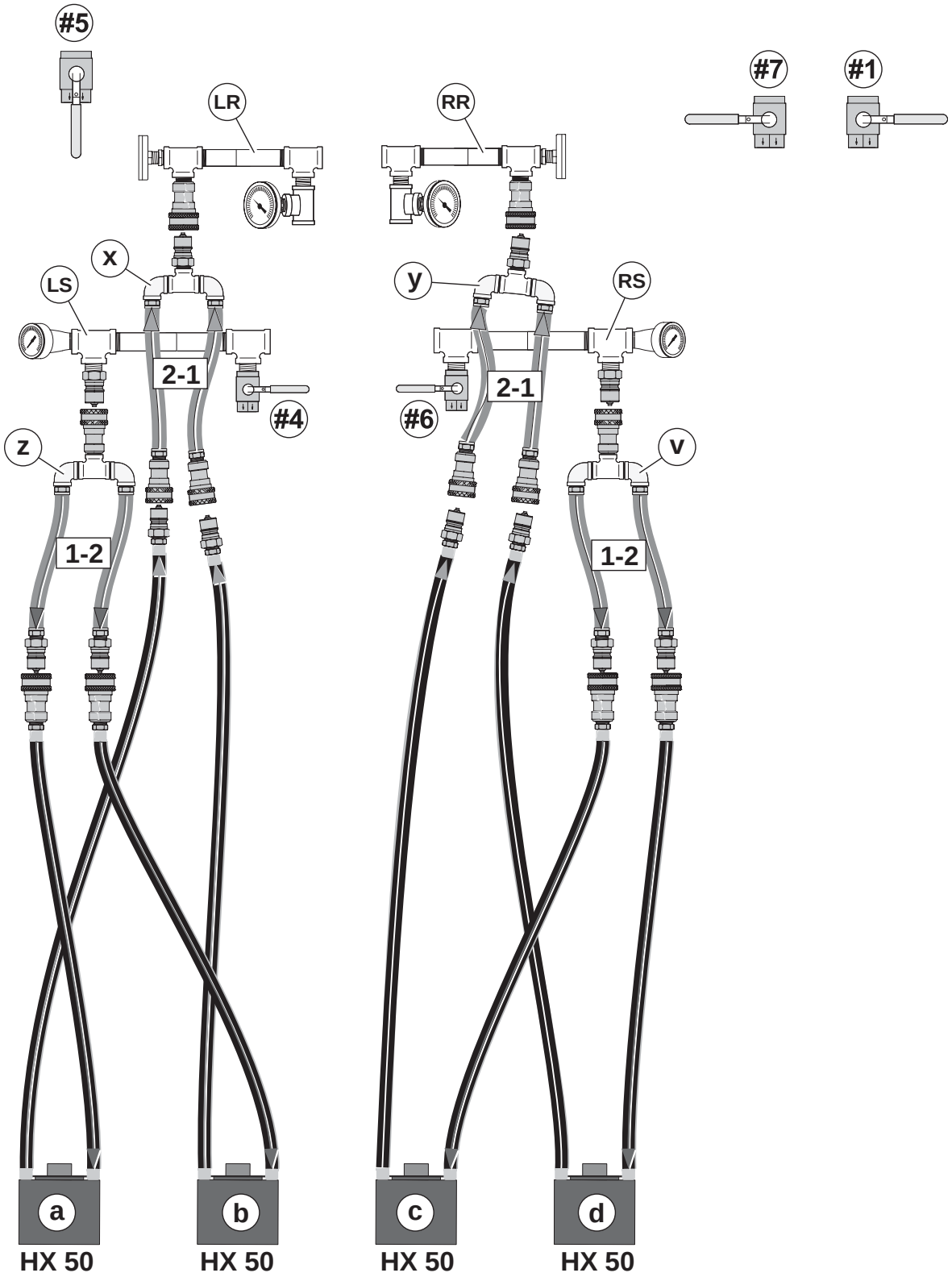
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



wc_gr008558

5.10 Connecting Three HX 50 Heat Exchangers

Requirements

- Machine stopped
- Three HX 50 Heat Exchangers
- One 2-1 adapter
- One1-2 adapter

Connect adapters

Perform the procedure below to connect the Heat Exchangers to the machine.

1. Connect a 2-1 adapter **(x)** to the left return plumbing rack **(LR)**.
2. Connect a 1-2 adapter **(z)** to left accessory supply **(LS)**.

Connect the HX hoses

1. Position the Heat Exchangers **(a** thru **c)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
3. Connect Heat Exchanger **(b)** to 1-2 adapter **(z)** and 2-1 adapter **(x)**.
4. Connect Heat Exchanger **(c)** to right accessory supply **(RS)**.
5. Connect Heat Exchanger **(c)** to return plumbing rack **(RR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Open cross-connect valve #5.
4. Close valve #4 and valve #6.

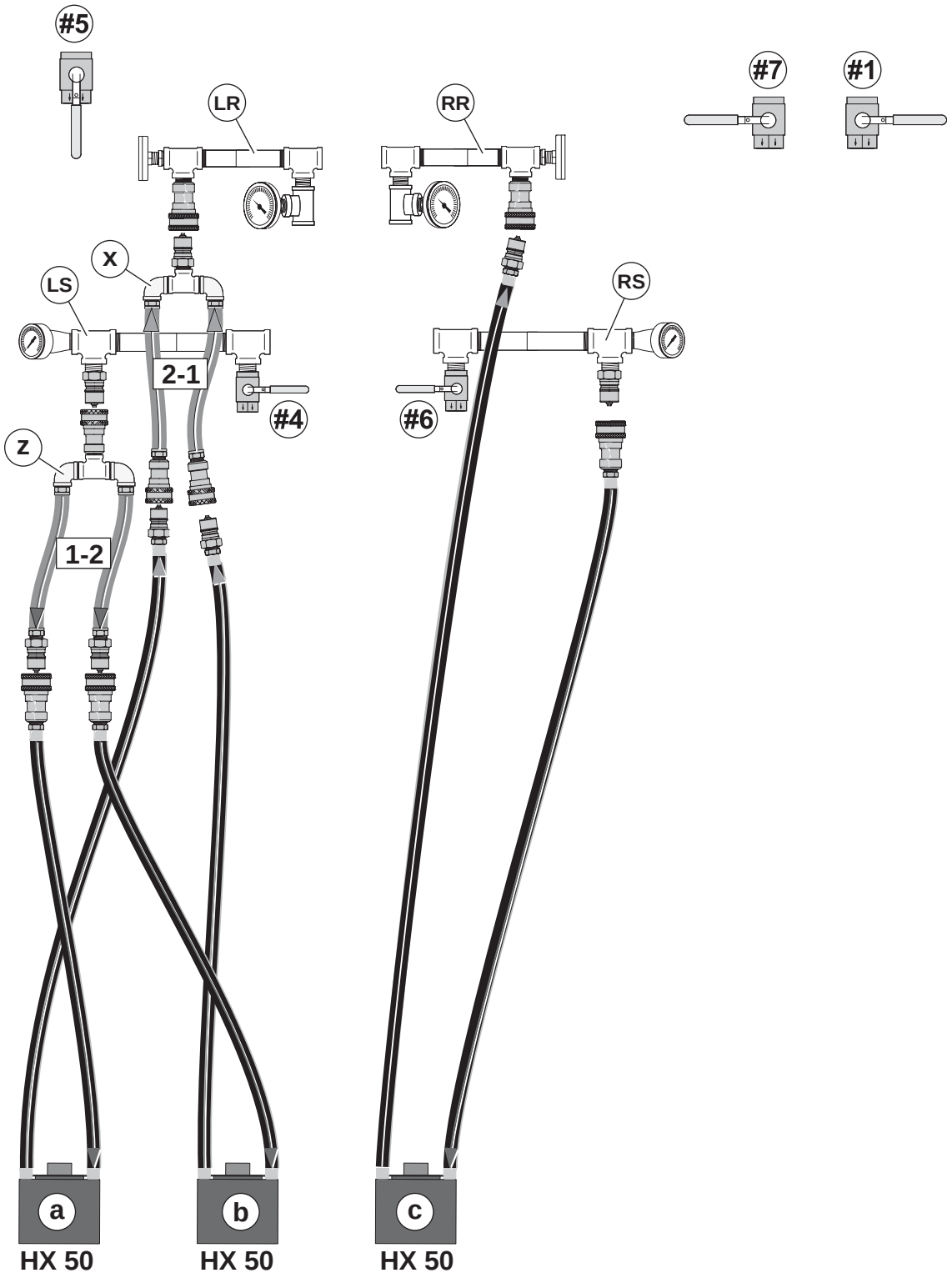
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



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5.11 Connecting Two HX 50 Heat Exchangers

Requirements

- Machine stopped
- Two HX 50 Heat Exchangers

Connect the HX hoses

1. Position the Heat Exchangers **(a** and **b)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.
4. Connect Heat Exchanger **(b)** to right accessory supply **(RS)**.
5. Connect Heat Exchanger **(b)** to return plumbing rack **(RR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Cross-connect valve #5 may be open or closed.
4. Close valve #4 and valve #6.

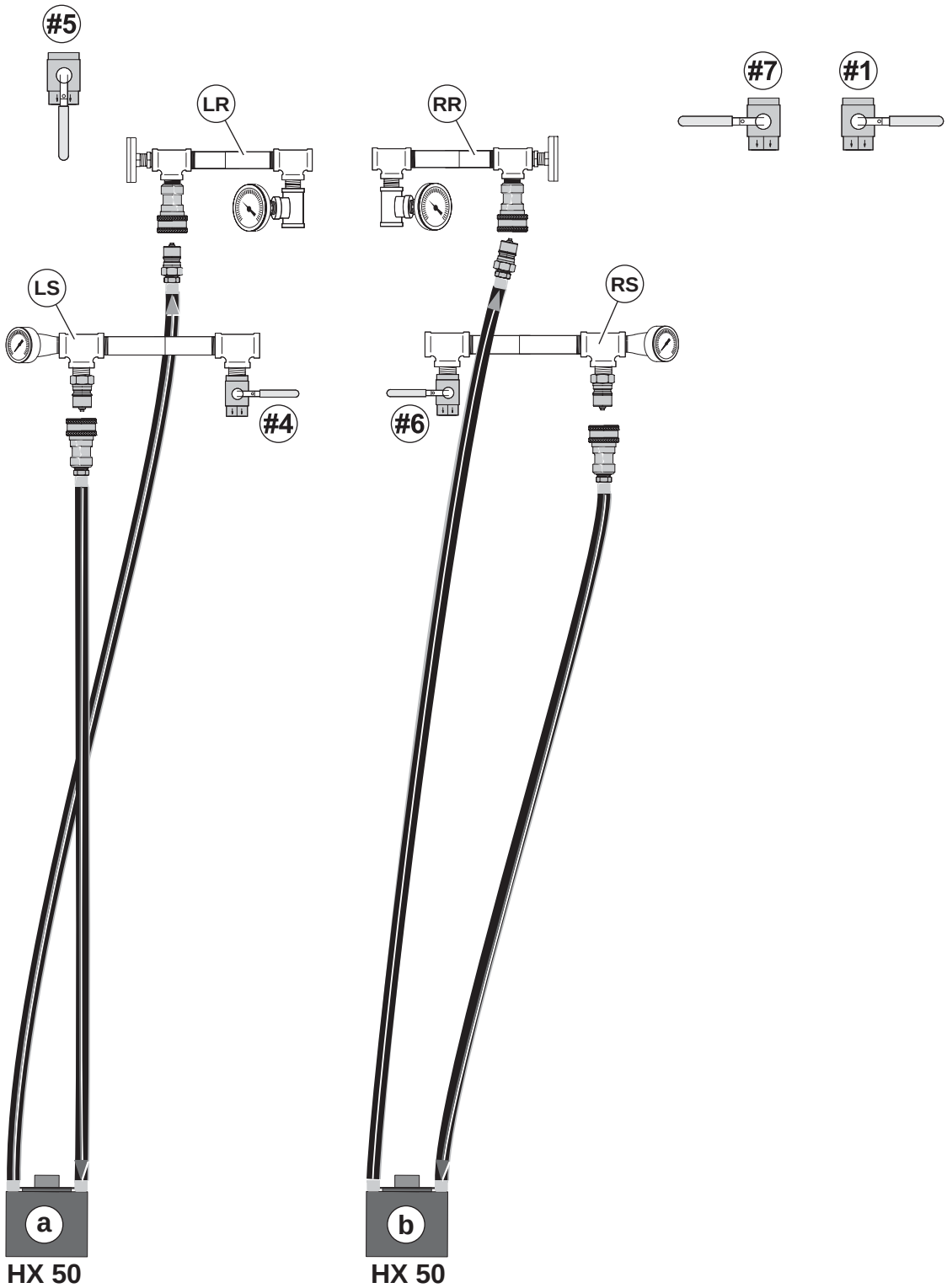
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



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5.12 Connecting One HX 50 Heat Exchanger

Requirements

- Machine stopped
- One HX 50 Heat Exchanger

Connect the HX hoses

1. Position the Heat Exchanger **(a)** within the space to be heated.
2. Connect Heat Exchanger to left accessory supply **(LS)**.
3. Connect Heat Exchanger to return plumbing rack **(LR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchanger to the appropriate electrical source.

NOTICE: Cross-connect valve #5 may be open or closed. If closed, do not turn on the right pump.

3. Close valve #4 and valve #6.

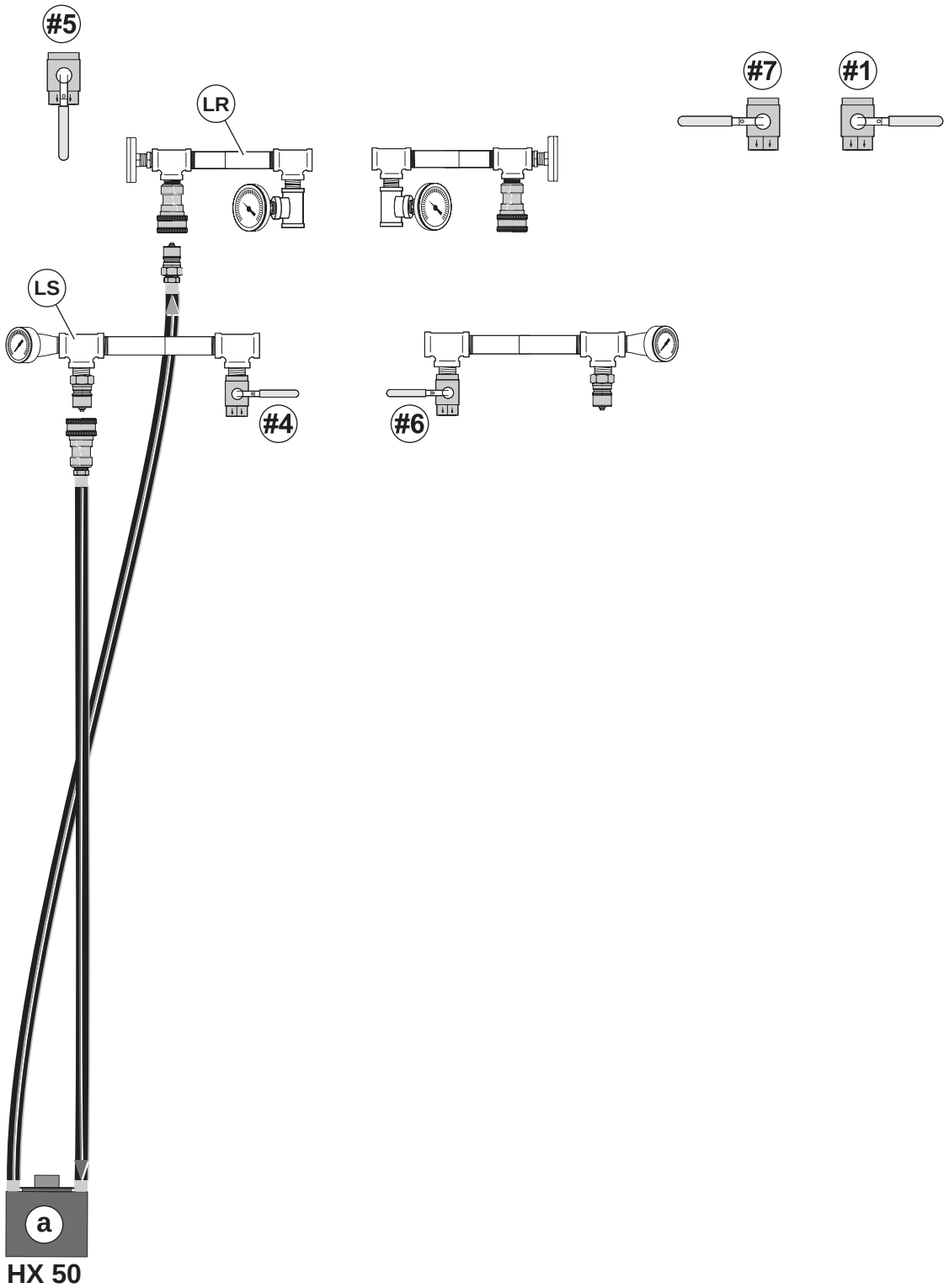
Run the machine

NOTICE: Only start the pump when the Heat Exchanger is connected. Starting the pump when the Heat Exchanger is not connected will cause excess system pressure which may damage the pump.

1. Start the E 3000 (left pump only) and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchanger and adjust the thermostats as desired.

Result

The Heat Exchanger has now been connected and is operating.



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5.13 Connecting Three HX 100 Heat Exchangers

Requirements

- Machine stopped
- Three HX 100 Heat Exchangers
- One 2-1 adapter
- One Single Pump Pack (SPP)
- Auxiliary Pump Pack (APP) (See topic *Mounting the Auxiliary Pump Panel.*)

Connect adapter

Perform the procedure below to connect the Heat Exchangers to the machine.

1. Connect a 2-1 adapter **(y)** to the right return plumbing rack **(RR)**.

Connect the HX hoses

1. Position the Heat Exchangers **(a** thru **c)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.
4. Connect Heat Exchanger **(b)** to 2-1 adapter **(y)** and right accessory supply **(RS)**.
5. Connect Heat Exchanger **(c)** to 2-1 adapter **(y)**.

Connect the SPP

1. Position the SPP near the machine.
2. Connect Heat Exchanger **(c)** to the SPP **(d)**.
3. Connect hose **(e)** to the supply port of the SPP and to valve #1 of the machine.
4. Open valve #1.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Connect the SPP power cord to the APP.
4. Open cross-connect valve #5.
5. Close valve #4 and valve #6.

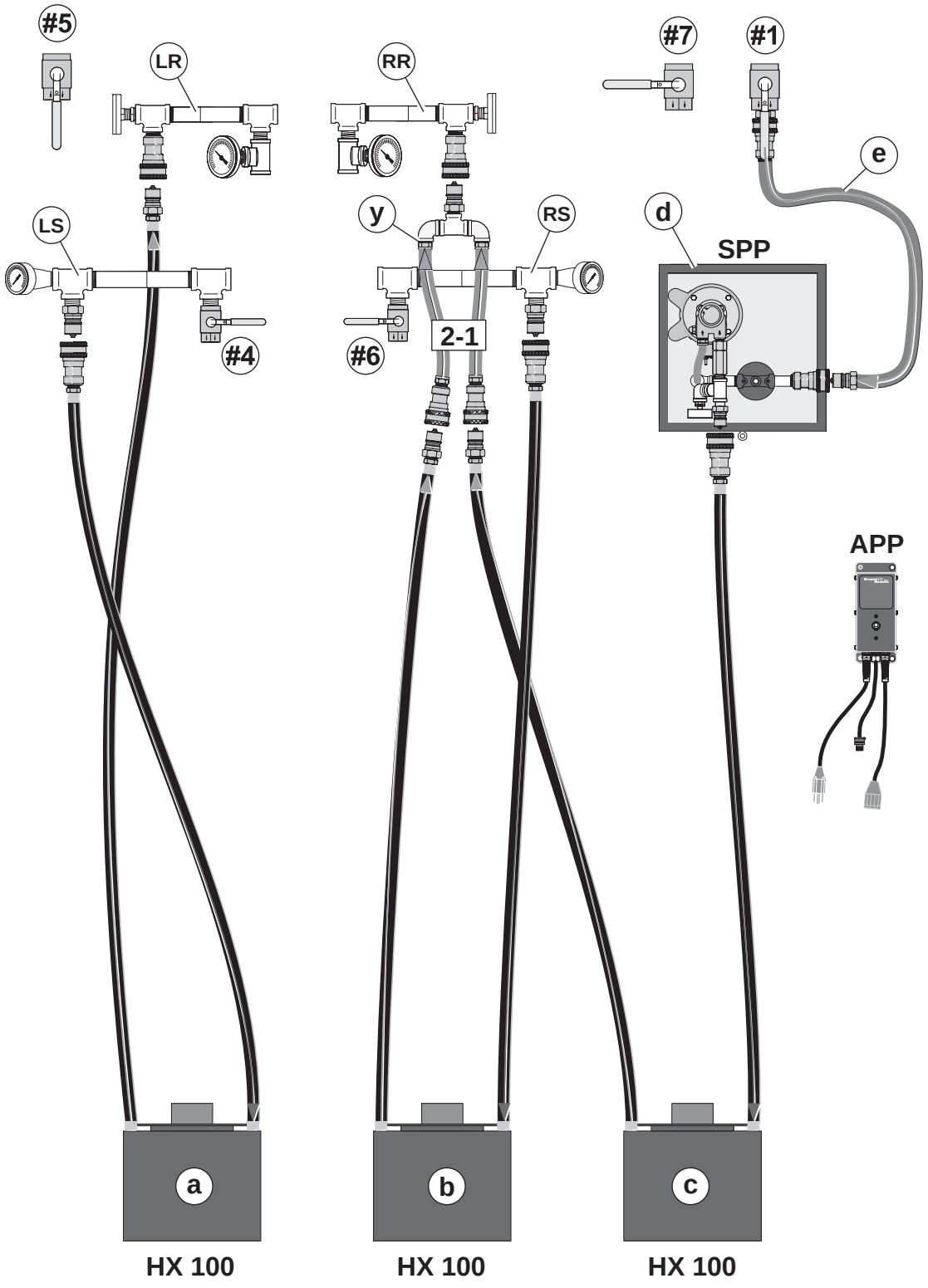
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



wc_gr008580

5.14 Connecting Two HX 100 Heat Exchangers

Requirements

- Machine stopped
- Two HX 100 Heat Exchangers

Connect the HX hoses

1. Position the Heat Exchangers **(a** and **b)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.
4. Connect Heat Exchanger **(b)** right accessory supply **(RS)**.
5. Connect Heat Exchanger **(b)** to return plumbing rack **(RR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Open cross-connect valve #5.
4. Close valve #4 and valve #6.

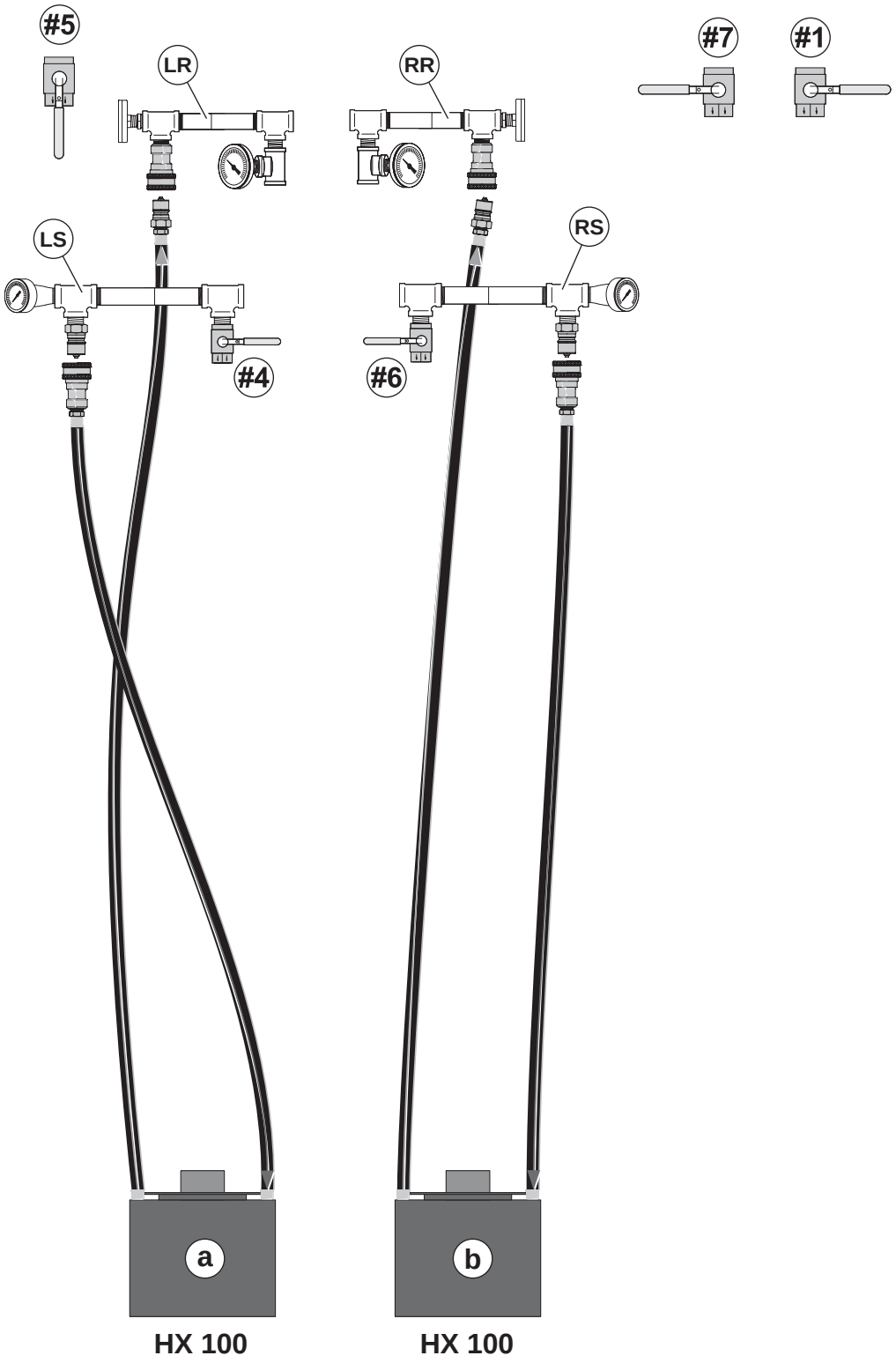
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



wc_gr008582

5.15 Connecting One HX 100 Heat Exchanger

Requirements

- Machine stopped
- One HX 100 Heat Exchangers

Connect the HX hoses

1. Position the Heat Exchanger **(a)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchanger to the appropriate electrical source.

NOTICE: Cross-connect valve #5 may be open or closed. If closed, do not turn on the right pump.

3. Close valve #4 and valve #6.

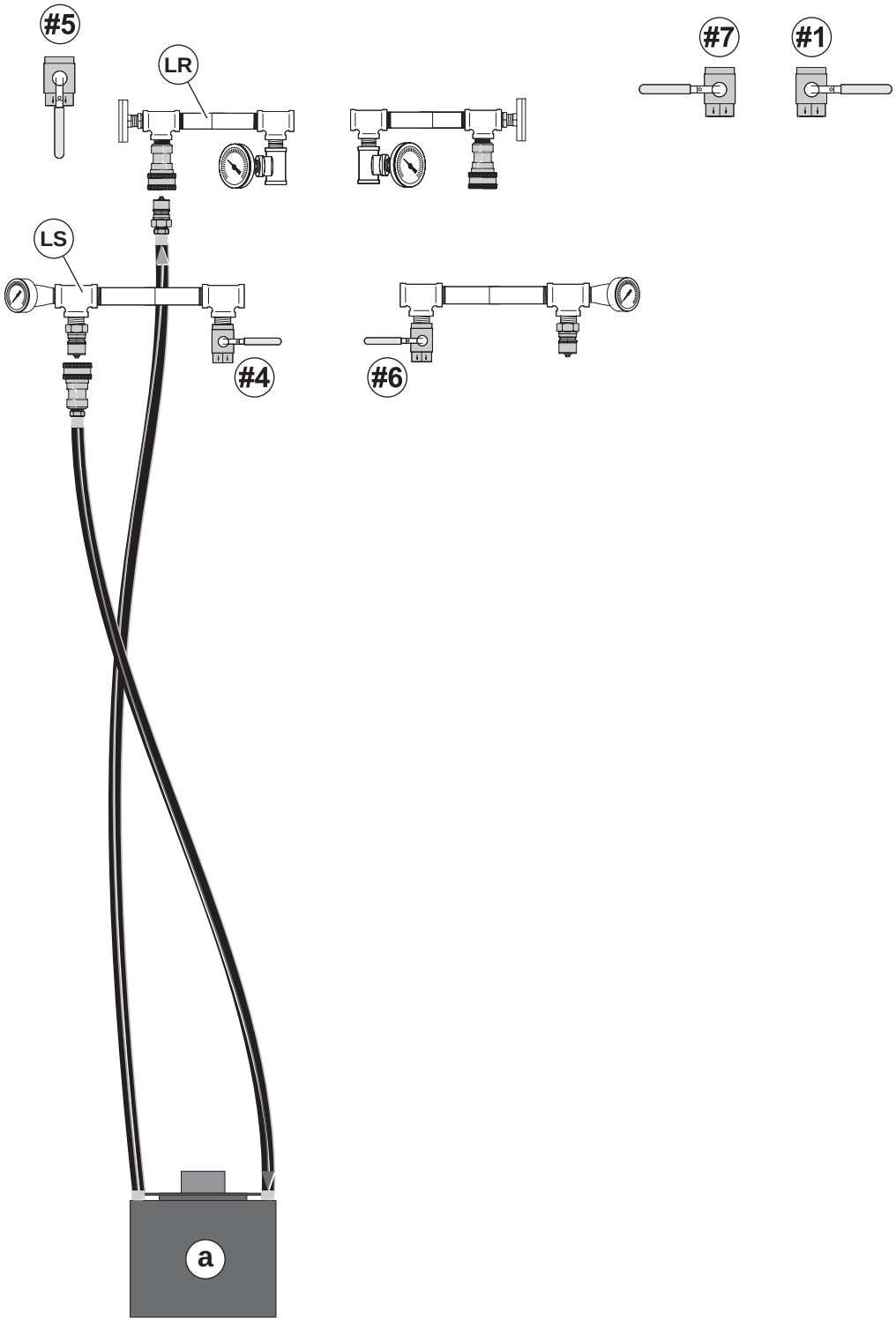
Run the machine

NOTICE: Only start the pump when the Heat Exchanger is connected. Starting the pump when the Heat Exchanger is not connected will cause excess system pressure which may damage the pump.

