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HEAT KING



OPERATOR'S MANUAL

MODELS:HK150, HK300, HK500

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All sales made by Tamarack Industries, here after referred to as Tamarack, a Division of ELJO Industries Inc. are subject to these conditions unless otherwise agreed in writing with a duly authorized officer of Tamarack. In all cases of conflict between these conditions and the requirements of the purchase order, these conditions shall prevail.

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For one year from date of purchase, Tamarack will replace or repair for the original purchaser, free of charge, any part or parts, found upon examination by any Tamarack Authorized Service Depot or by the Tamarack factory, to be defective in material or workmanship or both. Equipment and accessories not manufactured by Tamarack are warranted only to the extent of the original manufacturer's warranty. All transportation charges on parts submitted for replacement or repair under this warranty must be borne by the purchaser. For warranty service contact your nearest Tamarack Authorized Service Depot.

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WARRANTY VOID IF NOT REGISTERED

P.O. Box 234, Station "L"
Winnipeg, Manitoba
Canada R3H 0Z5

TAMARACK INDUSTRIES

HEAT KING

WARRANTY REGISTRATION FORM & INSPECTION REPORT

WARRANTY REGISTRATION (please print)

This form must be filled out by the dealer and signed by both the dealer and the customer at the time of delivery.

Customer's Name _____ Distributor Name _____
Address _____ Address _____
City, State, Code _____ City, State, Code _____
Phone Number (____) _____ Check One:
Contact Name _____ Private
Heat King Model _____ Contractor
Serial Number _____ Other _ _ _ _ _
Delivery Date _____

DISTRIBUTOR INSPECTION REPORT

____ Tire Pressure Checked
____ Wheel Bolts Torqued
____ Brakes Work
____ Check Fluid Levels (Fuel and Glycol)
____ Lubricate Machine
____ Check That All Controls Function
____ Check That There Is A Filter In Cannister

SAFETY

____ Emergency Stop Switch Works
____ All Decals Installed and Legible
____ Lights and Reflectors Installed,
Clean and Working
____ Review Operating And
Safety Instructions

I have thoroughly instructed the buyer on the above described equipment which review included the Operator's Manual content, equipment care, adjustments, safe operation and applicable warranty policy.

Date _____ Dealer's Rep. Signature _____

The above equipment and Operator's Manual have been received by me and I have been thoroughly instructed as to care, adjustments, safe operation and applicable warranty policy.

Date _____ Owner's Signature _____

WHITE	YELLOW	PINK
Tamarack. EQ.	DISTRIBUTOR	CUSTOMER

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Tamarack Industries
330 Saulteaux Crescent
Winnipeg, Manitoba
R3H 0Z5 Canada

REPORTING SAFETY DEFECTS

If you believe that your vehicle 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 Tamarack Industries.

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

To contact NHTSA you may either call the Auto Safety Hotline toll free at 1-800-424-9393 (366-0123 in Washington, DC area) or write to:

NHTSA
 U.S. DEPARTMENT of TRANSPORTATION
 400 7th Street SW, (NSA-11)
 Washington, DC
 20590

You can also obtain other information about motor vehicle safety from the Hotline.

SERIAL NUMBER LOCATION

Always give your dealer, distributor or factory the serial number of your Heat King when ordering parts or requesting service or other information.

The serial number plate is located inside the front frame where indicated and the VIN plate is located on the front left corner of the frame. Please mark the number in the space provided for easy reference.



Serial Number



Vehicle Identification Number

PLATE LOCATION

Model _____

Serial Number _____

VIN Number _____



WARNING



CALIFORNIA - Proposition 65 Warning

Engine exhaust and some of its constituents and some dust created by power sanding, sawing, grinding, drilling and other construction activities contains chemicals known to the State of California to cause cancer, birth defects and other reproductive harm.

Some examples of these chemicals are:-

- Lead from lead-based paints
- Crystalline silica from bricks
- Cement and other masonry products
- Arsenic and chromium from chemically treated lumber

Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals:

ALWAYS work in a well ventilated area, and work with approved safety equipment, such as dust masks that are specially designed to filter out microscopic particles.

1 INTRODUCTION

Congratulations on your choice of a Tamarack Industries Heat King to complement your construction operation. This equipment has been designed and manufactured to meet the needs of a discriminating buyer for the efficient heating and/or thawing of construction sites.

Safe, efficient and trouble free operation of your Tamarack Heat King requires that you and anyone else who will be operating or maintaining the Heater, read and understand the Safety, Operation, Maintenance and Trouble Shooting information contained in the Operator's Manual.



This manual is applicable to the Models HK 500, HK300 and HK150 Heat Kings Heaters built by Tamarack Industries. Use the Table of Contents or Index as a guide when searching for specific information.

Keep this manual handy for frequent reference and to pass on to new operators or owners. Call your Heat King distributor or dealer if you need assistance or information.

OPERATOR ORIENTATION - The directions left, right, front and rear, as mentioned throughout this manual, are defined like a Trailer. The double doors are the rear, the hitch the front and the side doors are on the left.

2 SAFETY

SAFETY ALERT SYMBOL

This Safety Alert symbol means **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!**



The Safety Alert symbol identifies important safety messages on the Tamarack Heat King and in the manual. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.

Why is SAFETY important to you?

3 Big Reasons

Accidents Disable and Kill
Accidents Cost
Accidents Can Be Avoided

SIGNAL WORDS:

Note the use of the signal words **DANGER**, **WARNING** and **CAUTION** with the safety messages. The appropriate signal word for each message has been selected using the following guide-lines:

DANGER - Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations, typically for machine components that, for functional purposes, cannot be guarded.

WARNING - Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.

CAUTION - Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

SAFETY

YOU are responsible for the **SAFE** operation and maintenance of your Tamarack Industries Heat King. **YOU** must ensure that you and anyone else who is going to operate, maintain or work around the Heat King be familiar with the operating and maintenance procedures and related **SAFETY** information contained in this manual. This manual will take you step-by-step through your working day and alerts you to all good safety practices that should be adhered to while operating the Heater.

Remember, **YOU** are the key to safety. Good safety practices not only protect you but also the people around you. Make these practices a working part of your safety program. Be certain that **EVERYONE** operating this equipment is familiar with the recommended operating and maintenance procedures and follows all the safety precautions. Most accidents can be prevented. Do not risk injury or death by ignoring good safety practices.

- Heater owners must give operating instructions to operators or employees before allowing them to operate the machine, and at least annually thereafter.
- The most important safety device on this equipment is a SAFE operator. It is the operator's responsibility to read and understand ALL Safety and Operating instructions in the manual and to follow these. Most accidents can be avoided.
- A person who has not read and understood all operating and safety instructions is not qualified to operate the machine. An untrained operator exposes himself and bystanders to possible serious injury or death.
- Do not modify the equipment in any way. Unauthorized modification may impair the function and/or safety and could affect the life of the equipment.
- Think SAFETY! Work SAFELY!

2.1 GENERAL SAFETY

1. Read and understand the Operator's manual and all safety signs before operating, maintaining, adjusting, servicing or cleaning the Heater.



2. Only trained competent persons shall operate the Heater. An untrained operator is not qualified to operate the machine.

3. Have a first-aid kit available for use, should the need arise and know how to use it.



4. Do not allow riders.

5. Have a fire extinguisher available for use should the need arise and know how to use it.



6. Wear appropriate protective gear. This list includes, but is not limited to:

- A hard hat
- Protective boots with slip resistant soles
- Protective goggles
- Heavy gloves
- Hearing protection



7. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining

8. Wear appropriate hearing protection when operating for long periods of time.



9. Wear protective gloves



10. Ventilation ~ Never operate in a poorly ventilated or enclosed area. Avoid prolonged breathing of exhaust gases.



2.1 GENERAL SAFETY

11. Hot surface ~ Avoid contact with hot exhaust system. Allow to cool before performing repairs or service.



12. Electrocutation Hazard ~ Always use proper size grounded extension cord. Inspect all extension cords for cuts, frayed wires and broken connectors. Do not use cords if not in good condition.



13. Fire Hazard ~ Do not operate machine in the vicinity of open flames, sparks or while smoking.



14. Explosion Hazard ~ Battery
Take care when handling battery (if installed)



2.2 OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, maintaining or adjusting the Heater.
2. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
3. Do not allow riders in or on machine during transport.
4. Install and secure all guards and shields before starting and operating.
5. Clear the area of bystanders, especially small children, before starting and operating.
6. Keep the working area clean and free of debris to prevent slipping or tripping. Clean up fuel spills immediately if they occur.
7. Slow down. Use care when working around unit - the steps, frame or floor may be wet and/or slippery.

8. Do not allow personnel that are taking drugs, alcohol or any medications that impair the senses or when excessively tired or stressed to operate the Heater.
9. Do not operate unit in a poorly ventilated or enclosed area to prevent asphyxiation when the heaters are operating.
10. Do not smoke when filling fuel tank or when working around machine.
11. Always wear heavy gloves when working on the machine to prevent burns when touching hot components.
12. Use the foot pedal switch to engage the hose reel take up or extend function and guide the hose by hand.
13. Keep all electrical lines and components in good working order. Do not operate in wet conditions or when standing in water. Damp or wet conditions can cause shocks, trip the breakers or the ground fault interrupts (GFIs).
14. Keep all components in good condition. Do not operate with glycol leaks. Check hoses, lines, couplers and manifolds frequently for leaks.
15. Review safety instructions with operators annually.

2.3 ELECTRICAL SAFETY

1. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
2. Place all controls in their OFF position before plugging in power cords.
3. Keep all electrical components in good repair before starting.
4. Do not lay power lines or connectors in water or on a wet surface. Dry connectors and raise power lines out of the water before and during operation.
5. Do not operate machine if there are electrical malfunctions. Correct problem before resuming work.
6. Always use the foot pedal control when extending or retracting the hose. Do not bypass foot pedal at any time.

2.4 MAINTENANCE SAFETY

1. Review the Operator's Manual and all safety items before working with, maintaining or operating the Heater.
2. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
3. Follow good shop practices:
 - Keep service area clean and dry.
 - Be sure electrical outlets and tools are properly grounded.
 - Use adequate light for the job at hand.



4. Keep hands, feet, clothing and hair away from all moving and/or rotating parts of the hose reel and drive system.
5. Always wear heavy gloves to prevent burns when handling hot components. Wait until burners, coils and glycol system components have cooled before working on them.
6. Do not attempt any adjustment or maintenance to any system of the Heater unless the power wires are disconnected.
7. Make sure that all guards, shields and hoods are properly installed and secured before operating the Heater.
8. Securely support the machine using blocks or safety stands before working beneath it or changing tires.
9. Store and transfer diesel fuel, solvents, cleaners or any flammable liquids only in safety standard approved containers.

2.5 TIRE SAFETY

1. Failure to follow proper procedures when mounting a tire on a wheel or rim can produce an explosion which may result in serious injury or death.
2. Do not attempt to mount a tire unless you have the proper equipment and experience to do the job.
3. Have a qualified tire dealer or repair service perform required tire maintenance.
4. Torque wheel nuts to 165 ft-lbs see section 7.2.

2.6 STORAGE SAFETY

1. Store unit in an area away from human activity.
2. Do not permit children to play on or around the stored Heater.

2.7 REFUELING SAFETY

1. Handle fuel with care. It is highly flammable.
2. Allow burners to cool for 5 minutes before refueling. Clean up spilled fuel before restarting engine.
3. Do not refuel the machine while smoking or when near open flame or sparks.
4. Always use an approved fuel container.
5. Fill fuel tank outdoors.
6. Prevent fires by keeping machine clean of accumulated trash, grease and debris.



2.8 HEATER SAFETY

1. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
2. Always wear heavy gloves when working on burners, glycol tank, plumbing and hoses to prevent burns.
3. Wait until all systems and components cool before working on machine.
4. Never operate burners in an enclosed area without adequate ventilation to prevent asphyxiation.
5. Do not smoke around machine or when refueling.

2.9 TRANSPORT SAFETY

1. Attach to towing vehicle and secure with a mechanical retainer. Cross the safety chains under the hitch and anchor to truck frame.
2. Connect the brake anchor cable to the truck frame to activate the trailer brakes if the trailer unexpectedly unhooks. Provide sufficient slack for turning. Tow vehicle must be equipped with a trailer brake controller.
3. Plug in wiring harness for the trailer lights and brakes.
4. Check that all lights and reflectors required by the DOT are clean and functioning.
5. Never exceed a safe travel speed.
6. Do not allow riders on machine.
7. Do not drink and drive.

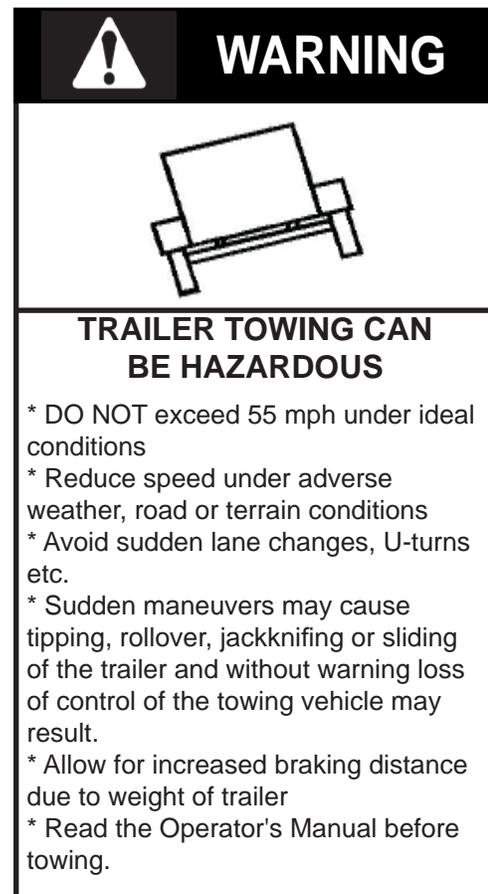
2.10 SAFETY SIGNS

1. Keep safety signs clean and legible at all times.
2. Replace safety signs that are missing or have become illegible.
3. Replaced parts that displayed a safety sign should also display the current sign.

4. Safety signs are available from your Distributor or the factory.

How to Install Safety Signs:

- Be sure that the installation area is clean and dry.
- Be sure temperature is above 50°F (10°C).
- Decide on the exact position before you remove the backing paper.
- Remove the smallest portion of the split backing paper.
- Align the sign over the specified area and carefully press the small portion with the exposed sticky backing in place.
- Slowly peel back the remaining paper and carefully smooth the remaining portion of the sign in place.
- Small air pockets can be pierced with a pin and smoothed out using the piece of sign backing paper.



