MONITOR HEATING SYSTEMS
Service Manual

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Section 1: Description

1-1 SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>Monitor 441</th>
<th>Monitor 422</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Type</td>
<td>Crystal Clear K-I Kerosene</td>
<td>Crystal Clear K-I Kerosene</td>
</tr>
<tr>
<td>Heater Efficiency</td>
<td>93%*</td>
<td>93%*</td>
</tr>
<tr>
<td>Heat Rating</td>
<td>High: 43,000 BTU/hour</td>
<td>High: 22,000 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>H.Medium: 33,900 BTU/hour</td>
<td>H.Medium: 17,400 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>L.Medium: 21,000 BTU/hour</td>
<td>L.Medium: 11,700 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>Low: 16,200 BTU/hour</td>
<td>Low: 9,600 BTU/hour</td>
</tr>
<tr>
<td>Heater Output</td>
<td>High: 40,000 BTU/hour</td>
<td>High: 20,400 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>H.Medium: 31,500 BTU/hour</td>
<td>H.Medium: 16,200 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>L.Medium: 19,500 BTU/hour</td>
<td>L.Medium: 10,900 BTU/hour</td>
</tr>
<tr>
<td></td>
<td>Low: 15,000 BTU/hour</td>
<td>Low: 8,900 BTU/hour</td>
</tr>
<tr>
<td>Fuel Tank</td>
<td>Separate (Not supplied with heater)</td>
<td>1.32 Gallons; Separate tank optional</td>
</tr>
<tr>
<td>Fuel Consumption</td>
<td>High: 0.319 Gallon/hour</td>
<td>High: 0.164 Gallon/hour</td>
</tr>
<tr>
<td></td>
<td>H.Medium: 0.25 Gallon/hour</td>
<td>H.Medium: 0.13 Gallon/hour</td>
</tr>
<tr>
<td></td>
<td>L.Medium: 0.16 Gallon/hour</td>
<td>L.Medium: 0.09 Gallon/hour</td>
</tr>
<tr>
<td></td>
<td>Low: 0.12 Gallon/hour</td>
<td>Low: 0.07 Gallon/hour</td>
</tr>
<tr>
<td>Power Source</td>
<td>120 Volts AC; 60 Hz</td>
<td>120 Volts AC; 60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Ignition: 340 Watts</td>
<td>Ignition: 250 Watts</td>
</tr>
<tr>
<td></td>
<td>Operation: 80 Watts (Average)</td>
<td>Operation: 55 Watts (Average)</td>
</tr>
<tr>
<td>Heated Air Delivery</td>
<td>High: 338 Cubic feet/minute</td>
<td>High: 176 Cubic feet/minute</td>
</tr>
<tr>
<td></td>
<td>H.Medium: 338 Cubic feet/minute</td>
<td>H.Medium: 176 Cubic feet/minute</td>
</tr>
<tr>
<td></td>
<td>L.Medium: 300 Cubic feet/minute</td>
<td>L.Medium: 113 Cubic feet/minute</td>
</tr>
<tr>
<td></td>
<td>Low: 300 Cubic feet/minute</td>
<td>Low: 113 Cubic feet/minute</td>
</tr>
<tr>
<td>Vent Pipe Hole</td>
<td>2 1/2-inches Diameter</td>
<td>2 1/2-inches Diameter</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Height: 26.6 inches</td>
<td>Height: 25.6 inches</td>
</tr>
<tr>
<td></td>
<td>Width: 28.7 inches</td>
<td>Width: 20.9 inches</td>
</tr>
<tr>
<td></td>
<td>Depth: 13.8 inches</td>
<td>Depth: 12.4 inches</td>
</tr>
<tr>
<td>Weight</td>
<td>82 Pounds, empty</td>
<td>55 Pounds, empty</td>
</tr>
</tbody>
</table>

* When considering heat of concentration is lost then net efficiency is 87%.

1-2 SPECIAL FEATURES

AUTOMATIC IGNITION
Memory Back Up: Set memory can be kept in case of power failure for up to 5 minutes.
Dual Blowers: Separate fans for combustion and room air circulation.
Thermostatically Controlled: Adjusts to the desired room temperature.
Built-In Timer: Heater will automatically operate as programmed by the user.
Automatic Reset After Power Failure: Heater will automatically resume operation after power is restored.
Indicator Lights: Easy-to-see signals show when heater is in operation, when timer is activated, and when the burner is operating in low, medium or high modes.
Choice of Fuel Supply: Large tank gravity fed system, large tank system with pump (M-441) built-in capsule tank or connect to separate tank (M-422)
Multiple Heat Exchanger: Extracts 87% of heat from burner.
Clean Operation: Products of combustion are vented outside.
Consumes No Room Air: Air for combustion is drawn from outside.
Easy Installation: Complete instructions included in this guide.

1-3 SAFETY FEATURES
SAFE RE-LIGHTING: Heater will not restart until its combustion chamber has cooled.
ELECTRICAL PROTECTION: Heater automatically shuts off in the unlikely event of a malfunction in the electrical circuitry or disruption of the power supply.
NO EXHAUST IN ROOM: Products of combustion are discharged outdoors.
FLUE PIPE: Outside air is drawn through a pipe-within-a-pipe venting system. This process preheats combustion air and regains heat from exhaust gases.