1. Start the E 3000 (left pump only) and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchanger and adjust its thermostat as desired.

Result

The Heat Exchanger has now been connected and is operating.



HX 100

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5.16 Connecting Two HX 200 Heat Exchangers

Requirements

- Machine stopped
- Two HX 200 Heat Exchangers
- One 2-1 adapter
- One Dual Pump Pack (DPP)
- Auxiliary Pump Pack (APP) (See topic *Mounting the Auxiliary Pump Panel.*)

Connect the HX hoses

1. Position the Heat Exchangers **(a** and **b)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.
4. Connect Heat Exchanger **(b)** to return plumbing rack **(RR)**.
5. Connect Heat Exchanger **(b)** to 2-1 adapter **(c)**.

Connect the DPP

1. Position the DPP near the machine.
2. Connect the 2-1 adapter **(c)** to both outputs of the DPP **(d)**.
3. Connect hose **(e)** to the supply port of the DPP and to valve #1 of the machine.
4. Open valve #1.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Connect the DPP power cord to the APP.
4. Open cross-connect valve #5.
5. Close valve #4 and valve #6.

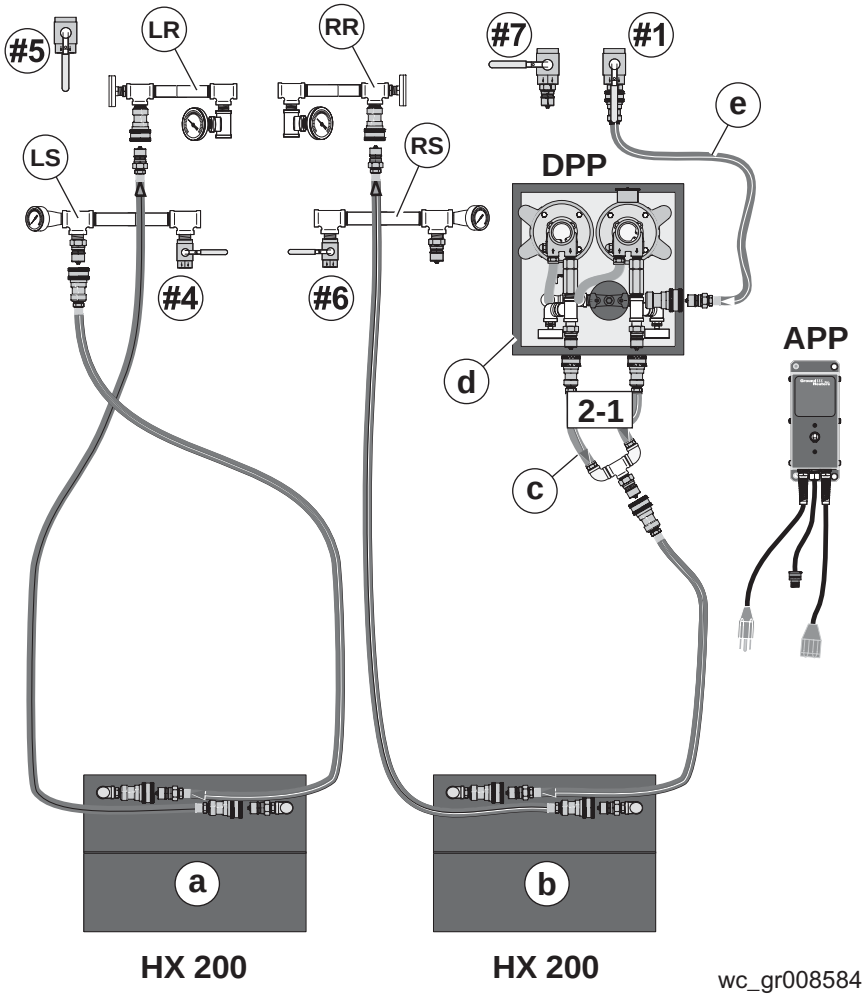
Run the machine

NOTICE: Only start the pumps when the Heat Exchangers are connected. Starting the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.


#5
LR
RR
#7
#1
e
LS
RS
DPP
#4
#6
APP
d
2-1
c
a
b
HX 200
HX 200
wc_gr008584

5.17 Connecting One HX 200 Heat Exchanger

Requirements

- Machine stopped
- One HX 200 Heat Exchanger

Connect the HX hoses

1. Position the Heat Exchangers **(a)** within the space to be heated.
2. Connect Heat Exchanger **(a)** to left accessory supply **(LS)**.
3. Connect Heat Exchanger **(a)** to return plumbing rack **(LR)**.

Complete the installation

1. Insulate the supply and return hoses.
2. Connect the Heat Exchangers to the appropriate electrical source.
3. Connect the DPP power cord to the APP.
4. Open cross-connect valve #5.
5. Close valve #4 and valve #6.

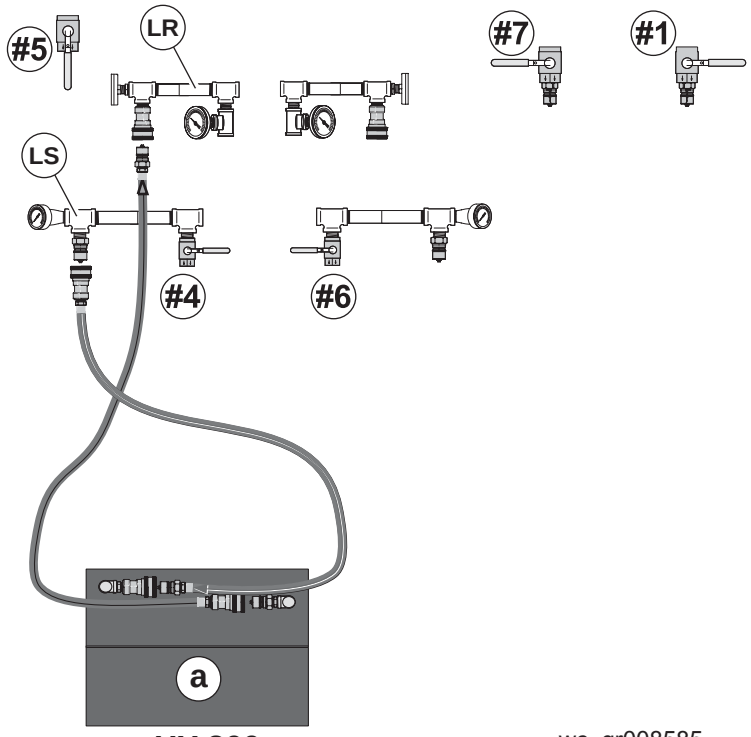
Run the machine

NOTICE: Only turn on the pumps when the Heat Exchangers are connected. Turning on the pumps when the Heat Exchangers are not connected will cause excess system pressure which may damage the pumps.

1. Start the E 3000 and operate it with the temperature controller set to 180°F (80°C).
2. Turn on the Heat Exchangers and adjust the thermostats as desired.

Result

The Heat Exchangers have now been connected and are operating.



HX 200

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6 Burner Setup—Oil

6.1 Factory Settings

Head	Firing rate L/hr (gph)	Nozzle size	Fuel pressure bar (psi)	Air band setting	Air shutter
F220	10.4 (2.75)	2.25 80° B	10.3 (150)	0	6.5

6.2 Setting up the Burner

Background The burner consists of several different components and subsystems. Each of these components or subsystems must be operating correctly for the burner to function properly.

Fuel Low ambient temperatures cause diesel fuels to gel. Gelled fuels will cause burner ignition failure and/or burner fuel pump damage. Always use the proper fuel for the conditions.

Fuel Blend Guide		
Lowest expected ambient temperature °F (°C)	**Generator powered**	**Shore powered**
Below 5 (-15)	50-50 blend of #2 diesel and #1 diesel, plus additives OR 50-50 blend #2 diesel and K1 kerosene, plus additives	100% #1 diesel plus additives OR 100% K1 kerosene, plus additives
5 to 25 (-15 to -4)	70-30 blend of #2 diesel and #1 diesel, plus additives OR 70-30 blend of #2 diesel and K1 kerosene, plus additives	
Above 25 (-4)	Winter-blend diesel	

Tools required The following tools are required to adjust the burner:

- High-quality combustion analyzer
- Smoke spot tester
- Fuel pressure test gauge
- General hand tools

Mandates

- Adjustments must be made so that the machine conforms to the requirements of local, state, and federal codes and authorities.
- Adjustments shall be made at the job site.

This procedure continues on the next page.

Continued from the previous page.

When

Adjust the burner:

- Before operating the machine at elevations 305 m (1,000 ft) above or below the location of the previous adjustments
- Before starting at a new job site
- After any burner maintenance or repair has been performed
- If burner performance is in question

Procedure

Follow the procedure below to set up the burner.

1. Shut down the machine.
2. Set the burner electrodes.
   (See topic *Setting/Checking the Electrodes*.)
3. Check the burner nozzle.
   (See topic *Replacing the Burner Nozzle*.)
4. Check/set the “Z” distance.
   (See topic *Setting the “Z” Distance*.)
5. Set the air settings.
   (See topic *Adjusting the Air Settings*.)
6. Start the machine and the burner.
7. Check/set the fuel pressure.
   (See topic *Adjusting the Fuel Pressure*.)
8. Conduct a smoke spot test. Follow the smoke spot tester manufacturer’s instructions and the general guidelines below.

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- Use the access hole in the exhaust stack.
- Several samples should be taken as the heater warms.
- The final sample should be taken just before the heater reaches 71°C (160°F).

This procedure continues on the next page.

Continued from the previous page.

9. Analyze the combustion. Follow the combustion analyzer manufacturer's instructions and the general guidelines below.

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- Use the access hole in the exhaust stack.
- Take several samples as the heater warms.
- Take the final sample just before the heater reaches 71°C (160°F).

10. Re-adjust the air setting(s) if necessary until the smoke spot test and combustion analysis are within the following parameters:

- O_2 content: 4–6%
- Smoke spot: 1 or less

Result The burner has now been set up.

6.3 Setting/Checking the Electrodes

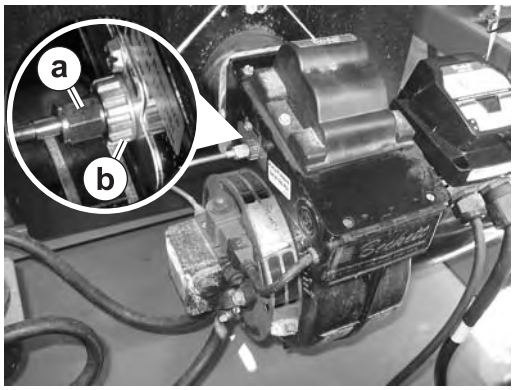
Requirements

- Power supplies disconnected
- Ruler/measuring device

Procedure

Follow the procedure below to check the electrodes.

1. Disconnect the power supplies.
2. Remove the copper fuel line **(a)** between the fuel pump and the burner housing.
3. Remove the spline nut **(b)** that is seated against the escutcheon plate.



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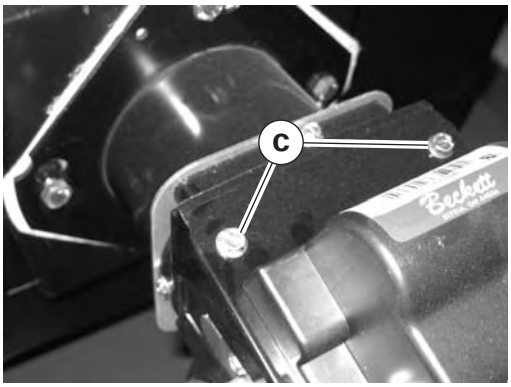

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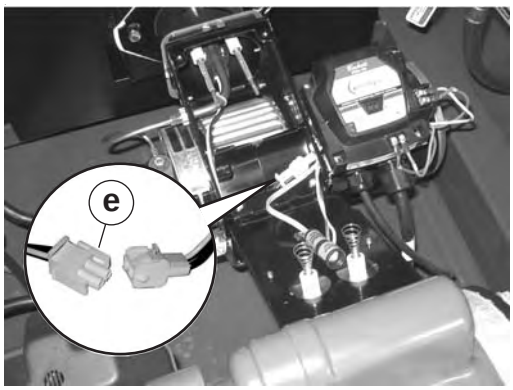
4. Remove screws **(c)** and open igniter cover.
5. Disconnect the wiring **(e)** to the nozzle/electrode assembly.



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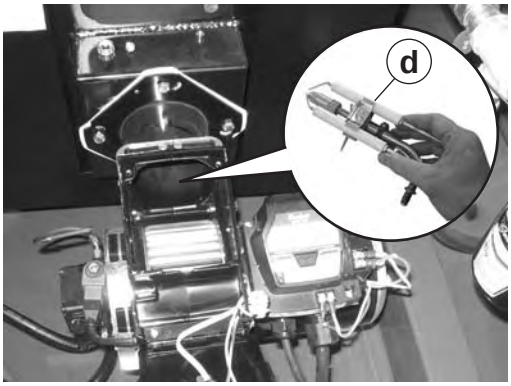

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6. Maneuver the nozzle/electrode assembly **(d)** up and out of the burner.

This procedure continues on the next page.

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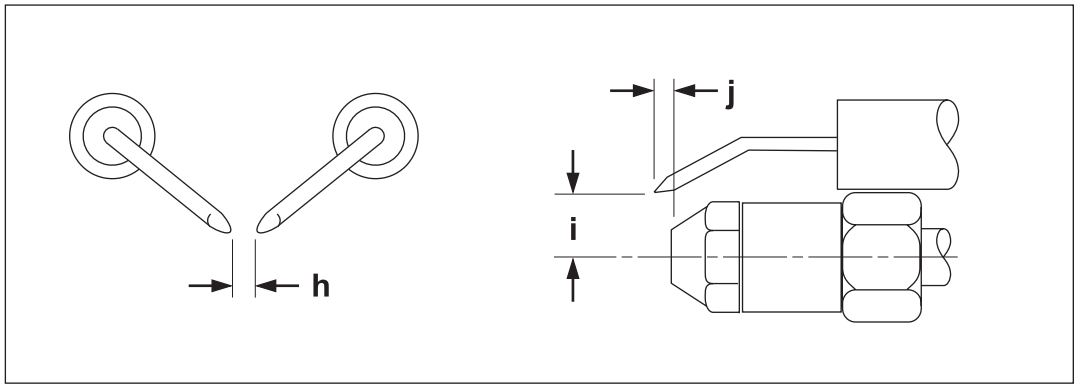
7. Use the measurements below to properly set the electrodes.



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Ref.	Description	Gap distance
h	Electrode tip to electrode tip	5/32 in. (4 mm)
i	Nozzle center to electrode tip	5/16 in. (7.5 mm)
j	Nozzle end to electrode tip end	1/16 in. (1.5 mm)

8. Reconnect the preheater wiring.
9. Reinstall the nozzle assembly into the burner.

Result The electrodes have now been checked/adjusted.

6.4 Replacing the Burner Nozzle

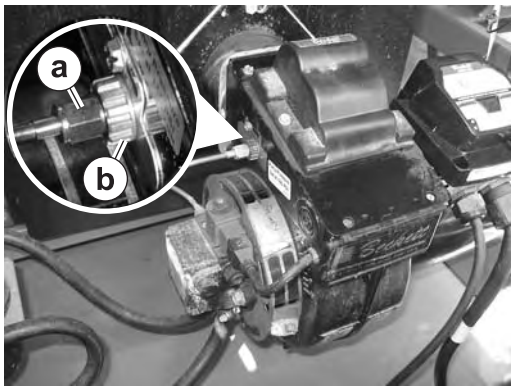
Requirements

- Power supplies disconnected
- Machine cool

Procedure

Follow the procedure below to replace the burner nozzle.

1. Disconnect the power supplies.
2. Remove the copper fuel line **(a)** between the fuel pump and the burner housing.
3. Remove the spline nut **(b)** that is seated against the escutcheon plate.



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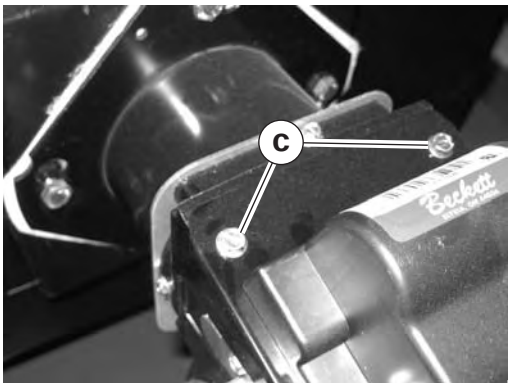

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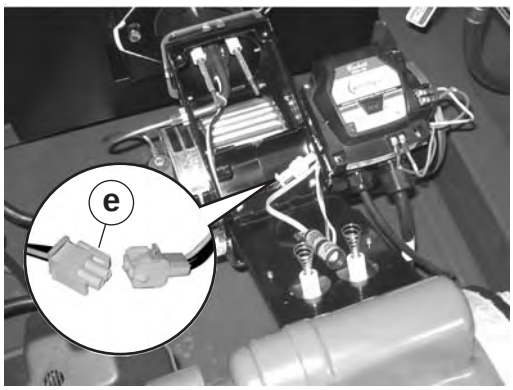
4. Remove screws **(c)** and open igniter cover.
5. Disconnect the wiring **(e)** to the nozzle/electrode assembly.



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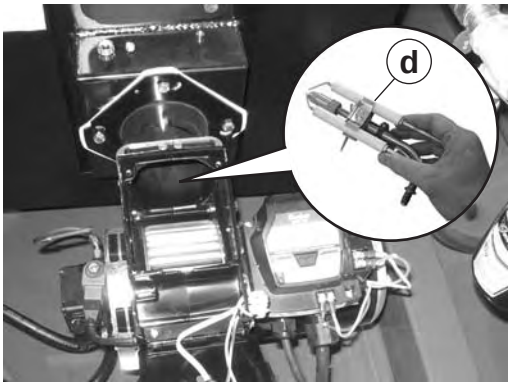

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6. Maneuver the nozzle/electrode assembly **(d)** up and out of the burner.

This procedure continues on the next page.

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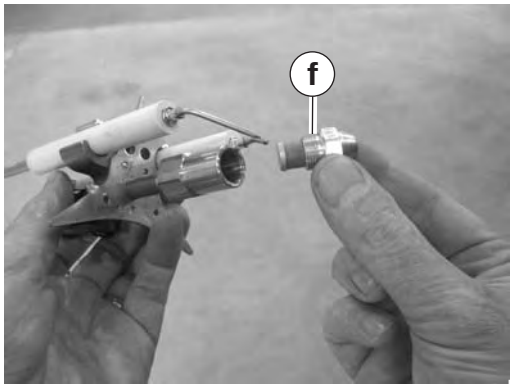
7. Unscrew the burner nozzle **(f)** from the burner tube.



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8. Install a new burner nozzle.

Note: *Do not use thread sealant on the threads of the nozzle.*

9. Reconnect the preheater wiring.

10. Reinstall the nozzle/electrode assembly into the burner.

Result The burner nozzle has now been replaced,

6.5 Setting the “Z” Distance

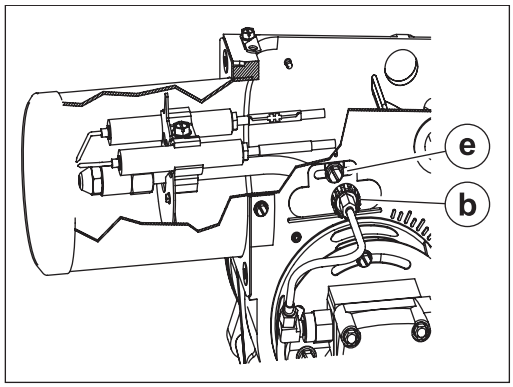
Prerequisites

- Burner removed from the machine
- Beckett T501 gauge

Procedure

Follow the procedure below to set the “Z” distance on F220 heads.

1. Remove the burner from the machine.



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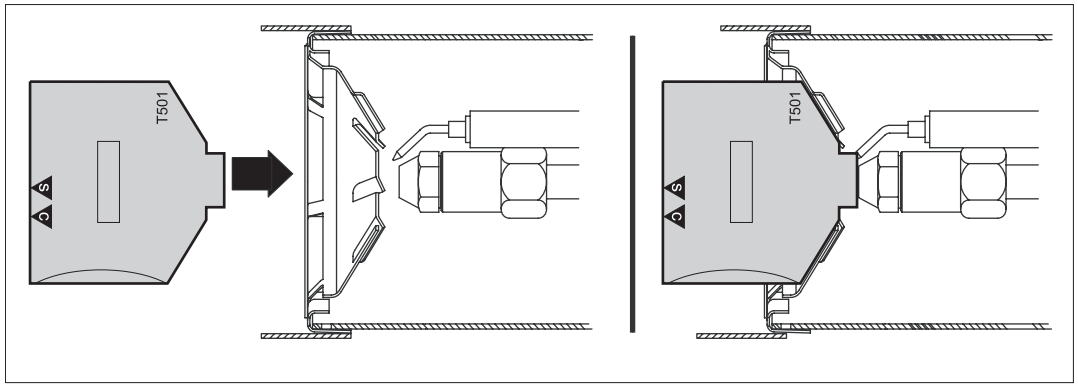
2. Loosen the knurled nut **(b)**.
3. Loosen the position locking screw **(e)**.
4. Set the “Z” distance by using the T501 gauge or by measuring as follows:

Beckett T501 gauge

Using the Beckett T501 gauge.

a. Position the gauge into the flame retention head as shown.



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b. Slide the nozzle assembly so that the front face of the burner nozzle touches the T501 gauge.
c. Tighten the position locking screw.

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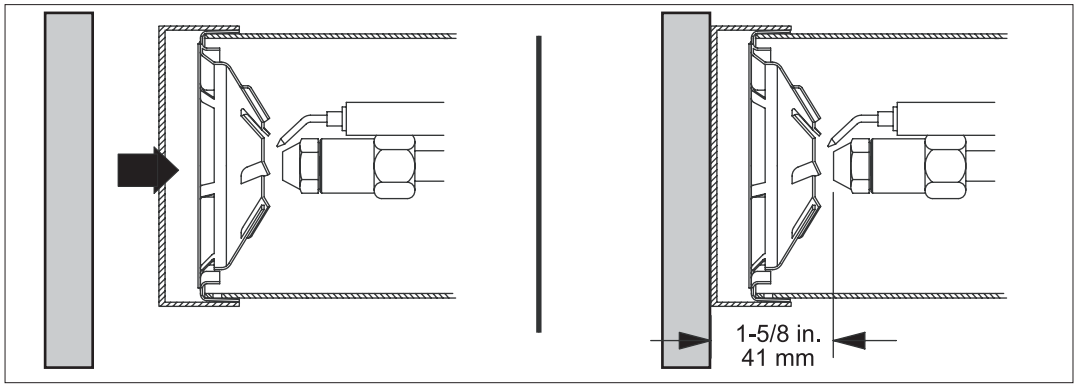
Measuring

Measuring the “Z” distance.

a. Place a straight edge over the end of the flame retention head.



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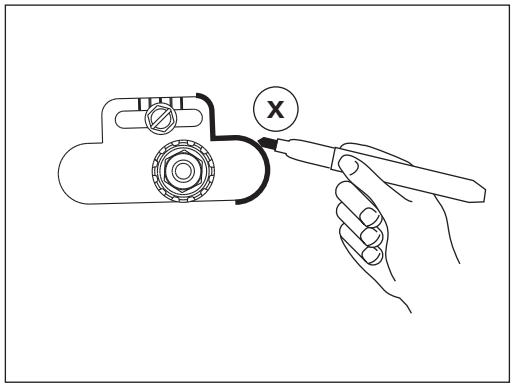
b. Adjust the nozzle assembly until the distance between the front face of the burner nozzle and the end of the flame retention head measures 1-5/8 inches (41 mm). This is the “Z” distance.

c. Tighten the position locking screw **(e)**.

After setting the “Z” distance, complete the procedure.

5. Tighten the knurled nut **(b)**.

6. Mark **(x)** the escutcheon plate for later reference.



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The procedure to set the “Z” distance is now complete.

6.6 Adjusting the Air Settings

Factory settings

- Air band: 0
- Air shutter: 6.5

Note: *These settings are initial settings only. Adjust the air settings as necessary to obtain the proper smoke spot and combustion analysis values.*

Background

There are two parts to adjusting the air setting: 1) air band; and 2) air shutter. Adjust the air band to make large adjustments. Adjust the air shutter to make small adjustments.

Effects

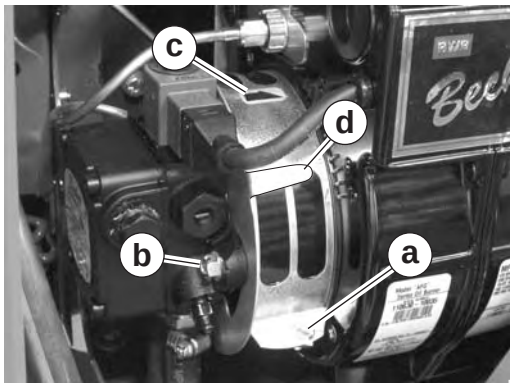
The air setting has the following effects on combustion.

- Higher O_2 percentage (excess air settings) lowers soot production but raises stack temperature and reduces efficiency: lean mixture.
- Lower O_2 percentage (inadequate air settings) increases efficiency and lowers stack temperature but may cause soot build-up: rich mixture.

Procedure

Follow the procedure below to adjust the air settings.

1. Initial setting of the air damper should be performed with the machine shut down.
2. Loosen the air band locking screw **(a)** and the air shutter locking screw **(b)**.



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3. Using the band position pointer **(c)** to determine position, move the air band to a higher number to increase air volume. Turn it to a lower number to decrease air volume.
4. Using the shutter position pointer **(d)** to determine position, move the air shutter to a higher number on the shutter position pointer to increase air volume. Turn it to a lower number to decrease air volume.
5. After the air settings have been made, tighten the band-locking screw **(a)** and the shutter-locking screw **(b)**.

Result

The air settings have now been adjusted.

6.7 Adjusting the Fuel Pressure

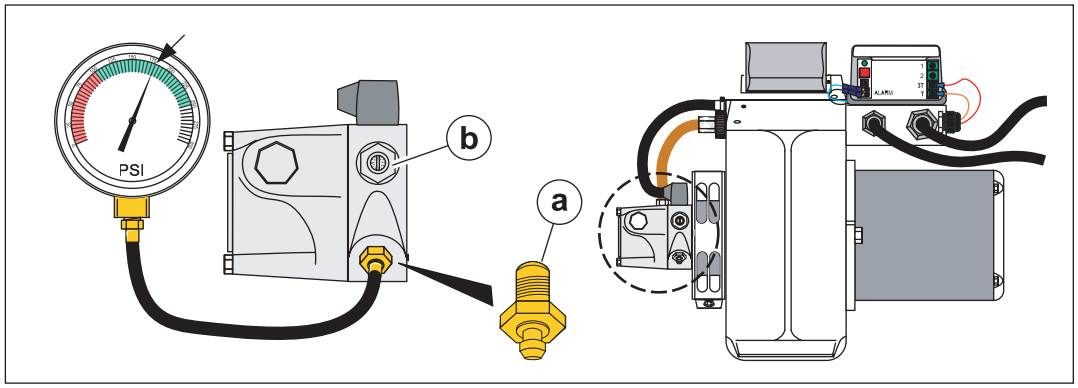
Factory setting

"F" head: 150 psig (10.0 bar)

Procedure

Follow the procedure below to check and adjust the fuel pressure.

1. Shut down the machine.
2. Remove the bleeder valve **(a)** from the fuel pump.



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3. Insert the gauge in place of the bleeder valve.
4. If your machine has a generator, start it.
5. Move the burner ON-OFF switch to ON. The burner will go through a pre-purge cycle. Monitor and make adjustments during the pre-purge cycle.
6. Turn the adjusting screw **(b)** clockwise to increase fuel pressure, counterclockwise to decrease fuel pressure.

Result

The fuel pressure has now been adjusted.

7 Burner Setup—Gas

7.1 Factory Settings

Make sure you have proper certification or licensing required by the locality, state, or province in which the machine is being installed to connect natural gas or LP.

	E 3000	
	NG	LP
Air damper setting	3.8	4.0
Combustion head setting	5.0	5.0
Gas manifold pressure (in. w.c.)	3.1	4.5
Orifice (mm)	2.2	2.2
Diaphragm	C6	C3

7.2 Restrictions for Connecting the Gas Supply

Requirements The technician installing the supply gas shall have proper certification or licensing required by the locality, state, or province in which the machine is being installed to connect natural gas or LP.

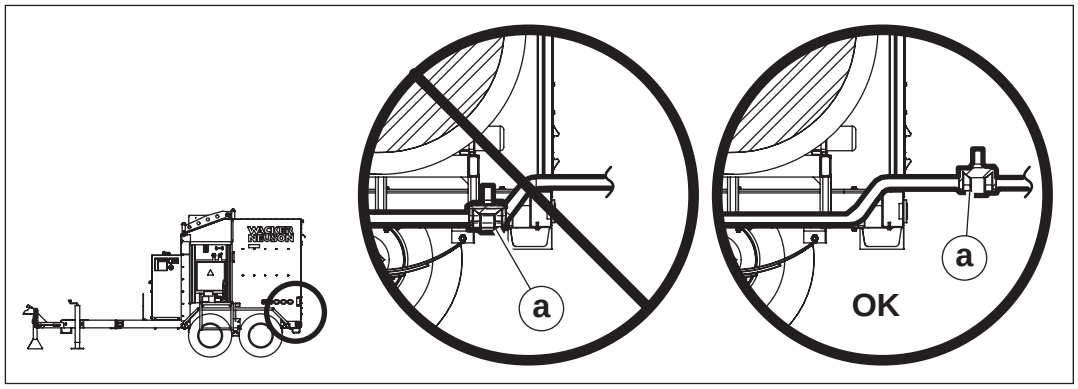
Restrictions

- The supply gas regulator **(a)** shall not be installed inside the machine enclosure.

WARNING
Explosion hazard. Vented gas from the regulator accumulating within the machine enclosure poses an explosion hazard if ignited.