3 SAFETY SIGN LOCATIONS

The types of safety signs and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various Safety Signs, the type of warning and the area, or particular function related to that area, that requires your SAFETY AWARENESS.

- Think SAFETY! Work SAFELY!



REMEMBER - If Safety Signs have been damaged, removed, become illegible or parts replaced without safety signs, new signs must be applied. New safety signs are available from your authorized dealer.

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- Think SAFETY! Work SAFELY!



HK500 Front Panel shown above
HK150 and HK300 shown below

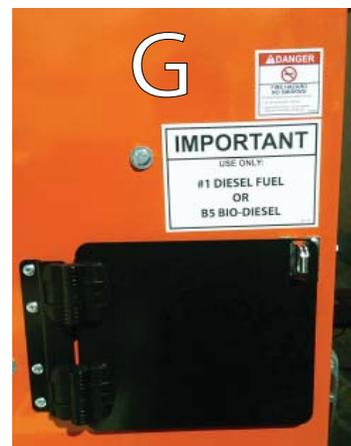
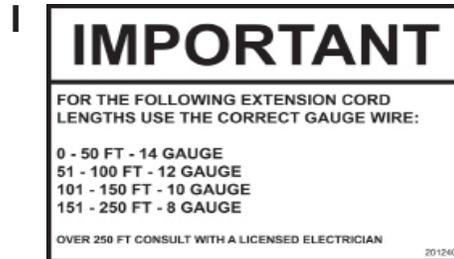


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3 SAFETY SIGN LOCATIONS

 **WARNING**

Improper maintenance of this machine can cause serious injury or death.

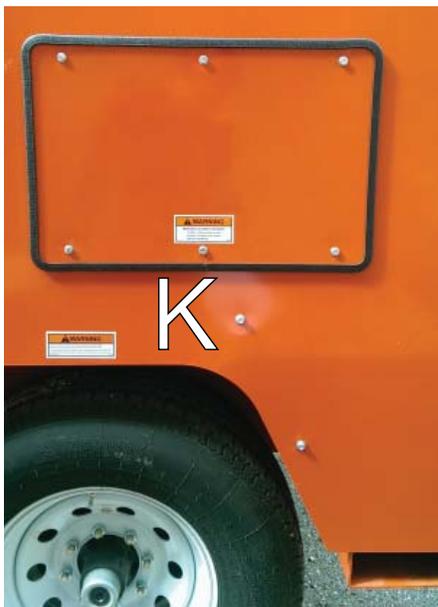
Make certain that the wheel lug nuts are tight. See Owners Manual for torques.

Check the pressure and overall condition of tires. Inflate to pressure found on tire sidewall.

Ensure all wheel bearings are properly lubricated and maintained as per axle manufacturer's specifications.

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4 OPERATION

4.1 TO THE NEW OPERATOR OR OWNER

The Heat King is designed to heat a glycol solution and circulate it through hoses to heat an area or keep it warm. It is the responsibility of the operator to be familiar with the machine before starting.

It is the responsibility of the owner or operator to read this manual before starting. Follow all safety instructions exactly. Safety is everyone's business. By following recommended procedures, a safe working environment is provided for the operator, bystanders and the environment.

Many features incorporated into this machine are

the result of suggestions made by customers like you. Read this manual carefully to learn how to operate the machine safely and how to set it to provide maximum operating efficiency. By following the operating instructions in conjunction with a good maintenance program, your Heat King will provide many years of trouble-free service.

4.1 TO THE NEW OPERATOR OR OWNER



OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, maintaining or adjusting the Heater.
2. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
3. Do not allow riders in or on machine during transport.
4. Install and secure all guards and shields before starting and operating.
5. Clear the area of bystanders, especially small children, before starting and operating.
6. Keep the working area clean and free of debris to prevent slipping or tripping. Clean up fuel spills immediately if they occur.
7. Slow down. Use care when working around unit - the frame or floor may be wet and/or slippery.
8. Do not allow personnel that are taking drugs, alcohol or any medications that impair the senses or when excessively tired or stressed to operate the Heater.
9. Do not operate unit in a poorly ventilated or enclosed area to prevent asphyxiation when the heaters are operating.
10. Do not smoke when filling fuel tank or when working around machine.
11. Always wear heavy gloves when working on the machine to prevent burns when touching hot components.
12. Use the foot pedal switch to engage the hose reel take up or extend function and guide the hose by hand.
13. Keep all electrical lines and components in good working order. Do not operate in wet conditions or when standing in water. Damp or wet conditions can cause shocks or trip the breakers.
14. Keep all components in good condition. Do not operate with glycol leaks. Check hoses, lines, couplers and manifolds frequently for leaks.
15. Review safety instructions with operators annually.

4.2 PRE-OPERATION CHECKLIST

Efficient and safe operation of the Heat King requires that each operator reads and understands the operating procedures and all related safety precautions outlined in this manual. A pre-operation checklist is provided for the operator. It is important for both personal safety and maintaining the good mechanical condition of the machine that this checklist is followed.

Before operating the Heater and each time thereafter, the following areas should be checked off:

1. Check all fluid levels: fuel and glycol. Refuel or top up glycol as required.
2. Check for leaks. Stop leaks or correct condition before continuing work. Check hoses, couplers, lines, manifolds and fittings.
3. Check that the heater coil and circulation pumps are functioning properly.
4. Check that the ground fault switches are set.
5. Check that reel drive foot pedal switch functions.
6. Check that the frame is level.

4.3 HOW THE MACHINE WORKS

The Heat King is designed to heat a tank of glycol and circulate the solution through a series of hoses to warm the area around the hoses. It consists of one or two high capacity burners (depending on the model) that heats a large tank of glycol. A pump circulates the glycol in the tank through the heater coils to heat the fluid. Another pump circulates the hot fluid from the reservoir through distribution manifolds on the back of the frame.

Hoses to circulate the hot glycol are stored on the

large reel at the rear of the unit. A foot pedal is used to extend or retract the circulation hose reel power unit. The fuel tank for the burners is located under the glycol tank and is filled at the left rear corner. Control Panels in the front and rear compartment are used to control all machine functions. A dry battery in the front compartment is used to power the self-contained trailer brakes. A jack on the hitch is used to level the frame.



Model shown above: HK500. HK150&300 are single burner machines with the same or similar parts.

- A—Heating Coil
- B Burner
- C Pressure Switch
- D Circulation Pump
- E Field Pump
- F Glycol Level Cut-Off
- G Compressor
- H Fuel Filter
- I Control Panel
- J Hose Reel
- K Reel Drive
- L Distribution Manifold
- M Fuel Tank

Fig. 1 MACHINE COMPONENTS (LOCATIONS MAY DIFFER ON SOME MODELS. HK500 SHOWN)

4.4 CONTROLS.

Model HK500.

Front Panel.

Before starting to work, all operators should familiarize themselves with the location and function of the controls.

1. Front Control Panel:

a. Circuit Voltage:

This gage displays the supply voltage in circuit 1 or 2 depending upon the circuit selected. The voltage must always be over 108 volts to properly operate the pump motors.

This gage is used to assist in troubleshooting. If the circuit voltage supply drops below 109 V, it could cause damage to components.

b. Voltage Selection:

This two position rotary switch selects the circuit (circuit 1 or circuit 2) voltage that is displayed on the above voltage gage.

c. Total Operating Time:

This hour meter displays the total time that power is provided to the heater loop.

d. Total Burner Time:

This hour meter displays the total time that the burners have been operating and is activated.

e. Circuit 1 Breaker:

Under normal operation, circuit breaker is depressed. If circuit breaker load is exceeded, it will trip the breaker and extend.

f. Circuit 1 Ground Fault Interrupter:

This interrupter circuit monitors the power flow through circuit 1 and trips or breaks the circuit when there is a ground or short. Correct the condition, depress the red button to reset interrupter and resume work.

g. Circuit 2 Breaker:

Under normal operation, circuit breaker is depressed. If circuit breaker load is exceeded,



Fig. 2 FRONT CONTROL PANEL

it will trip the breaker and extend.

h. Circuit 2 Ground Fault Interrupter:

This interrupter circuit monitors the power flow through circuit 2 and trips or breaks the circuit when there is a ground or short. Correct the condition, depress the red button to reset interrupter and resume work.

j. Emergency Stop:

This red two position push-pull switch controls the power circuit to the machine. Depress the switch to break the circuit and stop the machine. Pull the switch out for the machine to operate. Be sure that all switches are returned to their off positions before restarting the machine. Remember that the Emergency Stop switches on both the front and rear panels must be pulled out for the machine to run.

4.4 CONTROLS, HK 500. Rear Panel.

2. Rear Control Panel:

a. Circuit 1 Power:

This light comes on when the power to circuit 1 is turned on and everything is functioning normally. It goes out when the breaker or interrupter trips or the power is turned off.

b. Circulation Pump:

This light comes on when the burner coil circulation pump is on, and the pump is creating pressure, and goes out when the pump is off.

c. Left Burner Flame:

This light comes on when the left burner is on. The light goes out when the flame goes out.

d. Right Burner Flame:

This light comes on when the right burner is on. The light goes out when the flame goes out.

e. Compressor (Front Receptacle):

This light comes on when there is power to the outlet plugs on the front control panel and goes out when the power is off. Plug the compressor power cord into this outlet box.

f. Warning Indicators:

• Low Glycol:

This left red light comes on when the glycol reservoir level goes below the switch level and goes off when the level is above. Stop unit immediately and add glycol to the reservoir when this light comes on. Do not over fill reservoir.

• Overtemp:

This right red light come on when the burners are on with no call for heat.

g. Digital Display:

This system monitors the temperature of the glycol in the reservoir and entering the circulation manifold. It is shown on the digital display.

h. Call for heat / Indicator Light:

This light monitors the temperature in the glycol tank and flashes when the tank temperature is below the preset temperature. The light stops flashing when the tank gets up to temperature.

k. Temperature Switches:

This 3 push button switch monitors, controls and sets the system temperatures.

Depress the left button and hold to determine the reservoir temperature set point.

Depress and hold the center switch to lower the temperature while the left switch is depressed.

Depress and hold the right switch to raise the temperature while the left switch is depressed. The temperature can be set from 180°F (82°C) to -40°F (-40°C). With this setting, the internal computer controls the burners to maintain this temperature.

m. Return Temperature:

This gage monitors and displays the temperature of the glycol in the return manifold. It functions only when the field pump is running.

n. Circuit 2 Power:

This light comes on when the power to circuit 2 is turned on and everything is functioning normally. It goes out when the breaker or interrupter trips or the power is turned off.

o. Field Pump:

This light comes on when the field pump is turned on and goes out when the pump is off.

p. Circuit 1 Power:

This 2 position rotary switch controls the power to circuit 1. Turn the switch clockwise to turn the power to circuit 1 on and counterclockwise for off. The circuit 1 power light will come on when the power is turned on.

q. Heater/Compressor Selector Switch:

This 3 position rotary switch selects the system that will be supplied with power from circuit 1. Turn fully counterclockwise to select the (compressor system). When this system is turned on, the compressor (front receptacle) light will come on. Move the switch to the vertical position to turn circuit 1 off. Turn fully clockwise to turn the heater loop circuit on. When this system is turned on, the burner start-up sequence starts. First, the circulation pump light comes on as the pump starts. Then the left burner igniter starts. When that burner is operating, the left burner flame light comes on. This burner starting sequence then repeats itself with the

right burner.

r. **Lights:**

This 2 position rotary switch controls the power to the lights on the machine in both the front and rear compartments. Turn clockwise to turn on and counterclockwise to turn off.

s. **Circuit 2 Power:**

This 2 position rotary switch controls the power to circuit 2. Turn the switch clockwise to turn the power to circuit 2 on and counterclockwise for off. When the power is turned on, the circuit 2 power light will come on.

t. **Hose Reel/Field Loop Selector Switch:**

This 3 position rotary switch selects the system that will be supplied with power from circuit 2. Turn fully counterclockwise to select the hose reel system. Turn fully clockwise to provide power to the field loop system. In this position, the field pump light will come on.

u. **Hose Reel Direction:**

This 2 position rotary switch selects the direction of hose reel operation. Turn the switch fully clockwise to extend the hose and counterclockwise for retracting.

v. **Emergency Stop:**

This 2 position push-pull switch controls the power to the machine. Push the switch in to stop all machine functions and pull out to provide power. It is recommended that all controls be placed in their off position before the switch is pulled out and power restored. Both the front and rear panels have Emergency Stop switches. Both must be pulled out to restart the machine.

3. **Foot Pedal:**

The hose reel extend-retract function is controlled by the foot pedal switch. Move the pedal 4 to 6 feet (1.2 to 1.9 m) behind the reel during operation. Depress the pedal with your foot to activate the reel drive and release it to stop. Set the operating direction with the switch on the rear control panel.

Guide the hose with your hands while the reel is turning. Always wear heavy gloves to prevent burns.



Fig. 3 REAR CONTROL PANEL



Fig. 4 FOOT PEDAL

4.4 CONTROLS, HK150 & HK300.

Before starting to work, all operators should familiarize themselves with the location and function of the controls.

1. Control Panel:

a. Digital Display:

This system monitors the temperature of the glycol in the reservoir and entering the circulation manifold. It is shown on the digital display.

b. Warning Light:

This light monitors the temperature in the glycol tank and flashes when the tank temperature is below the preset temperature. The light stops flashing when the tank gets up to temperature.

c. Temperature Switches:

These 3 push button switches monitor, control and set the system temperatures.

Depress the left button and hold to determine the reservoir temperature set point.

Depress and hold the center switch to lower the temperature while the left switch is depressed.