1-4 DESCRIPTION
The Monitor heaters are composed of the following:
1-9 BURNER POT
Designed specifically to support combustion, the Burner Pot (refer to Figure 1-2) contains a series of air holes, an igniter tube (to accommodate the igniter), and a fuel inlet fitting (interconnects the fuel line). It is secured to a mounting plate near the bottom of the Combustion Chamber.

The Combustion Ring Assembly is seated on three (3) screws or pins in the Burner Pot.

1-10 COMBUSTION RING ASSEMBLY
This assembly is a special structure, designed to promote efficient combustion.

1-11 BURNER CAP
Secured by tabs and a screw on the Burner Pot, the Burner Cap "shapes" the flame into its configuration and height. (M-422 only)

1-12 FLAME SENSOR
Mounted on the outside wall of Combustion Chamber, the Flame Sensor always supervises the flame.

1-13 IGNITER
Located within the igniter tube of the Burner Pot, the igniter is designed to pre-heat the Burner Pot and to vaporize and ignite the air-fuel mixture to start the combustion process.

The igniter is secured by a bracket and screw to the igniter tube. The cover plate is secured to the combustion chamber by three (3) phillips head screws.

1-14 COMBUSTION AIR SYSTEM
The Combustion Air System channels air to and from the heater.

Outside air is drawn into the heater by the Combustion Blower through an airway to the Combustion Chamber.

A Combustion Blower draws the intake air into the through a Flue Pipe. This air enters the Combustion Chamber at the Burner Pot and mixes with the fuel to support combustion. Remaining air is heated and is drawn into the Heat Exchanger.

As the heated air passes through the Heat Exchanger, an Air Circulation Fan blows room air past the Heat Exchanger and out again into the room, heating passing air by convection. Exhaust vapors exiting from the Heat Exchanger are vented through the Flue Pipe.

A deterioration of air pressure at the Air Pressure Switch is an abnormal condition; the heater is shut down by the malfunction.
1-15 FLUE PIPE

Flue Pipes are available in three (3) sizes. This provides the flexibility to meet the installation requirements for dwelling of various wall thicknesses.

One side of the Flue Pipe contains a “T”-shaped fitting consisting of four ports. This side is mounted on the interior wall of the dwelling. The pipe side of the Flue Pipe is vented outside the dwelling.

The Flue Pipe Assembly consists of two concentric tubes. Outside air is drawn through the cylindrical space between the tubes. Combustion by-products are vented through the inner tube.

As the cool air enters, it is heated by the hot air that is exiting the system.

A large-bore, flexible hose connects the air inlet port on the Flue Pipe with the Combustion Blower; a cloth-covered metal pipe connects the Combustion Blower with the exhaust outlet on the Flue Pipe.

IMPORTANT: If extension kits are utilized, use the correct damper as follows:

<table>
<thead>
<tr>
<th>Extension Kit</th>
<th>M-441</th>
<th>M-442</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3 elbows with Extra &quot;STANDARD&quot; damper</td>
<td>&quot;STANDARD&quot; damper</td>
<td>unused</td>
</tr>
<tr>
<td>Short Extension Kit</td>
<td>damper</td>
<td>damper</td>
</tr>
<tr>
<td>Length: 12&quot;</td>
<td>Length: 20&quot;</td>
<td></td>
</tr>
<tr>
<td>Up to 3 elbows with Medium Extension Kit</td>
<td>&quot;EXTENSION&quot; damper</td>
<td>unused</td>
</tr>
<tr>
<td>Length: 30&quot;</td>
<td>Length: 38&quot;</td>
<td></td>
</tr>
<tr>
<td>Up to 3 elbows with Long Extension Kit</td>
<td>&quot;EXTENSION&quot; damper</td>
<td>unused</td>
</tr>
<tr>
<td>Length: 38&quot;-73&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1-16 COMBUSTION BLOWER

The combustion blower on the Monitor 422 is a dual function fan.

The intake fan draws in outside air thru the flue pipe for internal combustion. The cooling fan which runs on a common shaft with the intake fan circulates air inside the heater cabinet to keep internal components cool.

The Monitor 441 combustion blower has a two stage intake fan.

Burner modes control fan speeds and the solenoid damper in the blower casing. Those functions are as follows:

1-17 HEAT EXCHANGER

An inlet at the top of the Heat Exchanger permits the heated air to travel from the Combustion Chamber into the exchanger.

An outlet at the bottom of the exchanger permits combustion by-products to be vented to the Flue Pipe.

While moving through the Heat Exchanger, the hot air within the exchanger heats the outside metal walls. The hot metal walls, in turn, heat air that is pushed past the exchanger and is circulated into the room. An air baffle, directly in front of the exchanger, deflects the heated air upwards, and out, through the louver assembly.

A pair of Over-Heat Protector Switches protect the heater from damage due to excessive heat built-up.

1-18 AIR CIRCULATION FAN

Both Monitor circulation fans are driven by two-speed motors and are designed to circulate the heated room air.

If the heater is running in low and medium-low burn modes; the fan also runs at low-speed; in medium-high or high burn modes, the fan advances to high-speed.

Operation of the fan is controlled by the microprocessor and fan thermostat switch.

Physically assembled with a protective wire cage for the Monitor 441 and 422, the entire fan assembly is secured to a bracket on the rear of the Heater Cabinet.