▶ Do not install the supply gas regulator inside the machine enclosure.

- Use only industry-approved hose/piping to connect the gas supply to the machine.



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7.3 Setting up the Burner

Background

The burner consists of several different components and subsystems. Each of these components or subsystems must be operating correctly for the burner to function properly.

Tools required

The following tools are required to adjust the burner:

- High-quality combustion analyzer
- Smoke spot tester
- Manometer
- General hand tools

Mandates

- Adjustments made shall be done so that the machine conforms to the requirements of local, state, and federal codes and authorities.
- Adjustments shall be made at the job site.

When to adjust

Adjust the burner:

- Before operating the machine at elevations 305 m (1,000 ft) above or below the location of where the last adjustments were made
- Before starting at a new job site
- After any burner maintenance or repair has been performed
- If burner performance is in question

Procedure

Follow the procedure below to set up the burner.

1. Shut down the machine.
2. Adjust the ionization probe and the electrode.
   (See topic 7.4)
3. Check the burner orifice.
   (See topic 7.5)
4. Set the air settings.
   (See topic 7.6)
5. Adjust the head setting.
   (See topic 7.7)
6. Check/set the supply gas pressure.
   (See topic 7.8)
7. Start the machine and the burner.
8. Check/set the burner gas pressure.
   (See topic 7.9)

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9. Conduct a smoke spot test. Follow the smoke spot tester manufacturer's instructions and the general guidelines below.

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- Use the access hole in the exhaust outlet.
- Take several samples as the heater warms.
- Take the final sample just before the heater reaches 71°C (160°F).

10. Analyze the combustion. Follow the combustion analyzer manufacturer's instructions and the general guidelines below.

ghi_gr006183

- Use the access hole in the exhaust outlet.
- Take several samples as the heater warms.
- Take the final sample just before the heater reaches 71°C (160°F).

11. Re-adjust the air setting(s) if necessary until the smoke spot test and combustion analysis are within the following parameters:
- O_2 content: 4–6%
- Smoke spot: 1 or less

Result The burner has now been set up.

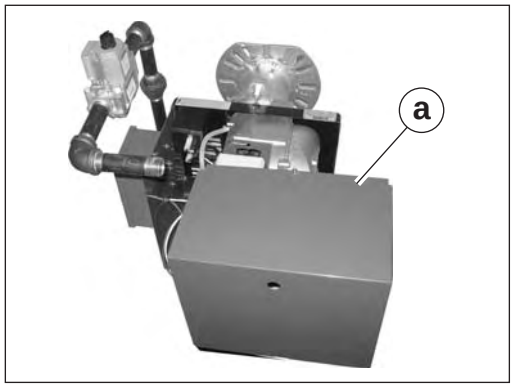
7.4 Removing and Installing the Combustion Head

Requirements
- Machine shut down
- Burner cool

Removal

Perform the procedure below to remove the combustion head.

1. Open the access door and locate the burner.
2. Remove the burner assembly cover **(a)**.



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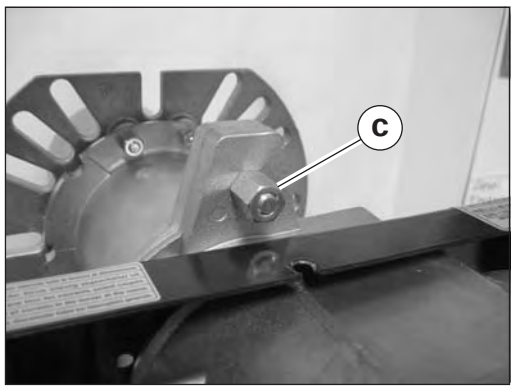

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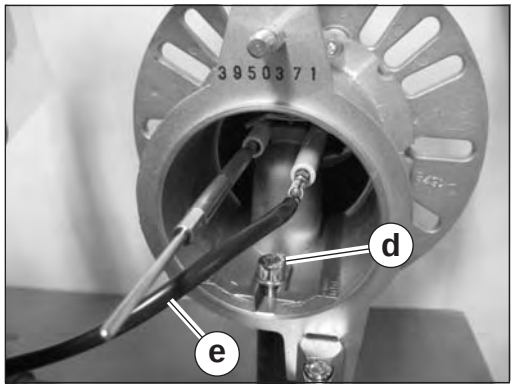
3. Remove nut **(c)** and open the burner.
4. Make note of the position of the combustion head, then remove screw **(d)**.



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5. Disconnect the wire **(e)**.

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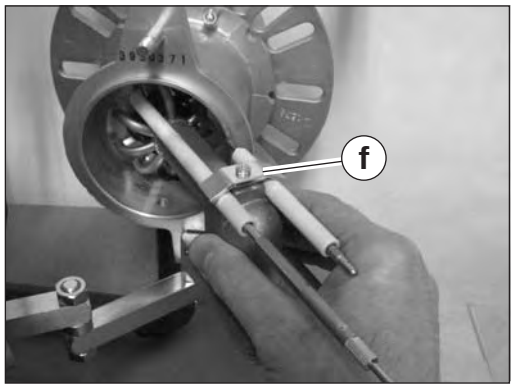
6. Remove the combustion head **(f)**.



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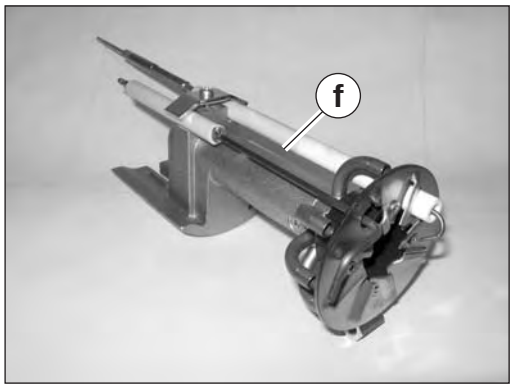

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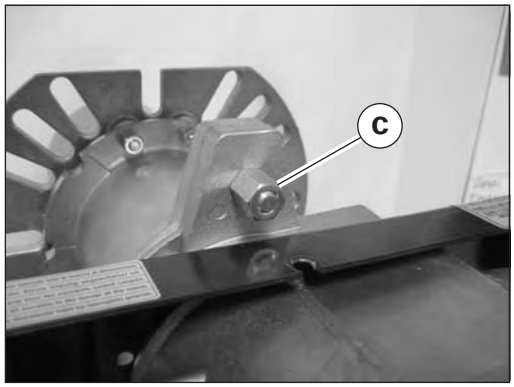
Installation

Perform the procedure below to install the combustion head.

1. Install the combustion head into the burner. Adjust the combustion per topic *Adjusting the Combustion Head*.
2. Reconnect the wire to the ignition electrode.
3. Close the burner and install nut **(c)**.



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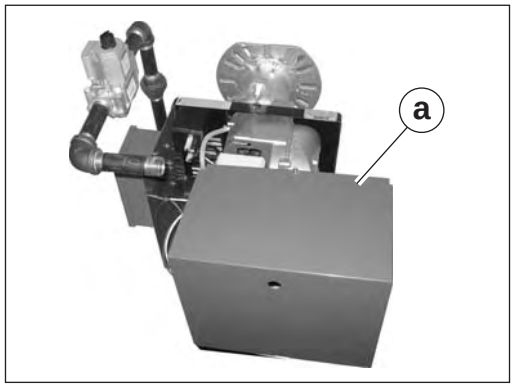

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4. Install the burner assembly cover **(a)**.

Result

The procedure to remove and install the combustion head is now complete.

7.5 Adjusting the Ionization Probe and the Electrode

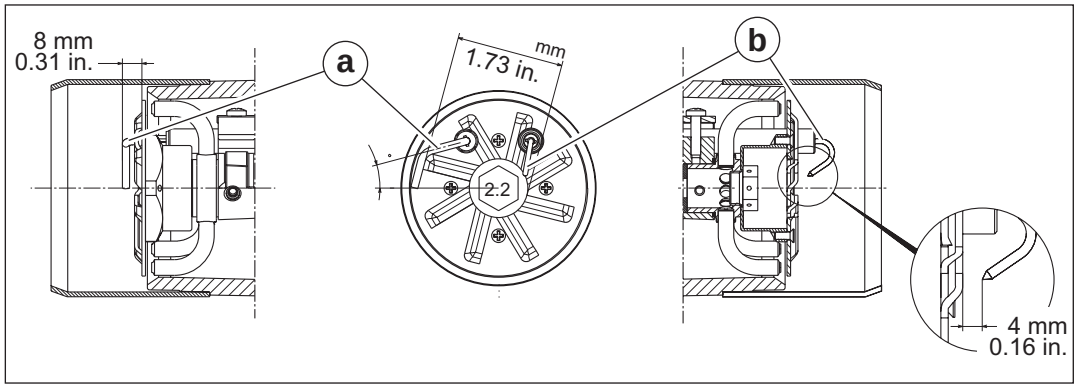
Requirements

- Machine shut down
- Burner cool

Procedure

Perform the procedure below to adjust both the ionizaton probe and the electrode.

1. Shut down the machine and allow it to cool.
2. Remove the combustion head assembly. See topic *Removing and Installing the Combustion Head*.
3. Clean the combustion head.
4. Adjust the ionization probe **(a)** so that it is positioned from the mixing plate as shown.



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5. Adjust the electrode **(b)** so that it is positioned from the mixing plate as shown.

Result

Both the ionization probe and the electrode have now been adjusted. Reinstall the combustion head.

7.6 Changing the Burner Diaphragm

Requirements

- Machine shut down
- Machine cool
- Correct burner diaphragm: C6 for NG; C3 for LP

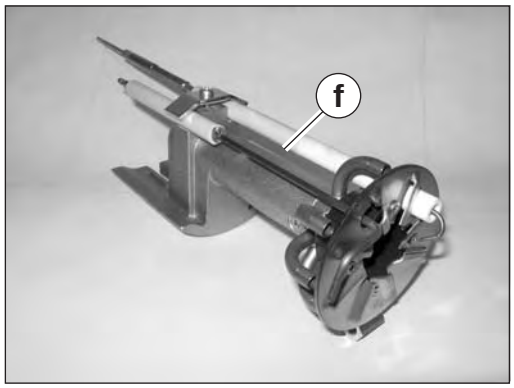
Background

The burner can burn either LP or Natural Gas (NG). The burner comes from the factory set up to burn NG. In order to burn LP (or to switch back from LP to NG), the burner diaphram must be changed.

Procedure

Perform the procedure below to change the burner diphragm.

1. Shut down the machine and allow it to cool.
2. Remove the combustion head assembly **(f)**. See topic *Removing and Installing the Combustion Head*.



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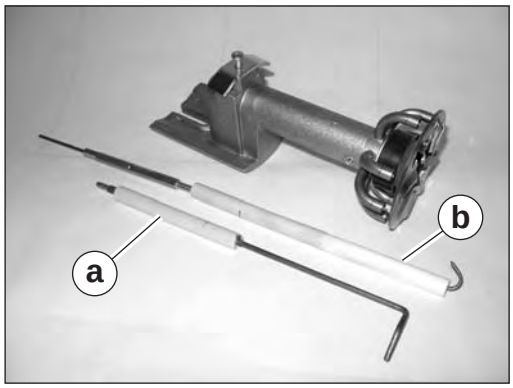

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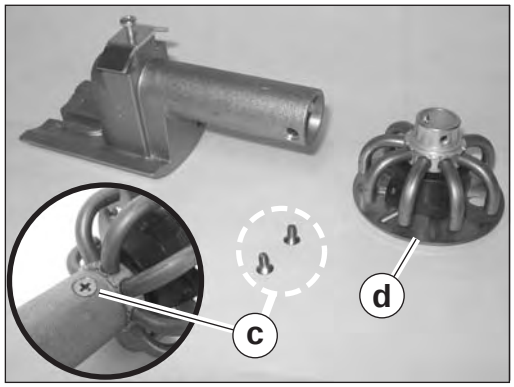
3. Loosen the clamp screw and remove the ionization probe **(a)** and the ignition electrode **(b)**.
4. Remove the two screws **(c)** and remove the gas diffuser **(d)**.



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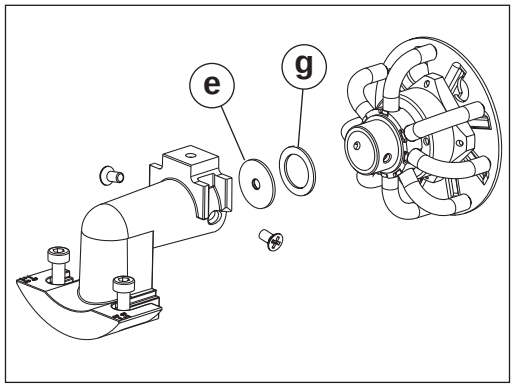

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6. Remove the diphragm **(e)** from the elbow. Install a new diaphragm.

Note: *There is a seal (g) inside the elbow; it may be reused. Replace it if it is damaged.*

Result

The procedure to change the diaphragm is now complete. Reassemble the burner. Adjust the ionization probe and the ignition electrode.

7.7 Checking and Adjusting the Air Damper (Gate) Setting

Requirements

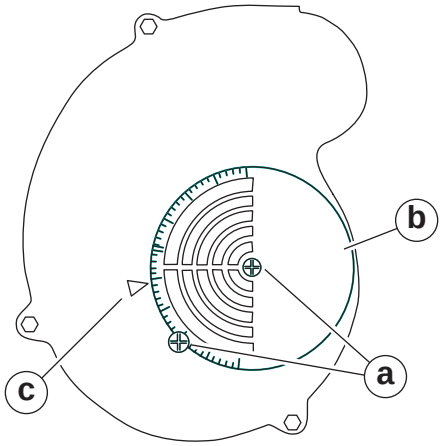
- Machine shut down
- Burner cool

Procedure

Follow the procedure below to check the air damper setting.

Note: *This procedure must be performed at each new job site. The proper setting depends on environmental conditions at the job site.*

1. Shut down the machine and allow it to cool.
2. Remove the burner cover.
3. Loosen the two screws **(a)** that secure the air adjustment plate **(b)**.



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4. Rotate the air adjustment plate so that the proper number on the air adjustment plate lines up with the setting indicator **(c)**. See topic *Factory Settings*.
5. Once the air adjustment plate is set, tighten the two screws **(a)**.

Result

The air damper setting has now been adjusted.

7.8 Adjusting the Combustion Head

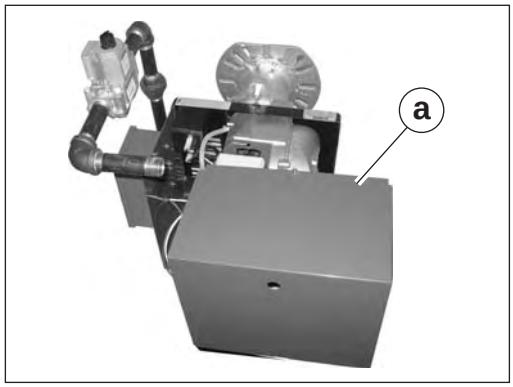
Requirements

- Machine shut down
- Machine cool

Procedure

Perform the procedure below to adjust the combustion head.

1. Open the access door and locate the burner.
2. Remove the burner assembly cover **(a)**.



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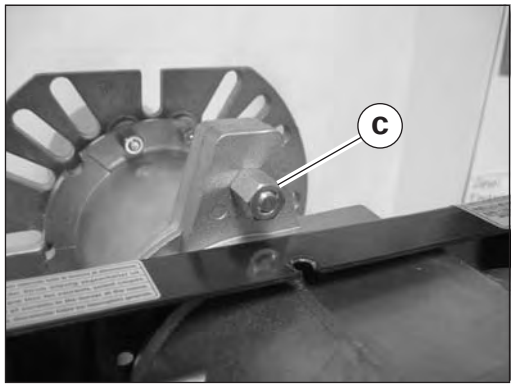

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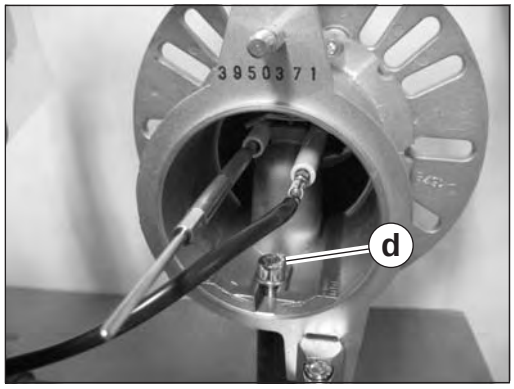
3. Remove nut **(c)** and open the burner.
4. Loosen screw **(d)**.



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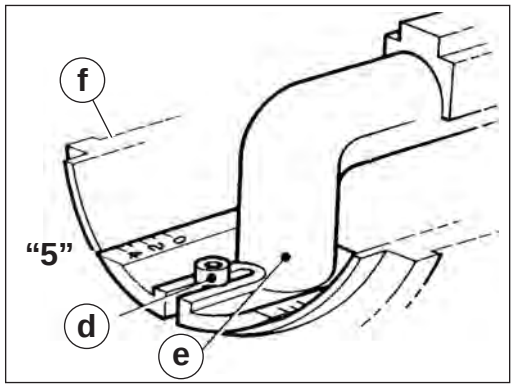

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5. Move the elbow **(e)** so that the edge of the air tube **(f)** coincides with the set point number **("5")**.
6. Tighten screw **(d)**.
7. Close the burner and reinstall nut **(c)**.
8. Reinstall the burner cover.

Result

The combustion head has now been adjusted.

7.9 Checking the Supply Gas Pressure

Requirements

- Machine shut down
- Supply gas turned off
- Manometer
- Nipple

Checking pressure

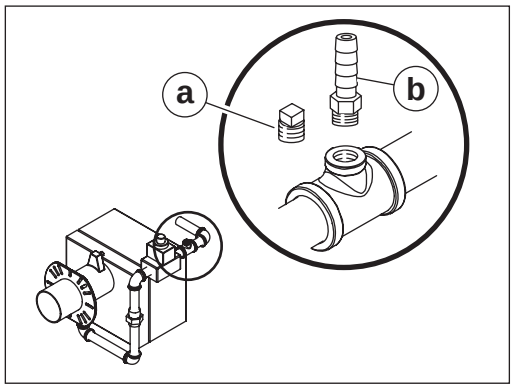
Perform the procedure below to check and adjust the supply gas pressure.

1. Shut down the machine and allow it to cool.
2. Close the supply gas shutoff valve.

WARNING
Explosion and fire hazard. When combined with air, the gas used for this burner is explosive. Explosions can cause severe injury or death.

- ▶ Close the supply gas shutoff valve before continuing with this procedure.
- ▶ Extinguish all sources of ignition before continuing this procedure.

3. Remove the plug **(a)** from the tee fitting.



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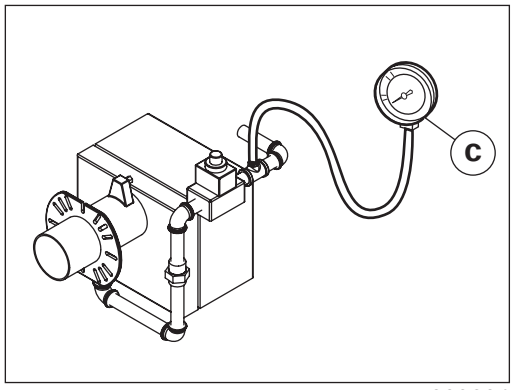
4. Install a nipple **(b)** into the tee fitting.
5. Connect the hose of the manometer **(c)** to the nipple.



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6. Open the supply gas shutoff valve.

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7. Check the pressure reading on the manometer. See section *Technical Data* for the correct pressure. Adjust the supply gas pressure as needed.
8. After the supply gas pressure has been set, turn off the supply gas.
9. Remove the manometer and the nipple.
10. Re-install the plug.
11. Perform a leak test at the plug.

Result The supply gas pressure has now been checked and adjusted.

7.10 Checking and Adjusting the Burner Gas Pressure

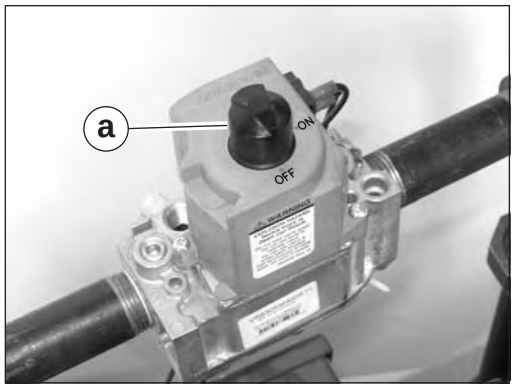
Requirements

- Machine shut down
- Adequate supply gas pressure
- Manometer

Checking pressure

Follow the procedure below to check and adjust the burner gas pressure.

1. Turn the control knob **(a)** to the “OFF” position.



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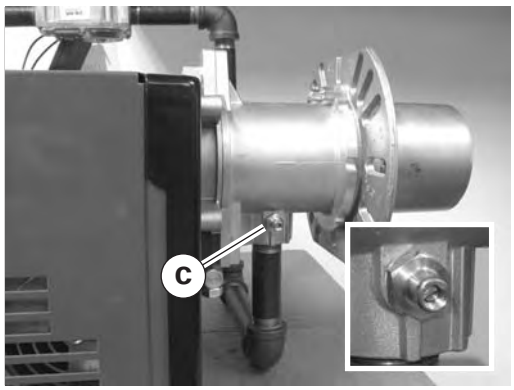

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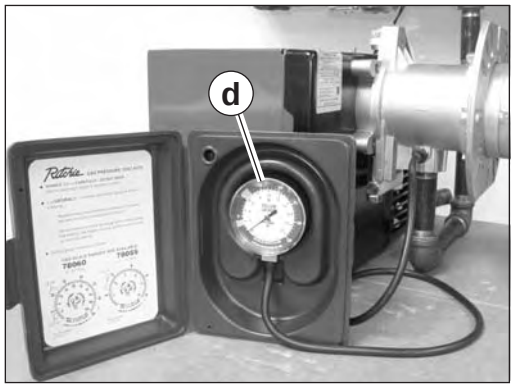
2. Locate the pressure test port **(c)**.
3. Insert a small screwdriver into the pressure test port and back off the needle valve two revolutions.
4. Connect the hose of the manometer **(d)** to the pressure test port.



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5. Turn the control knob to the “ON” position.
6. Start the machine.
7. With the burner firing, check the pressure reading on the manometer. See section *Technical Data* for the correct pressure.

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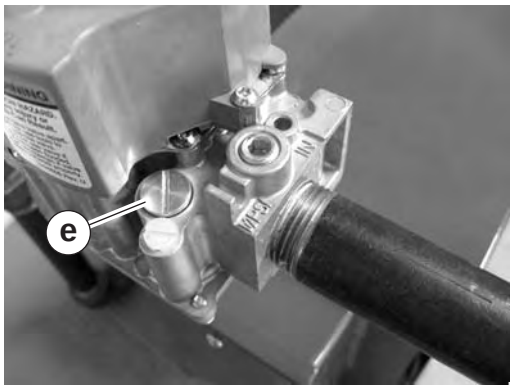
Adjusting pressure

Follow the procedure below to adjust the burner gas pressure at the gas control valve.

1. Remove the cap **(e)**.



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2. Turn the screw under the cap to adjust the burner gas pressure: clockwise to increase pressure, counterclockwise to decrease pressure.

Once the burner gas pressure is set:

3. Reinstall the cap.
4. Shut down the machine.
5. Remove the manometer tube from the pressure test port.
6. Tighten the needle valve.

NOTICE: Do not overtighten the needle valve. Damage to the needle valve will occur.

7. Perform a leak test at the pressure test port.

Result

The burner gas pressure has now been checked and adjusted.

8 Maintenance

8.1 Periodic Maintenance Schedule

The table below lists basic machine maintenance. Tasks designated with check marks may be performed by the operator. Tasks designated with square bullet points require special training and equipment.

Task	Interval* (hours of service)		
	Daily	2 Week	Yearly
	---	(50)	(1200)
Inspect hose couplings.	✓		
Clean quick-connect couplings	✓		
Inspect hoses and connectors.	✓		
Inspect electrical cords/ connections.		■	
Check HTF level. Fill if necessary.		✓	
Check/adjust burner air setting.			■
Check/adjust fuel pressure.			■
Check/adjust electrodes.			■
Replace burner nozzle.			■
Clean HTF strainer.			■
Replace fuel filter.			■
Lubricate hose reel chain.			■
Lubricate hose reel bearings.			■
Clean turbulator tubes.			■
Inspect rope gasket.			■
Test the burner exhaust and adjust the settings.	As needed or upon changing job sites		
* Use whichever comes first, calendar time or service hours.			

Note: *Test the trailer breakaway system monthly.*

8.2 Inspecting the HTF System and the Fuel System

Requirements

- Machine shut down
- Burner cool

HTF System

Hoses:

1. Rotate the hose reel brake T-handle counterclockwise to release the brake.
2. Unwind all the hose off the reel. Inspect the hose for leaks and/or damage.
3. Repair any leaks and repair/replace any damaged hoses. See topic *Repairing a Hose*.
4. Turn on the machine and rewind the hose onto the reel.
5. Engage the brake by turning the T-handle clockwise.

Pump, motor, and hydronic heater:

1. Inspect the pumps and motor assemblies and associated plumbing for leaks and/or damage.
2. Inspect hydronic heater and associated plumbing for leaks and/or damage.
3. Repair/replace any damaged components.
4. Repair any leaks.

Fuel System

Burner:

1. Inspect all fuel hoses and connections for leaks and/or damage.
2. Inspect the fuel filter and associated fuel hoses for leaks and/or damage.
3. Repair/replace any damaged hoses, pipes, or connectors.
4. Repair any leaks.

Fuel tank:

1. Inspect all fuel hoses running into and out of the fuel tank for leaks and/or damage.
2. Repair/replace any damaged hoses, pipes, or connectors.
3. Repair any leaks.

8.3 Repairing a Hose

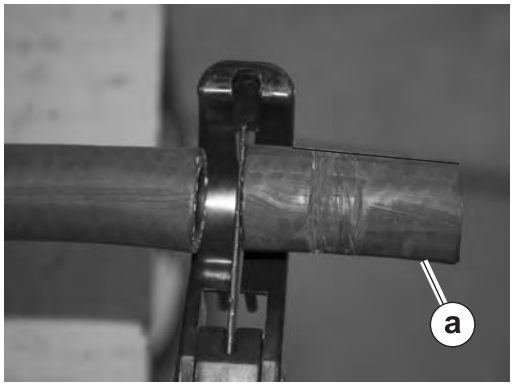
Requirements

- Hose nipple
- Two hose ferrules
- Hose crimping tool, Wacker Neuson part number 5000169002

Procedure

Follow the procedure below to repair a damaged hose.

1. Shut down the machine and allow the Heat Transfer Fluid (HTF) to cool.
2. Locate the damaged portion of the hose and clamp locking pliers on either side of the damaged portion.
3. Cut away the damaged portion of the hose **(a)** using a utility knife or similar tool.



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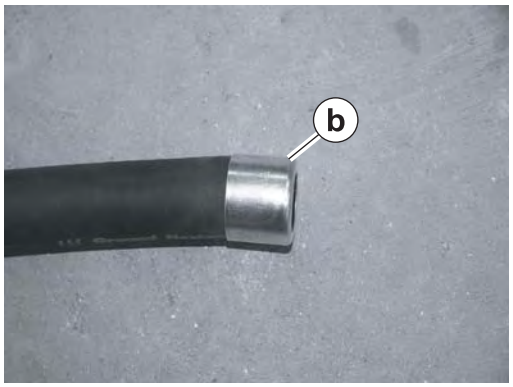
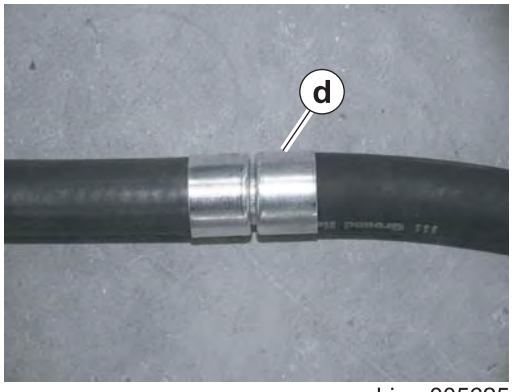


ghi_gr005623

4. Install a ferrule **(b)** on each end of the freshly cut hose.
5. Insert a nipple **(c)** into one of the ferrules.

NOTICE: Do not use petroleum to lubricate the nipple. If lubrication is needed, use HTF.

ghi_gr005624



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6. Insert the free end of the nipple into the second ferrule. Be sure to push each end of each hose to the lip of the nipple.

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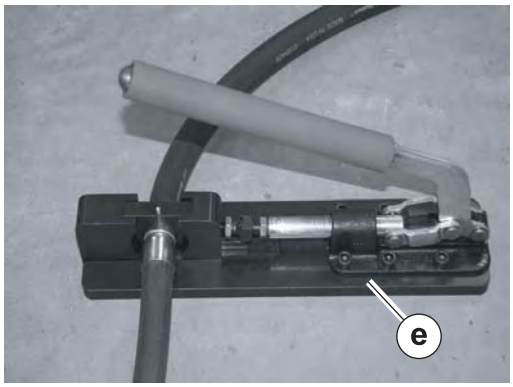
7. Use a Wacker Neuson brand hose crimper **(e)** to crimp both ferrules.



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8. Rotate the hose 90 degrees and crimp both ferrules again.

The procedure is now complete.

8.4 Inspecting the Electrical Components

Requirements

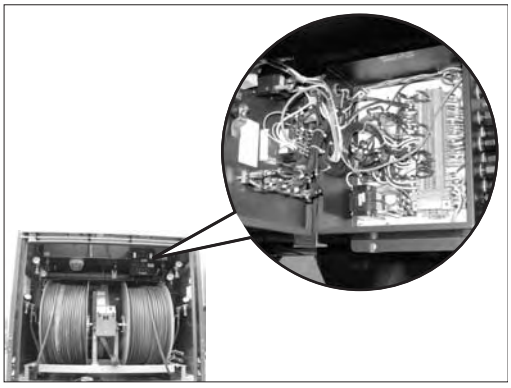
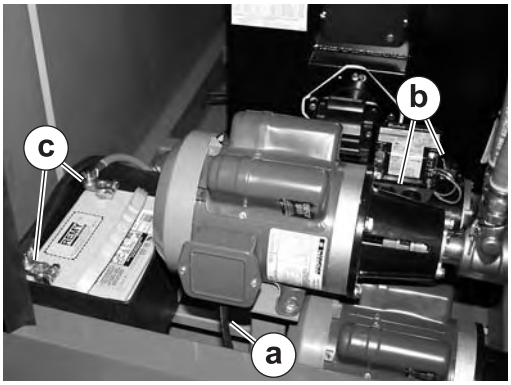
- Machine shut down and cooled
- Circuit breaker off
- Power disconnected

WARNING
Electric shock hazard. High voltage exists at various locations in the machine. High voltage can cause severe injury or death.