Depress and hold the right switch to raise the temperature while the left switch is depressed. The temperature can be set from 180°F (82°C) to -40°F (-40°C). With this setting, the internal computer controls the burner to maintain this temperature.

d. Circuit Power:

This 2 position rotary switch controls the power to circuit. Turn the switch clockwise to turn the power to circuit on and counterclockwise for off. The circuit power light will come on when the power is turned on. The burner oil preheater comes on to preheat the nozzle.

e. Hose Reel Direction:

This 2 position rotary switch selects the direction of hose reel operation. Turn the switch fully clockwise to extend the hose and counterclockwise for retracting.

f. Hose Reel/Field Loop Selector Switch:

This 3 position rotary switch selects the system that will be supplied with power. Turn



Fig. 2a CONTROL PANEL

fully counterclockwise to select the hose reel system. Move the switch to its vertical position to turn off. Turn fully clockwise to provide power to the field loop system. In this position, the field pump light will come on.

g. Compressor/Heater Loop Selector Switch:

This 3 position rotary switch selects the system that will be supplied with power. Turn fully counterclockwise to select the (compressor system). When this system is turned on, the compressor light will come on. Move the switch to the vertical position to turn off. Turn fully clockwise to turn the heater loop circuit on. When this system is turned on, the burner start-up sequence starts. First, the circulation pump light comes on as the pump starts. Then the burner igniter starts. When that burner is operating, the burner flame light comes on.

h. Emergency Stop:

This 2 position push-pull switch controls the power to the machine. Push the switch in to stop all machine functions and pull out to provide power. It is recommended that all controls be placed in their off position before

- j. **Return Temperature:**
This gage monitors and displays the temperature of the glycol in the return manifold. It functions only when the field pump is running.
- k. **Total Operating Time:**
This hour meter displays the total time that power is provided to the heater loop.
- l. **Circuit Breaker:**
Under normal operation, circuit breaker is depressed. If circuit breaker load is exceeded, it will trip the breaker and extend.
- m. **Ground Fault Interrupter:**
This interrupter circuit monitors the power flow through the system and trips or breaks the circuit when there is a ground or short. Correct the condition, depress the red button to reset interrupter and resume work.
- n. **Circuit Power:**
This light comes on when the power is turned on and everything is functioning normally. It goes out when the breaker or interrupter trips or the power is turned off.
- p. **Circulation Pump:**
This light comes on when the burner coil circulation pump is on, and the pump is creating pressure, and goes out when the pump is off.
- r. **Burner Flame:**
This light comes on when the burner is on. The light goes out when the flame goes out.
- s. **Field Pump:**
This light comes on when the field pump is turned on and goes out when the pump is off.
- t. **Compressor:**
This light comes on when there is power to the compressor and goes out when the power is off.

Warning Indicators:

- u. **Low Glycol:**
This left red light comes on when

the glycol reservoir level goes below the switch level and goes off when the level is above. Stop unit immediately and add glycol to the reservoir when this light comes on. Do not over fill reservoir.

- v. **Overtemp:**
This right red light come on when the burners are on with no call for heat.

2. Flashing Beacon

The Flashing Beacon is located on the rear of the Heat King Unit. This beacon provides a visual indication that the Heater Loop Circuit is in the "ON" position.



Fig. 3 FLASHING BEACON

3. Foot Pedal / Hose Reel:

The hose reel extend-retract function is controlled by the foot pedal switch. Depress the pedal with your foot to activate the reel drive and release it to stop. Set the operating direction with the switch on the control panel. Guide the hose with your hands while the reel is turning. Always wear heavy gloves to prevent burns.



Fig. 4 FOOT PEDAL

Foot Pedal / Hose Reel Continued:

Starting in model year 2015-16, Heat Kings have the ability to free wheel out, you no longer need a person to press the foot pedal to unspool the hose making it a one person operation. There is still the option to use the foot pedal to spool out like the previous models if you wish to.

Unspooling: To spool out the hose, release the lock pin as shown in the picture below. Loosen the belt tension knob to allow the hose reel to free-wheel out. Start pulling the hose off the reel, if you find that the reel is free-wheeling too fast, increase the drag tension by turning the knob clockwise.

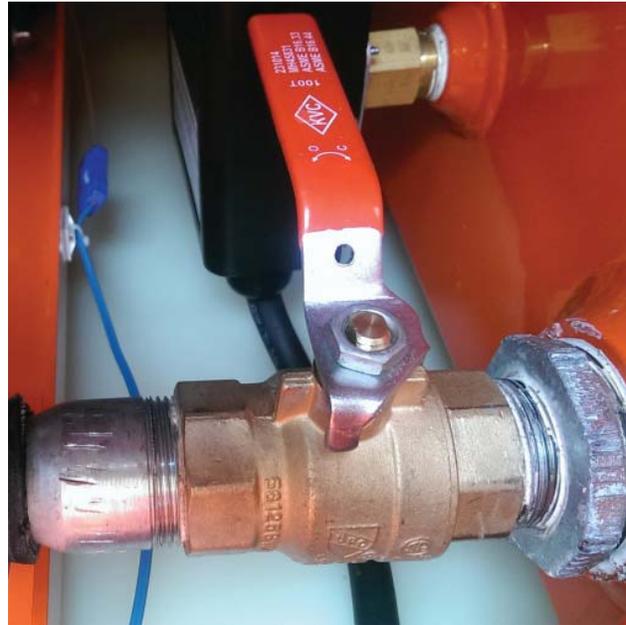
Spooling In: To spool the hose onto the reel, turn the selector switch on the control panel to the hose reel position. Select "IN" on the hose reel direction switch. Adjust the belt tension knob by turning clockwise. Depress the foot switch to begin spooling in the hose. If you find the reel is not pulling the hose in and the belt is slipping, increase the belt tension, with the belt tensioning knob.

Once the hose is all spooled in, release the lock pin to lock the reel in position for transport.

4. Valves:

Many circuits are designed with valves that control the flow in the circuit. Move the handle parallel to the line to open the valve and at right angles to close the valve. In most cases, a valve is placed in a line to allow for convenient isolation and servicing of a system.

Fig. 5 VALVES (TYPICAL)



Valve Closed



Valve Open



4.5 GROUND THAWING PRINCIPLES

The Heat King unit is designed to provide a source of warm or hot fluid that is available to pump through hoses to transfer heat to a surface. It is designed to warm, thaw or maintain a uniform temperature over a specific working area.

In the construction industry, there is a need to pour and cure concrete at any time of the year. Depending on your geographical location and the time of the year, the thawing and heating requirement will vary. Always review your needs and formulate a work plan before starting.

Any item, including the ground, can and will be melted or thawed when brought next to something that is warm. The Heat King heats a glycol solution to a temperature between -40°F and 180°F, depending on the selected temperature, and circulates it through a hose. The warm hose transfers heat to anything around it that is cooler.

Although soil, per se, does not freeze, the water contained in the soil does freeze and the water is what must be thawed. Changing ice to water takes a lot of heat energy that must all be supplied by the Heat King.

4.5.1 THAWING PRINCIPLES

To thaw ground quickly, efficiently and effectively, there are some recommendations that must be followed by the operator when planning and carrying out the project:

1. Cover the ground with a good vapor barrier to prevent any water vapor from escaping. A lot of energy is required to convert ice to water and then water to vapor. Preventing the vapor from escaping by use of the barrier will force it to remain on the ground and keep the heat on the ground.
2. Keeping the vapor and/or warmed water on the ground will force the heat back into the frozen ground to thaw it out. As the frozen ground continues to thaw, eventually the ground will be completely thawed and can even be warmed. When the ground is thawed, the surface water can and generally will soak away and transfer the heat to the lower levels of the ground. Frozen ground acts as a barrier to water and must be thawed before it will allow the liquid water to soak into the ground. An added benefit is that this warm liquid will transfer heat into the ground to help speed the thawing of the deeper levels.
3. When ground thawing, always use vapor barrier to retain the vapors on the ground and

keep the hoses clean. Always lay insulating blankets over the top of the hoses to hold the heat against the ground. Without the insulating blanket, heat can be reflected off the ground and escape into the surrounding area without doing any thawing. As a minimum, the insulating blanket should provide an R factor of at least R15. Using an insulating blanket with a poly cover also helps to keep blankets clean or they can be cleaned easily.

4.5.2 THAWING PLAN

Always formulate a plan to complete a thawing project before starting. A well thought out plan will save much time and insure that the job is completed in as short a time as possible. Gather all the equipment and bring to the worksite before starting to prevent or minimize delays. Although there are many ways to plan and perform a thawing project, these items should be considered and followed as the project is planned:

1. Remove all the ice and snow from the surface that will be thawed. Use a heavy piece of equipment for this job to be sure the ground is completely exposed and the heating hose can be placed directly on the ground.
2. Determine the depth of the frost. Generally a small auger works well for this purpose. Hose layout and spacing is dependent upon the depth of the frost and the time to thaw.
3. Cover the ground with a polyethylene vapor barrier to retain any vapors. Without a vapor barrier, the thawing time will be dramatically increased.
4. Lay out the heating hoses over the vapor barrier on the frozen ground. Refer to the hose spacing table for a general guideline. However it is recommended that all the hose be used for each thawing project even if it exceeds the minimum spacing. If the hoses have a closer spacing, it will speed the thawing rate.
5. Start the Heat King and preheat the glycol to 180°F.
6. Cover the heating hoses with poly clad insulation blankets to retain the heat. The blankets should provide at least an insulation factor of R15. If the ambient temperature is within 10°F of freezing and the frost is less than 2 feet deep, an R factor of R10 can be used.
7. Start the Heat King field loop and proceed with the thawing. Do not stop until the frost is completely gone and the surface water has soaked away.

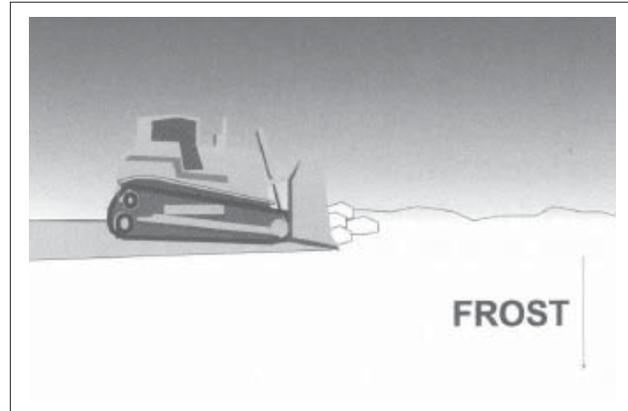


Fig. 6 GROUND CLEARING

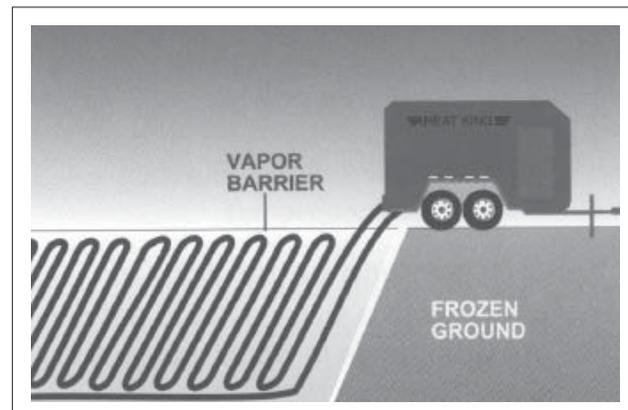


Fig. 7 THAWING AREA

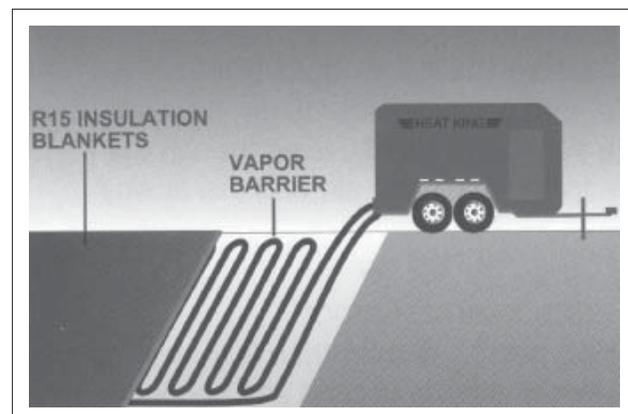


Fig. 8 INSULATING BLANKET

8. **Thawing Rate:**

- a. Refer to Table 1 for the recommended hose layout versus frost depth. Remember to use all the hose whenever setting up a thawing project. Reduce the hose spacing if required.
- b. With ideal conditions, the thawing rate will be 1 foot per day for the first 3 feet and 1/2 foot per day to 6 foot of depth. These are guidelines for the best thawing conditions.
- c. Some factors that will slow the thawing rate include:
 - i. **Soil Compaction:**
If the area to be thawed is compacted, the rate of thaw may slow to 6 inches per day or less.
 - ii. **Soil Moisture:**
If the soil moisture content is very low, i.e. dry clay, the thawing rate will slow to 6 inches per day or less.
 - iii. **Ambient Conditions:**
In extreme conditions, such as very cold temperatures (-30°F) or high winds, it is recommended that to insulation blankets be covered with hay bales to increase the insulation.
- d. Contact your dealer, distributor or the factory if you need further instructions for extreme conditions. Always have your structural or civil engineer review and approve your plan.

Table 1 Spacing vs Depth

Hose Spacing	Frost Depth
24"	1' - 3'
16"	4'
14"	5'

4.6 CONCRETE CURING PRINCIPLES

The Heat King can be used to establish the environmental conditions that are required to cure concrete. Review this section prior to starting your concrete project to understand all the requirements and limitations of correct concrete curing.

4.6.1 CURING PRINCIPLES

Concrete does not dry; it cures. Concrete curing is a chemical reaction that puts out heat, especially during the first day. The warmer the concrete, the faster it cures. When it is frozen or very cold, it stops curing altogether.

Be familiar with these items when establishing the conditions for concrete curing:

1. Concrete Stages:

- a. Concrete is always in its liquid or plastic when it is put in place. In this condition it can be placed, formed, consolidated, screeded and bull floated.
- b. After an initial set (6 to 8 hours at 60° to 70°F), it can be finished through floating, troweling or brooming.
- c. Final set is usually another 6 hours at 70°F. It is now hard, but far from fully cured. It will continue to cure and gain strength as time passes, so long as it is warm enough.
- d. After 6 or 7 days at 65° to 70°F, concrete has generally achieved 75% of its design strength. At this point, its forms can be stripped and loads applied.
- e. After 28 days, concrete has achieved its design strength, although it will continue to cure and gain strength for up to a year.

2. Conditions Required For A Good Cure:

a. Moisture:

Since the concrete curing process uses water, there must be water available for the process to continue. If the concrete gets too hot, the moisture will evaporate and it will stop curing. This is why the Heat King is not operated over 80°F when curing concrete.

b. Temperature:

Concrete cures best at a temperature between 65° and 80°F. As the temperature goes below this range, the curing rate slows. If it slows too much, the project will be delayed and waste a lot of time.