A metal conduit, at the rear of the heater, protects the fan wiring from damage.

1-19 AIR PRESSURE SWITCH

This switch consists of a rubber diaphragm which senses changes in air pressure (it is connected to the Combustion Blower) and normally-open, micro switch.

Should an abnormal pressure differential exist, the switch opens to disable the circuitry that controls the supply of fuel. Since the flow of fuel to the Burner...
MONITOR HEATING SYSTEMS
Section 1: Description

Pot is cut off, the flame extinguishes (after all fuel currently in the line has been consumed), and the Burner Status indicators blink.

This safety mechanism can be triggered by several conditions:
- Leak or loose connection in air line
- Leak, loose, or broken tubing which connects the Air Pressure Switch with the Combustion Blower
- Clogged or blocked Air Line
- Blocked or clogged Flue Pipe
- Intake port of Combustion Blower is blocked.
- Combustion Blower is inoperable

1-20 FUEL DELIVERY SYSTEM
Fuel Delivery is a very important aspect of the Monitor's operation.

The fuel flow must be maintained at a level corresponding to the burn mode, so that combustion can be conducted efficiently.

Fuel moves by gravity-flow from the external fuel storage tank or the capsule fuel tank to the Fuel Constant Level Valve.

The Solenoid Pump meters the flow of fuel from the Fuel Constant Level Valve to the Burner Pot.

The metered flow of fuel is carried to the Burner Pot by a copper fuel line.

1-21 EXTERNAL FUEL TANK
The Monitor 422 gives the user the option of either using the internal capsule tank or hooking up to an external fuel tank.

Fuel for the Monitors can be stored in, and fed from an external storage tank. The tank, which generally is dealer installed, should contain a shutoff valve, a fuel filter and a vent. Installation of the tank should conform to local regulations and to the specifications and guidelines documented in this Service Manual.

(Capsule tank cannot be used in Connecticut and Massachusetts.)

1-22 FUSIBLE LINK VALVE
Basically, the Fusible Link Valve is a safety mechanism that cuts-off fuel to the heater in the event of an overheat condition at the valve.

The fusible link valve is mounted as a standard item on the Monitor 422. Located outside the rear of the Heater Cabinet, the Fusible Link Valve is a spring-loaded device that cuts off the supply of fuel to the heater when the temperature level (at the valve) exceeds a predefined maximum limit.

An inlet on the bottom of the valve allows fuel to pass into the heater. The handle—which can also manually be opened or closed—sits on a spring-loaded stem which contains a low-melting point alloy.

The fusible link valve can be externally mounted on the Monitor 441 if required.

1-23 FUEL CONSTANT LEVEL VALVE
This valve has an automatic shutoff safety mechanism and a Fuel Set Lever. The safety mechanism prevents fuel from flooding or overflowing from the fuel reservoir. The Fuel Set Lever resets the float so the Fuel Constant Level Valve can resume operation.

The fuel reservoir is a tank which contains a float assembly, a safety mechanism, and a priming lever. Both the Monitor 441 and 422 fuel control valves are basically the same, however they are of different size and material and can not be interchanged.

Fuel enters the Fuel Constant Level Valve through an inlet at the bottom of the reservoir. As the level of fuel rises, it passes through a filter (which removes most particies and foreign matter from the fuel), flows up through an open inlet valve and enters the tank.

IMPORTANT: The Fuel Constant Level Valve filter should be cleaned or replaced periodically. Time intervals will depend on purity and quality of fuel.

Within the Valve, a float mechanism controls the level of fuel that will be permitted to the reservoir. As the fuel level drops, the float drops down to increase the inlet valve opening to admit more fuel into the valve. When the fuel level reaches its maximum volume, the float rises to shut the inlet valve.

In the event that fuel within the reservoir rises to an abnormally high level, a float within the reservoir rises to trip a safety lever. This safety lever drops to prevent fuel from entering into the reservoir.

Should a foreign substance cause the inlet valve to stick (or prevent it from opening), the Fuel Set Lever is utilized to free the valve and to admit fuel to the reservoir.

CAUTION: Care must be taken to prevent dust, dirt, or other debris from clogging or blocking the inlet valve. If debris collects on the seat of the inlet valve it may cause tripping of the safety lever and will require cleaning.
1-24 SOLENOID PUMP
The Solenoid Pump is mounted on the Fuel Constant Level Valve, controlled by a microcomputer and four modes (High, Medium-High, Medium-Low, Low): fuel flow is delivered to the Burner Pot.

1-25 ELECTRICAL SYSTEM
Electrical power is supplied to the Monitor to run the Microprocessor and the other electrically-energized component.

Electrical operation of the Monitor can be thought of as having the following eight (8) distinct phases: plug-in; turn-on; pre-purge pre-heat; ignition; pre-combustion; heating; Shutdown and post-purge.

All electronic diagrams, such as wiring diagram, circuit board layout, and electrical schematic can be found in Section 7 of this Service Manual.

1-26 MICROPROCESSOR
Principally consisting of a 64-pin Integrated Circuit, the Microprocessor provides safety timings, controls relays and provides clock and thermostat functions for the Monitor heater. A component layout of the Printed Circuit Board is found in Section 7 of this Service Manual.