▶ Disconnect the power supplies before inspecting the electrical systems.

Inspections

Inspect the electrical connections and cables on the following items for corrosion, wear, or damage. Repair or replace as necessary.

Item	Reference Photo
Control panel ▶ Open the control panel	 ghi_gr006463
Pump/motor **(a)** Burner **(b)** Battery **(c)**	 ghi_gr006462

This procedure continues on the next page.

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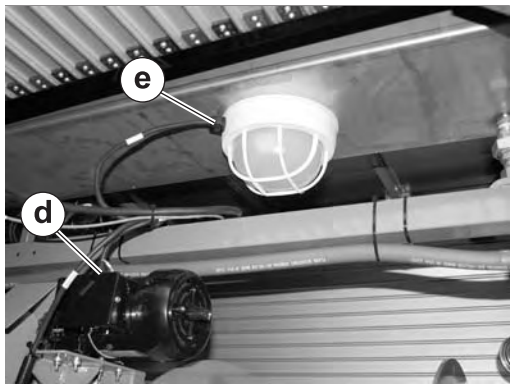
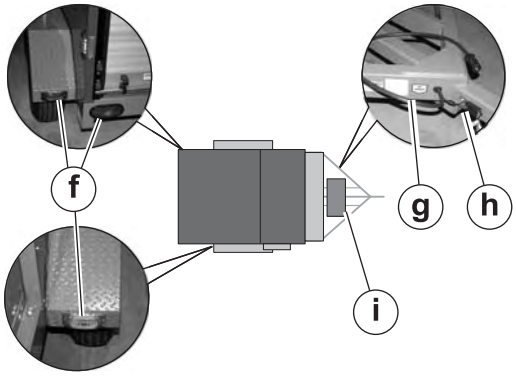
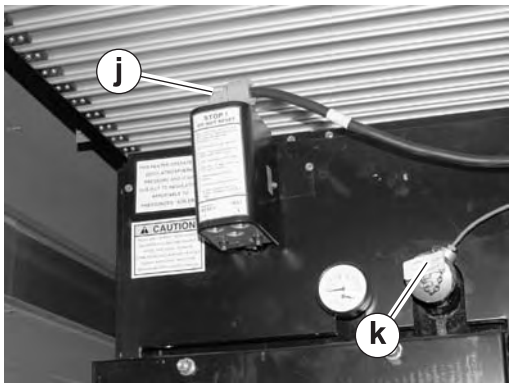
<table>
<tr><th>Item</th><th>Reference Photo</th></tr>
<tr><td>Hose reel rewind motor (d)
Light (e)</td><td> 

ghi_gr006464</td></tr>
<tr><td>Trailer
▶ Lights (f)
▶ Wiring harness (g)
▶ Brake (h)
Generator (i)
(if applicable)</td><td> 

ghi_gr006465</td></tr>
<tr><td>Low-level shut-down device (j)
Thermocouple (k)</td><td> 

ghi_gr006466</td></tr>
</table>

8.5 Filling the HTF Reservoir

Requirements

- Genuine Wacker Neuson Heat Transfer Fluid, or
- Dowfrost HD 50 Heat Transfer Fluid
- Machine is on a level surface

NOTICE: Use only factory-recommended Heat Transfer Fluid (HTF). Failure to comply may damage the machine.

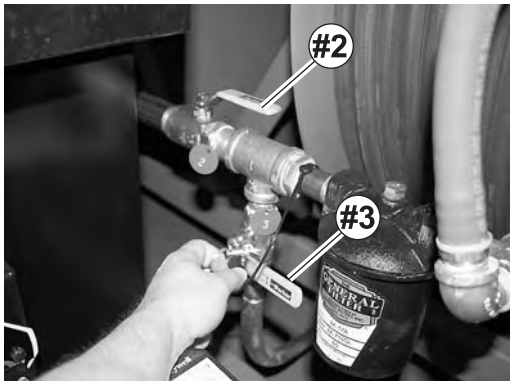
Background

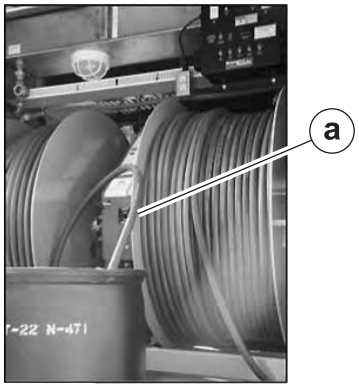
The procedure for routine filling of the HTF reservoir differs slightly from that when a low level fault is encountered. If your machine has experienced a low level fault, see topic *"Resetting a Low HTF Fault" .*

Procedure

Follow the procedure below to fill the HTF reservoir.

1. Move the burner switch to the OFF position.
2. Move both pump switches to the OFF position.
3. Clean the fill hose.
4. Power up the machine.
5. Remove the locking pin, then open valve #3 and close valve #2 simultaneously.





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6. Place the open end of the fill hose **(a)** into a container full of HTF.

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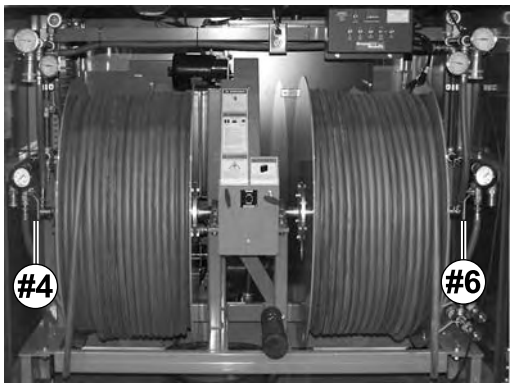
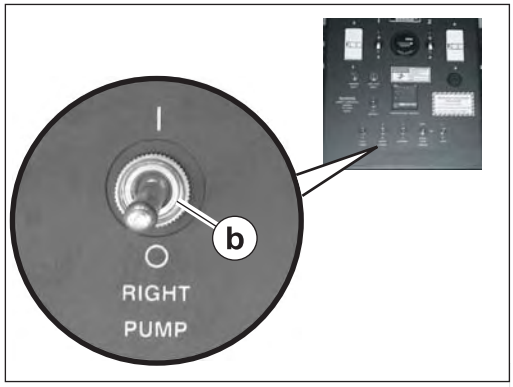
7. Open valve #6 (right hose reel supply valve).



ghi_gr006265

8. Move the right pump switch **(b)** to the ON position and watch the HTF reservoir sightglass **(c)**, then move the right pump switch to the OFF position when the level is between the minimum and maximum marks on the sightglass.

NOTICE: Do not overfill the HTF reservoir. Doing so may damage the machine.



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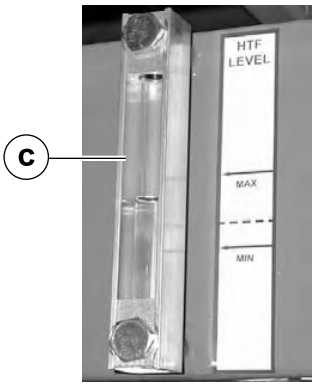

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9. Move valve #3 to the normal position.
10. Remove the fill hose from the HTF container. Allow any HTF within the hose to drip back into the container. Cap the hose if a cap is included.
11. Move the fill hose to its storage location under the hose reel.
12. Open valve #2 and close valve #3 simultaneously.

Result The HTF reservoir has now been filled.

8.6 Cleaning the HTF Strainer

Requirements

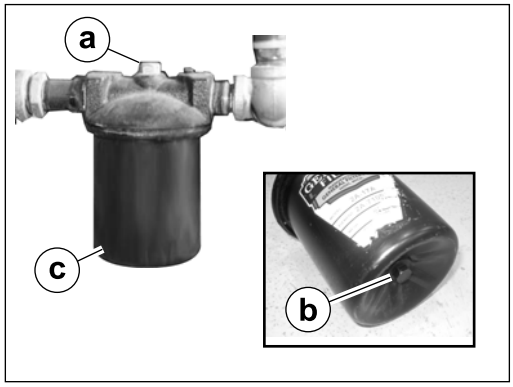
- Machine shut down
- Source of clean, warm water

Removal

Perform the procedure below to clean the HTF strainer.

Note: *In the interests of environmental protection, place a plastic sheet and a container under the machine to collect any liquid which drains off. Dispose of this liquid in accordance with local environmental protection laws.*

1. Loosen, but do not remove, the top screw **(a)**.
Note: *There is a second screw **(b)** under the canister **(c)**. Hold this screw while loosening the screw* **(a)**.



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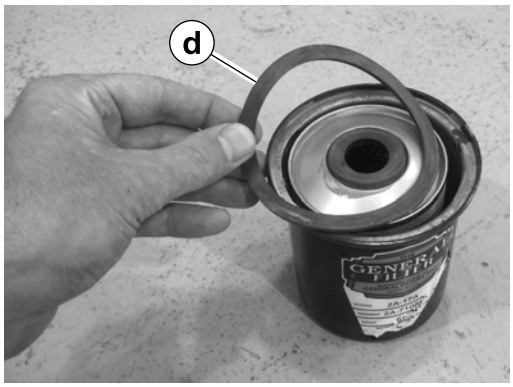
2. Tap on screw **(a)** with a hammer to release the gasket seal.
3. Remove the canister **(c)** by removing screw **(a)**—support the canister while doing so.
4. Dispose of the HTF that remains in the canister.
5. Remove the gasket **(d)** from the canister. Replace it if it is damaged.



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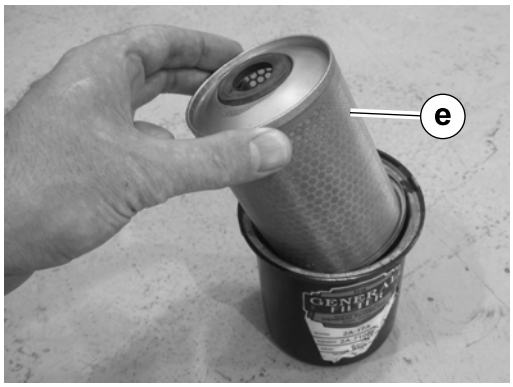

wc_gr007696

6. Remove the strainer basket **(e)** from the canister.
7. Rinse the strainer basket and the canister with clean, warm water.

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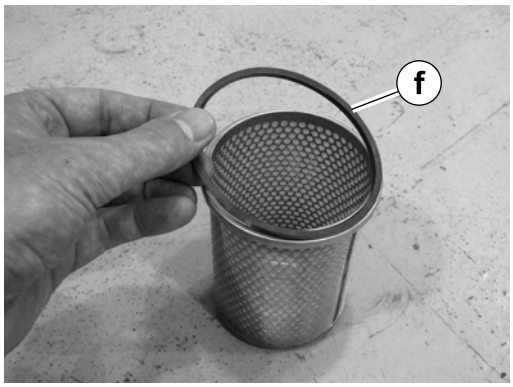
Installation

1. Inspect the strainer gasket **(f)** and replace it if it is damaged.



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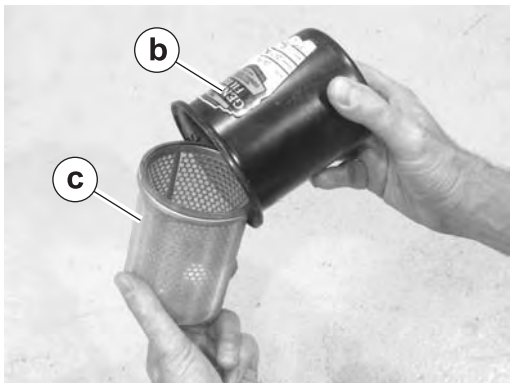

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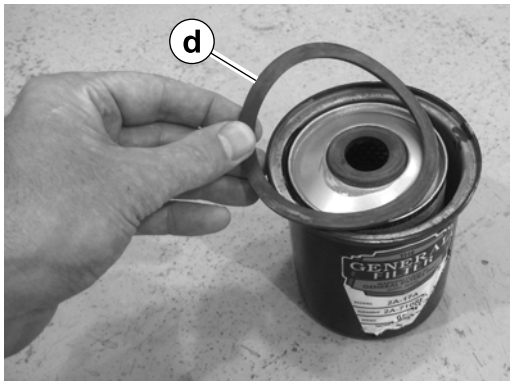
2. To ensure strainer gasket **(f)** placement, install the canister **(b)** over the strainer basket **(c)**.
3. Install the gasket **(d)** to the canister.



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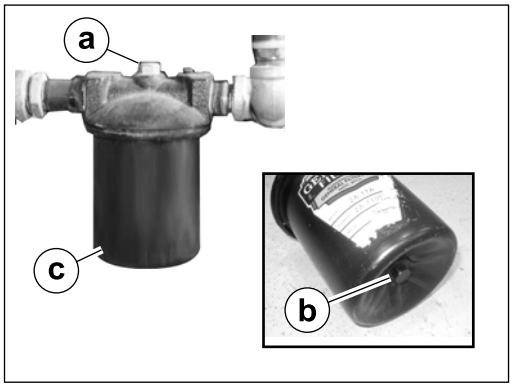


wc_gr007694

4. Install the strainer housing (including strainer basket) **(c)** into the machine using the screw **(a)** and screw **(b)**.

Result

The HTF strainer is now clean and ready for operation.

8.7 Replacing the Fuel Filter

Requirements

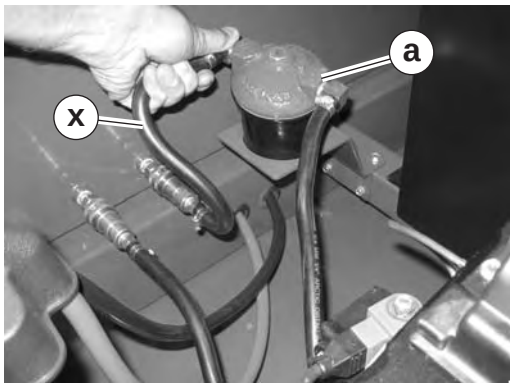
- Machine shut down
- New fuel filter element and gasket kit

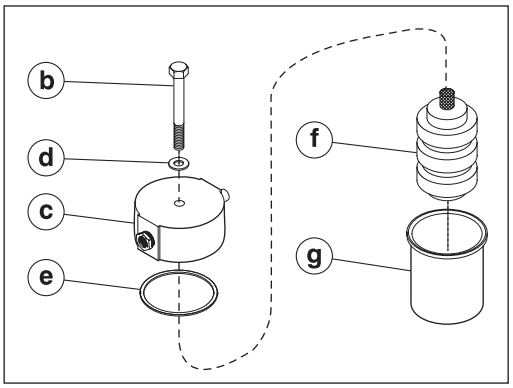
Removal

Perform the procedure below to remove the fuel filter element.

Note: *In the interests of environmental protection, place a plastic sheet and a container under the burner to collect any liquid which drains off. Dispose of this liquid in accordance with local environmental protection regulation.*

1. Locate the fuel filter **(a)**. Remove it from the bracket.
2. Disconnect the fuel hose **(x)**.





wc_gr008592

3. Loosen (do not remove at this time) the bolt **(b)** that secures the filter housing cap **(c)**.
4. Hold the filter housing **(g)** and lightly tap the bolt **(b)** with a hammer to break the seal between the gasket **(e)** and the housing **(g)**.
5. Remove the bolt **(b)** and gasket **(d)**.
6. Remove the filter housing cap **(c)** and gasket **(e)**.
7. Pull the fuel filter element **(f)** out of the housing.

Installation

Perform the procedure below to install the new fuel filter.

1. Remove any remaining gasket material from the filter housing cap or the housing.
2. Place the new fuel filter element **(f)**, with exposed screen portion facing up, into the housing **(g)**.
3. Place the new gasket **(e)** on the top lip of the housing.
4. Slide the new gasket **(d)** on the bolt **(b)**.
5. Reinstall the filter housing cap **(c)** to the housing **(g)** with bolt **(b)**.
6. Reinstall the filter to the bracket.
7. Reconnect the fuel hose **(x)**.

Result

The fuel filter has now been replaced.

8.8 Lubricating the Hose Reel System

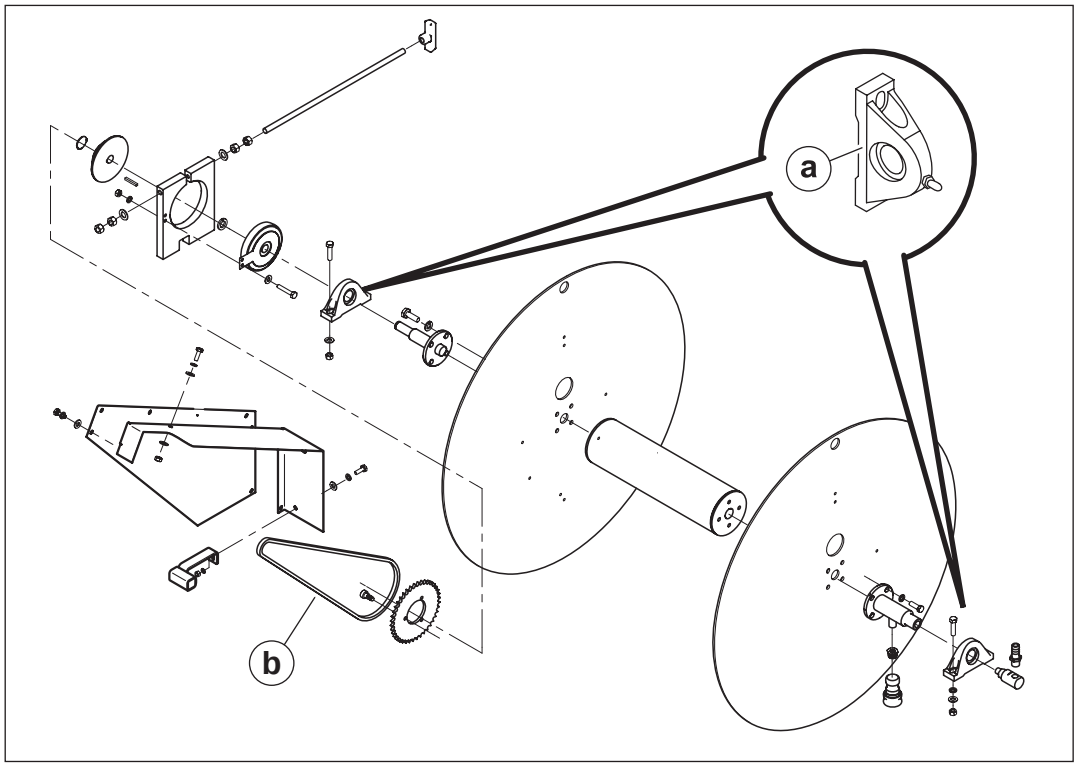
Requirements

- Machine shut down
- Machine cool

Procedure

Perform the procedure below to lubricate the hose reel system.

1. Disconnect electric power from the machine.
2. Apply low temperature bearing grease, with several pumps from a grease gun, to each bearing **(a)**.



wc_gr007823

3. Lightly apply a low temperature lubricating oil to the chain **(b)**.

Result

The hose reel system has now been lubricated.

8.9 Cleaning the Turbulators and the Exhaust Ducting

Requirements

- Machine shut down
- Machine cool

Procedure

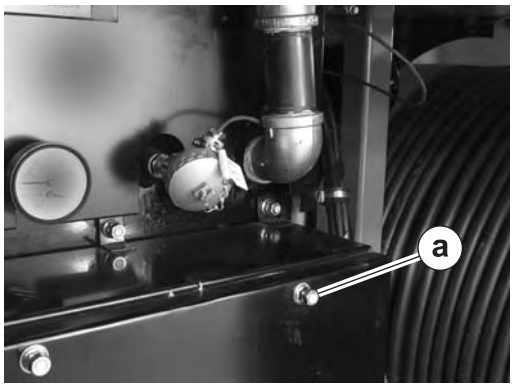
Follow the procedure below to clean/change the turbulator tubes.

1. Allow the machine to cool.

WARNING
Burn hazard. The hydronic heater is very hot when the machine is operating. When hot it can cause severe burns.

► Allow the machine to cool before performing this procedure.

2. Remove the nuts **(a)** that secure the flue box door **(b)**.



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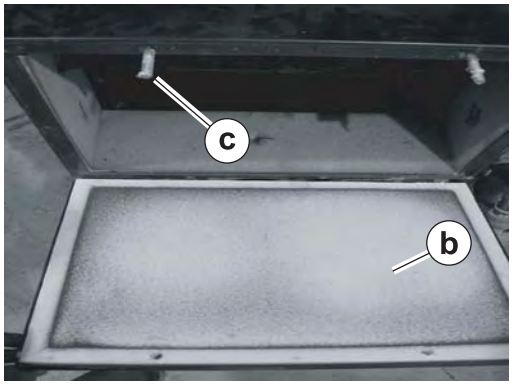
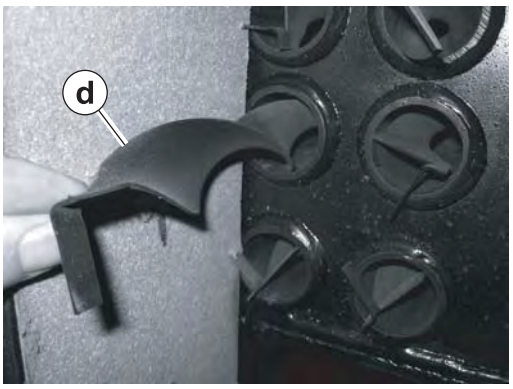


ghi_gr005627

3. Open the flue box door.

NOTICE: If the door panel insulation does not open with the door, carefully remove it from where it is caught on the bolts **(c)**. Inspect all panels for damaged insulation. Replace all damaged panels.

4. Locate the turbulators housed in the burner tubes.



ghi_gr005629

5. Remove the turbulators **(d)** by pulling the turbulator tab. Replace any turbulator that is badly eroded.
6. Clean each burner tube with a bottle brush.

This procedure continues on the next page.

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7. Vacuum out each burner tube.
8. Remove the exhaust stack **(e)** (both inner and outer panels).

wc_gr008604

9. Vacuum out the exhaust ducting **(f)** and the heater.
10. Reinstall the exhaust stack.
11. Reassemble the machine.

Result The procedure is now complete.

8.10 Inspecting/Replacing the Rope Gasket

Requirements

- Machine shut down
- Machine cool

Integrity inspection

Follow the procedure below to confirm the integrity of the flue box rope gasket.

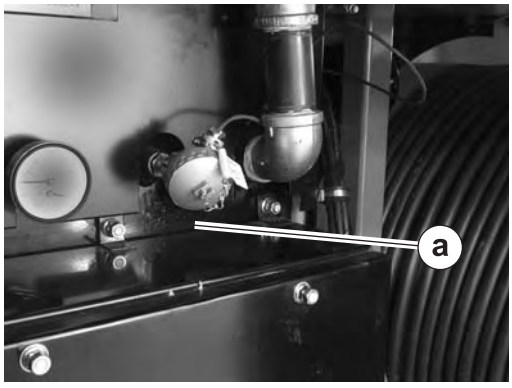
1. Allow the machine to cool.

WARNING
Burn hazard. The hydronic heater is very hot when the machine is operating. When hot it can cause severe burns.

▶ Allow the machine to cool before performing this procedure.

2. Inspect the area around the flue box door **(a)** for the following signs of leakage.
   - White or brown residue is visible.
   - Rope gasket is protruding from flue box.
   - Bubbles are visible on the black painted surface.

NOTICE: If any of these symptoms exist, investigate and repair the source.



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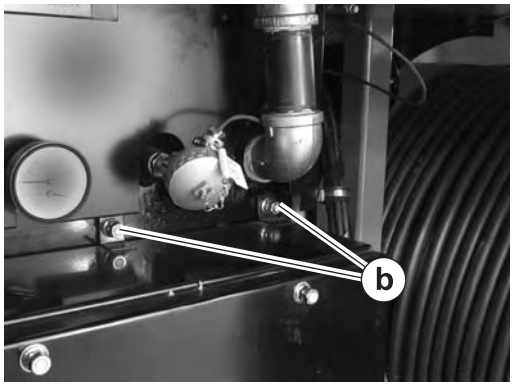
Replace the rope gasket

Follow the procedure below to replace the rope gasket.

1. Remove the nuts **(b)** that secure the flue box door and remove the door.



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ghi_gr006511

2. Remove the old gasket **(c)** and replace with a new one.

Note: *You may need to use a tool (such as a screwdriver) to remove the gasket.*

The procedure is now complete. Reassemble the machine.

8.11 Removing the Oil Burner

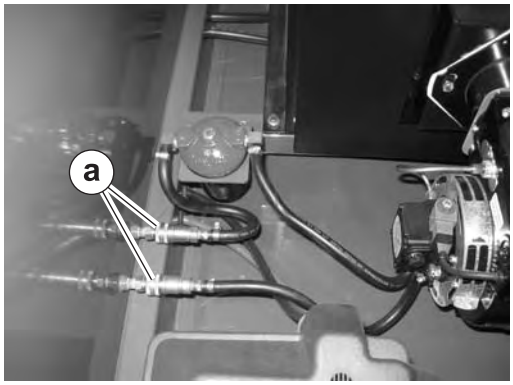
Requirements

- Power supplies disconnected
- Machine cool

Procedure

Follow the procedure below to remove the burner.

1. Disconnect the power supplies.
2. Disconnect fuel lines **(a)** at the quick-connects.



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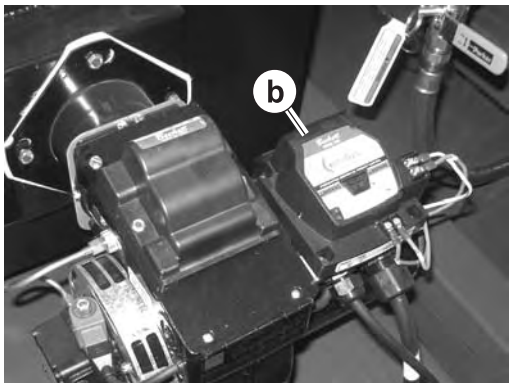

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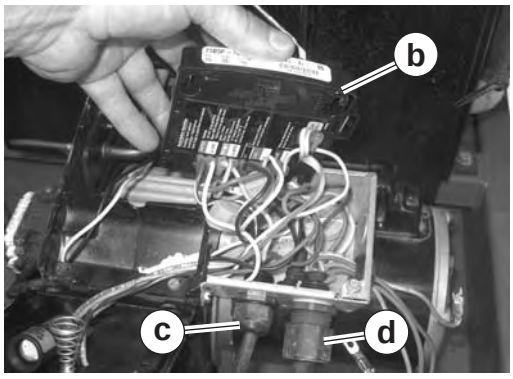
3. Remove the burner controller **(b)** to expose the wiring. Label all the wires to assist in reconnecting.
4. Disconnect all wires coming from the snap switch cable **(c)** at the burner controller.



wc_gr008595


ghi_gr005411

5. Disconnect all wires coming from the burner cable **(d)**.
6. Remove the screws that secure the burner to the machine and maneuver the burner from the machine.

Result

The procedure to remove the burner is now complete.

8.12 Installing the Burner

Requirements

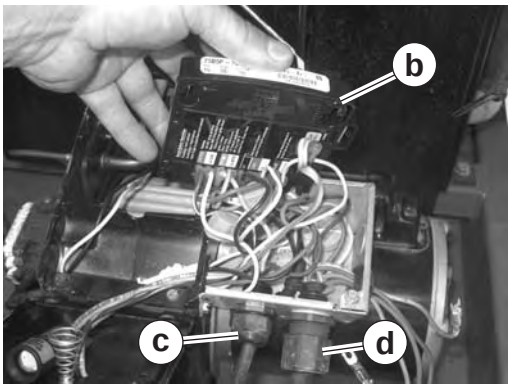
- Power supplies disconnected
- Machine cool

Procedure

Follow the procedure below to install the burner.

1. Position the burner inside the machine and secure it to the hydronic heater.

ghi_gr005411



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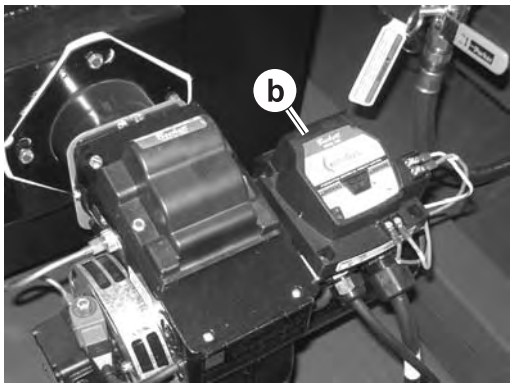
2. Reconnect the wiring from the snap switch cable **(c)** and burner cable **(d)** to the burner controller.
3. Mount the burner controller **(b)** to the burner.



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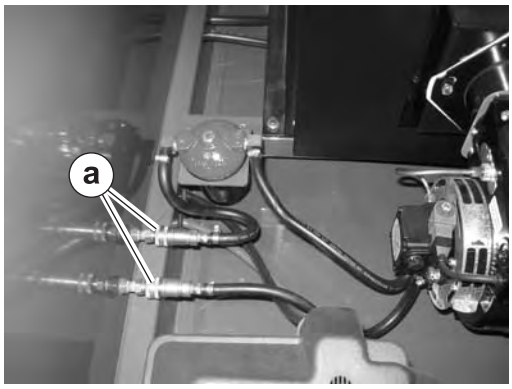


wc_gr008302

4. Connect the fuel lines **(a)** at the quick-connects.

Result

The procedure to install the burner is now complete.

8.13 Storing the Machine

Short-term storage

1. Fill the HTF reservoir if it is low.
2. Stop the machine. See topic *Shutting Down and Packing Up the Machine*.
3. Remove and store any accessories.
4. Allow the heater to cool sufficiently.
5. Verify that all control switches are in the OFF position.
6. Fill the fuel tank if it is low. Allow space in the fuel tank for fuel expansion.