If the temperature drops too much, the concrete will freeze and stop curing. If concrete freezes before the final set (about 12 hours at 70°F), it may have to be removed. Use the Heat King to keep the concrete from freezing and maintain it at the required curing temperatures.

c. Objectives For Proper Curing In Cold Temperatures:

These objectives must be met in order to insure that concrete cures properly in cold temperatures:

- i. Don't let the concrete freeze.
- ii. Keep the concrete above 65°F so that it cures properly and quickly.
- iii. Keep the concrete below 80°F so that it won't bake and lose moisture.

4.6.2 CURING PLANS

This section contains some suggested plans for curing concrete in a variety of applications.

4.6.2.1 SLAB ON GRADE ABOVE 25°F (HOSE REUSED)

1. Thaw the ground according to the Heat King thaw plan.
2. Prepare the ground for concrete.
3. Place rebar.
4. Preheat the ground, run Heat King at 180°F, place hoses at 24" centers, put on insulating blankets and let the ground heat to at least 85°F.
5. Remove insulating blankets and rewind the hoses.
6. Turn the Heat King down to 85°F.
7. Bring in the concrete at 75°F.
8. Place 75°F concrete.
9. As soon as the concrete has reached the final set put on a vapor barrier.
10. Place hoses at no more that 20" centers, if you have extra hose use it. The more hose that you use, the more even the heat.
11. Place R15 of insulating blankets over the curing area.
12. Monitor the return temperature on the Heat King. Adjust the Heat King until the return temperature is in the 65-75°F range.
13. Keep the heat on until the desired design strength has been achieved (this will not be less than 7 days).
14. This is a general guideline, have your structural

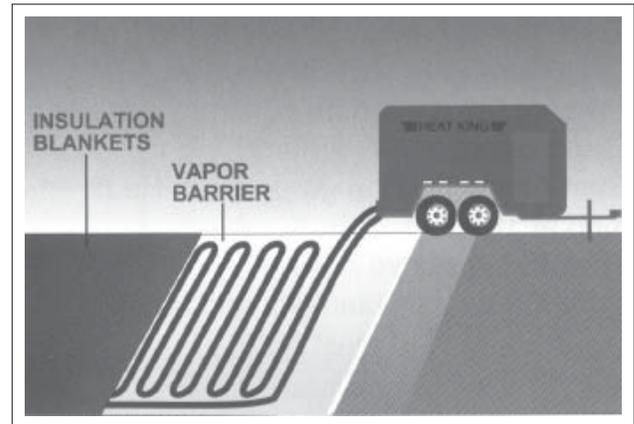


Fig. 9 GROUND THAWING

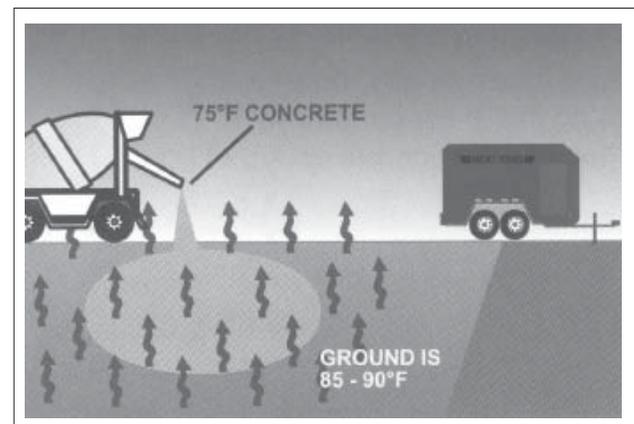


Fig. 10 CONCRETE POURING

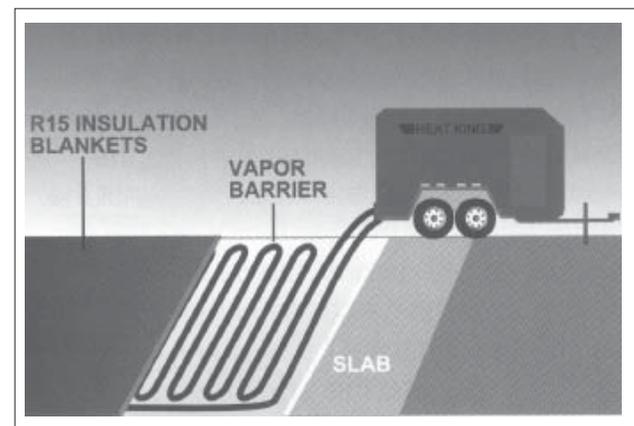


Fig. 11 CURING

4.6.2.2 SLAB ON GRADE BELOW 25°F (HOSE ABANDONED)

1. Thaw the ground according to the Heat King thaw plan.
2. Prepare the ground for concrete.
3. Place hoses at 20" centers.
4. Start preheating the ground, run Heat King at 180°F.
5. Place rebar above hose.
6. Put on insulating blankets and let the ground heat to at least 85°F.
7. Remove the insulating blankets.
8. Turn the Heat King down to 85°F.
9. Bring in the concrete at 75°F.
10. Place 75°F concrete on top of hoses.
11. As soon as the concrete has reached the final set put on a vapor barrier and R15 insulating blankets.
12. Monitor the return temperature on the Heat King. Adjust the Heat King until the return temperature is in the 65-75°F range.
13. Keep the heat on until the desired design strength has been achieved this will not be less than 7 days.
14. You can now use the system as a temporary radiant floor heating system until the permanent heating system is in place. Do not run the Heat King above 85°F until the concrete is fully cured.
15. This is a general guideline, have your structural or civil engineer approve your plan.

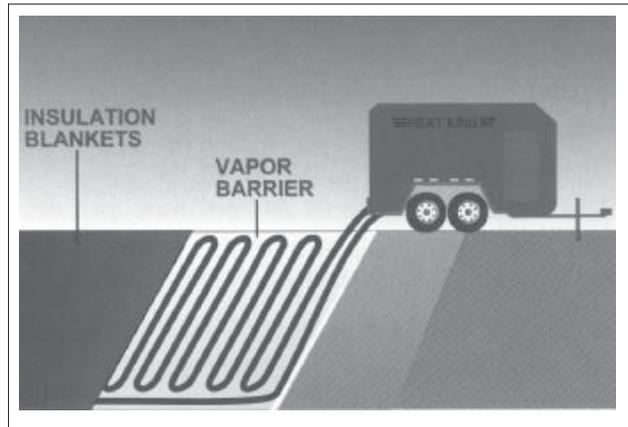


Fig. 12 THAWING

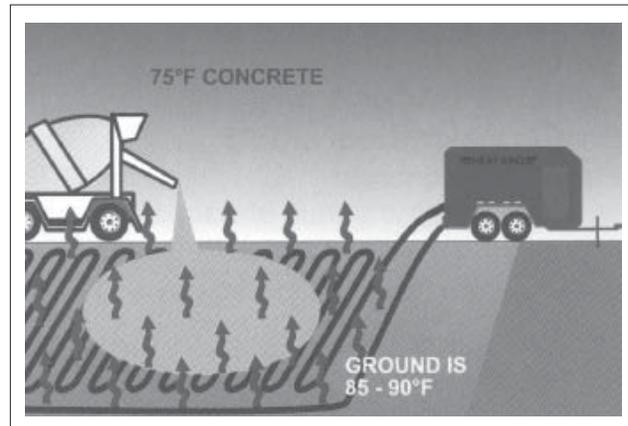


Fig. 13 POURING

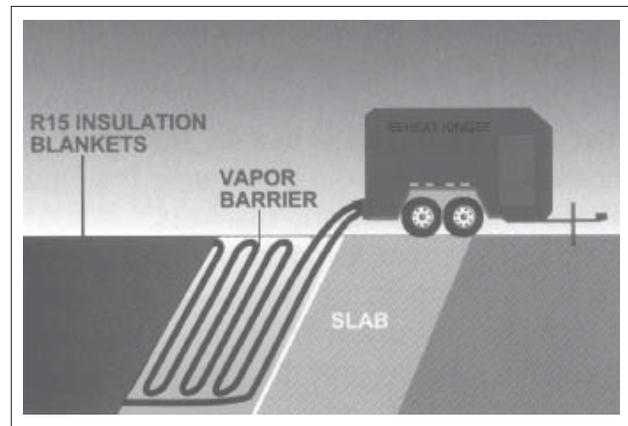


Fig. 14 CURING

4.6.2.3 GRADE BEAMS AND WALLS (BELOW 10°F HOSE ABANDONED)

Follow this plan with walls up to 10 inches thick.

1. Run hose at bottom of wall in the middle of the forms.
2. Run another hose through the wall for every 4' of height or portion thereof.
3. Run a hose near the top of the wall.
4. Run hoses on outsides of form at bottom, every 2' up the forms (both sides).
5. Put at least R15 of insulating blankets over forms.
6. Run the Heat King at 180°F to preheat forms and rebar for at least 3 hours.
7. Remove the insulating blankets.
8. Turn the Heat King down to 85°F,
9. Pour 75°F concrete.
10. Replace vapor barrier, insulating blankets and wrap tight.
11. Monitor the return temperature on the Heat King.
12. Adjust the Heat King until the return temperature is in the 65-75°F range.
13. Keep the heat on until the desired design strength has been achieved, this will not be less than 7 days.
14. This is a general guideline, have your structural

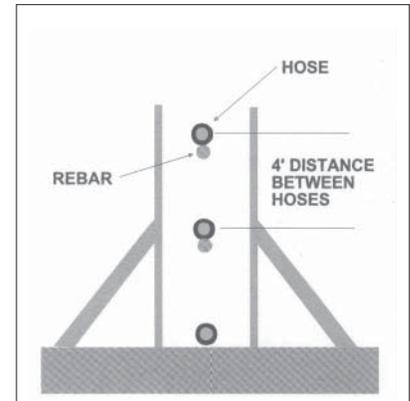


Fig. 15 HOSE LOCATION

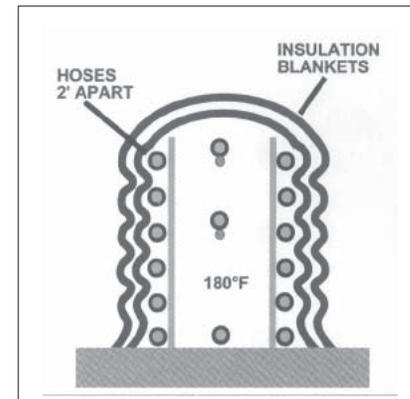


Fig. 16 OUTSIDE HOSE

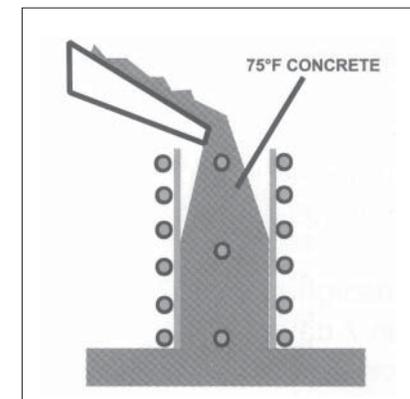


Fig. 17 CONCRETE

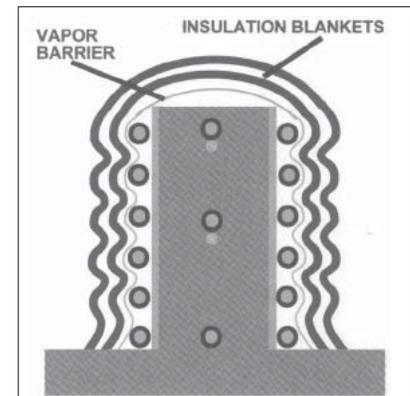


Fig. 18 CURING

4.6.2.4 GRADE BEAMS AND WALLS ABOVE 10°F (HOSE REUSED)

Follow this plan with walls between 10 and 24 inches:

1. Run hoses on outsides of form at bottom, and every 2' up the forms (both sides).
2. Put at least R15 of insulating blankets over forms.
3. Run the Heat King at 180°F to preheat forms and rebar for at least 3 hours.
4. Remove the insulating blankets.
5. Turn the Heat King down to 100°F.
6. Pour 75°F concrete.
7. Cover the forms with a vapor barrier, insulating blankets and wrap tight. It is important that there is an air tight, well insulated envelope around the forms.
8. Monitor the return temperature on the Heat King.
9. Adjust the Heat King until the return temperature is in the 65-75°F range.
10. Keep the heat on until the desired design strength has been achieved. (This will not be less than 7 days).
11. This is a general guideline, have your structural

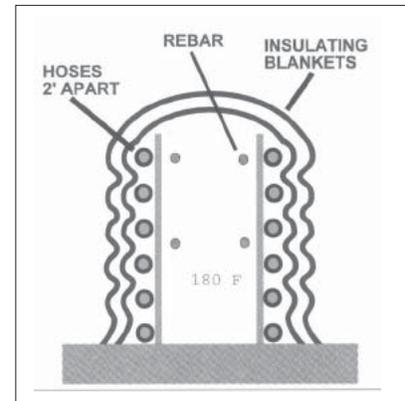


Fig. 19 INSTALLATION

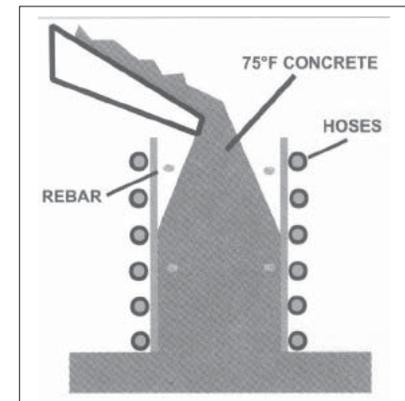


Fig. 20 CONCRETE

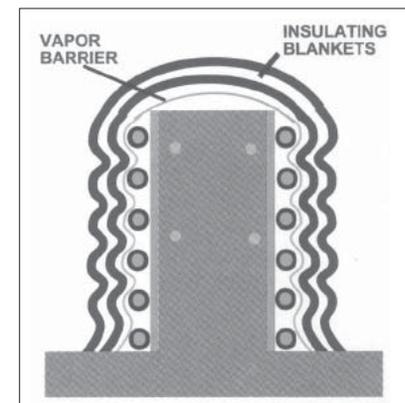


Fig. 21 CURING

4.6.2.5 GRADE BEAMS AND WALLS BELOW 10°F (HOSE ABANDONED)

Follow this plan with walls between 10 and 24 inches:

1. Run 2 hoses at bottom of wall in forms within 2" of form.
2. Run another 2 hoses through the wall for every 4' of height or portion thereof.
3. Run 2 hoses near the top of the wall within 2" of form.
4. Run hoses on outsides of form at bottom, and every 2' up the forms (both sides).
5. Put at least R15 of insulating blankets over forms.
6. Run the Heat King at 180°F to preheat forms and rebar for at least 3 hours.
7. Remove the insulating blankets.
8. Turn the Heat King down to 85°F.
9. Pour 75°F concrete.
10. Place vapor barrier, replace insulating blankets and wrap tight.
11. Monitor the return temperature on the Heat King.
12. Adjust the Heat King until the return temperature is in the 65-75°F range.
13. Keep the heat on until the desired design strength has been achieved. (This will not be less than 7 days).
14. This is a general guideline, have your structural

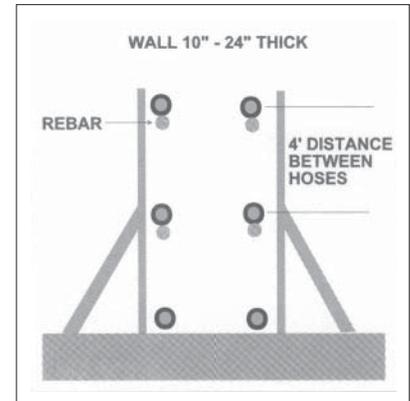


Fig. 22 INSTALLATION

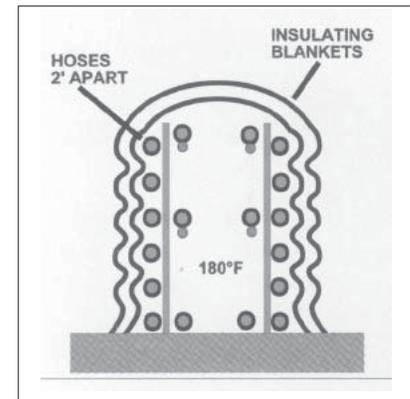


Fig. 23 OUTSIDE HOSES

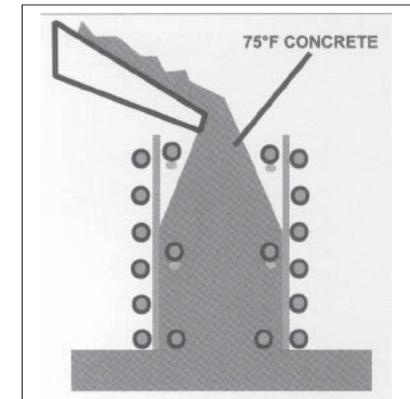


Fig. 24 CONCRETE

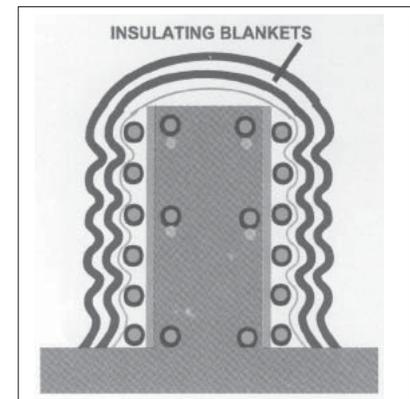


Fig. 25 CURING

4.7 SET-UP

The machine must be placed and set-up properly to perform as expected. Follow these instructions when bringing the Heat King to a work site and preparing it for operation.

1. Locate the unit in an area that is firm, level and with good drainage to minimize standing water. Be sure there is sufficient space on all sides to access the machine as required.
2. Level the frame using the jack on the hitch. Use a carpenter's level to be sure.
3. Open all the doors and secure with the anchor latch on the side of the frame behind each door. Wait at least 10 minutes for the unit to vent and air out before connecting power wires or starting unit to allow the fumes and vapors to dissipate.



Hitch Jack



Fig. 26 LEVELING

NOTE

If the frame is not level, the burners will not be able to use the total amount of fuel in the tanks.

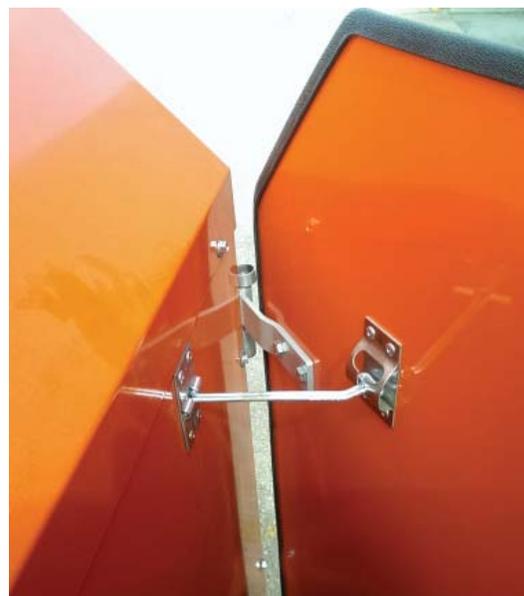


Fig. 27 DOOR LATCH (TYPICAL)

- Turn all switches off on the front (if equipped) and rear control panels.



Front



Rear

Fig. 28 CONTROL PANELS. HK500 shown above, HK150&HK300 Below.



- All Heat Kings run on 115 volt, 60 Hz power. Different models have different requirements. See power usage guide below:
 HK 500 requires two independent 20 Amp circuits.
 HK 300 requires two independent 20 Amp circuits.
 HK 150 requires one independent 20 Amp circuit
 Be sure each circuit is independent with its own breaker or fuse.

6. Check the fuel level on the fuel gauge under or beside the fuel filter or the back of the fuel tank, add as required. Do not smoke when refueling.



HK300



HK500



HK150



Fig. 31 FUEL FILL



7. Check the glycol level in the reservoir. Be sure the level is between minimum and maximum levels.



Fig. 32 GLYCOL LEVEL

8. Pull the Emergency Stop button out on both control panels.

4.8 START-UP PROCEDURE

Review and follow the start-up procedure whenever starting up the Heat King:

1. Check and be sure that the machine is properly positioned and set-up at the work site (see section 4.7).
2. Check that all switches are in the off position.
3. Power Requirements: HK 500- Plug the power cords into 2 separate 20 amp circuits. HK 300- Plug the power cords into 2 separate 20 amp circuits. HK 150- Plug the power cord into a 20 amp circuit.
4. On the rear control panel, turn the power switches to their on position for circuit 1 and circuit 2 (HK500 only. Other Heat Kings are single circuits). The power light(s) will come on.
5. Turn the lights on.
6. Set the operating temperature on the temperature controller on the control panel. (see section 4.4)
7. Turn the Comp/Heater Loop switch to the Heater Loop position.
8. The circulation pump light will come on as the pump creates pressure while circulating fluid through the coils.
9. A few seconds later, the Left Burner Flame light will come on as the flame in the left burner comes on. HK150&HK300 models are single burner machines.
10. A few seconds later, Right Burner Flame(HK500) light will come on as the flame in the right burner comes on.
11. Turn the reel drive circuit on (A) and place in the extend mode (B).

IMPORTANT

The internal computer controls the start-up sequence to minimize electrical loads.



Fig. 33 REAR CONTROL PANEL. HK500 shown above, HK150/300 below.



12. Pull the reel drive foot pedal out of its stowed position and place about 6 to 10 feet behind the unit.
13. Depress the foot pedal to extend the hose.
14. Guide the hose by hand as it extends. Have a helper lay the hose out as the hose extends.



Stowed Position



Foot Pedal Placed

- Fig. 35 FOOT PEDAL**
Fig. 36 FOOT PEDAL DEPRESSED
Fig. 37 GUIDING HOSE

15. As the first hose segment is extended, stop the reel and disconnect the hose from the reel spool.
16. Lay the hose out per the thawing or warming plan.
17. Connect each end of the heating hose to the couplers on the rear manifolds.
18. Repeat the hose extending process with each of the remaining hose segments.

NOTE

It is recommended that all the hose segments be used to reduce the working time.



Manifolds



Connected

Fig. 38 HOSES

19. When the light on the Supply Temperature display stops flashing, the glycol in the reservoir is at the preset level.
20. Open the valve to the supply side manifold.



Fig. 39 VALVE

21. Turn the Hose Reel/Field Loop switch to the field loop position.
22. The Field Pump light will come on and the glycol will circulate through the heating hose.



Fig. 40 FIELD LOOP

23. Visually inspect the hoses and couplers for leaks. Stop any leaks to prevent losing any glycol into the worksite.

Check for leaks frequently during the first few hours of operation. Correct any leak before continuing work.

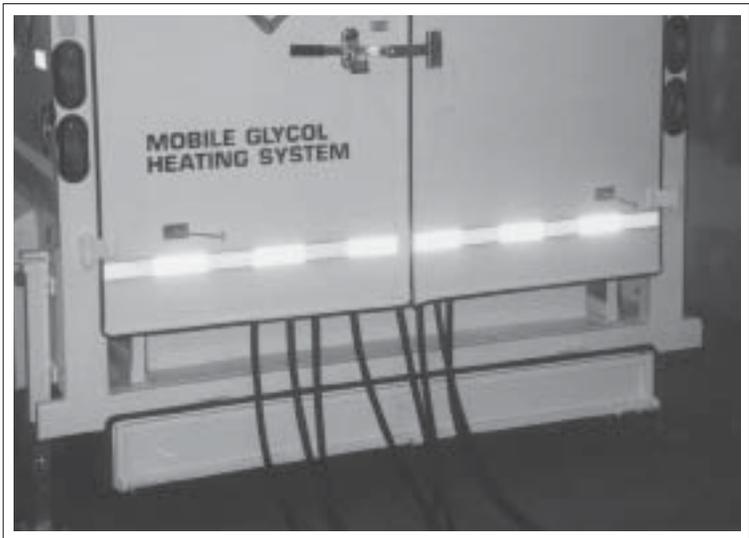


Fig. 41 HOSES

4.9 SHUT-DOWN PROCEDURE

Review and follow the shut-down procedure whenever shutting down the Heat King:

1. Turn the Reel Motor/Field Loop switch to its off position.
2. Turn the Compressor/Heater Loop switch to its off position.
3. If appropriate blow out field lines. Although blowing out the field lines with a non-disposable line application is optional, it is recommended for a disposable line application.

NOTE

If disposable lines were used for your application, it is recommended that the lines be blown out and the glycol returned to the reservoir for reuse. Use the compressor to blow out the hoses or any other circulation system used.



Fig. 42 CONTROL PANEL



Fig. 43 SUPPLY MANIFOLD VALVES (SIMULATED)

When blowing out the lines, follow this procedure:

- a. Close all the supply manifold shut-off valves except one.
 - b. Turn the Compressor/Heater Loop switch on the rear control panel to the Comp position.
 - c. Wait for a few minutes for the hose to blow-out completely.
 - d. Close the valve to the hose that has been blown out and open the next one.
 - e. Wait for a few minutes to blow this circuit out and then repeat with the next circuit.
 - f. Repeat until all the lines are blown out one line at a time.
 - g. Turn the on/off switch on the back of the compressor to the off position.
 - h. Turn the compressor/heater loop switch on the control panel to the off position.
4. Turn the Reel Motor/Field Loop switch to the Reel Motor position.



Fig. 45 COMPRESSOR



Fig. 46 VALVES (TYPICAL) HK500 shown

5. Pull the hose reel switch pedal cord out and position the assembly 4 to 6 feet in back of the frame.
6. Disconnect a hose from the left (return) manifold.
7. Attach the free end to the coupler end on the reel anchor.
8. Step on the foot switch and guide the hose on the reel.

NOTE

The best results are obtained when the hose is wrapped on the reel by one layer of hose at a time across the full width of the reel.

9. When this length of hose is on the reel, stop and disconnect the other end from the feed manifold.
10. Connect this free end to the end of the next hose and start the hose reel to roll up the next hose segment.
11. Repeat with each of the next segments in turn until they are all rolled up on the reel.
13. Leave the hose end facing to the back to provide easy access when starting the next job.
14. Stow the foot pedal switch and cord along the right rear side of the frame.
15. Close and lock rear doors.



Fig. 47 FOOT SWITCH, Fig. 48 GUIDING HOSE



Fig. 49 STOWED

4.10 OPERATING



OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, maintaining or adjusting the Heater.
2. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
3. Do not allow riders in or on machine during transport.
4. Install and secure all guards and shields before starting and operating.
5. Clear the area of bystanders, especially small children, before starting and operating.
6. Keep the working area clean and free of debris to prevent slipping or tripping. Clean up fuel spills immediately if they occur.
7. Slow down. Use care when working around unit - the steps, frame or floor may be wet and/or slippery.
8. Do not allow personnel that are taking drugs, alcohol or any medications that impair the senses or when excessively tired or stressed to operate the Heater.
9. Do not operate unit in a poorly ventilated or enclosed area to prevent asphyxiation when the heaters are operating.
10. Do not smoke when filling fuel tank or when working around machine.
11. Always wear heavy gloves when working on the machine to prevent burns when touching hot components.
12. Use the foot pedal switch to engage the hose reel take up or extend function and guide the hose by hand.
13. Keep all electrical lines and components in good working order. Do not operate in wet conditions or when standing in water. Damp or wet conditions can cause shocks or trip the breakers.
14. Keep all components in good condition. Do not operate with glycol leaks. Check hoses, lines, couplers and manifolds frequently for leaks.
15. Review safety instructions with operators annually.

Each operator should review this section of the manual when starting a project and as often as required to be familiar with the machine. When operating, follow this procedure:

1. Review and follow the Set-Up and Pre-Operation checklists.
2. Review the location and function of all controls.
3. Review the machine Set-Up procedure (Section 4.7).
4. Review the Start-Up and Shut-Down procedures (Sections 4.8 and 4.9).
5. Transport to the work site and position appropriate for the project. Be sure to leave sufficient space to provide easy access to all sides of the machine.

6. Set-up machine per Section 4.7 and to accommodate the project plan.
7. Start the machine per Section 4.8.
8. **Emergency Stop:**
Both front and rear control panels (HK500) are designed with red emergency stop switch. HK150 & HK300 have rear panel only. Depress the stop switch to stop the pumps and shut off the burners. The lights will stay on even though all the machine functions have shut down. Always place all controls in the off position before restarting. Correct the situation leading to shut-down before resuming work and always follow the recommended start-up procedure.