1-27 TEMPERATURE SENSOR
The sensor which is capable of sensing room temperature within a range of 42°F to 96°F, can be left mounted on the back of the heater cabinet or be wall mounted.

Approximately 6' (about 200 cm) of No. 20 AWG Wire is supplied with the sensor to facilitate wall mounting the sensor in a favorable location.

1-28 SAFETY MECHANISMS
Several safety mechanisms have been built into the Monitor Heating System. These devices protect the user against personal injury, protect the heater against damage, and shutdown the heater if a malfunction occurs.

1-29 CLOTH COVERED EXHAUST PIPE
Insulating cloth covers are to be placed over all metal surfaces of the Exhaust Line during installation.

Since combustion by-products are vented at elevated temperatures, the Exhaust Pipe will become hot during operation. The insulating cloth covers protect the user from burn hazards associated with accidental contact with these heated metal surfaces.

During installation make sure that all Exhaust Lines are tight. Do not operate the heater without the insulating covers.

1-30 AIR CIRCULATION FAN GUARD
This guard is an integral part of the fan assembly. The guard protects the user against physical injury which could occur from accidental contact with revolving metal fan blade.

1-31 FUSE
2-amp. and 10-amp. 125VAC fuses protect the heater from damage resulting from power overloads.

In the event of a power surge or internal wiring hazards, the fuse opens and power to the heater is cut off.

The electrical outlet into which the heater is connected should be protected by at least a 15-amp. fuse or circuit breaker.

1-32 OVERHEAT PROTECTOR SWITCHES
Connected in series, two (2) normally-closed Overheat Protector Switches safeguard the heaters against damage due to overheating.

The Monitor 422 switches are rated 110°C (230°F). The Monitor 441 switches are rated 115°C (239°F). Should a Monitor overheat (internal temperatures rise beyond 110°C (230°F) on the Monitor 422, 115°C (239°F) on the Monitor 441), either or both switches will open to shut down the heater. After extinguishing the flame, the Burner Status indicators continue to blink. The Overheat Protector Switches will automatically reset after cooling down.

Once the heater has cooled to 90°C (194°F), the system can be restarted. To restart the Monitor, proceed as follows:

A. Press ON OFF Switch to OFF.
B. Allow heater to cool.
C. Troubleshoot the cause of the overheat.
D. Press ON OFF switch to ON
E. Proceed with normal operation.

1-33 SLIDE SELECTOR FOR THE RESET TEMP.
Once power is restored after power interruption by power failure or by disconnecting heater plug from wall outlet, heater will resume operation in the MANUAL mode and maintain room temperature according to the setting temperature selected by using the selector for the reset temperature at the lower right hand side of the cabinet.
Monitor Heating Systems
Section 1: Description

Figure 1.1 Elements of Combustion System (Monitor 441)
2-1 INTRODUCTION
Installing the Monitor System at the user's location can be performed quickly and economically. The Monitor 422 can be used as either an internally fueled (capsule tank) or remotely fueled System. The Monitor 441 model is strictly a remotely fueled system and both are externally vented. As such both need the installation of an externally vented intake exhaust system and if remotely fueled, will need the installation of a remote fuel storage tank.

By completing each step of the easy-to-follow installation instructions (each step should be completed in the exact order specified), the Technician is directed through the installation process.

This section contains all relevant installation information including:
- Installation specifications
- List of installation tools
- Alternative types of venting systems (and installation procedures for each)
- Basic requirements for fuel tank installation
- Instructions to install the Monitor System

IMPORTANT: Before beginning installation of the Monitor vented heating system (including any electrical wiring and fuel supply equipment), check local building, electrical, mechanical and fire codes. The requirements of these codes must be followed to insure lawful installation and use.

The heater can be located almost anywhere within the dwelling provided that electrical, fuel, and exhaust specifications are met.

2-2 PHYSICAL PLACEMENT OF HEATER
In addition to the space taken up by the heater, interior space must also be reserved for free air circulation. Remove all combustibles from the heating area.

Unless building or fire codes dictate otherwise, the Monitor system can be placed on any floor surface (including carpeting or other combustible material) and provide safe operation.

2-3 DRILLING REQUIREMENTS
Through-the-wall Flue Pipe installation requires that a 2 1/2” (65mm) hole be drilled through the dwelling wall (interior to exterior). The hole must be pitched downward toward the outside at an approximate angle of 2 (about 1” per foot), The appropriate wall area (in which hole will be drilled) must contain no internal obstacles such as piping, wiring, air ducts, or studs.

RECOMMENDED TOOL KIT FOR MONITOR HEATER SERVICE TECHNICIANS
1. 2 Phillips Head Screwdriver
2. Steel Tape Measure
3. Felt Tip Pen or Pencil
4. Caulking Material (exterior grade)
5. Electrical Drill
(reverse capability recommended)
6. Hole Saw, Saber (Jig) Saw, or other appropriate tool for cutting a 2 1/2” diameter hole for flue pipe
7. Rubber Clipping Tool
8. Long Drill Bit—
9. 2 Standard Screwdriver
10. Adjustable Wrenches (various sizes)
11. Copper Tubing Cutter
12. Copper Tubing Flaring Tool
13. V.O.M. (Volt, Ohm. Meter with shielded probes)
14. Level
15. Plumber’s Pipe Thread Tape
16. Small assortment of Self-Tapping Screws
17. Assorted Pliers (Slip Joint, Needle nose, Cutting, Lock Joint)
18. Phenolic Probe or Insulated Screwdriver
19. Supply of 125V, 2 and 10 Amp fuses
20. Floor mat to cover carpeting
21. Quart size pan for draining fuel

2-4 POWER REQUIREMENTS

WARNING

THE MONITOR POWER CORD MUST BE PLUGGED INTO A DIRECTLY ACCESSIBLE WALL OUTLET. DO NOT USE AN EXTENSION CORD TO MAKE THIS ELECTRICAL CONNECTION.