Long-term storage

1. Fill fuel tank with stabilized fuel and operate the burner for at least fifteen minutes to ensure circulation through entire fuel system. Any brand of fuel stabilizer is acceptable.
2. Allow heater to cool sufficiently. Cover the chimney and the burner with plastic wrap or other waterproof material. This will prevent corrosive moisture build-up and blockages caused by animal nests.
3. Shut and lock all doors.
4. If the machine has a trailer, protect the trailer tires from direct sun light.
5. When removing from storage, the machine must be prepared for operation. See topic *Preparing the Machine for Seasonal Operation*.

8.14 Storing the Genset

Short term

If the genset sits idle for more than one month, exercise the genset at least two hours each month by running the genset at approximately 1/2 rate power. A single two-hour exercise period is preferred over several shorter periods.

Long term

If the genset is to be idle for more than 120 days:

1. Change the engine oil.
2. Place a tag on the genset designating engine oil viscosity.
3. Disconnect the battery.
4. Plug the exhaust tail pipe to keep out dirt, moisture, bugs, etc.
5. Clean the genset.

When returning the genset back into service:

1. Reconnect the battery.
2. Check the oil tag and change the engine oil if the oil viscosity is not appropriate for the expected temperature.
3. Remove the plug from the exhaust tail pipe.
4. Inspect the genset.
5. Clean the genset if necessary.

8.15 Preparing the Machine for Seasonal Operation

Background

After removing the machine from long-term storage, it must be prepared for operation. Perform the procedures below before each seasonal use.

Before powering up machine

Perform the procedures below before you power up the machine.

Item	Task
Machine exterior	Clean all outside surfaces
Heater and burner	■ Remove protective coverings from chimney and burner. ■ Remove any carbon buildup from the heater and burner assemblies. ■ Replace the burner nozzle. ■ Verify burner electrode position.
Controls and wiring	■ Inspect all wires for damage, corrosion, or wear. Replace damaged wiring. ■ Inspect all electrical components for damage, corrosion, or wear. Replace damaged electrical components.
HTF system	■ Inspect all hoses and couplings for wear or damage. Replace damaged hoses and couplings. ■ Clean the HTF strainer basket.
Fuel system	Replace the fuel filter element.

With machine powered up

Perform the procedures below with the machine powered up.

Item	Task
Burner	■ Verify fuel pump pressure. ■ Verify burner combustion.

8.16 Connecting and Maintaining the Battery

WARNING
Explosion hazard. Batteries can emit explosive hydrogen gas.
- ▶ Keep all sparks and flames away from the battery.
- ▶ Do not short-circuit battery posts.

WARNING
Battery fluid is poisonous and corrosive.
- ▶ In the event of ingestion or contact with skin or eyes, seek medical attention immediately.

Battery connections

To connect the battery:
- Connect the positive (+) battery cable to the battery.
- Connect the negative (-) battery cable to the battery.

To disconnect the battery:
- Stop the engine.
- Place all electrical switches in the OFF position.
- Disconnect the negative (-) battery cable from the battery.
- Disconnect the positive (+) battery cable from the battery.

Maintaining the battery
- Follow the battery manufacturer's maintenance recommendations.
- Keep battery terminals clean and connections tight.
- When necessary, tighten the cables and grease the cable clamps with petroleum jelly.
- Maintain the battery at full charge to improve cold weather starting.

Precautions

Observe the following precautions to prevent serious damage to the electrical system.
- Do not disconnect the battery while the machine is running.
- Do not attempt to run the machine without a battery.
- Do not attempt to jump-start the machine.
- In the event that the machine has a discharged battery, either replace the battery with a fully charged battery or charge the battery using an appropriate battery charger. See *Technical Data* for the equivalent battery specification.
- Dispose of waste batteries in accordance with local environmental regulations.

9 Genset Maintenance

9.1 Periodic Maintenance Schedule

The table below lists basic machine maintenance. Tasks designated with check marks may be performed by the operator. Tasks designated with square bullet points require special training and equipment.

Task	Interval* (hours of service)				
	Daily	**Monthly**	**—**	**Yearly**	**Every 2 years**
	—	**—**	**(150)**	**(500)**	**(1000)**
Conduct a general inspection.	✓				
Check the engine oil level.	✓				
Check the engine coolant level.	✓				
Clean and check battery.		✓			
Clean spark arrestor.^			✓		
Change engine oil and oil filter ****, ***.**			✓		
Replace engine air filter element.				✓	
Replace engine fuel filter.					■
Flush coolant system.					■
Replace coolant system pressure cap.					✓
Replace engine V-belt.^					■
Replace coolant hoses and thermostat.^					■
Adjust engine valve lash.^					■
Service fuel injectors.^					■
Check generator bearings, drive belt, belt tensioner, and drive coupling.^					■

* Use whichever comes first, calendar time or service hours.
** Perform at least once per year.
*** Change oil and filter after first 50 hours of operation.
^ Must be performed by authorized Onan service representative.

9.2 Checking the Engine Oil

Requirements

- Genset stopped
- Machine level

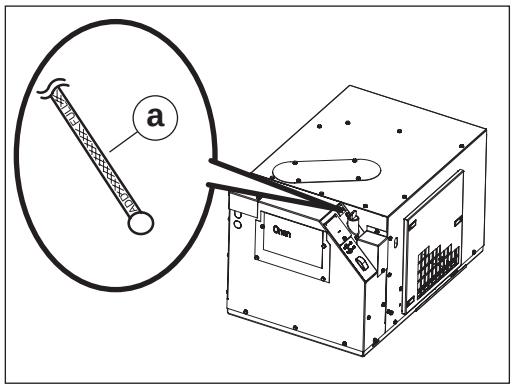
Checking

Perform the procedure below to check the engine oil.

WARNING
Burn hazard. Crankcase pressure can blow hot oil out of the fill opening causing severe burns.

▶ Stop the genset before removing the dipstick/plug.

1. Pull the dipstick/plug **(a)** out of the oil fill opening.



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2. Wipe the dipstick/plug clean.
3. Reinsert the dipstick/plug into the engine fully. The dipstick/plug will snap into place.
4. Remove the dipstick/plug and check the oil on the dipstick.

Adding oil

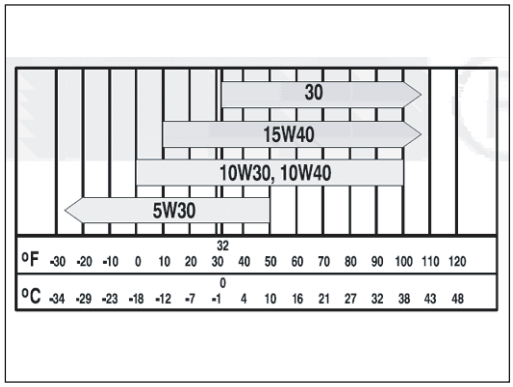
NOTICE: Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Add oil when the oil level approaches the “ADD” mark on the dipstick/plug.

1. Add oil through the fill opening until the oil level reaches the “FULL” mark on the dipstick/plug.
2. Reinstall the dipstick/plug into the engine fully.

9.3 Changing the Engine Oil and Oil Filter

Requirements

- Engine warm
- New oil filter
- Fresh, clean oil



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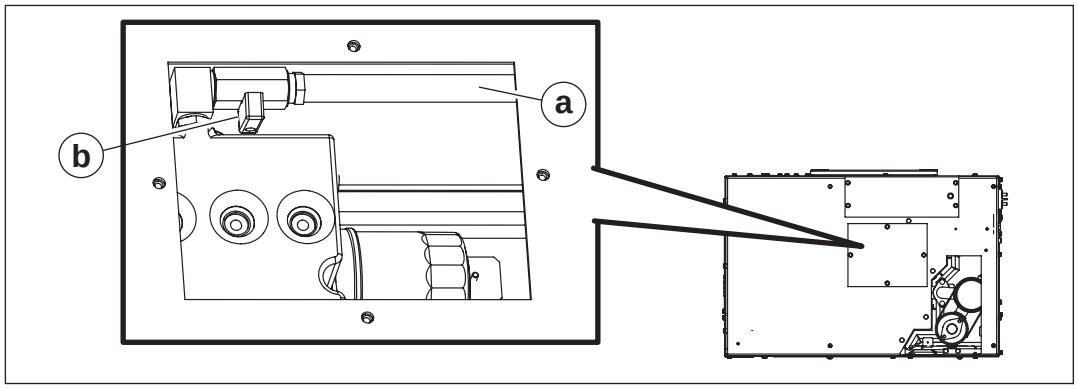
Draining oil

Perform the procedure below to change the oil and oil filter.

Note: *In the interests of environmental protection, place a plastic sheet and a container under the machine to collect any liquid which drains off. Dispose of this liquid in accordance with local environmental protection laws.*

1. Operate the genset until warm, then stop the engine.
2. Pull the oil dipstick/plug out approximately 5 cm (2 in.) to allow the oil to drain faster.
3. Remove the front and bottom access covers.
4. Position the drain hose **(a)** into a container.



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5. Open the drain valve **(b)** and drain the used oil. Dispose of used oil in accordance with local environmental protection laws.
6. Close the drain valve.

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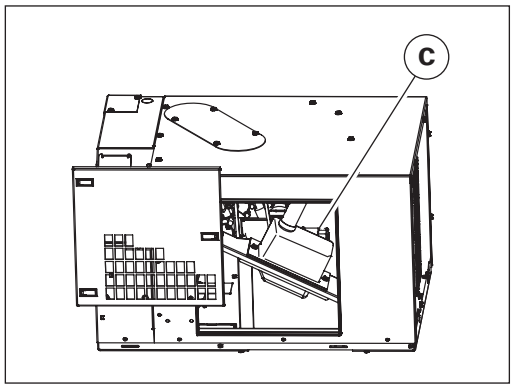
7. Unscrew the oil filter **(c)** and remove it through the front access opening.



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8. Clean the oil filter mounting surface of the engine.

Filling

1. Apply a thin coat of clean oil to the gasket of the new oil filter.
2. Thread the oil filter onto the engine until the gasket touches the block. Then, turn the oil filter an additional 180°–270°.
3. Refill the engine with 1.7 qt (1.9 liters) of oil.
4. Reinstall the access covers.
5. Start the genset and allow it to run for a 1–3 minutes.
6. Check the oil level. Add oil as needed.

Result

The engine oil and oil filter have now been changed.

WARNING
Most used oil contains small amounts of materials that can cause cancer and other health problems if inhaled, ingested, or left in contact with skin for prolonged periods of time.

- ▶ Take steps to avoid inhaling or ingesting used engine oil.
- ▶ Wash skin thoroughly after exposure to used engine oil.

9.4 Checking the Engine Coolant Level

Requirements

- Genset stopped
- Engine cool

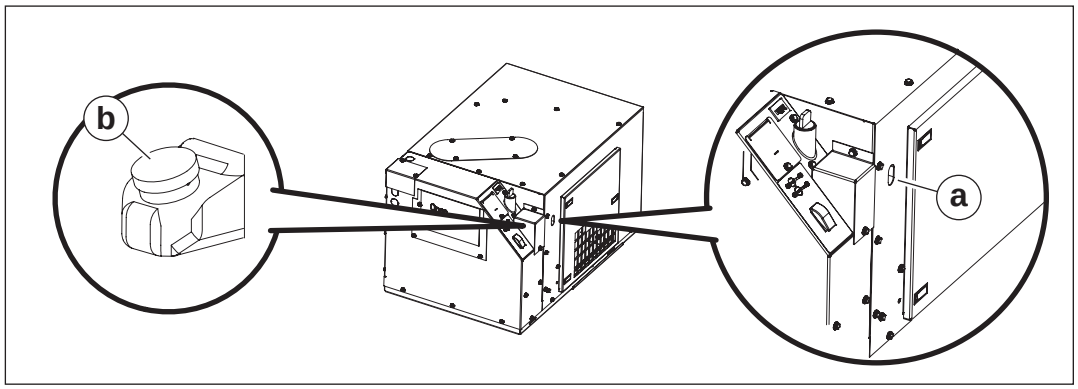
Checking

Perform the procedure below to check the engine coolant level.

WARNING
Personal injury hazard. Contact with moving parts and hot exhaust can cause severe injury.

▶ Do not run the genset with the access covers removed.

1. Check the engine coolant level through the opening **(a)** in the panel. When cold, the coolant level should be at the COLD mark on the recovery tank **(b)**.



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2. Fill the recovery tank when the engine is cold to the COLD mark on the recovery tank.

9.5 Replacing the Air Filter Element

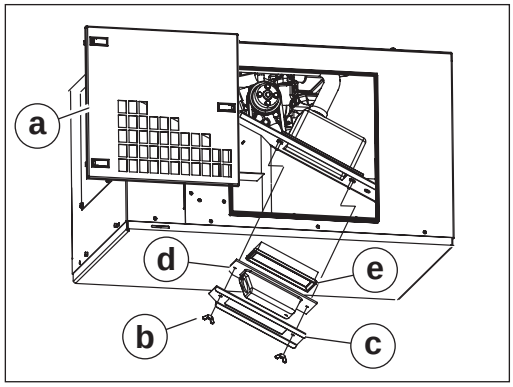
Requirements

- Engine stopped
- New air filter element

Removing

Perform the procedure below to replace the air filter element.

1. Disconnect the battery.
2. Remove the front access cover **(a)**.



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3. Remove the wing nuts **(b)**, bracket **(c)**, filter housing **(d)**, and the filter element **(e)**.

Installing

1. Perform the procedure below to install the air filter element.
2. Install the new air filter element using the filter housing, bracket, and wing nuts. Tighten wing nuts hand tight.
3. Reinstall the front access cover.
4. Reconnect the battery.

Result

The air filter element has now been installed.

9.6 Replacing Engine Fuel Filter

Requirements

- Genset shut down and cool
- New fuel filter

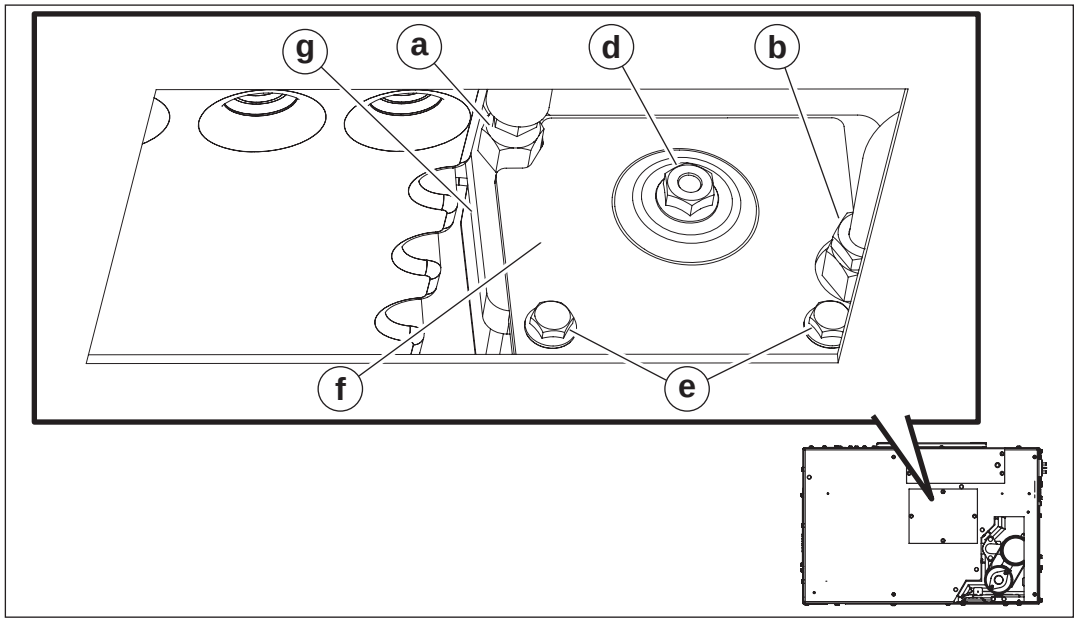
WARNING
Fire hazard. Diesel fuel can ignite and cause severe burns.

▶ Keep a type ABC fire extinguisher (or equivalent) at hand when performing this procedure.

Removal

Perform the procedure below to remove the fuel filter.

1. Close the fuel supply valve.
2. Disconnect the battery.
3. Disconnect the flare nuts that secure the access cover to the genset and remove the access cover.
4. Disconnect the fuel lines **(a** and **b)**. Be careful not to spill fuel.



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5. Remove the filter mounting nut **(d)** and two filter bracket mounting screws **(e)**.
6. Remove the filter bracket **(f)** and filter **(g)**. Dispose of the filter according to state and local regulations.

Installation

Perform the procedure below to install the fuel filter.

1. Secure the filter bracket **(f)** loosely to the new filter **(g).** Place the filter bracket and new filter in the generator.

This procedure continues on the next page.

Continued from the previous page.

2. Loosely secure the filter and filter bracket **(f)** to the generator with the two filter bracket mounting screws **(e)** and reconnect the fuel lines **(a** and **b)**.
   Note: *Take care not to cross-thread the fuel fittings. Thread them in by hand and tighten one flat past seating*.
3. Tighten the filter mounting nut **(d)** and filter bracket mounting screws **(e)**.
4. Reinstall the access cover using the flare nuts.

Prepare the machine

Prepare the machine for operation.

1. Reconnect the battery.
2. Open the fuel supply valve.
3. Replace any covers, guards, or access panels.
4. Prime the fuel system.

- Hold the control switch to the STOP/PRIME position for at least one minute.
  Note: *The priming sequence will begin after two seconds.*

Result

The fuel filter has now been replaced.

9.7 Changing Engine Coolant

Requirements

- Genset shut down and cool
- 50/50 mixture of ethylene glycol and water
- Collection container, 2-liter (1/2-gal)
- Funnel

Background

The genset is filled with a 50/50 mixture of ethylene glycol and water at the factory. This formula is suitable for temperatures as low as -37°C (-34°F).

Use the best quality ethylene glycol solution available; one that is formulated with rust inhibitors and coolant stabilizers. Use distilled water, or fresh water that contains small amounts of minerals or corrosive chemicals.

NOTICE: Replace the pressure cap **(x)** every two years. The pressure cap provides proper cooling system pressure which is essential for best engine cooling.

Note: *In the interests of environmental protection, place a plastic sheet and a container under the machine to collect any liquid which drains off. Dispose of this liquid in accordance with local environmental protection laws.*

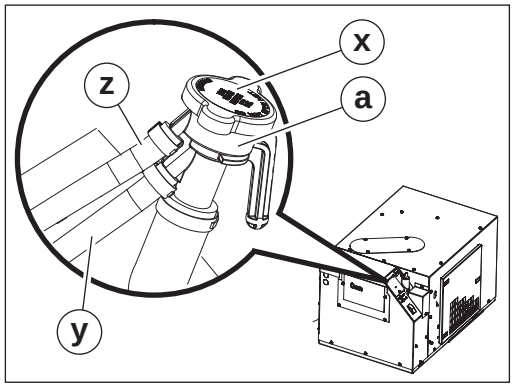
Draining

Perform the procedure below to drain the coolant.

WARNING
Burn hazard. Hot coolant spray can cause severe burns.

▶ Allow the engine to cool before changing the coolant.

1. Disconnect the battery.
2. Remove the access cover. The fill hose assembly **(a)** is connected to the access cover. Disconnect the fill hose from the access cover.



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3. Pull the fill hose assembly out of the generator as far as it will go.
4. Relieve any remaining pressure by turning the pressure cap **(x)** slowly without pushing down. Then, remove the pressure cap by turning and pushing down.

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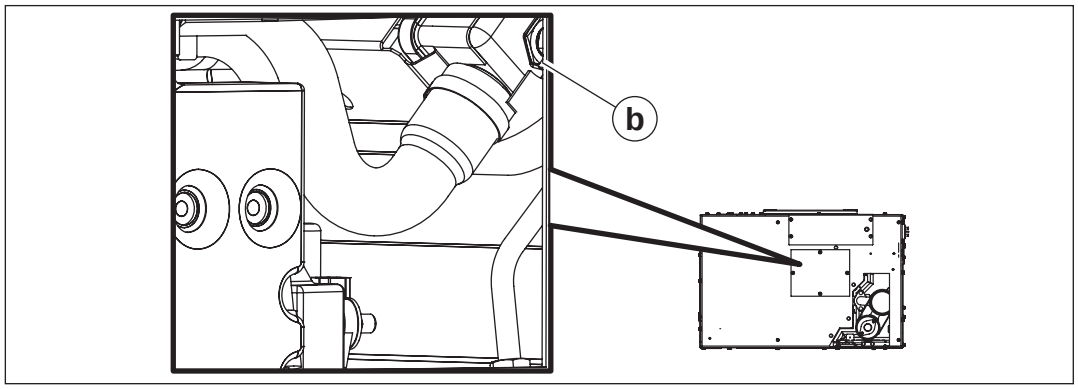
5. Remove bottom access cover.
6. Position the collection container under the drain cock **(b)**.



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7. Open the drain cock and drain the coolant. Approximately 1.5 L (1.5 qts.) will drain.

Cleaning

Clean and flush the cooling system with radiator cleaning chemicals. Follow the instructions for cleaning and flushing that are included with the cleaning chemicals.

Filling

Perform the procedure below to fill the coolant system.

1. Close the radiator drain cock.
2. Fill the cooling system with coolant through the fill opening using a funnel.

Note: *Using a funnel will prevent coolant from entering the vent hose* **(y)***. If coolant enters the vent hose, it may block escaping air as the system fills. If the vent hose is blocked, the system will seem full when in fact it is not. If the vent hose does become blocked:*

   a. Pinch closed the overflow hose **(z)**.
   b. Blow the vent hose clear.

3. Reconnect the battery.
4. Start the genset and operate the genset for a few minutes, then shut it down.
5. Add more coolant if necessary.
6. Reinstall the pressure cap.
7. Reinstall the access cover.
8. Fill the recovery tank with coolant to the “COLD” mark.

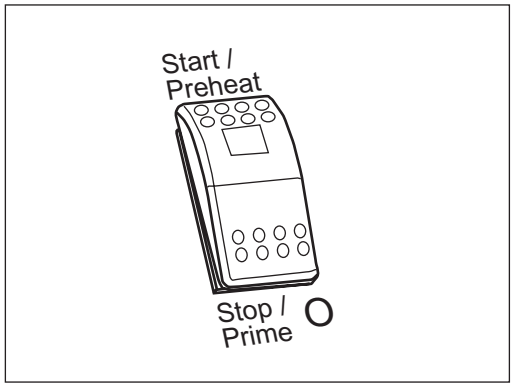
Result

The engine coolant has now been changed.

9.8 Genset Shut-Down Codes

Background

The genset controller includes built-in diagnostic capabilities. Through the blinking of the light indicator on the control switch, a genset fault may be diagnosed. After a fault shutdown, the indicator light will blink a code that indicates the type of fault.



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The indcator light will repeatly blink 1, 2, 3, or 4 blinks at a time.

- **One blink** signifies a shutdown due to a high-temperature condition.
- **Two blinks** indicates a shutdown due to a loss of engine oil pressure.
- **Three blinks** indicates a shutdown due to a service fault.
  Each type of service fault is indicated by a second-level shut-down code. When the indicator is blinking three blinks, pressing Stop will cause the two-digit, second-level shut-down code to appear. (Pressing Stop again will stop the blinking.) The two-digit codes consist of 1, 2, 3, 4, or 5 blinks, a brief pause, 1 to 9 blinks, and then a long pause. The code then repeats. For example, shut-down code 36 appears as:

blink-blink-blink—pause—*blink, blink, blink, blink, blink, blink*—long pause—repeat

- **Four blinks** indicates that engine cranking exceeded the preset time without the engine starting. The preset time is 20 seconds when the ambient temperature is above 0°C (32°F); 30 seconds when the ambient temperature is below 0°C (32°F).

Note

- Be careful not to interpret first-level shut-down faults numbers 3 and 4 as second-level shut-down codes “33” and “44”, which have not been asigned as shut-down codes.
- The genset controller stops the diagnostic fault blinking after five minutes. To resume the blinking, press and release Stop three times rapidly (within three seconds).
- The last fault logged will blink, even after the condition that caused the shut-down condition has been corrected.

Code	Fault Type	Corrective Action
1	**High temperature fault** First-level fault; engine coolant temperature exceeded 110°C (230°F).	1. Check engine coolant level and add coolant as necessary. 2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom and sides of the genset. 3. Flush the coolant system to remove debris which may be clogging passages.
2	**Low oil pressure fault** First-level fault; low oil pressure cutoff switch is open.	1. Check the engine oil level and add oil as necessary. 2. Drain any excess oil if the oil level is above the “FULL” mark on the dipstick. (The oil will foam if the level is too high which can lead to the loss of oil pressure.)
3	**Service check** First-level fault code signifying a second-level code has occurred.	Check the second-level fault code by momentarily pressing Stop. The second-level fault will appear.
4	**Over-crank fault** Cranking time without starting was exceeded.	1. Check fuel level; refill fuel tank. 2. Check for fuel leaks; repair as necessary. 3. Prime the engine fuel system by holding the control switch at Stop for one minute. 4. Replace engine air filter. 5. Replace the fuel filter.
12	**Over-voltage fault** The controller is not able to regulate to rated voltage.	See authorized Cummins Onan dealer.
13	**Under-voltage fault** The controller is not able to regulate to rated voltage.	Turn off the line circuit breaker on the console. If the genset now starts and runs, the load on the genset is too great. Disconnect the extra loads.
14	**Over-frequency fault** The controller is not able to regulate to rated frequency.	1. Disconnect any extra loads. 2. Check for and repair fuel leaks. Air in the fuel supply can disrupt frequency. Prime the engine fuel system by holding the control switch at Stop for one minute.
15	**Under-frequency fault** The controller is not able to regulate to rated frequency.	1. Disconnect any extra loads. 2. Check fuel level; refill fuel tank. 3. Check for and repair fuel leaks. Air in the fuel supply can disrupt frequency. Prime the engine fuel system by holding the control switch at Stop for one minute. 4. Replace engine air filter. 5. Replace the fuel filter.
19	**Governor actuator fault** The controller sensed that the actuator circuit is either open or shorted	See authorized Cummins Onan dealer.

Code	Fault Type	Corrective Action
22	**Governor overload fault** The duration of operation at or near full-duty cycle was beyond the design limit.	1. Disconnect any extra loads. 2. Check for and repair fuel leaks. Air in the fuel supply can disrupt frequency. Prime the engine fuel system by holding the control switch at Stop for one minute. 3. Replace the engine air filter. 4. Clean the spark arrestor. 5. Replace the fuel filter.
24	**Temperature sender fault** The controller sensed that the sender circuit is either open or shorted	See authorized Cummins Onan dealer.
27	**AC voltage sensed fault** The controller was unable to sense output voltage.	See authorized Cummins Onan dealer.
29	**High battery voltage fault** The controller sensed battery system voltage greater than 19 volts.	See authorized Cummins Onan dealer.
32	**Low cranking speed fault** Cranking speed less than 100 rpm (2.5 Hz) for more than 12 seconds.	1. Clean and tighten the battery connections. 2. Recharge or replace the battery. 3. Replace the engine oil with oil of the proper viscosity for the ambient temperature.
35	**Control card fault** Microprocessor EEPROM error during self test	See authorized Cummins Onan dealer.
36	**Engine stopped fault** The genset stopped without a command from the controller.	1. Check fuel level; refill fuel tank. 2. Check for and repair fuel leaks. Air in the fuel supply can disrupt frequency. Prime the engine fuel system by holding the control switch at Stop for one minute. 3. Replace engine air filter. 4. Replace the fuel filter.
38	**Field overload fault** Field voltage exceeded 150VDC	See authorized Cummins Onan dealer.
41	**Shorted rotor fault** The rotor circuit is shorted to ground.	See authorized Cummins Onan dealer.
42	**Processor fault** Microprocessor ROM error during self test	See authorized Cummins Onan dealer.
43	**Processor fault** Microprocessor RAM error during self test	See authorized Cummins Onan dealer.
45	**Speed sense fault** Controller unable to sense quadrature frequency	1. Check fuel level; refill fuel tank. 2. Check for and repair fuel leaks. Air in the fuel supply can disrupt frequency. Prime the engine fuel system by holding the control switch at Stop for one minute.

Code	Fault Type	Corrective Action
57	**Over-prime fault** Prime mode exceeded 3 minutes.	1. Check control switch. Remove anything that may be holding it in the Prime position.

10 Troubleshooting

10.1 Troubleshooting the Machine

Problem / Symptom	Reason	Remedy
Thaw progress is below capacity.	The insulation is insufficient.	Add additional insulation blankets.
	The moisture is insufficient.	Verify that there is standing water on job site.
	There is no vapor barrier.	Lay down vapor barrier.
	The HTF is not flowing.	Verify that the pump pressure is nominal and hoses are not restricted.
	The temperature control is not set properly.	Set the temperature control to optimum setting. This setting depends on environmental conditions at the job site.
	The soil conditions are not as expected.	Re-evaluate thawing plan based on job site conditions.
Pump will not start.	There is no power.	Verify that the breaker switch is ON. Verify that the HTF level is within range and low level cutoff control is reset (low level indicator light must be OFF).
	The HTF temperature is below -26°C (-15°F).	Warm the HTF and hoses before starting machine; see topic *Preheating the Heat Transfer Fluid (HTF)* in this manual.
Hose rewind does not work.	The hose reel brake is not fully released.	Fully release the hose reel brake.
	The motor temperature is below nominal value (<18°C (0°F)).	Warm the enclosure by running the machine with all doors closed *or* warm the enclosure using an external heat source.
	The foot pedal switch has failed.	Replace the foot pedal switch.

Problem / Symptom	Reason	Remedy
Pump is noisy and HTF flow is below nominal value.	The suction valve is not fully open.	Verify that the suction valve is fully open.
	The HTF temperature is below -26°C (-15°F).	Warm the HTF and hoses before starting machine; see topic *Preheating the HTF* in this manual.
	The strainer basket is clogged.	Clean the strainer basket; see topic *Cleaning the HTF Strainer*.