9. **Extreme Cold Start-Up:**
Always be aware of the following items whenever operating in very cold temperatures:

- a. **Fuel Type:**
#1 and #2 Fuel Oil and 2-K Kerosene are the fuel types the machine can use. If using Home Heating Fuel, ensure it is #1. If #2 is used, it could cause damage to the burners. If dealing with extreme cold conditions, use 2-K Kerosene because it will not gel as easily. Gelling of the fuel will make the burners soot. If kerosene cannot be used in extreme conditions, contact the factory for a special additive to help treat the fuel so it flows well. This can become a problem if the fuel tank is filled during the summer and not operated until it is very cold.

- b. **Glycol Freeze Temperature:**
Although the 50:50 glycol solution does not freeze until it reaches -30°F, it can become slush at -20°F and not move freely through the heaters at start-up. At temperatures below -30°F, it is recommended that a 60:40 glycol: water solution be used to give protection down to -60°F (-51°C). Do not operate with less than a 50:50 glycol solution strength.

Fig. 50 EMERGENCY STOP SWITCHES



HK500 Rear Panel



HK500 Front Panel



HK150 & HK300 Panel

12. Burner Adjustment:

The machine is designed with two fuel oil-fired burners to heat the glycol mixture. The air/fuel ratio is preset from the factory for 23°F to 41°F (-5°C to 5°C) at 760 ft. (232 m) above sea level and may not work well for all conditions. An easy way to check the quality of fuel burn is to watch the color of the exhaust out of the burner. If it is not clear, it will form soot and can foul the burners themselves. White smoke means too much air, black smoke means too much fuel.

NOTE

It is preferable to adjust the burners using a Heat King approved Smoke Spot Tester.

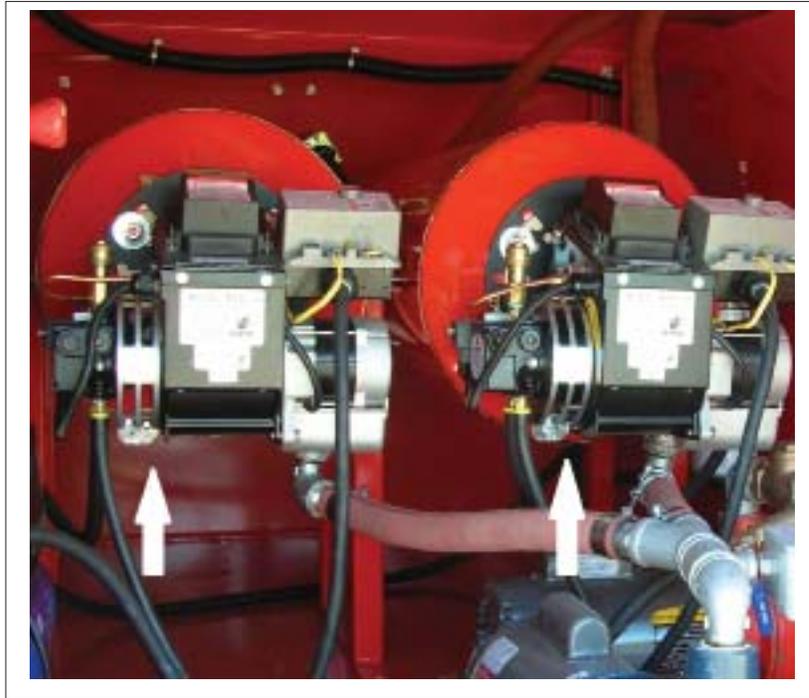


Fig. 54 BURNER AIR BANDS

To adjust the burners without a Smoke Spot Tester, follow this procedure:

- Completely close the burner vents.
- Turn on burners.
- Have a second person monitor the color of the exhaust smoke while the first person slowly opens the air bands until the exhaust is clear.

IMPORTANT

If the air band will not move, use a 1/2 inch wrench to loosen and move air vent bolt.



Fig. 55 GLYCOL FILTER

13. Glycol Strainer:

The glycol circuit is designed with a strainer in the field loop circuit to remove all contaminants from the system. Clean the filter every year to keep the system clean. Clean more frequently if dirt gets in during filling or hose attach-

15. Fuel Filters:

Each burner fuel circuit is designed with a filter to remove contaminants from the fluid. Change every 750 burner hours to keep the system clean. Change more frequently if contaminants are introduced into the system during refueling or if poor quality fuel is used.



Fig. 57 FUEL FILTER

16. Long-Term Operation:

The Heat King is designed to operate on its own without a person in attendance. This is particularly beneficial when used on long term thawing and curing projects.

It is recommended that when left unattended the doors be closed and padlocked to prevent any vandalism or interference by outsiders. The fuel door is also padlockable.



Fig. 58 PAD-LOCKABLE SIDE, REAR AND FUEL DOORS

17. Manifold Loop:

A short hose with couplers on each end can be used to check out the system. Attach each end to a manifold and open the valve. This will allow the glycol to circulate and



Fig. 59 GLYCOL LOOP

18. Operating Hints:

- a. Always wear heavy gloves when working with the Heat King. The system can be operated at up to 180°F and burn unprotected hands or skin.
- b. Do not smoke around the machine or when refueling. Keep all flames, sparks or embers away from the machine at all times.



- c. Always guide the hoses when extending or retracting the hoses. Guide the hose in a single layer across the width of the reel to reduce the size of the reel.
- d. Although the Heat King glycol has been selected as a non-polluting solution, it is recommended that special care be taken to minimize and/or eliminate leaks or spills. Always clean up spills and correct leaks before continuing work.



Fig. 62 GUIDING HOSE

4.11 TRANSPORT

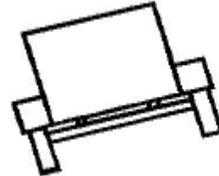


TRANSPORTING SAFETY

1. Attach to towing vehicle and secure with a mechanical retainer. Cross the safety chains under the hitch and anchor to truck frame.
2. Connect the brake anchor cable to the truck frame to activate the trailer brakes if the trailer unexpectedly unhooks. Provide sufficient slack for turning.
3. Check that all lights and reflectors required by the DOT are clean and functioning.
4. Do not exceed 55 mph under ideal conditions.
5. Do not allow riders on machine.
6. Do not drink and drive.



WARNING



TRAILER TOWING CAN BE HAZARDOUS

- * DO NOT exceed 55 mph under ideal conditions
- * Reduce speed under adverse weather, road or terrain conditions
- * Avoid sudden lane changes, U-turns etc.
- * Sudden maneuvers may cause tipping, rollover, jackknifing or sliding of the trailer and without warning loss of control of the towing vehicle may result.
- * Allow for increased braking distance due to weight of trailer
- * Read the Operator's Manual before towing.

When transporting the machine, review and follow these instructions:

1. Be sure all bystanders are clear of the machine.
2. Back the truck up to the hitch and lower hitch over the ball.
3. Secure with a mechanical retainer.

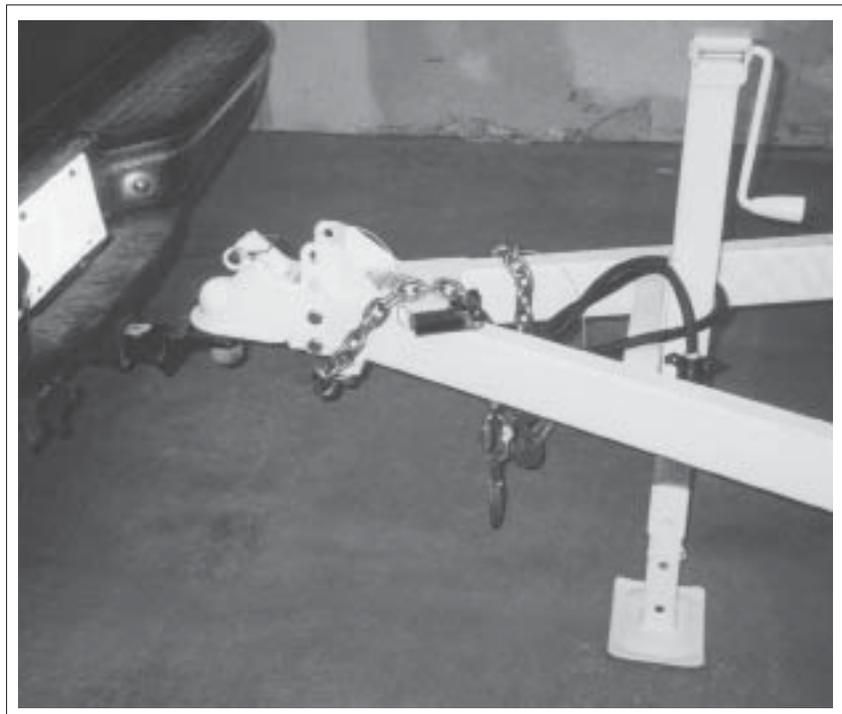


Fig. 63 HITCH

4. Cross the safety chains under the hitch and attach to truck frame.
5. Attach the brake line to the truck frame. Be sure to leave sufficient slack for turning.



Fig. 64 SAFETY CHAINS/BRAKE LINE

6. Connect electrical harness to truck plug-in.
7. Raise and secure the hitch jack.
8. Reverse the Heat King set-up procedure to secure unit for transporting see Section 4.6).
9. Check and be sure that all lights are working.
10. Do not allow riders on machine.
11. Never exceed a safe travel speed.
12. Do not drink and drive.

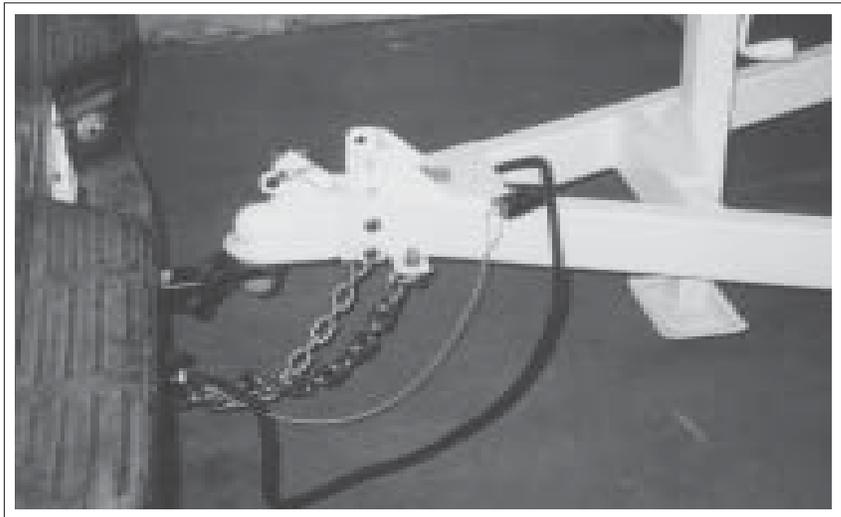


Fig. 65 ELECTRICAL HARNESS/JACK

13. Check with local highway authorities on the specific requirements for transporting fuel oil and glycol through their jurisdiction. Always comply with the requirements before transporting. A copy of the Material Safety Data sheets is contained in Section 7 for your convenience.

4.12 STORAGE



STORAGE SAFETY

1. Store unit in an area away from human activity.
2. Do not permit children to play on or around the stored Heater.

4.12.1 PLACING IN STORAGE

After the season's use, the machine should be thoroughly inspected and prepared for storage. Repair or replace any worn or damaged components to prevent any unnecessary down time at the start of next season. To insure a long, trouble free life, this procedure should be followed when preparing the unit for storage:

1. Clear the area of bystanders, especially small children.
2. Thoroughly wash the machine using a pressure washer to remove all dirt, mud, debris and residue.
3. Inspect the hoses and burners for damage. Repair or replace damaged parts. Remove all entangled material.
4. Check the glycol level in the reservoir. Add as required.
5. Drain and remove the diesel fuel from the tank whenever the unit will be stored for more than 30 days. Removing the fuel during storage eliminates the formation of organic matter in the system and prevents leaks. Always refill the tank before its next use.
6. Lubricate all grease fittings. Make sure that all grease cavities have been filled with grease to remove any water residue from the washing.
7. Touch up all paint nicks and scratches to prevent rusting.
8. Move to storage area.
9. Select an area that is dry, level and free of debris.
10. Place blocks under the hitch if required.
11. Padlock each door.
12. Unhook from tow unit (see Section 4.10).
13. If the machine cannot be placed inside, cover with a waterproof tarpaulin and tie securely in place.
14. Store the machine in an area away from human activity.
15. Do not allow children to play on or around the stored machine.

5 SERVICE AND MAINTENANCE



MAINTENANCE SAFETY

1. Review the Operator's Manual and all safety items before working with, maintaining or operating the Heater.
2. Place all controls in their OFF position, disconnect power cords and wait for all moving parts to stop before servicing, adjusting or maintaining.
3. Have a first-aid kit available for use should the need arise and know how to use it.
 - Keep service area clean and dry.
 - Be sure electrical outlets and tools are properly grounded.
 - Use adequate light for the job at hand.
4. Keep hands, feet, clothing and hair away from all moving and/or rotating parts of the hose reel and drive system.
5. Always wear heavy gloves to prevent burns when handling hot components. Wait until burners, coils and glycol system components have cooled before working on them.
6. Do not attempt any adjustment or maintenance to any system of the Heater unless the power wires are disconnected.
7. Make sure that all guards, shields and hoods are properly installed and secured before operating the Heater.
8. Securely support the machine using blocks or safety stands before working beneath it or changing tires.
9. Store and transfer diesel fuel, solvents, cleaners or any flammable liquids only in safety standard approved containers.

5.1 SERVICE

5.1.1 FLUIDS AND LUBRICANTS

1. **Grease:**
Use an SAE multipurpose high temperature grease or a multipurpose lithium base grease.
2. **Fuel:**
Use only #1 fuel oil or 2-K Kerosene for all operating conditions. Capacity: 92 gallon.
3. **Glycol:**
Use only Tamarack glycol for all operating conditions. Do not mix or combine other types. Reservoir Capacity: 130 gallon.
4. **Gearbox Oil:**
Use an SAE 80W90 oil for all operating conditions. Do not mix oil types or viscosities. Gearbox Capacity: 1.5 US qts.
5. **Storing Lubricants and Fluids:**
Your machine can operate at top efficiency only if clean lubricants are used. Use clean containers to handle all fluids. Store them in an area protected from dust, moisture and other contaminants.