Line current to the system should be 120 VAC at 60 Hz. The electrical system should be protected against current overload by means of at least a 15-ampere fuse or circuit breaker.

NOTE: The wall outlet should supply electricity for the Monitor system only. Do not connect any other electrical appliance to it.

CAUTION: In some installations, it may be best to hard-wire the heater to the house circuits. A competent, licensed electrician should do this.
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2-5 FUEL TANK REQUIREMENTS

WARNING:

INSTALLATION OF ANY REMOTELY LOCATED FUEL TANKS MUST COMPLY WITH ALL LOCAL STANDARDS AND OR BUILDING CODES.

Heater fuel (crystal clear kerosene only) can be stored in remotely located storage tanks ranging from 55 gallon drums to 275 gallon tanks. When using large tanks a pressure regulator with a max. of 2.5 PSI should be installed near heater inlet.

CAUTION: In some installations, it may be better to install permanent fuel tank plumbing. A licensed Plumber should do this.

2-6 TEMPERATURE SENSOR WIRING REQUIREMENTS

A wall-mounted temperature Sensor gauges room temperature and automatically regulates the heating cycles of the Monitor System.

The standard sensor wire is 8½', long and can be left mounted on the back of the cabinet as shipped. If this is not practical the sensor can be mounted on a wall.

CAUTION: If sensor is to be mounted remotely be careful not to place it in direct sunlight, on uninsulated exterior walls in drafty areas etc., as this will create an inaccurate temperature reading.

2-7 BUILDING CODES

Fire regulations, electrical and other local building codes may govern the installation and use of a vented heater and related fueling systems. Prior to installation, check and comply with all codes.

2-8 UNPACKING

Save all shipping materials until the Monitor has been completely installed and is working properly.
A. Cut the two plastic ribbons that hold the shipping carton together.
B. Remove the top.
C. Remove from the shipping carton the Cardboard (drilling) Template and the Owner's Guide.

NOTE: The Dealer should complete the Registration Card at time of customer purchase and return it to Monitor Products, Inc. as soon as possible.
D. Remove the spill tray from shipping carton and remove the plastic bag.
E. Remove the plastic bag covering the heater.
F. Remove the plastic bag containing the heater parts and set it aside.
G. Remove the Flue Pipe from the rear of the heater. When ready to install, separate Flue Pipe from cardboard packing materials.
H. Firmly grasp cabinet handles (one on each side of heater cabinet) and lift heater off the cardboard shipping base.
I. Check for parts as listed in Monitor Owners Guide.

IMPORTANT: Only the standard-size Flue Pipe is shipped with the heater. The Monitor dealer will also stock Medium Flue Pipes, Window Kits, Extension Kits, and other accessories that may be required for non-standard installations.
2-9 HEATER INSTALLATION
In choosing a location for your heater, the following guidelines must be considered:
- The heater MAY be installed on combustible floors.
- The area around the heater should be free of obstacles that might interfere with the free flow of air.
- Allow the clearances shown in Figure 2-1.
- The heater must not be installed in a combustible fireplace.
- An AC wall outlet must be within reach of the heater's power cord. Extension cords must not be used.
- The area outside where the flue pipe will emerge should be free of foliage, fuel storage tanks and flammable objects. Air should circulate freely in the area. Allow the clearances shown on following page.
- The wall where flue pipe hole will be cut should be free of plumbing pipes, electrical wires, studs, air ducts and other obstacles.

NOTE: After using the installation template as a guide for drilling the flue pipe hole, the Monitor Flue Pipe can be normally installed according to the illustration procedure in the Monitor Manual.

Just in case the template was misplaced, the approximate flue pipe hole location measurements are as follows:

The center of The Joint Pipe opening, which connects to the Flue Pipe.

![Diagram 2-1](image1)

![Diagram 2-2](image2)
FLUE PIPE CLEARANCES

Flue pipe installations should provide for venting to an unconfined space through which there is a free flow of outdoor air. Clearances to adjacent walls or obstacles must comply with the requirements shown below.

**Frontal Clearance**

**CAUTION:**
Do not attach anything onto the outlet of the flue pipe.

**Overhead Clearance**

**Side Clearance**

**IMPORTANT:**
In an open area with strong wind, a wind break may be necessary.

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**Figure 2-3**
HOW TO PREVENT FREEZING IN COLD CLIMATE

Exhaust Elbow

24" (60cm) or more

Front Obstacle

20" (50cm) or more

SNOW SURFACE or GROUND

In areas of heavy snow falls, ground surface clearance must be increased according to average snow falls, to prevent flue pipe from being buried.