10.2 Troubleshooting the Oil Burner

Problem / Symptom	Reason	Remedy
The burner does not start.	Improper switch position or protective function action.	Verify that the breaker is ON. Verify that the HTF level is within range and low level shutdown device is reset (low level indicator light must be OFF).
	The over-temperature limit has tripped.	Allow the burner to cool.
	The burner primary control is in lockout mode.	Reset the burner control.
The burner starts; the flame does not ignite.	There is no fuel.	Fill fuel tank.
	The burner nozzle is damaged or worn.	Replace the burner nozzle.
	The electrodes are defective.	Replace the electrodes.
	The cadmium cell is malfunctioning.	Replace the cadmium cell.
	The burner primary control is malfunctioning.	Replace the burner primary control.
The burner starts and the flame ignites, but the unit locks out.	The fuel pressure is set incorrectly.	Adjust the fuel pressure.
	The burner nozzle is damaged or worn.	Replace the burner nozzle.
	The air damper is set incorrectly.	Adjust the air damper.
	The cadmium cell is malfunctioning.	Replace the cadmium cell.
	The burner primary control is malfunctioning.	Replace the burner primary control.
Combustion is poor or noisy.	There is a lack of fresh air to burner.	Ensure there is an adequate air supply.

10.3 Troubleshooting the Gas Burner

Problem / Symptom	Reason	Remedy
The flame ignites, but the burner goes to lockout within 5 seconds	The phase/neutral lines are reversed.	Correct the wiring.
	The wiring to ground is faulty.	Correct the wiring.
	The ionization probe is grounded, or not in contact with the flame, or the circuit to the control box is broken.	Correct the wiring.
	The spark interferes with the flame signal due to incorrect setting of the electrode.	Readjust the ignition electrode.
The burner goes to lockout after the prepurge period because the flame does not ignite.	There is air in the gas line.	Bleed the gas line.
	The gas valve is passing too little gas.	Check and adjust the gas pressure.
	The spark is irregular or not present.	Readjust the ignition electrode.
The burner does not start when the temperature controller calls for heat.	There is low gas pressure.	Adjust the gas pressure.
	The 24V switching relay is faulty.	Replace the 24V relay.
	The burner switch is OFF.	Turn the burner switch ON.
	The circuit breaker is tripped.	Reset the circuit breaker.
	Terminals on the control module are bent or loose.	Repair or replace the control module.
	The motor is faulty.	Repair or replace the motor.
	The capacitor is faulty.	Replace the capacitor.
	The end switch on the air damper is faulty.	Replace the end switch.
	The control module is faulty.	Replace the control module.
	The air pressure switch is not in the normally closed position.	Replace the air switch.
The burner continues to repeat the starting cycle without going into lockout.	Gas pressure switch set incorrectly.	Reset the gas pressure switch.
The burner does not go through prepurge, and the control module goes to lockout.	Air pressure switch is not changing from normally closed to normally open due to insufficient air pressure in the combustion head.	Adjust the combustion head.

11 Technical Data

11.1 Machine

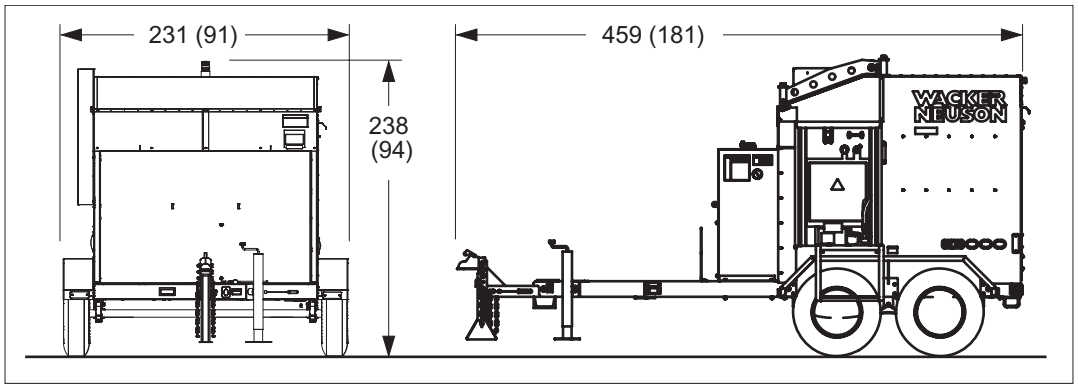
Model E 3000	Units	Item No. 0620158	Item No. 0620219	Item No. 0620678	Item No. 0620679
Weight (no fuel)	kg (lb)	2,531 (5,580)	2,769 (6,105)	2,928 (6,457)	3,209 (7,073)
Weight (full fuel)	kg (lb)	3,262 (7,190)	3,500 (7,715)	3,613 (7,966)	3,893 (8,582)
Generator weight	kg (lb)	240 (525)			
Fuel tank capacity	L (gal)	871 (230)			
Hose length	m (ft)	914 (3,000)			
HTF capacity	L (gal)	435 (115)			
HTF pump	L/hr (gph)	2 X 1,003 (2 X 265)			
Burner nozzle	gph X deg	2.25 X 80° B			
Fuel pressure	bar (psi)	10.34 (150)			
Fuel input	type	Diesel			
Heat ouput	kW/hr (BTU)/hr	113 (385,000)			
Heater efficiency	%	83			
Run time (up to)	hr	140			
Hose pressure	bar (psi)	6.2–7.5 (90–110)			
Standard thaw capacity	m^2 (ft^2)	279–558 (3,000–6,000)			
Accelerated thaw capacity	m^2 (ft^2)	558 (6,000)			
Standard cure capacity	m^2 (ft^2)	558 (6,000)			
Expanded cure capacity	m^2 (ft^2)	1,672 (18,000)			
Frost prevention capacity	m^2 (ft^2)	836 (9,000)			
Air heat capacity (requires accessories)	m^3 (ft^3)	14,865 (525,000)			

11.2 Trailer

Item Number Model		0620158 E 3000	0620219 E 3000	0620678 E 3000	0620679 E 3000
GAWR (Gross Axle Weight Rating)	kg (lb)	1,588 (3,500)		2,359 (5,200)	
Wheel diameter	mm (in.)	356 (14)		381 (15)	
Tire code	—	225 75R14		215 75R15	
Tire pressure	kPa (psi)	345 (50)		448 (65)	
Lug nut torque	Nm (ft-lbs)	150 (110)			
GVWR (Gross Vehicle Weight Rating)	kg (lb)	3,499 (7,715)		3,895 (8,582)	
Brake type	—	Electric			
Maximum towing speed	km/h (MPH)	72 (45)			

11.3 Dimensions

cm (in.)



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Material Safety Data Sheet

The Dow Chemical Company

Product Name: DOWFROST* HD 50 Heat Transfer Fluid, Dyed

Issue Date: 09/24/2010
Print Date: 18 Aug 2011

The Dow Chemical Company encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. Product and Company Identification

Product Name
DOWFROST* HD 50 Heat Transfer Fluid, Dyed

COMPANY IDENTIFICATION
The Dow Chemical Company
2030 Willard H. Dow Center
Midland, MI 48674
USA

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: 989-636-4400
Local Emergency Contact: 989-636-4400

2. Hazards Identification

Emergency Overview
Color: Yellow to green
Physical State: Liquid.
Odor: Characteristic
Hazards of product:

No significant immediate hazards for emergency response are known.

OSHA Hazard Communication Standard
This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Potential Health Effects
Eye Contact: May cause slight temporary eye irritation. Corneal injury is unlikely.
Skin Contact: Prolonged contact is essentially nonirritating to skin. Repeated contact may cause flaking and softening of skin.
Skin Absorption: Prolonged skin contact is unlikely to result in absorption of harmful amounts.

Inhalation: At room temperature, exposure to vapor is minimal due to low volatility. Mist may cause irritation of upper respiratory tract (nose and throat).
Ingestion: Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.
Aspiration hazard: Based on physical properties, not likely to be an aspiration hazard.
Effects of Repeated Exposure: In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

3. Composition Information

Component	CAS #	Amount
Propylene glycol	57-55-6	> 48.0 - < 54.0 %
Water	7732-18-5	< 50.0 %
Dipotassium hydrogen phosphate	7758-11-4	< 3.0 %

4. First-aid measures

Eye Contact: Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.
Skin Contact: Wash skin with plenty of water.
Inhalation: Move person to fresh air; if effects occur, consult a physician.
Ingestion: No emergency medical treatment necessary.
Notes to Physician: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.
Emergency Personnel Protection: If potential for exposure exists refer to Section 8 for specific personal protective equipment.

5. Fire Fighting Measures

Extinguishing Media: To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam.
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed. To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam.
Special Protective Equipment for Firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.
Unusual Fire and Explosion Hazards: This material will not burn until the water has evaporated. Residue can burn.
Hazardous Combustion Products: Under fire conditions some components of this product may decompose. The smoke may contain unidentified toxic and/or irritating compounds. Combustion products may include and are not limited to: Carbon monoxide. Carbon dioxide.

6. Accidental Release Measures

Steps to be Taken if Material is Released or Spilled: Small spills: Absorb with materials such as: Cat litter. Sawdust. Vermiculite. Zorb-all®. Collect in suitable and properly labeled containers. Large spills: Dike area to contain spill. See Section 13, Disposal Considerations, for additional information.

Personal Precautions: Keep unnecessary and unprotected personnel from entering the area. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.
Environmental Precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

7. Handling and Storage

Handling

General Handling: No special precautions required. Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Storage

Do not store in: Galvanized steel. Opened or unlabeled containers. Store in the following material(s): Carbon steel. Stainless steel. Store in original unopened container. See Section 10 for more specific information. Additional storage and handling information on this product may be obtained by calling your sales or customer service contact.

8. Exposure Controls / Personal Protection

Exposure Limits

Component	List	Type	Value
Propylene glycol	WEEL	TWA Aerosol.	10 mg/m3

Personal Protection

Eye/Face Protection: Use safety glasses (with side shields).
Skin Protection: Wear clean, body-covering clothing.

Hand protection: Use gloves chemically resistant to this material when prolonged or frequently repeated contact could occur. Examples of preferred glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl alcohol ("PVA"). Polyvinyl chloride ("PVC" or "vinyl"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Respiratory Protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. In misty atmospheres, use an approved particulate respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.
Ingestion: Use good personal hygiene. Do not consume or store food in the work area. Wash hands before smoking or eating.

Engineering Controls

Ventilation: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

9. Physical and Chemical Properties

Physical State	Liquid.
Color	Yellow to green
Odor	Characteristic
Odor Threshold	No test data available
Flash Point - Closed Cup	Not applicable, Water boils off
Flammability (solid, gas)	Not applicable to liquids
Flammable Limits In Air	**Lower**: 2.6 %(V) *Literature* Propylene glycol. **Upper**: 12.5 %(V) *Literature* Propylene glycol.
Autoignition Temperature	371 °C (700 °F) *Literature* Propylene glycol.
Vapor Pressure	15.5 mmHg @ 20 °C *Literature*
Boiling Point (760 mmHg)	104 °C (219 °F) *Literature* .
Vapor Density (air = 1)	>1.0 *Literature*
Specific Gravity (H2O = 1)	1.06 20 °C/20 °C *Literature*
Freezing Point	-33.8 °C (-28.8 °F) *Literature*
Melting Point	Not applicable to liquids
Solubility in water (by weight)	100 % *Literature*
pH	9.5 *Literature*
Decomposition Temperature	No test data available
Partition coefficient, n-octanol/water (log Pow)	No data available for this product.
Evaporation Rate (Butyl Acetate = 1)	<0.5 *Estimated.*
Kinematic Viscosity	6.3 cSt *Literature*

10. Stability and Reactivity

Stability/Instability

Thermally stable at recommended temperatures and pressures.
Conditions to Avoid: Some components of this product can decompose at elevated temperatures. Generation of gas during decomposition can cause pressure in closed systems.

Incompatible Materials: Avoid contact with: Strong acids. Strong bases. Strong oxidizers.

Hazardous Polymerization

Will not occur.

Thermal Decomposition

Decomposition products depend upon temperature, air supply and the presence of other materials.

11. Toxicological Information

Acute Toxicity

Ingestion

For the major component(s): Propylene glycol. LD50, Rat > 20,000 mg/kg

Dermal

For the major component(s): Propylene glycol. LD50, Rabbit > 20,000 mg/kg

Inhalation

For the major component(s): No deaths occurred following exposure to a saturated atmosphere. LC50, 8 h, Vapor, Rat 4.1 mg/l

Eye damage/eye irritation

May cause slight temporary eye irritation. Corneal injury is unlikely.

Skin corrosion/irritation

Prolonged contact is essentially nonirritating to skin. Repeated contact may cause flaking and softening of skin.

Sensitization

Skin

For the major component(s): Did not cause allergic skin reactions when tested in humans.

Respiratory

No relevant information found.

Repeated Dose Toxicity

In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

Chronic Toxicity and Carcinogenicity

Similar formulations did not cause cancer in laboratory animals.

Developmental Toxicity

For the major component(s): Did not cause birth defects or any other fetal effects in laboratory animals.

Reproductive Toxicity

For the major component(s): In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.

Genetic Toxicology

In vitro genetic toxicity studies were negative. For the major component(s): Animal genetic toxicity studies were negative.

12. Ecological Information

ENVIRONMENTAL FATE

Movement & Partitioning

For the major component(s): Bioconcentration potential is low (BCF less than 100 or log Pow less than 3). Potential for mobility in soil is very high (Koc between 0 and 50).

Persistence and Degradability

For the major component(s): Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.

ECOTOXICITY

For the major component(s): Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).

13. Disposal Considerations

DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Recycler. Reclaimer. Incinerator or other thermal destruction device.

14. Transport Information

DOT Non-Bulk
NOT REGULATED

DOT Bulk
NOT REGULATED

IMDG
NOT REGULATED

ICAO/IATA
NOT REGULATED

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. Regulatory Information

OSHA Hazard Communication Standard
This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	No
Delayed (Chronic) Health Hazard	No
Fire Hazard	No
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Hazardous Substances List and/or Pennsylvania Environmental Hazardous Substance List:
The following product components are cited in the Pennsylvania Hazardous Substance List and/or the Pennsylvania Environmental Substance List, and are present at levels which require reporting.

Component	CAS #	Amount
Propylene glycol	57-55-6	> 48.0 - < 54.0 %

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Special Hazardous Substances List:
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

Toxic Substances Control Act (TSCA)

All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

CEPA - Domestic Substances List (DSL)

This product contains one or more substances which are not listed on the Canadian Domestic Substances List (DSL). Contact your sales or technical service representative for more information.

16. Other Information

Hazard Rating System

NFPA	Health	Fire	Reactivity
	0	0	0

Recommended Uses and Restrictions

Intended as a heat transfer fluid for closed-loop systems. We recommend that you use this product in a manner consistent with the listed use. If your intended use is not consistent with the stated use, please contact your sales or technical service representative.

Revision

Identification Number: 50551 / 1001 / Issue Date 09/24/2010 / Version: 4.0

Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

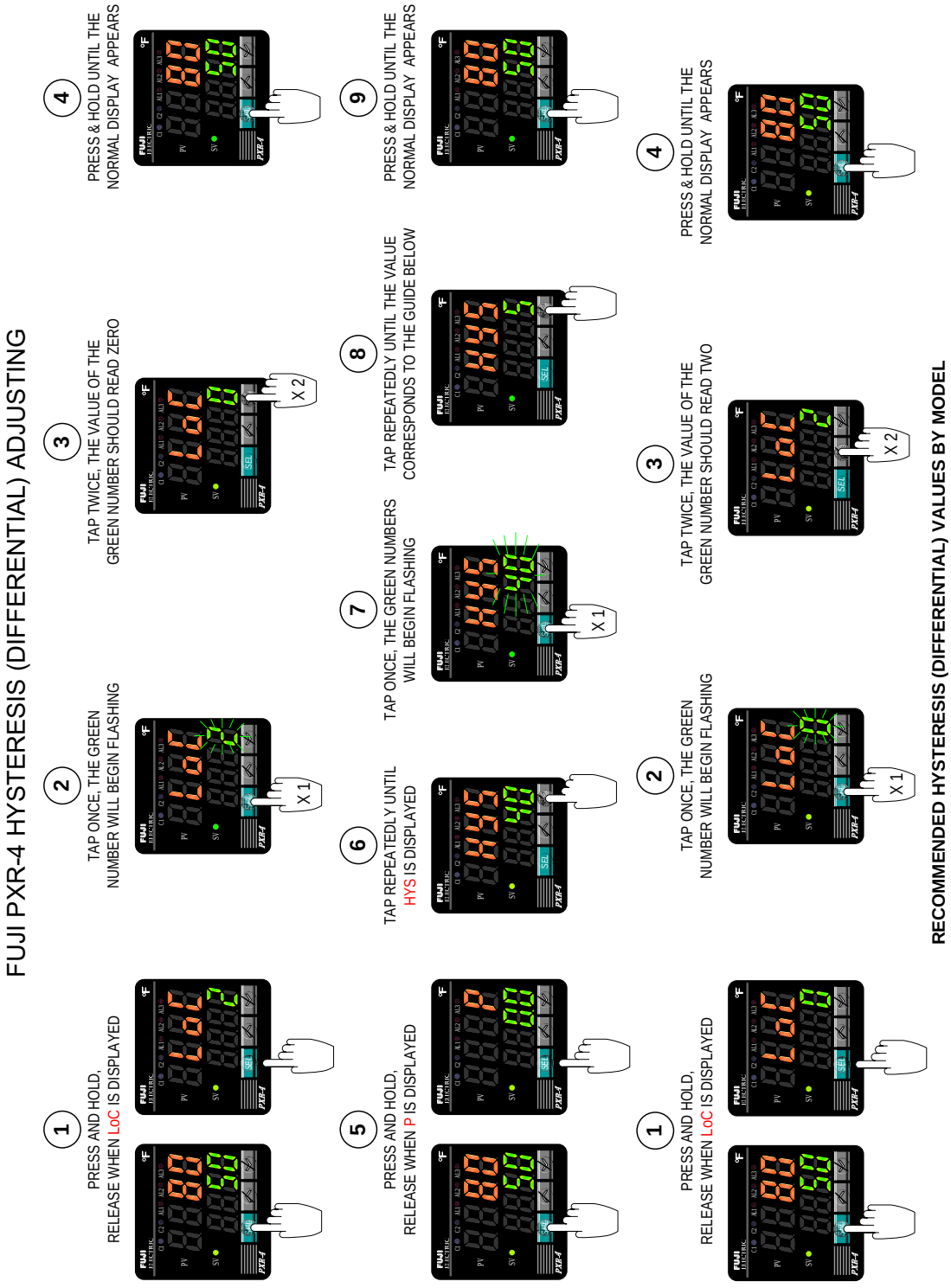
N/A	Not available
W/W	Weight/Weight
OEL	Occupational Exposure Limit
STEL	Short Term Exposure Limit
TWA	Time Weighted Average
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
DOW IHG	Dow Industrial Hygiene Guideline
WEEL	Workplace Environmental Exposure Level
HAZ_DES	Hazard Designation
Action Level	A value set by OSHA that is lower than the PEL which will trigger the need for activities such as exposure monitoring and medical surveillance if exceeded.

The Dow Chemical Company urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

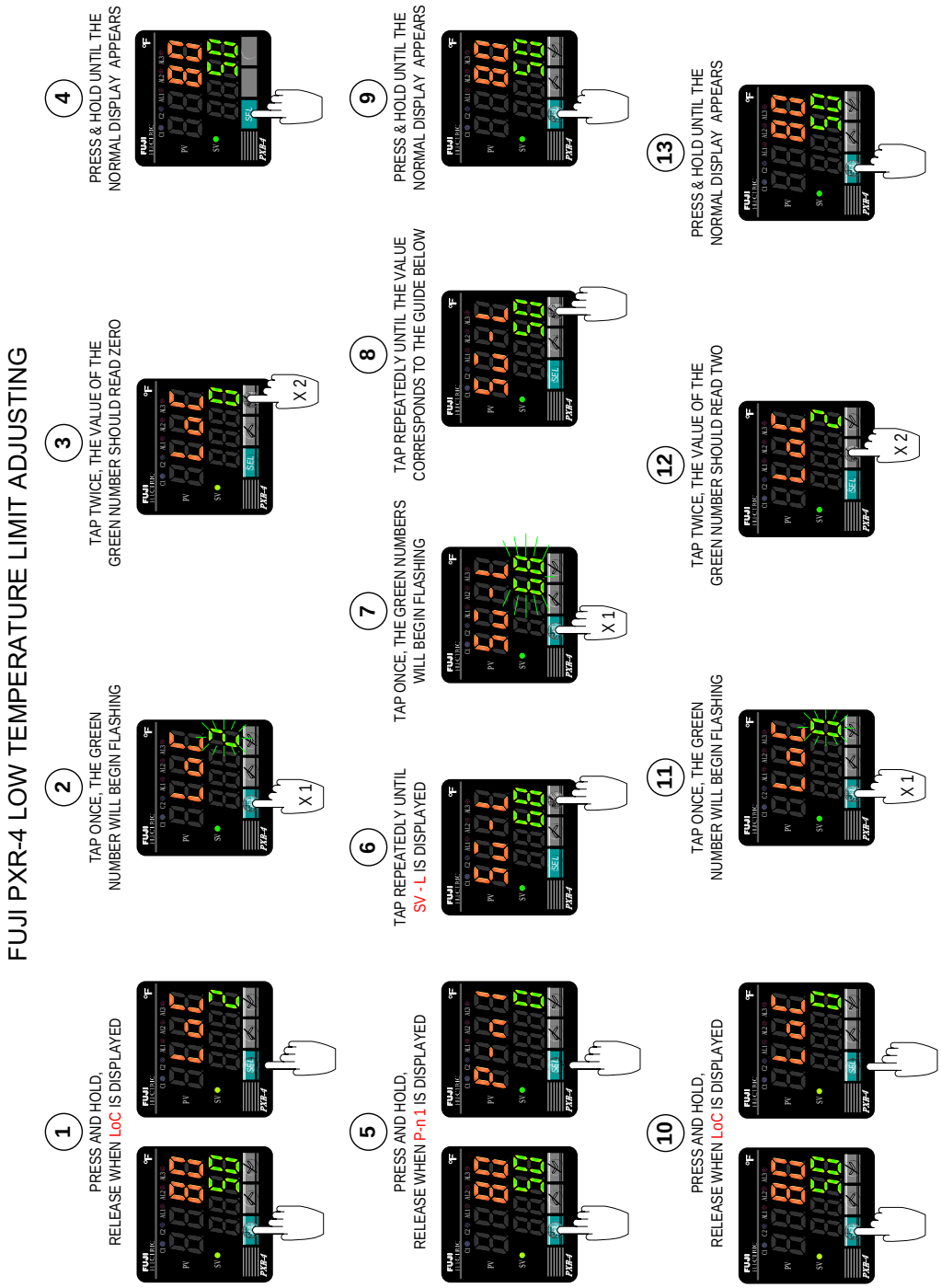
MSDS: Dowfrost™ HD 50

Fuji Temperature Controller

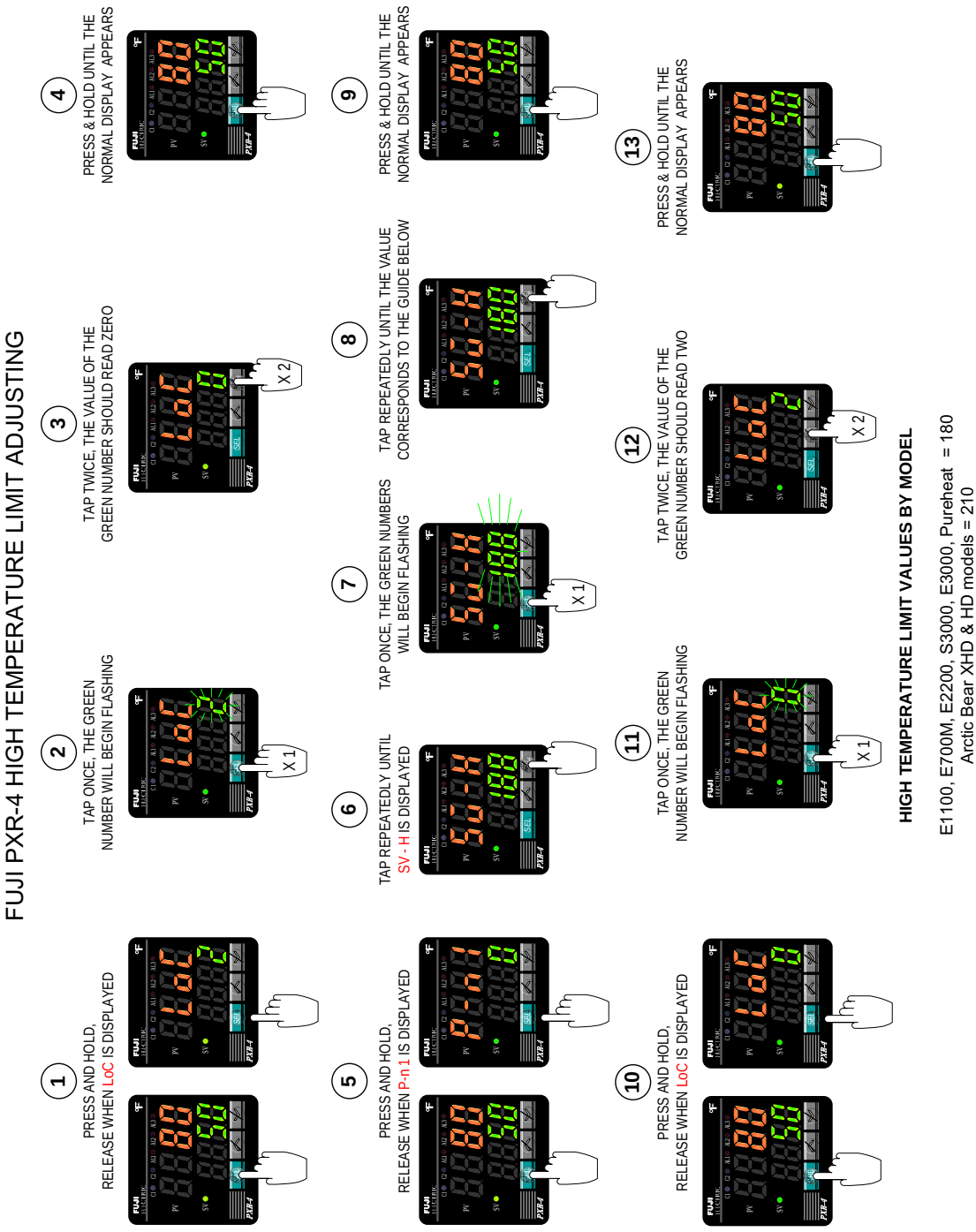
Fuji Temperature Controller Hysteresis (differential) Adjusting



Fuji Temperature Controller Low Temperature Limit Adjusting



Fuji Temperature Controller High Temperature Limit Adjusting



Tire Safety Information

Introduction to Tire Safety Information

Federal Regulation 49 CFR 575 requires trailer manufacturers to include certain tire information in the Owner’s Manuals for the trailers they manufacture. This regulation requires that the information be in the English language. This chapter includes all the information required by Federal Regulation 49 CFR 575.

1. TIRE SAFETY INFORMATION

This portion of the User's Manual contains tire safety information as required by 49 CFR 575.6.

Section 1.1 contains "Steps for Determining Correct Load Limit - Trailer".

Section 1.2 contains "Steps for Determining Correct Load Limit – Tow Vehicle".

Section 1.3 contains a Glossary of Tire Terminology, including "cold inflation pressure", "maximum inflation pressure", "recommended inflation pressure", and other non-technical terms.

Section 1.4 contains information from the NHTSA brochure entitled "Tire Safety – Everything Rides On It". This brochure This brochure, as well as the preceding subsections, describes the following items;

- Tire labeling, including a description and explanation of each marking on the tires, and information about the DOT Tire Identification Number (TIN).
- Recommended tire inflation pressure, including a description and explanation of:
  A. Cold inflation pressure.
  B. Vehicle Placard and location on the vehicle.
  C. Adverse safety consequences of under inflation (including tire failure).
  D. Measuring and adjusting air pressure for proper inflation.
- Tire Care, including maintenance and safety practices.
- Vehicle load limits, including a description and explanation of the following items:
  A. Locating and understanding the load limit information, total load capacity, and cargo capacity.
  B. Calculating total and cargo capacities with varying seating configurations including quantitative examples showing / illustrating how the vehicles cargo and luggage capacity decreases as combined number and size of occupants' increases. This item is also discussed in Section 3.
  C. Determining compatibility of tire and vehicle load capabilities.
  D. Adverse safety consequences of overloading on handling and stopping on tires.

1.1. STEPS FOR DETERMINING CORRECT LOAD LIMIT – TRAILER

Determining the load limits of a trailer includes more than understanding the load limits of the tires alone. On all trailers there is a Federal certification/VIN label that is located on the forward half of the left (road) side of the unit. This certification/VIN label will indicate the trailer's Gross Vehicle Weight Rating (GVWR). This is the most weight the fully loaded trailer can weigh. It will also provide the Gross Axle Weight Rating (GAWR). This is the most a particular axle can weigh. If there are multiple axles, the GAWR of each axle will be provided.

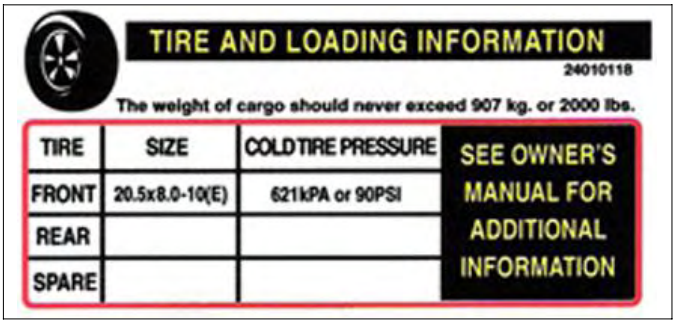
If your trailer has a GVWR of 10,000 pounds or less, there is a vehicle placard located in the same location as the certification label described above. This placard provides tire and loading information. In addition, this placard will show a statement regarding maximum cargo capacity. Cargo can be added to the trailer, up to the maximum weight specified on the placard. The combined weight of the cargo is provided as a single number. In any case, remember: the total weight of a fully loaded trailer can not exceed the stated GVWR.

For trailers with living quarters installed, the weight of water and propane also need to be considered. The weight of fully filled propane containers is considered part of the weight of the trailer before it is loaded with cargo, and is not considered part of the disposable cargo load. Water however, is a disposable cargo weight and is treated as such. If there is a fresh water storage tank of 100 gallons, this tank when filled would weigh about 800 pounds. If more cargo is being transported, water can be off-loaded to keep the total amount of cargo added to the vehicle within the limits of the GVWR so as not to overload the vehicle. Understanding this flexibility will allow you, the owner, to make choices that fit your travel needs.