5.1.2 GREASING

Refer to section 5.1.1 for recommended grease. Use the Maintenance Checklist provided to keep a record of all scheduled maintenance.

1. Use only a hand-held grease gun for all greasing. An air-powered greasing system can damage the seals on bearings and lead to early failures.
2. Wipe grease fitting with a clean cloth before greasing to avoid injecting dirt and grit.
3. Replace and repair broken fittings immediately.
4. If fittings will not take grease, remove and clean thoroughly. Also clean lubricant passage. Replace fitting if necessary.

5.1.3 SERVICING INTERVALS

Daily or 8 Hours

1. Check glycol reservoir level. Top up as required.



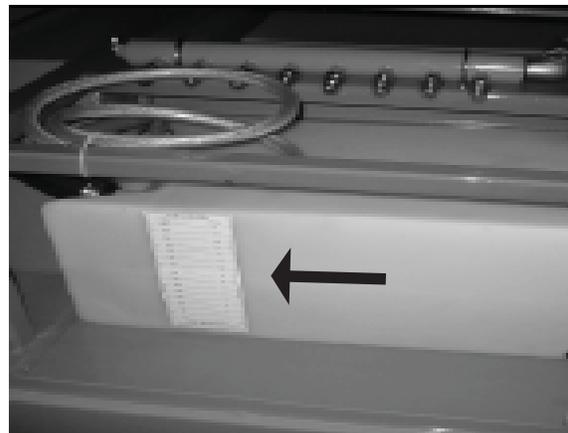
Fig. 66 GLYCOL LEVEL

2. Check fuel level. Add as required.



Fuel Cap

NOTE
Keys to locking fuel tank cap are attached to the rear tube of the reel frame from the factory. Remove and place in a secure place for use in the



Gage

Fig. 67 FUEL LEVEL

Each Heating Season

1. Grease the reel bearings (2 locations).



Right



Left

Fig. 68 REEL BEARINGS

2. Check the oil level in the gearbox
(view shown is system removed from machine).



WARNING

Machine is shown with drive system open for illustrative purposes only.



Fig. 69 GEARBOX OIL LEVEL

5.1.4 SERVICE RECORD

See Lubrication and Maintenance sections for details of service. Copy this page to continue record.

ACTION CODE: š CHECK C CHANGE
 L LUBRICATE CL CLEAN

<div style="text-align: right; padding-right: 10px;">HOURS</div> <div style="text-align: center; padding: 5px;">SERVICED BY</div>												
	MAINTENANCE											
DAILY OR 8 HOURS												
š Glycol reservoir Level												
š Fuel Level												
MONTHLY OR 100 HOURS												
L Reel Bearings (2)												
š Oil Level Gearbox												
ANNUALLY												
CL Machine												
C Compressor Oil												
C Glycol Filter												
C Cad Cell												
750 HOURS												
C Change Nozzles												
C Change Electrodes												
C Change Fuel Filter												
š Exhaust Terminals and Pipe												

5.2 MAINTENANCE

By following a careful service and maintenance program for your machine, you will enjoy many years of trouble-free service.

5.2.1 CLEANING GLYCOL STRAINER AND CHANGING FUEL FILTERS

Annually or every 700 hours (or more often if conditions are extremely dusty) the fuel and or glycol filter should be changed. To change, follow this procedure:

1. Clear the area of bystanders, especially small children.
2. Allow the machine to cool before changing the filters. Hot "glycol" can cause burns if it contacts exposed skin.
3. Be sure all controls are off.
4. Turn valves off to isolate the filters.
5. Place a pan under each filter to catch any fluid that spills.
6. Remove each fuel filter and replace with a new one.
7. Remove and clean the Glycol filter.
8. Dispose of fuel filters in an approved container and manner.
9. Start the unit and run for 1 minute.
10. Check the filters, and all fittings for leaks.
11. If leaks are found around the filter, tighten slightly and repeat step 8 and 9.



Glycol



Fuel

Fig. 72 FILTERS

5.2.2 CHANGING FUEL NOZZELS AND ELECTRODES

Annually or every 750hours (or more often if fuel quality is poor) the fuel nozzels and elecrodos should be changed. To change, follow this procedure:

1. Remove the drawer assembly (fuel tube, flame turbulator, fuel nozzle, electrodes) from the burner chasis. Shown in Fig 1.
2. Loosen the set screws that hold the electrode in place and remove them. Note there is a left and a right side electrode.
3. Remove the nozzle with a standard wrench and also use a backup wrench to keep the drawer assembly base from turning.
4. Replace the nozzle with the appropriate size for your Heat King model.
NOTE: use semi solid or hollow cone spray pattern nozzels.

HK500 use a 1.25 GPH, 80° nozzle @ 140 psi.

HK300 use a 1.65 GPH, 80° nozzle @ 120 psi

HK150 use a 1.00 GPH, 80° nozzle @ 120 psi

NOTE : FOR HIGH ALTITUDE USE (4000+ ft above sea level). Use the appropriate size for your heat king model.

HK500 use a 1.1 GPH, 80° nozzle @140 psi

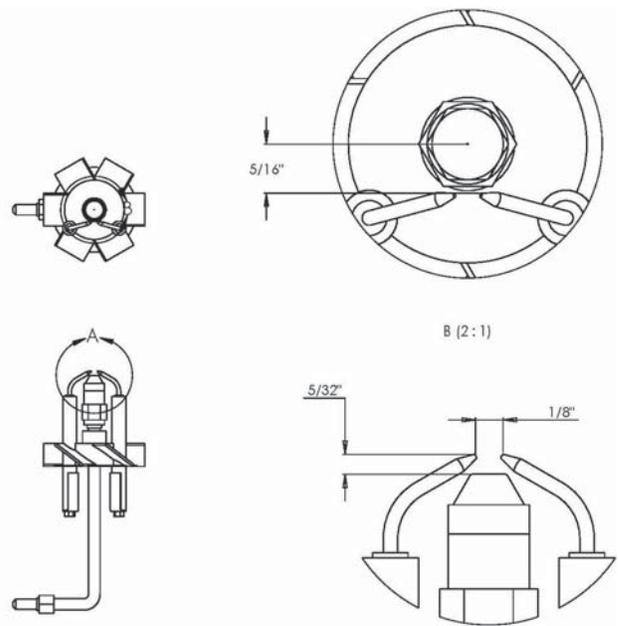
HK300 use a 1.5 GPH, 80° nozzle@120 psi

HK150 use a 0.8 GPH, 80°nozzle @120psi

5. Make sure nozzle is tight and then install the electrodes, set the gap and hieght according to this diagram, diagram 1 or use the appropriate wayne burner gap gauge.



Fig 1



electrode set up diagram

5.2.2 CHANGING FUEL NOZZELS AND ELECTRODES continued

6. Re-install the drawer assembly back into the burner chassis. Set the distance from the flat face of the nozzle to the top edge of the retention head to $7/8"$. or use a wayne gap gauge to be extra sure.

NOTE: to save this step of setting the height of the drawer assembly in the burner chassis, if you are not removing the burner from the coil, note the setting on the height gauge on the side of the burner and return it to that setting. Or scratch a line on the side of the burner to ensure an identical set up. If you are unsure it has been set up correctly, remove the burner from the coil so you can see the actual measurement.



5.2.3 Checking the condition of the exhaust pipes and terminals.

Annually or every 750hours the exhaust pipes and terminals should be checked for integrity, to check them, follow this procedure:

1. Visually inspect the exhaust pipes and terminals for rust, cracks, holes or loose screws or bolts and missing or cracked sealant.

If any components are found to have wear, replace the parts or reseal.

6 TROUBLE SHOOTING

The Tamarack Construction Heat King is a self-contained glycol heating system that can be used to thaw frozen ground or maintain a work area at a constant temperature. It is a simple system that requires minimal maintenance.

In the following trouble shooting section, we have listed many of the problems, causes and solutions to the problems which you may encounter.

If you encounter a problem that is difficult to solve, even after having read through this trouble shooting section, please contact your authorized dealer, distributor or the factory. Before you call, please have this Operator's Manual and the serial number from your machine ready.

PROBLEM	CAUSE	SOLUTION
Burners won't start.	No fuel.	Fill the fuel tank.
	No power.	Plug machine in and turn on.
		Breaker tripped. Reset breaker.
	Low glycol.	Fill glycol reservoir.
Switch off.	Pull out both Emergency Stop switches.	

NOTE: For the burners to be able to fire, three conditions must be met.

- 1) The Pressure switch on the circulation loop must see pressure. (gray plastic box on circ pump)
- 2) The low glycol sensor must sense glycol. (blue box on glycol tank)
- 3) The aquastat temperature has to allow the call for heat, by being below 230°F. This condition would be very rare, and should only trip off if there is not enough flow through the coil or the burner is burning too hot. (gray box on coil discharge beside exhaust)

Burners give off black smoke.	Wrong fuel/air mixture.	Reset air mixture.
	Fouled burner.	Clean burners.
	Plugged fuel filter(s).	Change filter(s).

Reel won't move.	No power.	Turn power on.
		Reset circuit breaker.
	Drive belt loose.	Adjust drive belt tension.

7 SPECIFICATIONS: HK500

7.1 MECHANICAL

1. General Capacities and Component Specifications

Height (w/ heater vent)	86 in.
Width	80 in.
Length (from hitch)	165 in.
Ground Clearance	16 in.
Weight (w/ glycol)	4500 lbs.
Weight (w/ fuel and glycol)	5190 lbs.
Fuel Capacity	192 US gal. (1444 lbs)
Glycol / water capacity	130 US gal. (2159 lbs)
Hose length	8 x 700 ft.
Circulation manifold	8 loops of 700 ft.
Burner	2 - 207,000 BTUH Oil Fired Burners
Compressor	1/3 HP
Pumps	1 - 1/2 HP Centrifugal Circulating Pump 1 - 3/4 HP Centrifugal Field Pump
Reel motor	1 - 3/4 HP Motor
Axles	1 - 7000 lb. rated w/ Electric Brakes
Tires	ST235/85R-16
Tire inflation pressure	80 psi.
Torque of wheel nuts	165 ft-lbs
Hitch	2-5/16" Ball, alternatively Pintle
Tie Downs	4 - For Transporting

2. Performance Specifications

Net Heat Input	414,000 BTUH
Fuel Consumption	2.96 US GPH
Fuel Requirement	#1 or #2 Fuel Oil or 2-K Kerosene
Run Time	65 Hours @ 100% Burn Time
Field Loop Pressure	50 psi
Reservoir Pressure	Atmospheric
Heating Coil Pressure	Atmospheric
Fuel Pump Pressure	140 psi
Maximum Thawing Area	11,200 ft ²
Maximum Curing Area	18,650 ft ²
Nozzle	Delavan 1.25 GPH 80° A
Electrical Requirement	2 x 20 Amp x 120 V AC

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SPECIFICATIONS: HK300

7.1 MECHANICAL

1. General Capacities and Component Specifications

Height (w/ heater vent)	70 in.
Width	80 in.
Length (from hitch)	12 ft.
Ground Clearance	13 in.
Weight (w/ glycol)	3270 lbs.
Weight (w/ fuel and glycol)	4380 lbs.
Fuel Capacity	192 US gal. (1444 lbs)
Glycol / water capacity	96 US gal.
Hose length	4 x 700 ft.
Circulation manifold	4 loops of 700 ft.
Burner	290,000 BTUH Oil Fired Burners
Compressor	2 Gal.
Pumps	1 - 1/2 HP Centrifugal Circulating Pump 1 - 1/2 HP Centrifugal Field Pump
Reel motor	1 - 1/2 HP Motor
Axles	1 - 5000 lb. rated w/ Electric Brakes
Tires	ST225/75R-15
Tire inflation pressure	50 psi.
Torque of wheel nuts	165 ft-lbs
Hitch	2-5/16" Ball, alternatively Pintle
Tie Downs	4 - For Transporting

2. Performance Specifications

Net Heat Input	280,000 BTUH
Fuel Consumption	1.95 US GPH
Fuel Requirement	#1 or #2 Fuel Oil or 2-K Kerosene
Run Time	47 Hours @ 100% Burn Time
Field Loop Pressure	50 psi
Reservoir Pressure	Atmospheric
Heating Coil Pressure	Atmospheric
Fuel Pump Pressure	140 psi
Maximum Thawing Area	4,200 ft ²
Maximum Curing Area	8,40 ft ²
Nozzle	Delavan 1.65 GPH 80° A
Electrical Requirement	2 x 20 Amp x 120 V AC

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SPECIFICATIONS: HK150

7.1 MECHANICAL

1. General Capacities and Component Specifications

Height (w/ heater vent)	70 in.
Width	80 in.
Length (from hitch)	12 ft.
Ground Clearance	13 in.
Weight (w/ glycol)	3170 lbs.
Weight (w/ fuel and glycol)	4280 lbs.
Fuel Capacity	92 US gal. (690 lbs)
Glycol / water capacity	75 US gal.
Hose length	2 x 700 ft.
Circulation manifold	2 loops of 700 ft.
Burner	1 - 150,000 BTUH Oil Fired Burners
Compressor	2 Gal.
Pumps	1 - 1/6 HP Centrifugal Circulating Pump 1 - 1/2 HP Centrifugal Field Pump
Reel motor	1 - 1/2 HP Motor
Axles	1 - 5000 lb. rated w/ Electric Brakes
Tires	ST225/75R-15
Tire inflation pressure	50 psi.
Torque of wheel nuts	165 ft-lbs
Hitch	2-5/16" Ball, alternatively Pintle
Tie Downs	4 - For Transporting

2. Performance Specifications

Net Heat Input	150,000 BTUH
Fuel Consumption	1.1 US GPH
Fuel Requirement	#1 or #2 Fuel Oil or 2-K Kerosene
Run Time	84 Hours @ 100% Burn Time
Field Loop Pressure	40 psi
Reservoir Pressure	Atmospheric
Heating Coil Pressure	Atmospheric
Fuel Pump Pressure	140 psi
Maximum Thawing Area	2800 ft ²
Maximum Curing Area	5600 ft ²
Nozzle	Delavan 1.0 GPH 80° A
Electrical Requirement	1 x 20 Amp x 120 V AC

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

7.2 BOLT TORQUE

CHECKING BOLT TORQUE

The tables shown below give correct torque values for various bolts and capscrews. Tighten all bolts to the torques specified in chart unless otherwise noted. Check tightness of bolts periodically, using bolt torque chart as a guide. Replace hardware with the same strength bolt.