Figure 2-4: FLUE PIPE CLEARANCES

INSTALLATION OF FLUE PIPE WINDOW KIT
A window kit makes it possible to vent the heater from dwellings in which through-the-wall venting is neither practical nor possible.

The Window Kit is available in two sizes: The Short Window Kit accommodates windows from 20 to 32" wide; the Long Window Kit accommodates windows from 31 to 50" wide.

NOTE: The procedure below describes how a Window Kit is installed in a double-hung window. The Window Kit can also be installed in a vertical, sliding type window.

Install the Window Kit in the manner outlined below:

STEP 1: Install Flue Pipe in Window Kit
A. Push the rubber seal into the Flue Pipe hole on the window kit frame. The hole on the seal should be positioned at the exterior side of the frame.
B. Using the four (4) Phillips head screws, fasten the spacer to the frame.
C. With the arrow on the Flue Pipe pointing UP, align the screw holes on the Flue Pipe with those on the Spacer. Secure with three (3) phillips head screws.
STEP 2: Install Window Kit in the Window

IMPORTANT: Prior to installation, clean the window frame of all dust, dirt, and debris.

A. Raise the lower window
B. Place the window kit frame into the innermost track of the window.
C. Expand the frame until it fits loosely within the width of the window; it may be necessary to loosen the large set screw on the frame in order to do so.
D. Slightly lift window kit frame. Slide the L-Adapter under the frame and position it at the point where the inner and outer frame meet.
E. Expand the frame to fit the window tightly. Adjust the position of the L-Adapter, if necessary. Tighten the set screw to secure the frame. Secure the L-Adapter to the window sill with two (2) wood screws.
F. Lower the window firmly down upon the top of the Window Kit frame.
G. Measure the width of the upper (outer) window (which is located in the outer track). Cut a length of the Rubber Packing to this size. Remove the protective backing and firmly mount it onto the underside of the outer window.

Figure 2-5
STEP 3: Install Window Lock

A special window lock replaces the usual clam-shell lock.

To install the window lock, proceed as follows:

A. Turn locking lever to left and disengage lock from lock bracket.
B. Attach lock bracket to left-hand side of upper window frame. Use the two wood screws provided.

NOTE: If the lock bracket prevents the lower window from sliding upward, notch the bracket into the upper window frame.

C. Slip lock into lock bracket.

IMPORTANT: Window can be locked by turning locking lever to right: to open, turn locking lever to left and remove lock from bracket.

D. Two adjustable-position stops are supplied to accommodate various window sash thicknesses. If short stop is too small, remove two retaining screws and brackets which hold the short stop to the underside of the lock. Remove the short stop and substitute the long stop. Adjust to proper position, and secure with screws and washers previously removed. (Before securing the stop to the window, remove the protective backing and firmly stick the stop packing onto the underside of the stop.)

NOTE: Windows with deep sills may require the use of an extra intake and exhaust elbow to provide clearance for flue pipe hook up. A piece of the air intake line can be cut to join the two intake elbows together.
2-10 INSTALLING AN EXTENSION KIT

Installing an Extension Kit requires the construction of an air line and the exhaust line. The air line is connected between the Air Supply Elbow at the rear of the heater and the air inlet port on the Flue Pipe. Similarly, the exhaust line is connected between the joint pipe at the rear of the heater, and the exhaust port on the Flue Pipe.

IMPORTANT: The PVC air line is longer than the exhaust line and may need to be cut to size. Be sure, however, to thoroughly deburr all rough edges.

Figure 2-7 COMPONENTS OF EXTENSION KIT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PIPE, Air supply</td>
<td>6</td>
<td>PIPE CLAMP, Bottom</td>
</tr>
<tr>
<td>2</td>
<td>JOINT, Air line</td>
<td>7</td>
<td>SCREW, Legs, mounting</td>
</tr>
<tr>
<td>3</td>
<td>ELBOW 90° Air line</td>
<td>8</td>
<td>SCREW, Pipe Clamp</td>
</tr>
<tr>
<td>4</td>
<td>LEG, Wall-standoff</td>
<td>9</td>
<td>BOND, Adhesive</td>
</tr>
<tr>
<td>5</td>
<td>PIPE CLAMP, Top</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Max lengths and bends allowable using extension kits.

Extension kits are available in four different lengths. For exact dimensions refer to the accessories catalog.

Figure 2-8 MAX LENGTHS AND BENDS ALLOWABLE USING EXTENSION KITS
2-11 TYPICAL MONITOR LIFTER PUMP INSTALLATIONS

For more detailed information look under Kerosene Lifter manual.

NOTE: The same minimum and maximum pump heights must be maintain as is with other fuel tanks. Figure 2-12.

MONITOR™ KEROSENE LIFTER

MONITOR™ KEROSENE LIFTER (CAN BE POSITIONED BEHIND UNIT)

MONITOR™ KEROSENE LIFTER

MONITOR™ KEROSENE LIFTER GRAVITY

Figures 2-9
2-12 USES FOR THE ELBOW ADAPTER KIT
Convert from Monitor 20-30 to 422/441 using an elbow adapter Kit (part=3213) and utilizing existing flue pipe installation.