When loading your cargo, be sure it is distributed evenly to prevent overloading front to back and side to side. Heavy items should be placed low and as close to the axle positions as reasonable. Too many items on one side may overload a tire. The best way to know the actual weight of the vehicle is to weigh it at a public scale. Talk to your dealer to discuss the weighing methods needed to capture the various weights related to the trailer. This would include the weight empty or unloaded, weights per axle, wheel, hitch or king-pin, and total weight.

Excessive loads and/or underinflation cause tire overloading and, as a result, abnormal tire flexing occurs. This situation can generate an excessive amount of heat within the tire. Excessive heat may lead to tire failure. It is the air pressure that enables a tire to support the load, so proper inflation is critical. The proper air pressure may be found on the certification/VIN label and/or on the Tire Placard. This value should never exceed the maximum cold inflation pressure stamped on the tire.

1.1.1. Trailers 10,000 Pounds GVWR or Less



Tire and Loading Information Placard – Figure 1-1

1. Locate the statement, “The weight of cargo should never exceed XXX kg or XXX lbs.,” on your vehicle’s placard. See figure 1-1.
2. This figure equals the available amount of cargo and luggage load capacity.
3. Determine the combined weight of luggage and cargo being loaded on the vehicle. That weight may not safely exceed the available cargo and luggage load capacity.

The trailer’s placard refers to the Tire Information Placard attached adjacent to or near the trailer’s VIN (Certification) label at the left front of the trailer.

1.1.2. Trailers Over 10,000 Pounds GVWR (Note: These trailers are not required to have a tire information placard on the vehicle)

1. Determine the empty weight of your trailer by weighing the trailer using a public scale or other means. This step does not have to be repeated.
2. Locate the GVWR (Gross Vehicle Weight Rating) of the trailer on your trailer’s VIN (Certification) label.
3. Subtract the empty weight of your trailer from the GVWR stated on the VIN label. That weight is the maximum available cargo capacity of the trailer and may not be safely exceeded.

1.2. Steps for Determining Correct Load Limit – Tow Vehicle

1. Locate the statement, “The combined weight of occupants and cargo should never exceed XXX lbs.,” on your vehicle’s placard.
2. Determine the combined weight of the driver and passengers who will be riding in your vehicle.
3. Subtract the combined weight of the driver and passengers from XXX kilograms or XXX pounds.
4. The resulting figure equals the available amount of cargo and luggage capacity. For example, if the “XXX” amount equals 1400 lbs. and there will be five 150 lb. passengers in your vehicle, the amount of available cargo and luggage capacity is 650 lbs. (1400-750 (5 x 150) = 650 lbs.).
5. Determine the combined weight of luggage and cargo being loaded on the vehicle. That weight may not safely exceed the available cargo and luggage capacity calculated in Step # 4.
6. If your vehicle will be towing a trailer, load from your trailer will be transferred to your vehicle. Consult the tow vehicle’s manual to determine how this weight transfer reduces the available cargo and luggage capacity of your vehicle.

1.3. Glossary Of Tire Terminology

Accessory weight
The combined weight (in excess of those standard items which may be replaced) of automatic transmission, power steering, power brakes, power windows, power seats, radio and heater, to the extent that these items are available as factory-installed equipment (whether installed or not).

Tire Safety Information

Bead
The part of the tire that is made of steel wires, wrapped or reinforced by ply cords and that is shaped to fit the rim.

Bead separation
This is the breakdown of the bond between components in the bead.

Bias ply tire
A pneumatic tire in which the ply cords that extend to the beads are laid at alternate angles substantially less than 90 degrees to the centerline of the tread.

Carcass
The tire structure, except tread and sidewall rubber which, when inflated, bears the load.

Chunking
The breaking away of pieces of the tread or sidewall.

Cold inflation pressure
The pressure in the tire before you drive.
Cord
The strands forming the plies in the tire.

Cord separation
The parting of cords from adjacent rubber compounds.

Cracking
Any parting within the tread, sidewall, or inner liner of the tire extending to cord material.

CT
A pneumatic tire with an inverted flange tire and rim system in which the rim is designed with rim flanges pointed radially inward and the tire is designed to fit on the underside of the rim in a manner that encloses the rim flanges inside the air cavity of the tire.

Curb weight
The weight of a motor vehicle with standard equipment including the maximum capacity of fuel, oil, and coolant, and, if so equipped, air conditioning and additional weight optional engine.

Extra load tire
A tire designed to operate at higher loads and at higher inflation pressures than the corresponding standard tire.

Groove
The space between two adjacent tread ribs.

Gross Axle Weight Rating
The maximum weight that any axle can support, as published on the Certification / VIN label on the front left side of the trailer. Actual weight determined by weighing each axle on a public scale, with the trailer attached to the towing vehicle.

Gross Vehicle Weight Rating
The maximum weight of the fully loaded trailer, as published on the Certification / VIN label. Actual weight determined by weighing trailer on a public scale, without being attached to the towing vehicle.

Hitch Weight
The downward force exerted on the hitch ball by the trailer coupler.

Innerliner
The layer(s) forming the inside surface of a tubeless tire that contains the inflating medium within the tire.

Innerliner separation
The parting of the innerliner from cord material in the carcass.

Intended outboard sidewall
The sidewall that contains a white-wall, bears white lettering or bears manufacturer, brand, and/or model name molding that is higher or deeper than the same molding on the other sidewall of the tire or the outward facing sidewall of an asymmetrical tire that has a particular side that must always face outward when mounted on a vehicle.

Light truck (LT) tire
A tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Load rating
The maximum load that a tire is rated to carry for a given inflation pressure.

Maximum load rating
The load rating for a tire at the maximum permissible inflation pressure for that tire.

Maximum permissible inflation pressure
The maximum cold inflation pressure to which a tire may be inflated.

Maximum loaded vehicle weight
The sum of curb weight, accessory weight, vehicle capacity weight, and production options weight.

Measuring rim
The rim on which a tire is fitted for physical dimension requirements.

Pin Weight
The downward force applied to the 5^{th} wheel or gooseneck ball, by the trailer kingpin or gooseneck coupler.

Non-pneumatic rim
A mechanical device which, when a non-pneumatic tire assembly incorporates a wheel, supports the tire, and attaches, either integrally or separably, to the wheel center member and upon which the tire is attached.

Non-pneumatic spare tire assembly
A non-pneumatic tire assembly intended for temporary use in place of one of the pneumatic tires and rims that are fitted to a passenger car in compliance with the requirements of this standard.

Non-pneumatic tire
A mechanical device which transmits, either directly or through a wheel or wheel center member, the vertical load and tractive forces from the roadway to the vehicle, generates the tractive forces that provide the directional control of the vehicle and does not rely on the containment of any gas or fluid for providing those functions.

Non-pneumatic tire assembly
A non-pneumatic tire, alone or in combination with a wheel or wheel center member, which can be mounted on a vehicle.

Normal occupant weight
This means 68 kilograms (150 lbs.) times the number of occupants specified in the second column of Table I of 49 CFR 571.110.

Occupant distribution
The distribution of occupants in a vehicle as specified in the third column of Table I of 49 CFR 571.110.

Open splice
Any parting at any junction of tread, sidewall, or innerliner that extends to cord material.

Outer diameter
The overall diameter of an inflated new tire.

Overall width
The linear distance between the exteriors of the sidewalls of an inflated tire, including elevations due to labeling, decorations, or protective bands or ribs.

Tire Safety Information

Ply
A layer of rubber-coated parallel cords.

Ply separation
A parting of rubber compound between adjacent plies.

Pneumatic tire
A mechanical device made of rubber, chemicals, fabric and steel or other materials, that, when mounted on an automotive wheel, provides the traction and contains the gas or fluid that sustains the load.

Production options weight
The combined weight of those installed regular production options weighing over 2.3 kilograms (5 lbs.) in excess of those standard items which they replace, not previously considered in curb weight or accessory weight, including heavy duty brakes, ride levelers, roof rack, heavy duty battery, and special trim.

Radial ply tire
A pneumatic tire in which the ply cords that extend to the beads are laid at substantially 90 degrees to the centerline of the tread.

Recommended inflation pressure
This is the inflation pressure provided by the vehicle manufacturer on the Tire Information label and on the Certification / VIN tag.

Reinforced tire
A tire designed to operate at higher loads and at higher inflation pressures than the corresponding standard tire.

Rim
A metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

Rim diameter
This means the nominal diameter of the bead seat.

Rim size designation
This means the rim diameter and width.

Rim type designation
This means the industry of manufacturer’s designation for a rim by style or code.

Rim width
This means the nominal distance between rim flanges.

Section width
The linear distance between the exteriors of the sidewalls of an inflated tire, excluding elevations due to labeling, decoration, or protective bands.

Sidewall
That portion of a tire between the tread and bead.

Sidewall separation
The parting of the rubber compound from the cord material in the sidewall.

Special Trailer (ST) tire
The "ST" is an indication the tire is for trailer use only.

Test rim
The rim on which a tire is fitted for testing, and may be any rim listed as appropriate for use with that tire.

Tread
That portion of a tire that comes into contact with the road.

Tread rib
A tread section running circumferentially around a tire.

Tread separation
Pulling away of the tread from the tire carcass.

Treadwear indicators (TWI)
The projections within the principal grooves designed to give a visual indication of the degrees of wear of the tread.

Vehicle capacity weight
The rated cargo and luggage load plus 68 kilograms (150 lbs.) times the vehicle's designated seating capacity.

Vehicle maximum load on the tire
The load on an individual tire that is determined by distributing to each axle its share of the maximum loaded vehicle weight and dividing by two.

Vehicle normal load on the tire
The load on an individual tire that is determined by distributing to each axle its share of the curb weight, accessory weight, and normal occupant weight (distributed in accordance with Table I of CRF 49 571.110) and dividing by 2.

Weather side
The surface area of the rim not covered by the inflated tire.

Wheel center member
In the case of a non-pneumatic tire assembly incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic rim and provides the connection between the non-pneumatic rim and the vehicle; or, in the case of a non-pneumatic tire assembly not incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic tire and provides the connection between tire and the vehicle.

Wheel-holding fixture
The fixture used to hold the wheel and tire assembly securely during testing.

1.4. TIRE SAFETY - EVERYTHING RIDES ON IT

The National Traffic Safety Administration (NHTSA) has published a brochure (DOT HS 809 361) that discusses all aspects of Tire Safety, as required by CFR 575.6. This brochure is reproduced in part below. It can be obtained and downloaded from NHTSA, free of charge, from the following web site:

http://www.nhtsa.dot.gov/cars/rules/TireSafety/ridesonit/tires_index.html

Studies of tire safety show that maintaining proper tire pressure, observing tire and vehicle load limits (not carrying more weight in your vehicle than your tires or vehicle can safely handle), avoiding road hazards, and inspecting tires for cuts, slashes, and other irregularities are the most important things you can do to avoid tire failure, such as tread separation or blowout and flat tires. These actions, along with other care and maintenance activities, can also:

- Improve vehicle handling
- Help protect you and others from avoidable breakdowns and accidents
- Improve fuel economy
- Increase the life of your tires.

This booklet presents a comprehensive overview of tire safety, including information on the following topics:
- Basic tire maintenance
- Uniform Tire Quality Grading System
- Fundamental characteristics of tires

Tire Safety Information

Use this information to make tire safety a regular part of your vehicle maintenance routine. Recognize that the time you spend is minimal compared with the inconvenience and safety consequences of a flat tire or other tire failure.

1.5. SAFETY FIRST–BASIC TIRE MAINTENANCE

Properly maintained tires improve the steering, stopping, traction, and load-carrying capability of your vehicle. Underinflated tires and overloaded vehicles are a major cause of tire failure. Therefore, as mentioned above, to avoid flat tires and other types of tire failure, you should maintain proper tire pressure, observe tire and vehicle load limits, avoid road hazards, and regularly inspect your tires.

1.5.1. FINDING YOUR VEHICLE'S RECOMMENDED TIRE PRESSURE AND LOAD LIMITS

Tire information placards and vehicle certification labels contain information on tires and load limits. These labels indicate the vehicle manufacturer's information including:

- Recommended tire size
- Recommended tire inflation pressure
- Vehicle capacity weight (VCW–the maximum occupant and cargo weight a vehicle is designed to carry)
- Front and rear gross axle weight ratings (GAWR– the maximum weight the axle systems are designed to carry).

Both placards and certification labels are permanently attached to the trailer near the left front.

1.5.2. UNDERSTANDING TIRE PRESSURE AND LOAD LIMITS

Tire inflation pressure is the level of air in the tire that provides it with load-carrying capacity and affects the overall performance of the vehicle. The tire inflation pressure is a number that indicates the amount of air pressure– measured in pounds per square inch (psi)–a tire requires to be properly inflated. (You will also find this number on the vehicle information placard expressed in kilopascals (kpa), which is the metric measure used internationally.)

Manufacturers of passenger vehicles and light trucks determine this number based on the vehicle's design load limit, that is, the greatest amount of weight a vehicle can safely carry and the vehicle's tire size. The proper tire pressure for your vehicle is referred to as the "recommended cold inflation pressure." (As you will read below, it is difficult to obtain the recommended tire pressure if your tires are not cold.)
Because tires are designed to be used on more than one type of vehicle, tire manufacturers list the "maximum permissible inflation pressure" on the tire sidewall. This number is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

1.5.3. CHECKING TIRE PRESSURE

It is important to check your vehicle's tire pressure at least once a month for the following reasons:

- Most tires may naturally lose air over time.
- Tires can lose air suddenly if you drive over a pothole or other object or if you strike the curb when parking.
- With radial tires, it is usually not possible to determine underinflation by visual inspection.

For convenience, purchase a tire pressure gauge to keep in your vehicle. Gauges can be purchased at tire dealerships, auto supply stores, and other retail outlets.
The recommended tire inflation pressure that vehicle manufacturers provide reflects the proper psi when a tire is cold. The term cold does not relate to the outside temperature. Rather, a cold tire is one that has not been driven on for at least three hours. When you drive, your tires get warmer, causing the air pressure within them to increase. Therefore, to get an accurate tire pressure reading, you must measure tire pressure when the tires are cold or compensate for the extra pressure in warm tires.

1.5.4. Steps for Maintaining Proper Tire Pressure

- Step 1: Locate the recommended tire pressure on the vehicle's tire information placard, certification label, or in the owner's manual.
- Step 2: Record the tire pressure of all tires.
- Step 3: If the tire pressure is too high in any of the tires, slowly release air by gently pressing on the tire valve stem with the edge of your tire gauge until you get to the correct pressure.
- Step 4: If the tire pressure is too low, note the difference between the measured tire pressure and the correct tire pressure. These "missing" pounds of pressure are what you will need to add.
- Step 5: At a service station, add the missing pounds of air pressure to each tire that is underinflated.
- Step 6: Check all the tires to make sure they have the same air pressure (except in cases in which the front and rear tires are supposed to have different amounts of pressure).

If you have been driving your vehicle and think that a tire is underinflated, fill it to the recommended cold inflation pressure indicated on your vehicle's tire information placard or certification label. While your tire may still be slightly underinflated due to the extra pounds of pressure in the warm tire, it is safer to drive with air pressure that is slightly lower than the vehicle manufacturer's recommended cold inflation pressure than to drive with a significantly underinflated tire. Since this is a temporary fix, don't forget to recheck and adjust the tire's pressure when you can obtain a cold reading.

1.5.5. Tire Size

To maintain tire safety, purchase new tires that are the same size as the vehicle's original tires or another size recommended by the manufacturer. Look at the tire information placard, the owner's manual, or the sidewall of the tire you are replacing to find this information. If you have any doubt about the correct size to choose, consult with the tire dealer.

1.5.6. Tire Tread

The tire tread provides the gripping action and traction that prevent your vehicle from slipping or sliding, especially when the road is wet or icy. In general, tires are not safe and should be replaced when the tread is worn down to 1/16 of an inch. Tires have built-in treadwear indicators that let you know when it is time to replace your tires. These indicators are raised sections spaced intermittently in the bottom of the tread grooves. When they appear "even" with the outside of the tread, it is time to replace your tires. Another method for checking tread depth is to place a penny in the tread with Lincoln's head upside down and facing you. If you can see the top of Lincoln's head, you are ready for new tires.

1.5.7. Tire Balance and Wheel Alignment

To avoid vibration or shaking of the vehicle when a tire rotates, the tire must be properly balanced. This balance is achieved by positioning weights on the wheel to counterbalance heavy spots on the wheel-and-tire assembly. A wheel alignment adjusts the angles of the wheels so that they are positioned correctly relative to the vehicle's frame. This adjustment maximizes the life of your tires. These adjustments require special equipment and should be performed by a qualified technician.

1.5.8. Tire Repair

The proper repair of a punctured tire requires a plug for the hole and a patch for the area inside the tire that surrounds the puncture hole. Punctures through the tread can be repaired if they are not too large, but punctures to the sidewall should not be repaired. Tires must be removed from the rim to be properly inspected before being plugged and patched.

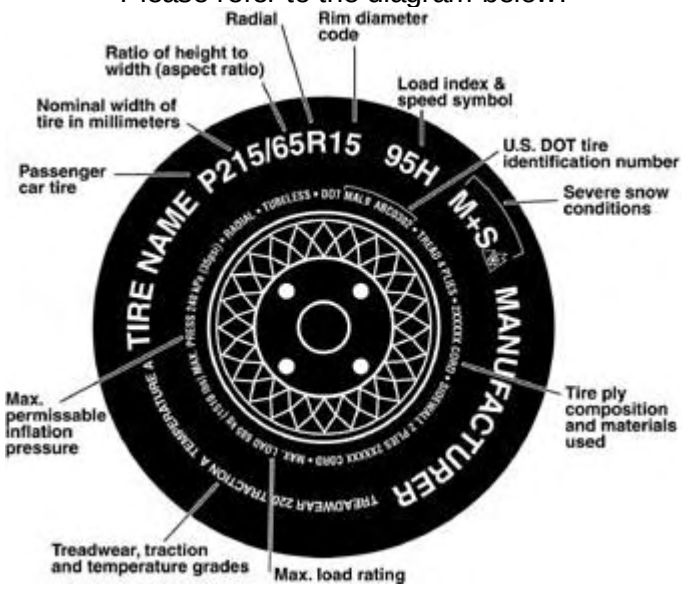
1.5.9. Tire Fundamentals

Federal law requires tire manufacturers to place standardized information on the sidewall of all tires. This information identifies and describes the fundamental characteristics of the tire and also provides a tire identification number for safety standard certification and in case of a recall.

Tire Safety Information

1.5.9.1. Information on Passenger Vehicle Tires

Please refer to the diagram below.



P
The "P" indicates the tire is for passenger vehicles.

Next number
This three-digit number gives the width in millimeters of the tire from sidewall edge to sidewall edge. In general, the larger the number, the wider the tire.

Next number
This two-digit number, known as the aspect ratio, gives the tire's ratio of height to width. Numbers of 70 or lower indicate a short sidewall for improved steering response and better overall handling on dry pavement.

R
The "R" stands for radial. Radial ply construction of tires has been the industry standard for the past 20 years.

Next number
This two-digit number is the wheel or rim diameter in inches. If you change your wheel size, you will have to purchase new tires to match the new wheel diameter.

Next number
This two- or three-digit number is the tire's load index. It is a measurement of how much weight each tire can support. You may find this information in your owner's manual. If not, contact a local tire dealer. Note: You may not find this information on all tires because it is not required by law.

M+S
The "M+S" or "M/S" indicates that the tire has some mud and snow capability. Most radial tires have these markings; hence, they have some mud and snow capability.

Speed Rating
The speed rating denotes the speed at which a tire is designed to be driven for extended periods of time. The ratings range from 99 miles per hour (mph) to 186 mph. These ratings are listed below. Note: You may not find this information on all tires because it is not required by law.

Letter Rating	Speed Rating
Q	99 mph
R	106 mph
S	112 mph
T	118 mph
U	124 mph
H	130 mph
V	149 mph
W	168* mph
Y	186* mph

* For tires with a maximum speed capability over 149 mph, tire manufacturers sometimes use the letters ZR. For those with a maximum speed capability over 186 mph, tire manufacturers always use the letters ZR.

U.S. DOT Tire Identification Number
This begins with the letters "DOT" and indicates that the tire meets all federal standards. The next two numbers or letters are the plant code where it was manufactured, and the last four numbers represent the week and year the tire was built. For example, the numbers 3197 means the 31st week of 1997. The other numbers are marketing codes used at the manufacturer's discretion. This information is used to contact consumers if a tire defect requires a recall.

Tire Ply Composition and Materials Used
The number of plies indicates the number of layers of rubber-coated fabric in the tire. In general, the greater the number of plies, the more weight a tire can support. Tire manufacturers also must indicate the materials in the tire, which include steel, nylon, polyester, and others.

Maximum Load Rating
This number indicates the maximum load in kilograms and pounds that can be carried by the tire.

Maximum Permissible Inflation Pressure
This number is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

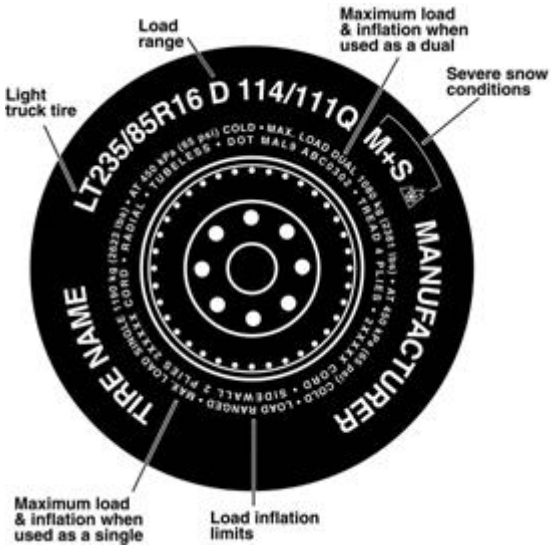
1.5.9.2. UTQGS Information

Treadwear Number
This number indicates the tire's wear rate. The higher the treadwear number is, the longer it should take for the tread to wear down. For example, a tire graded 400 should last twice as long as a tire graded 200.

Traction Letter
This letter indicates a tire's ability to stop on wet pavement. A higher graded tire should allow you to stop your car on wet roads in a shorter distance than a tire with a lower grade. Traction is graded from highest to lowest as "AA","A", "B", and "C".

Temperature Letter
This letter indicates a tire's resistance to heat. The temperature grade is for a tire that is inflated properly and not overloaded. Excessive speed, underinflation or excessive loading, either separately or in combination, can cause heat build-up and possible tire failure. From highest to lowest, a tire's resistance to heat is graded as "A", "B", or "C".

Please refer to the following diagram.



Tires for light trucks have other markings besides those found on the sidewalls of passenger tires.

LT
The "LT" indicates the tire is for light trucks or trailers.

ST
An "ST" is an indication the tire is for trailer use only.

Max. Load Dual kg (lbs) at kPa (psi) Cold
This information indicates the maximum load and tire pressure when the tire is used as a dual, that is, when four tires are put on each rear axle (a total of six or more tires on the vehicle).

Max. Load Single kg (lbs) at kPa (psi) Cold
This information indicates the maximum load and tire pressure when the tire is used as a single.

Load Range
This information identifies the tire's load-carrying capabilities and its inflation limits.

1.6. TIRE SAFETY TIPS

Preventing Tire Damage

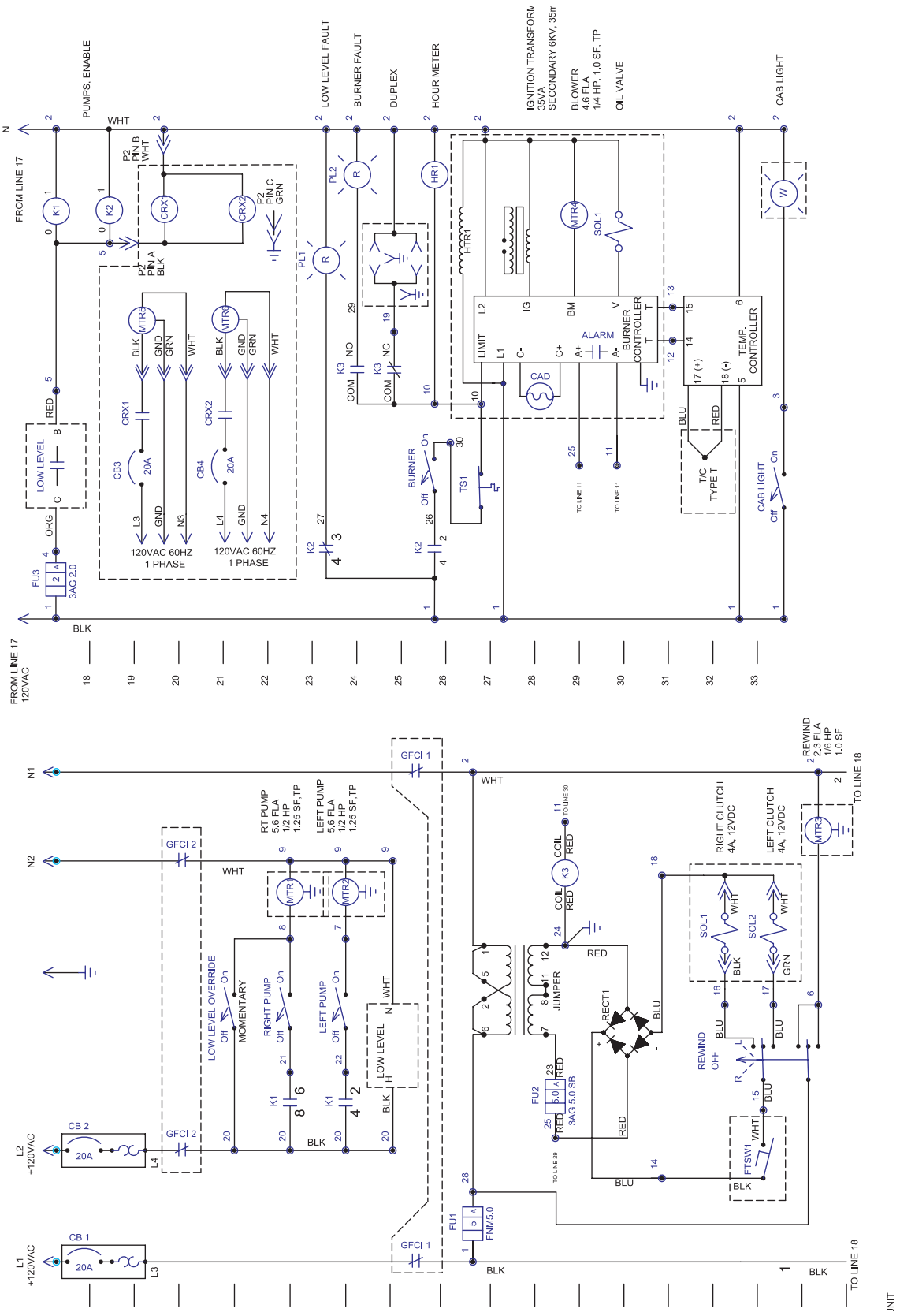
- Slow down if you have to go over a pothole or other object in the road.
- Do not run over curbs or other foreign objects in the roadway, and try not to strike the curb when parking.

Tire Safety Checklist

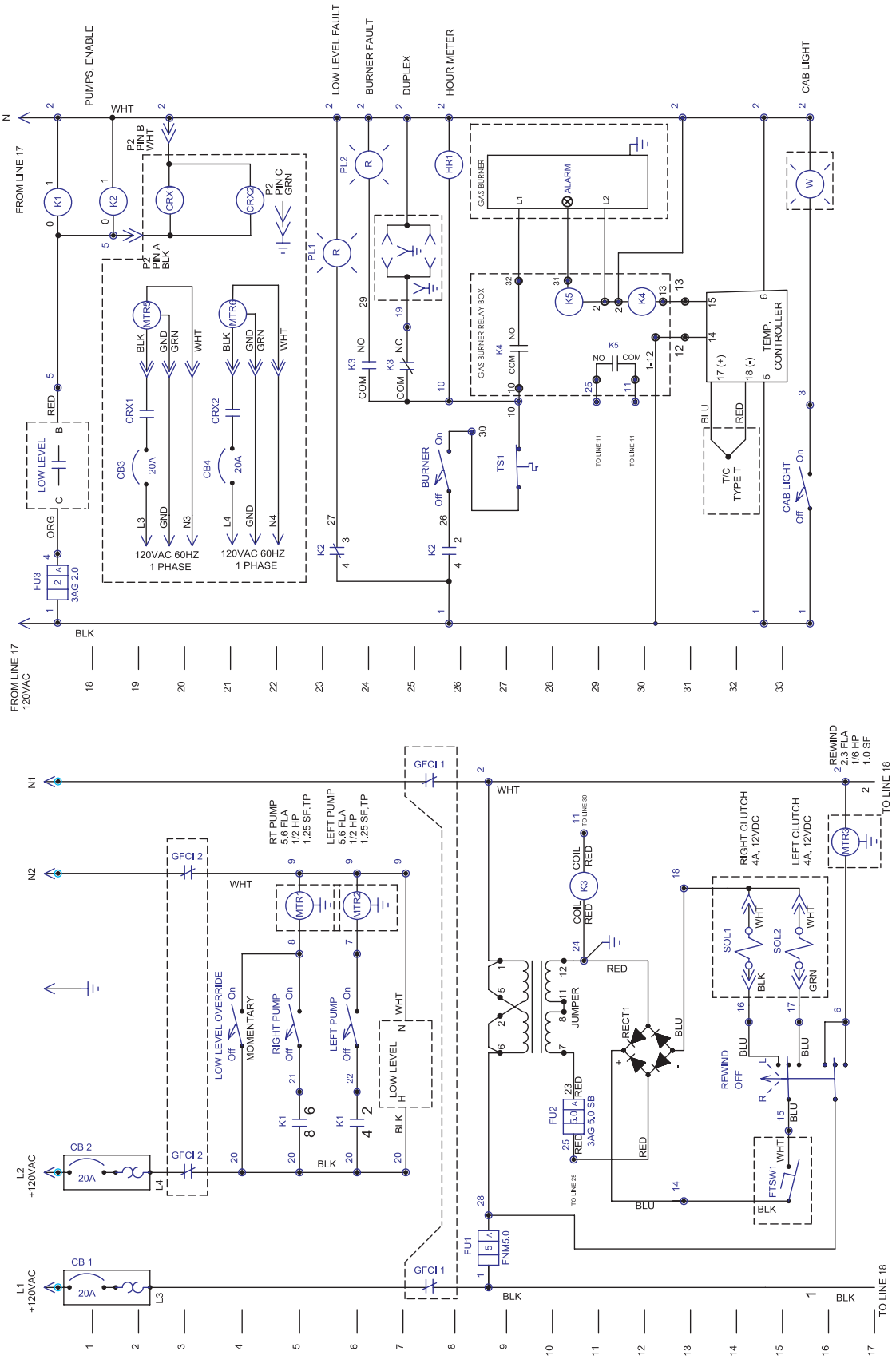
- Check tire pressure regularly (at least once a month), including the spare.
- Inspect tires for uneven wear patterns on the tread, cracks, foreign objects, or other signs of wear or trauma.
- Remove bits of glass and foreign objects wedged in the tread.
- Make sure your tire valves have valve caps.
- Check tire pressure before going on a long trip.
- Do not overload your vehicle. Check the Tire Information and Loading Placard or User's Manual for the maximum recommended load for the vehicle.