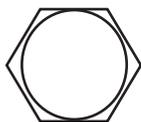
Imperial Torque Specifications

Bolt Dia. "A"	Bolt Torque*					
	SAE 2		SAE 5		SAE 8	
	Nm	Ft-Lbs	Nm	Ft-Lbs	Nm	Ft-Lbs
1/4	8	6	12	9	17	12
5/16	13	10	25	19	36	27
3/8	27	20	45	33	63	45
7/16	41	30	72	53	100	75
1/2	61	45	110	80	155	115
9/16	95	60	155	115	220	165
5/8	128	95	215	160	305	220
3/4	225	165	390	290	540	400
7/8	230	170	570	420	880	650
1	345	225	850	630	1320	970

Metric Torque Specifications

Bolt Dia. "A"	Bolt Torque*			
	8.8		10.9	
	Nm	Ft-Lbs	Nm	Ft-Lbs
M4	3	2.2	4.5	3.3
M5	6	4	9	7
M6	10	7	15	11
M8	25	18	35	26
M10	50	37	70	52
M12	90	66	125	92
M14	140	103	200	148
M16	225	166	310	229
M20	435	321	610	450
M24	750	553	1050	774

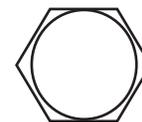
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SAE-5



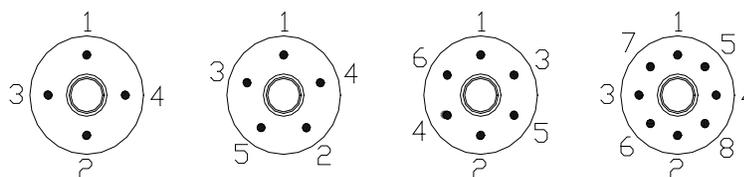
SAE-8



Torque figures indicated above are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or capscrews unless otherwise specified in this manual. When using locking elements, increase torque values by 5%.

WHEEL LUG NUT TORQUE:

Use the tightening pattern shown below, to ensure the even tightening of the lug nuts on each wheel.



Bolt Dia	Bolt Torque	
	Nm	Ft-Lbs
1/2"	136	100
9/16"	203	150

* Torque value for bolts and capscrews are identified by their head markings.

Material Safety Data Sheet

MSDS No.
Variant: Canada
Version No.
Validation Date: April 2003

PROPYLENE GLYCOL INDUSTRIAL

Section 1: IDENTIFICATION

Product Name: PROPYLENE GLYCOL INDUSTRIAL
Product Number: 0684-000
Chemical Name: 1,2-Propanediol
CAS Number: 57-55-6
Chemical Family: Glycols
Synonyms: Propylene Glycol, 1,2-Propanediol, 1,2-Dihydroxypropane, Monopropylene Glycol
Type of Use: Solvents, Lubricants and Antifreeze

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Non Emergency: CUSTOMER SERVICE

Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component Name:	CAS #	Concentration by Wt./Mol%		
		Avg.	Min.	Max.
Propylene Glycol	57-55-6		99.0	

Section 3: HAZARD IDENTIFICATION

Emergency Overview: This product has been classified in accordance with hazard criteria of the Controlled Product Regulations and the MSDS contains all the information required by the Controlled Products Regulations. This material does not meet the hazard criteria specified by the Canadian Hazardous Products Act and its regulations.

Signal Word: Caution
Hazards: WHMIS Class: Not Regulated. Slight eye irritant.
Physical State: Liquid
Colour: Clear, colourless (Pink - Inhibited Product)
Odour: Little or no odour.

Potential Health Effects:

Routes of Exposure: Eye, Skin, Inhalation.

Signs and Symptoms

of Acute Exposure: See Component Summary

* *Propylene Glycol* Slight eye irritant

Skin:	No significant signs or symptoms indicative of any adverse health hazard are expected to occur as a result of skin exposure. Not a skin absorption hazard.
Inhalation:	No significant signs or symptoms indicative of any health hazard are expected to occur as a result of inhalation exposure.
Eye:	May cause minor eye irritation.
Ingestion:	Not likely route of exposure. No significant signs or symptoms indicative of any health hazard are expected to occur as a result of ingestion.
Chronic Health Effects:	See component summary
* <i>Propylene Glycol</i>	No chronic health hazards are expected to occur from anticipated conditions of normal use of this material

Conditions Aggravated by Exposure: This material or its emissions may aggravate pre-existing eye disease.

Section 4: FIRST AID MEASURES

General:	After adequate first aid, no further treatment is required unless symptoms reappear.
Inhalation:	Not expected to present a significant inhalation hazard under anticipated conditions of normal use. If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain medical attention if breathing difficulty persists.
Eye:	Thoroughly flush the eyes with large amounts of clean low-pressure water for at least 15 minutes, occasionally lifting the upper and lower eyelids. If irritation persists, seek medical attention.
Skin:	Not expected to present a significant skin hazard under anticipated conditions of normal use. If skin contact occurs, remove contaminated clothing and wash skin thoroughly.
Ingestion:	Ingestion unlikely. If large quantity swallowed, give lukewarm water (pint/half litre) if victim completely conscious/alert. Obtain medical attention.
Physician's Detoxification Procedures:	Treat symptomatically. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

Section 5: FIRE FIGHTING MEASURES

Flammability Classification:	OSHA/NFPA Class IIIB combustible liquid. Slightly combustible.
Flashpoint/Method:	109°C (228°F) (PMCC) (Aqueous solution)
Auto-Ignition Temperature:	371°C (700°F)

Flammable Limits: LOWER: 2.4 vol%
UPPER: 17.4 vol%

**Hazardous
Combustion
Products:**

Incomplete combustion may produce carbon monoxide and other toxic gases

**Special Conditions
to Avoid:**

Heat from fire can generate flammable vapour. When mixed with air and exposed to ignition source, vapours can burn in open or explode if confined. May travel long distances along the ground before igniting and flashing back to vapour source. Fine sprays/mists may be combustible at temperatures below normal flash point. Aqueous solutions containing less than 95% propylene glycol by weight have no flash point as obtained by standard test methods. However, aqueous solutions of propylene glycol greater than 22% by weight, if heated sufficiently, will produce flammable vapours. Always drain and flush systems containing propylene glycol with water before welding or other maintenance. Refer to NFPA Code 13 for guidance in using propylene glycol in sprinkler system applications.

Extinguishing Media: SUITABLE: **SMALL FIRE:** Use dry chemicals, CO₂, water spray or alcohol-resistant foam.
LARGE FIRE: Use water spray, water fog or alcohol-resistant foam.
UNSUITABLE: Do not use solid water stream.

**Fire Fighting
Instructions:**

Protective Equipment/Clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters protective clothing will only provide limited protection.

INSTRUCTIONS: Move containers from fire area if you can do it without risk. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discolouration of tank. Always stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Section 6: ACCIDENTAL RELEASE MEASURES

Release Response: In case of accidental spill, may contaminate water supplies/pollute public waters. Evacuate/limit access. Equip responders with proper protection. Extinguish ignition sources; stop release; prevent flow to sewers or public waters. Notify fire and environmental authorities. Restrict water use for cleanup. Slippery walking/spread granular cover or soak up. Impound/recover large land spill; soak up small spill with inert solids. Use suitable disposable containers. On water, material is soluble and will disperse rapidly unless contained and collected quickly to minimize dispersion. Report per regulatory requirements.

Section 7: HANDLING AND STORAGE

Handling:

Hygroscopic. Handle with care. After handling, always wash hands thoroughly with soap and water. Always drain and flush systems containing propylene glycol with water before welding or other maintenance. Wear recommended personal protective equipment. Observe precautions pertaining to confined space entry.

Storage: Stainless steel containers. Lined steel. Mild steel. Reinforced plastic. Keep drums tightly closed to prevent contamination. Store at 65-90°F. Use dry nitrogen or low dew point air for tank padding.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering

Controls: No special ventilation is recommended under anticipated conditions of normal use beyond that needed for normal comfort control.

Personal Protection:

Inhalation: A respiratory protection program that meets OSHA's 29 CFR 1910.134 or ANSI Z88.2 requirements must be followed whenever workplace conditions warrant respirator use. No special respiratory protection is recommended under anticipated conditions of normal use with adequate ventilation.

Skin: Wear chemical resistant gloves such as; 4H(tm) (PE/EVAL). Avoid contact with skin. Where use can result in skin contact, practice good personal hygiene.

Eye: Wear eye protection appropriate to conditions of material use.

Other Hygienic

Practices: Selection of appropriate personal protective equipment should be based on an evaluation of the performance characteristics of the protective equipment relative to the task(s) to be performed, conditions present, duration of use and the hazards and/or potential hazards that may be encountered during use. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.

Recommended Work

Practices: Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet facilities. Promptly remove soiled clothing wash thoroughly before reuse.

Occupational Exposure Limits:

Component Name	Source/Date	Value/Units	Type	Notation	Carcinogenic Listing *
Propylene Glycol	US (ACGIH)/2001	N/L			N/L

*1 = OSHA *2 = IARC *3 = NTP *4 = Others N/L = Not Listed See section 11 for more information.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Density: 1,040 kg/m³, @ (25°C / 77°F)

Specific Gravity: 1.04 @ (25°C / 77°F), (Water = 1.0 @ 4°C (39.2°F))

Vapour: 2.6 @ (15-32°C / 60-90°F), (Air = 1.0)

Boiling Point: 188°C / 370°F, @ 760 mm Hg

pH: 7

Viscosity: 46 mPa.s, @ (25°C / 77°F), (Brookfield)

Solubility: Solubility (Water): Complete (In All Proportions)

**Octanol/Water
Partition Coefficient
in Kow:** - 0.92

**Melting/Freezing
Point:** - 60°C / - 76°F

Dry Point: 190°C / 374°F

Other Physical &

Chemical Properties: Volatile Characteristics: Slight 0.1 to 1.0% Hygroscopic. Additional properties may be listed in Sections 3 and 5.

Section 10: STABILITY AND REACTIVITY

Chemical Stability: This material is stable when properly handled and stored.

Conditions to Avoid: High temperatures, oxidizing conditions.

Incompatibility With: Reacts with strong oxidizing agents.

Decomposition

Products: Carbon Monoxide and other toxic vapours.

Hazardous

Polymerization: Not expected to occur.

**Reactions with Air
and Water:**

Not expected to occur.

Section 11: TOXICOLOGICAL INFORMATION

Product Summary: No additional toxicology information is available for this product itself. (see Component Toxicity Information)

Component Summary:

* *Propylene Glycol*

LD50 (Oral) Rat 20,000 MG/KG
Mouse 22,000 MG/KG

LD50 (Skin) Rabbit 20,800 MG/KG

Skin Effects: High concentrations of Propylene Glycol in water when held in contact with human skin under closed conditions have been reported to cause skin irritation (Cosmetics and Toiletries 99:83-91;1984). The authors attribute the observations to a sweat retention reaction by the skin. No reactions were observed in open patch tests with human subjects. One literature report indicates rare eczematous skin reactions and even more rarely an allergic skin reaction from exposure to Propylene Glycol (Anderson and Starr, Hautzart 33 (1) 1982).

Target Organ Effects: Eye. Skin.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: This material is expected to be non-hazardous to aquatic species

Toxicity to Fish: **Amphibians:**

<u>Test Type</u>	<u>Species</u>	<u>Value/Units</u>
LC50/96 Hours	Sheepshead Minnow	23,800 mg/l

Toxicity to Aquatic Invertebrates:

<u>Test Type</u>	<u>Species</u>	<u>Value/Units</u>
EC50/48 Hours	Daphnia	43,500 mg/l

Toxicity to Aquatic Plants:

<u>Test Type</u>	<u>Species</u>	<u>Value/Units</u>
EC50/72 Hours	Green Algae	19,000 mg/l

Environmental

Fate: Propylene Glycol is expected to degrade rapidly in the vapour phase by reaction with photochemically produced hydroxyl radicals. Propylene Glycol is expected to degrade relatively rapidly via biodegradation in water. It is not expected to be susceptible to hydrolysis, oxidation, volatilization, bioconcentration and absorption to sediments. Propylene Glycol is expected to degrade relatively rapidly via biodegradation in soil. Degradation in soil does not appear to be inhibited by high glycol concentrations or by subfreezing temperatures. Due to its high mobility and low absorptivity, Propylene Glycol is susceptible to leaching. However, concurrent biodegradation may be rapid enough to diminish the significance of leaching. Evaporation from dry (but not moist) soil surface is likely to occur.

Bioaccumulation: Based on the octanol/water partition coefficient, the bioconcentration factor is estimated to be < 1.

Biodegradation: This material is expected to be readily biodegradable.

Section 13: DISPOSAL CONSIDERATIONS

Contaminated product, soil, water, container residues and spill cleanup materials may be hazardous wastes. Comply with applicable Federal, State and Local Regulations.

Section 14: TRANSPORT INFORMATION

Special Requirements: This product is not classified under the Canadian Transportation of Dangerous Goods Act.

Proper Shipping Name: Not Regulated

UN/NA ID: Not Applicable

NAER Guidebook: Not Applicable

Marine Pollutant: No

Labels: Not Applicable

DOT Hazard Class: Not Regulated

IMDG Hazard Class: Not Regulated

ADR/VLG Hazard Class: Not Regulated

ICAO/IATA Hazard Class: Not Regulated

ADNR/VBG Hazard Class: Not Regulated

RID/VSG Hazard Class: Not Regulated

Section 15: REGULATORY INFORMATION

Regulatory Status: All components of this product appear either on the Domestic Substances List of the Canadian Environment (CEPA) or are exempted from these requirements. All components of this product are listed or are exempt from listing on the TSCA 8(b) inventory. If identified components of this product are listed under the TSCA 12(b) Export Notification Rule, they will be listed below.

Section 16: OTHER INFORMATION

Disclaimer of Responsibility: This document is generated for the purpose of distributing health, safety and environmental data. It is not a specification sheet nor should any displayed data be construed as a specification. The information on this MSDS was obtained from sources which we believe are reliable, However, the information is provided without any warranty, expressed or implied, regarding its correctness. Some information presented and conclusions drawn herein are from sources other than direct test data on the substance itself. The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of, or in any way connected with handling, storage, use or disposal of this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Latest Revision(s): Revised Section(s): 3, 4, 5.

END OF DOCUMENT

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