PARTS LIST EXPLODED

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Part</th>
<th>Ref.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exhaust Pipe Clamp</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Exhaust Elbow</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Exhaust Joint</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Joint Supporter</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Heat Insulation Cover</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Self-Tapping Screws</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Hose Clamp (this part comes with your Monitor™ Heater)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Air Damper (this part comes with your Monitor™ Heater)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Flue Pipe (this part comes with your Monitor™ Heater)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Remove Monitor 20-30 heater and flue pipe.
B. Install Monitor 422/441 flue pipe into sleeve.
C. Slide the exhaust elbow onto the exhaust port opening on the rear of the heater. (To locate exhaust port opening, see your Monitor Owner’s Guide.)
D. Secure the exhaust elbow by attaching the exhaust pipe clamp to the heater cabinet with two self-tapping screws.
E. Cover the adjustable exhaust pipe with heat insulation cover.

F. Remove metal cap on side mounted exhaust port of flue pipe and replace into the un-used port (the Monitor 422/441 is now ready to be positioned into place.)

NOTE: Be sure the exhaust elbow is firmly fixed on the flue pipe with a joint supporter.
G. Insert air supply elbow opening over flue pipe air intake flange and secure with hose clamp.

NOTE: The Standard Air Damper is installed over the flue pipe “air intake flange.” (To locate flue pipe “air intake flange,” see your Monitor™ Owner’s Guide.)

Elbow adapter kits may also be used to raise a flue pipe high enough to clear certain base board heating systems.

2-13 FUEL TANK INSTALLATION
Pictorial views of alternative types of storage facilities and delivery systems are illustrated (Figure 2-12).

Since fuel storage tank installation techniques vary from place-to-place (often dependent upon applicable codes), a particular installation procedure cannot be specified. However, certain criteria govern the fuel hook-up of the Monitor.

Use the following check list as a guide to the fuel storage facilities:

**WARNING:**

USE ONLY CRYSTAL CLEAR KEROSENE. NEVER USE GASOLINE, WHITE GAS, CAMP FUEL OR OTHER FLAMMABLE LIQUIDS. USE OF SUCH FUELS CAN RESULT IN AN EXPLOSIVE FIRE AND CAUSE SEVERE INJURY.

**Fueling Options Available**

Fueling of the Monitor Heating Systems can be accomplished in one of 3 ways:

1. Capsule Tank (on the Monitor 422)
2. Gravity Fed Large Capacity External Tank: Practical for large heating needs where bulk delivery of kerosene is available. This system should be installed by a qualified plumber or fuel supply technician.
3. Large Capacity External Tank with Pump: For large heating needs where a gravity fed system is not practical. An electric pump, the Monitor™ Kerosene Lifter, especially designed for use with Monitor heating systems.

*If a pumping system is used to supply fuel, the inlet pressure to the heater must not exceed 2.5 psi.*
To install a large capacity, gravity fed external tank, follow the instructions below. Use of a qualified installer is recommended.

- Installation height of the bottom of the fuel tank should be 16 inches or more above the floor surface on which the heater stands. This insures that inlet fuel pressure will be sufficient. The top of the fuel tank should be no higher than 8½ feet above the floor under the heater. This insures that inlet fuel pressure will not be excessive.
- The horizontal length of piping should not exceed 100 feet and should be free of sharp bends or obstructions.
- Piping should include no reverse U-type bends (to avoid air locks, which could block the fuel supply).
- Only 3/4” inch OD copper tubing should be used. The tubing should be bent carefully to avoid crimping.
- A fuel filter is recommended for use on the fuel line near tank, and a shut-off valve should be installed at the tank.
- Flare connections should be used at the fusible link valve connection on the heater and at the fuel filter to be installed at the tank.
- The fuel tank should be located no closer than 3 feet to a source of heat.
- The fuel tank should have an opening for filling on the top and a vent with a weather-proof cap on the side. On some tanks the vent and fill spout use the same opening.

55, 100, and 250 gallon tanks must contain:
- Shut-off valve at tank outlet
- Disposable fuel filter (protects heater against condensation and other impurities)
- Fueling inlet (protected by weather-proof cap)
- Ventilation outlet
- Clearance of at least 3 from any source of heat

Allowable Height Dimensions:
- Bottom of tank—at least 16” above floor holding heater (maintains sufficient pressure)
- Top of tank—maximum of 8½’ above floor holding heater (prevents excessive line pressure above 2.5 psi).
- Position of Lifter—more than 8’ above fuel inlet of heater requires pressure reduction valve.

RECOMMENDATION
Pipe fittings in the fuel supply to the Monitor heating systems should be sealed with pipe thread tape. The supply line from the tank to the Monitor Kerosene Lifter must be absolutely air tight. 275 gallons and bigger tanks should have a 2.5 P.S.I. max pressure reducer to avoid excessive pressure at heater inlet.

2.14 HEATER INSTALLATION
The Monitor heaters can be physically situated on carpeting or other combustible flooring with complete safety. The selected heater site must be accessible to an electrical outlet, must support free air circulation (both internal and external), and must not contain combustible materials in the heater’s immediate vicinity.

Figure 2.11 ALTERNATIVE SOURCES OF FUEL STORAGE
NOTE: Fuel tank must be a minimum 3 feet away from flue pipe.

Figure 2-12 TYPICAL FUEL LINE CONNECTIONS
3-1 INTRODUCTION
Monitor is an easy-to-operate vented kerosene heater. Routine operation features high BTU output, automatic adjustment of room temperature, low fuel and power consumption, and choice of automatic or manual heater operation.