12 Schematics

12.1 Composite Schematic—Machine with Oil Burner

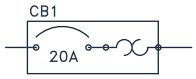
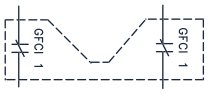
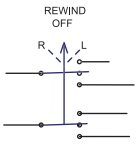
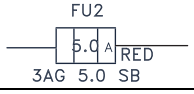
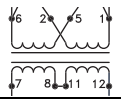
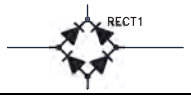
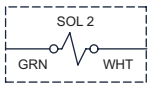


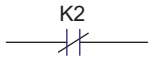
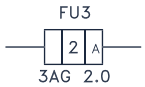
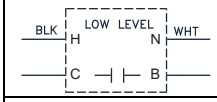
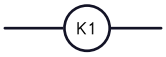
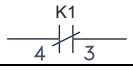
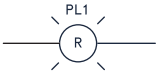
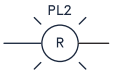
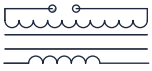
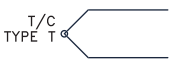
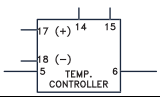
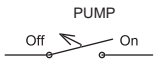
12.2 Composite Schematic—Machine with Gas Burner

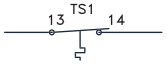
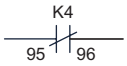
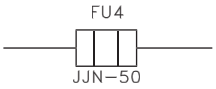
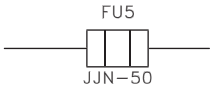
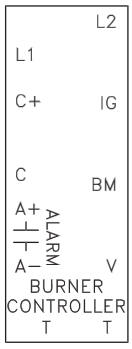


12.3 Electrical Schematic Components

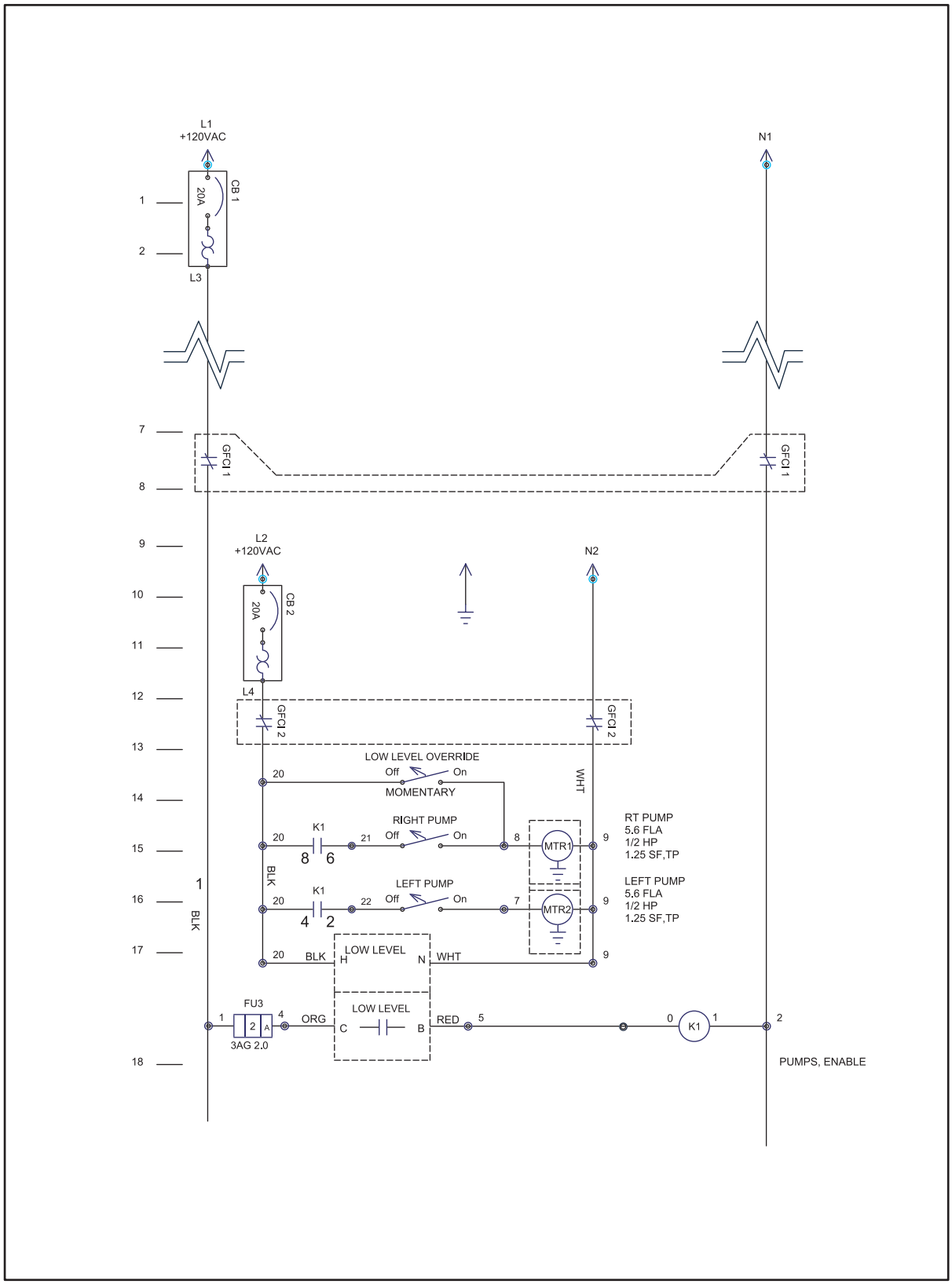
Use the following table of symbols for the schematics found throughout this chapter.

Symbol	Ref	Description
	CB1	Circuit breaker 1
	GFCI 1	Ground Fault Circuit Interrupt 1
	FU1	Fuse 1
	HOSE REWIND	Hose rewind ON/OFF switch
	MTR	Rewind motor RT (right) pump Left pump Burner motor
	FU2	Fuse 2
	n/a	Rewind transformer
n/a	n/a	To line 30
n/a	n/a	To line 29
	RECT1	Rectifier
	—	Foot switch 1
	SOL1	Solenoid 1 (right clutch)
	SOL2	Solenoid 2 (left clutch)
	SOL3	Solenoid 3 (fuel)
	K2	Relay coil (K2)

Symbol	Ref	Description
	K2	Relay normally closed contacts (K2)
	K2	Relay normally open contacts (K2)
	FU3	Fuse 3
	LOW LEVEL	Low-level shut-down device power connection terminals
	K1	Relay coil (K1)
	K1	Relay normally open contacts (K1)
	K1	Relay normally closed contacts (K1)
	PL1	Pilot light 1 Low level fault
	PL2	Pilot light 2 Burner fault
	DUPLEX	Duplex receptacle
	HOUR METER	Hour meter
	n/a	Ignition transformer
	T/C type T	Thermocouple Type T
	TEMP. CONTROLLER	Temp. (temperature) controller
	n/a	Cab light
	CAB LIGHT	Cab light ON/OFF switch
	BURNER	Burner ON/OFF switch
	PUMP	Pump ON/OFF switch

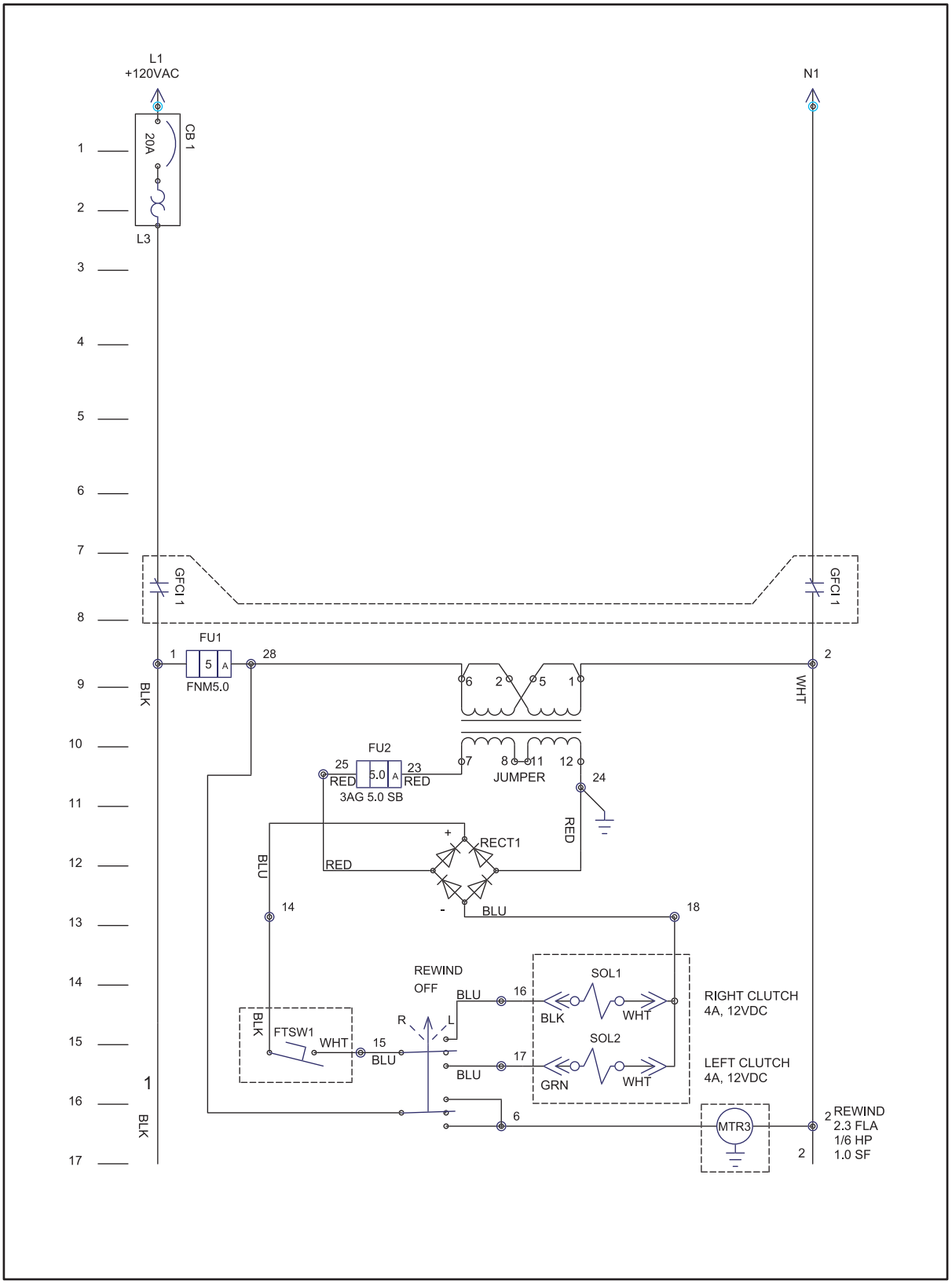
Symbol	Ref	Description
	TS1	Thermal switch 1 (snap disc)
	HTR1	Heater (fuel prewarmer)
	CAD	Cad cell
	LOW LEVEL OVERRIDE MOMENTARY	Low-level shut-down device momentary override ON/OFF switch.
	E-STOP	Emergency stop switch
	K4	Relay coil (K4)
	K4	Relay normally closed contacts (K4)
	K4	Relay normally open contacts (K1)
	FU4	Fuse 4
	FU5	Fuse 5
	BURNER CONTROLLER	Burner Controller

12.4 Circulation System Circuit



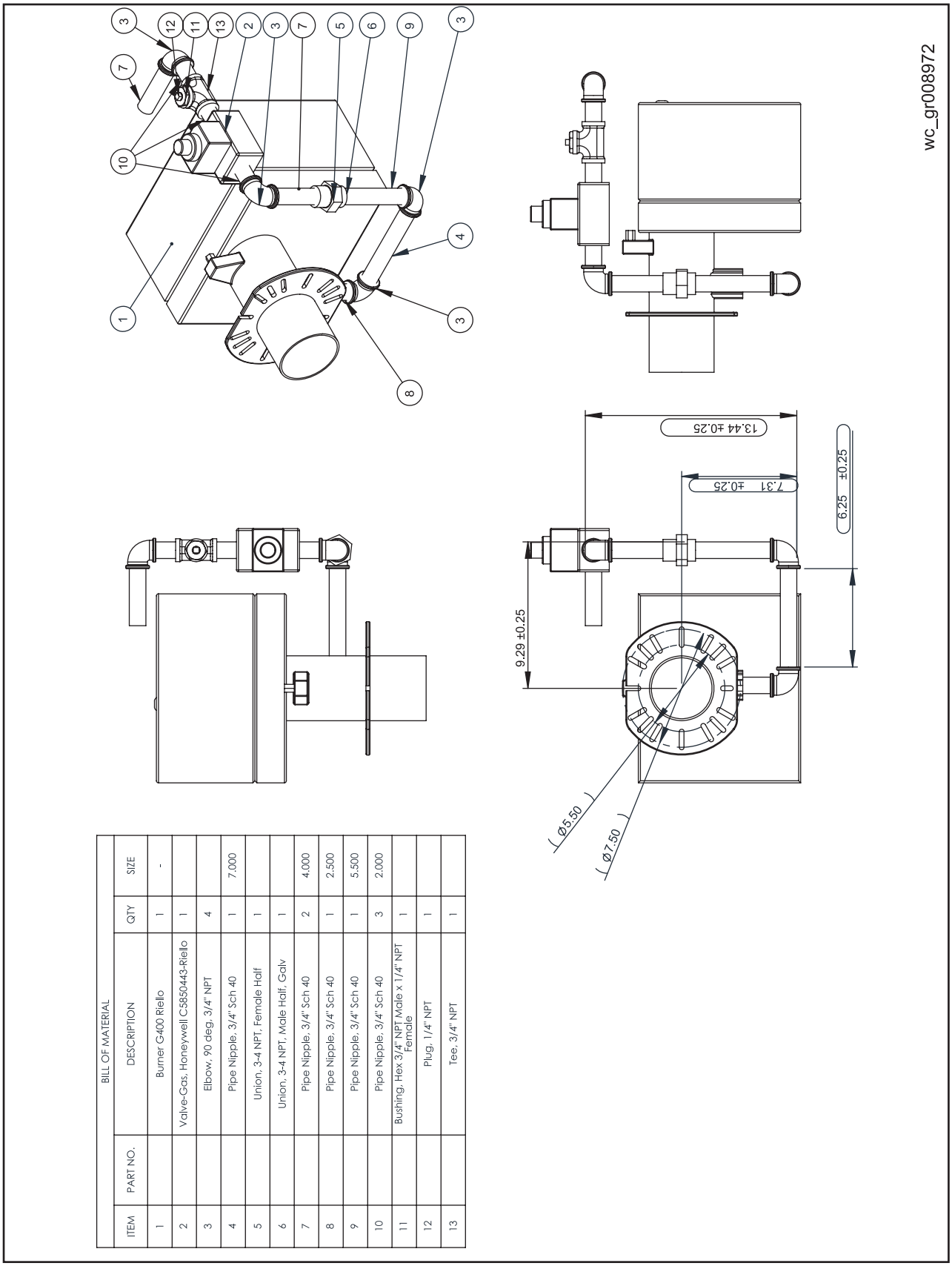
ghi_gr005798

12.5 Rewind System Circuit



ghi_gr005799

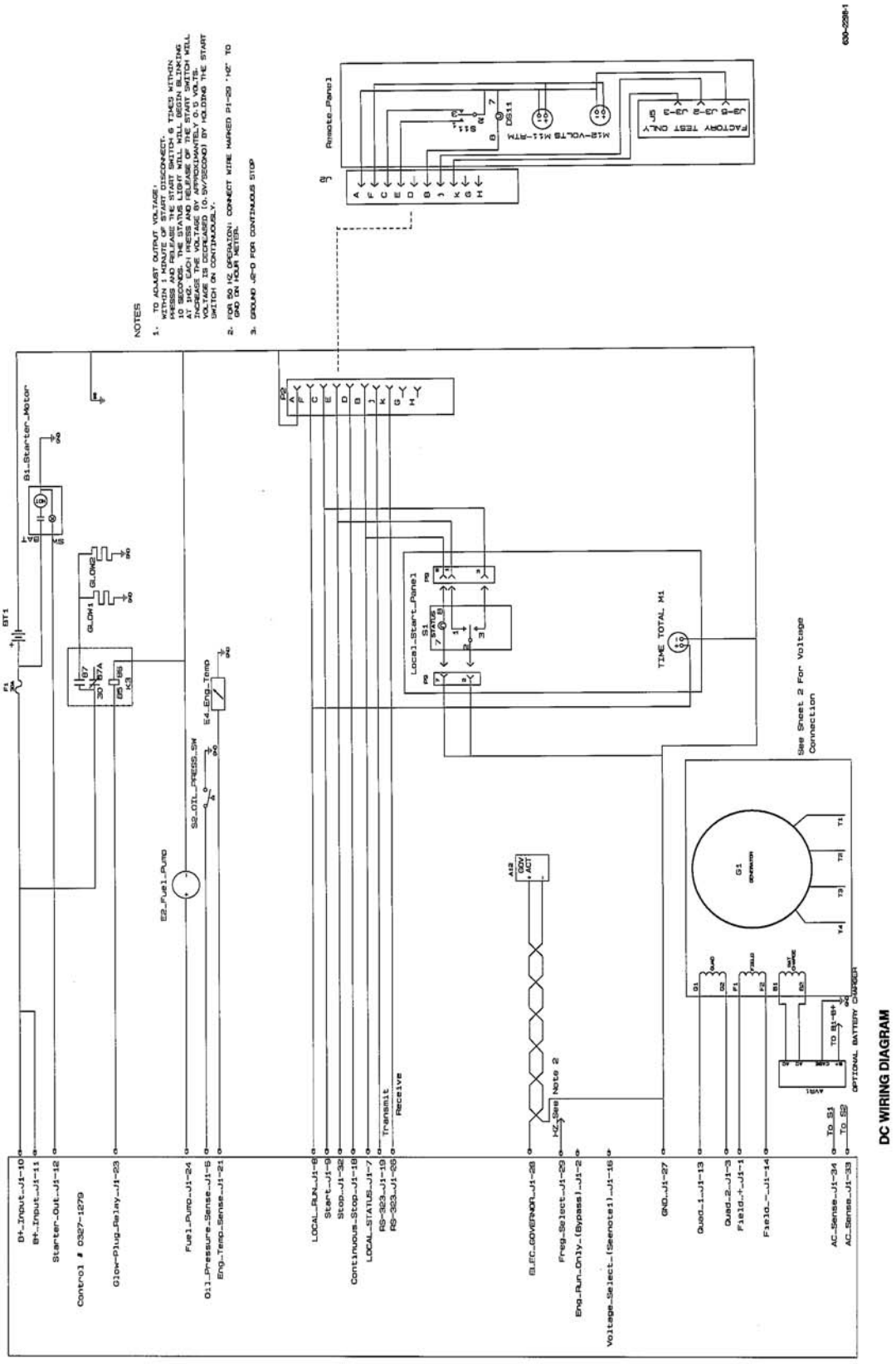
12.6 Gas Train Schematic



BILL OF MATERIAL

ITEM	PART NO.	DESCRIPTION	QTY	SIZE
1		Burner G400 Riello	1	-
2		Valve-Gas, Honeywell C5850443-Riello	1	
3		Elbow, 90 deg, 3/4" NPT	4	
4		Pipe Nipple, 3/4" Sch 40	1	7.000
5		Union, 3-4 NPT, Female Half	1	
6		Union, 3-4 NPT, Male Half, Galv	1	
7		Pipe Nipple, 3/4" Sch 40	2	4.000
8		Pipe Nipple, 3/4" Sch 40	1	2.500
9		Pipe Nipple, 3/4" Sch 40	1	5.500
10		Pipe Nipple, 3/4" Sch 40	3	2.000
11		Bushing, Hex 3/4" NPT Male x 1/4" NPT Female	1	
12		Plug, 1/4" NPT	1	
13		Tee, 3/4" NPT	1	

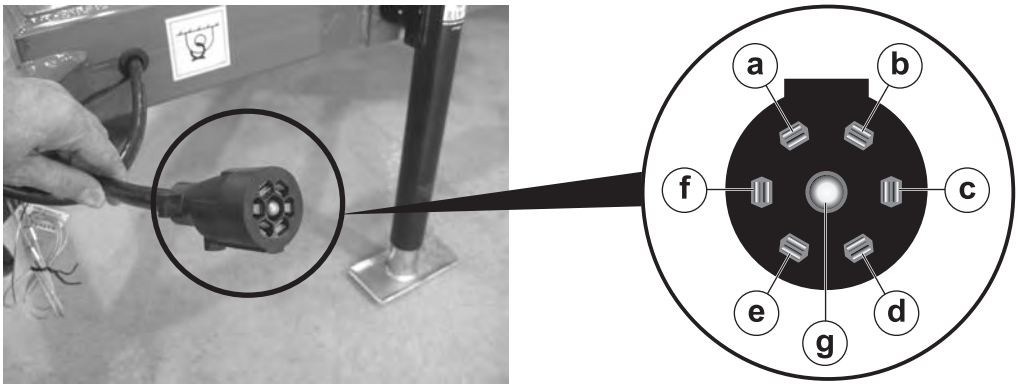
12.7 Generator



12.8 Trailer Plug — Wiring Diagram

Trailer plug

The slots on the trailer plug receptacle are each designated for specific components. The designations are as follows.



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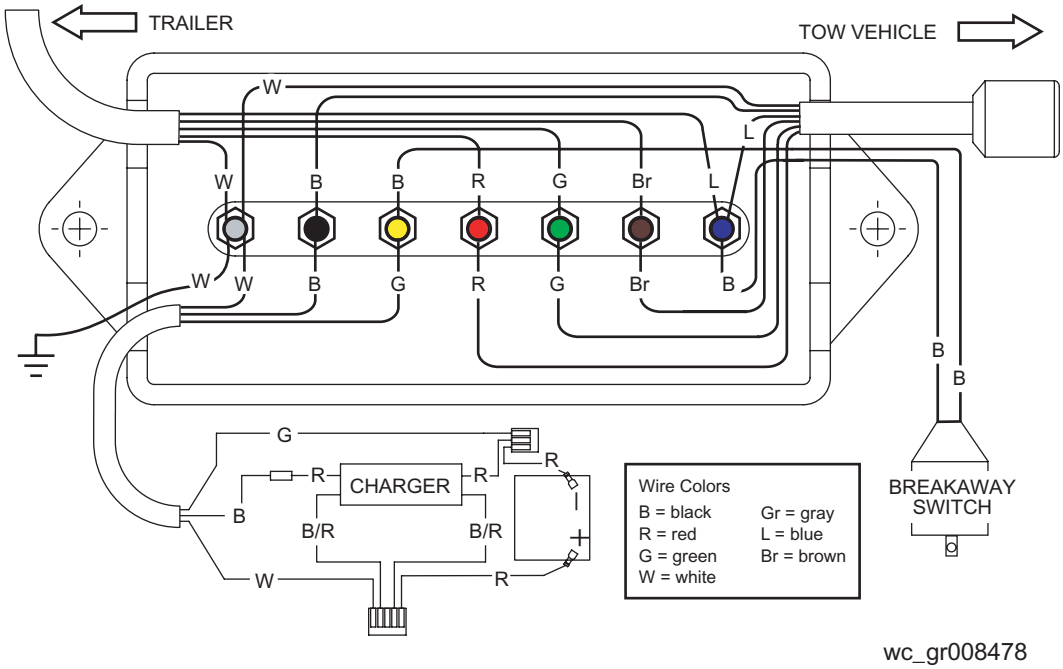
Ref	Designation	Wire color
a	Battery (+12V)	Black
b	Running lights	Green
c	Left hand turn/stop	Red
d	Ground	White
e	Electric brake	Blue
f	Right hand turn/stop	Brown
g	Back up	Yellow

12.9 Trailer Junction Box — Wiring Diagram

The wires inside the trailer junction box are designated for specific components. The designations are as follows.

Note: *The colors used on your vehicle's plug may vary from those used in the trailer junction box.*



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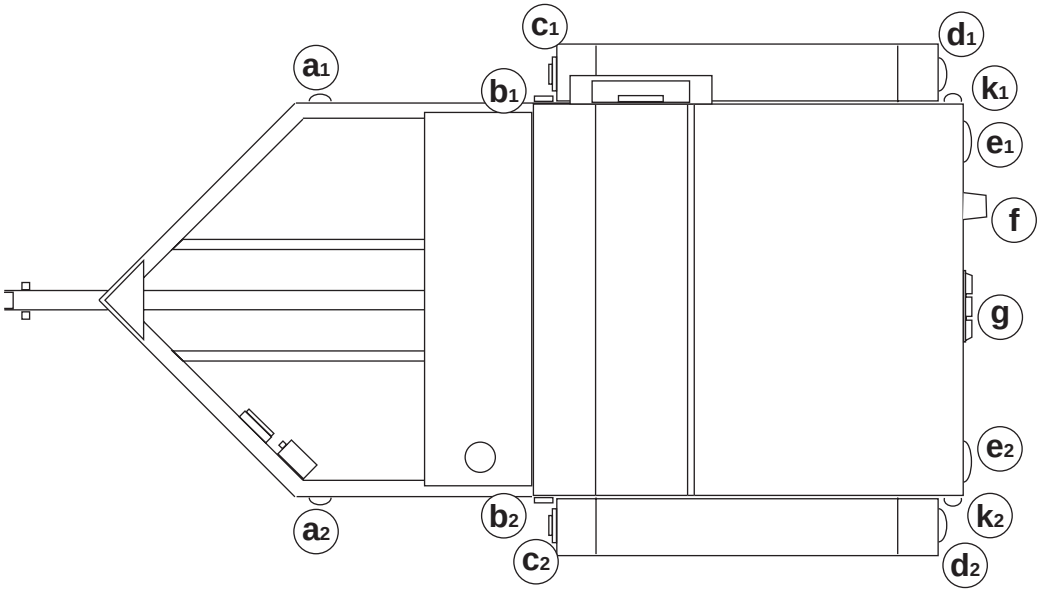
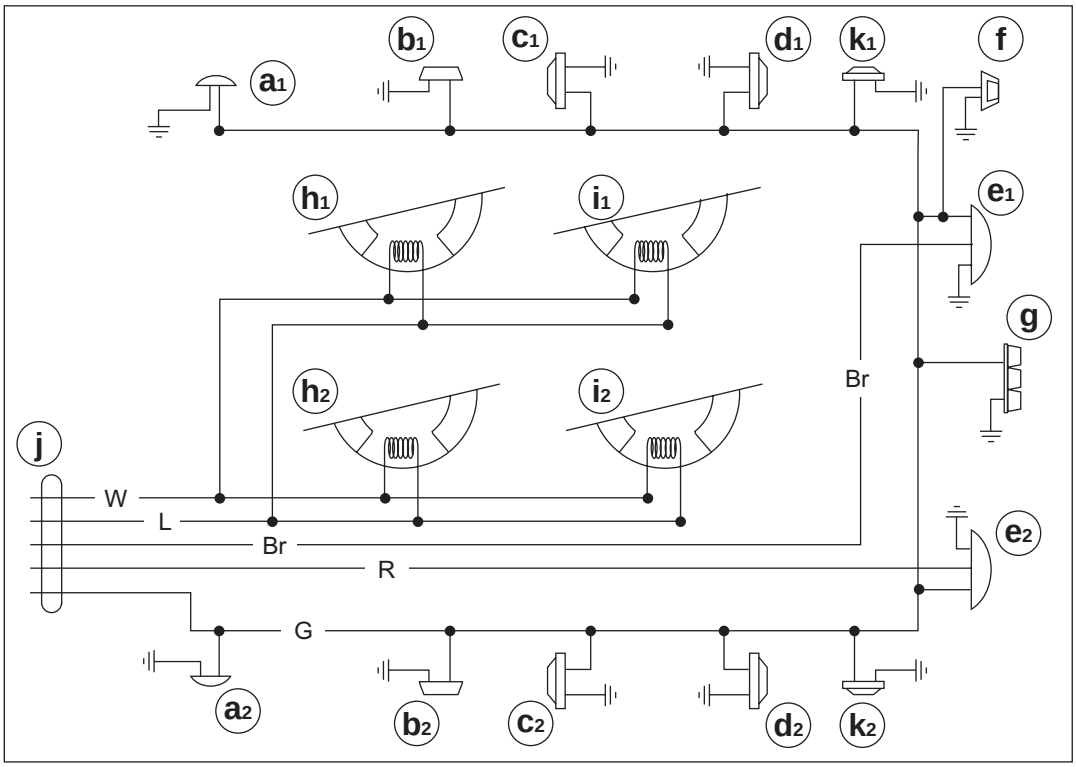
12.10 Trailer Lights and Brakes — Wiring Diagram





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12.11 Trailer Lights and Brakes — Components

Ref	Description	Ref	Description
a1	Right side light, amber	a2	Left side light, amber
b1	Right side miniature light, amber	b2	Left side miniature light, amber
c1	Right side fender light, amber	c2	Left side fender light, amber
d1	Right rear fender light, red	d2	Left rear fender light, red
e1	Right side stop and tail light	e2	Left side stop and tail light
f	License plate light	—	—
g	3-bulb combination light	—	—
h1	Right front brake	h2	Left front brake
i1	Right rear brake	i2	Left rear brake
j	To junction box	—	—

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