This section provides all information necessary to operate the Monitor Heating System. All operation procedures specified should be performed in the order in which they are described.

3-2 OPERATING SPECIFICATIONS
The following specifications apply to the operation of the Monitor 441 and the Monitor 422.

Monitor 441
- Rated Efficiency (as applied to kerosene heaters): 93%*.
- Rated Efficiency (as applied to central heating systems): 87%.
- Power Consumption: as follows:

<table>
<thead>
<tr>
<th>IGNITION</th>
<th>HIGH</th>
<th>MEDIUM-HIGH</th>
<th>MEDIUM-LOW</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGNITION</td>
<td>BURN</td>
<td>BURN</td>
<td>BURN</td>
<td>BURN</td>
</tr>
<tr>
<td>340watts</td>
<td>65watts</td>
<td>62watts</td>
<td>58watts</td>
<td>58watts</td>
</tr>
</tbody>
</table>

- Circulation Fan Output: 388 cubic feet min.
- Fuel source: Remote, separate tank
- Potential heating area: 900-3200 sq. feet

*The energy from the combustion process is released in the form of heat and vaporized water. Normally, heating systems discharge water from combustion to the atmosphere without condensing it. This 93% efficiency rating means that, assuming the water cannot be condensed, 93% of the heat produced by the combustion process is recovered. Assuming the water can be condensed, the efficiency is 87%.

NOTE: Actual effective heating area depends upon numerous factors such as type and severity of climate, type of dwelling construction, condition of dwelling, and thickness and effectiveness of dwelling insulation.

Table 3-1 lists Monitor 441 performance specifications at various user-selected heat output settings.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Rating</td>
<td>16,200</td>
</tr>
<tr>
<td>Heater Output hr.</td>
<td>15,000</td>
</tr>
<tr>
<td>Fuel Consumption (gal. hr)</td>
<td>0.12</td>
</tr>
<tr>
<td>8-hrs day runtime (5-gal. tank)</td>
<td>5.2days</td>
</tr>
<tr>
<td>Continuous-use runtime (5-gal. tank)</td>
<td>41.7hrs.</td>
</tr>
<tr>
<td>Continuous-use runtime (55-gal. tank)</td>
<td>57.3days</td>
</tr>
<tr>
<td>Continuous-use runtime (275-gal. tank)</td>
<td>19.1days</td>
</tr>
<tr>
<td>Continuous-use runtime (275-gal. tank)</td>
<td>286.5days</td>
</tr>
<tr>
<td>Continuous-use runtime (275-gal. tank)</td>
<td>95.5days</td>
</tr>
</tbody>
</table>
Section 3: Operation

Monitor 422

- Rated Efficiency (as applied to kerosene heater): 93%.
- Rated Efficiency (as applied to central heating systems): 87%.
- Power Consumption: as follows

<table>
<thead>
<tr>
<th>Setting</th>
<th>IGNITION</th>
<th>MEDIUM-HIGH</th>
<th>MEDIUM-LOW</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250watts</td>
<td>52watts</td>
<td>51watts</td>
<td>50watts</td>
</tr>
</tbody>
</table>

- Circulation Fan Output: 176 cubic feet/min
- Fuel source: 1.32 U.S. gal., separate tank optional
- Potentional heating area: 500-2000 sq. feet

Table 3-2 lists Monitor 422 performance specifications at various user-selected heat output settings.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Rating</td>
<td>9,600</td>
</tr>
<tr>
<td>Heater Output, hr.</td>
<td>8,900</td>
</tr>
<tr>
<td>Fuel Consumption (gal/hr)</td>
<td>0.07</td>
</tr>
<tr>
<td>8-hrs. day burntime (1.32-gal. tank)</td>
<td>2.4 days</td>
</tr>
<tr>
<td>Continuous-use burntime (1.32-gal. tank)</td>
<td>18.9 hrs.</td>
</tr>
<tr>
<td>8-hrs. day burntime (55-gal. tank)</td>
<td>98.2 days</td>
</tr>
<tr>
<td>Continuous-use burntime (55-gal. tank)</td>
<td>32.7 days</td>
</tr>
</tbody>
</table>

NOTE: Capsule tank cannot be used in Connecticut and Massachusetts.
3-3 OPERATING CONTROLS AND INDICATORS
Several controls and indicators are used to operate the heater and to monitor its performance as follows:

**Figure 3-1, INDICATORS**

<table>
<thead>
<tr>
<th>Figure 3-1, Item</th>
<th>Control or Indicator</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run Indicator Light</td>
<td>Light to indicate that power has been applied to heater. Illuminates when operation ON/OFF push-button switch is pressed to position ON.</td>
<td></td>
</tr>
<tr>
<td>AUTO Indicator Light</td>
<td>Lights when heater runs in automatic mode. AUTO, RUN, and appropriate BURNER STATUS indicators are illuminated simultaneously if heater is burning.</td>
<td></td>
</tr>
<tr>
<td>ECONOMY PLUS Indicator Light</td>
<td>Lights when heater runs in Economy Plus mode.</td>
<td></td>
</tr>
<tr>
<td>Empty Indicator Light</td>
<td>In case of using the cartridge tank, when the fuel is empty, EMPTY Indicator Light blinks. This Light is not provided with Monitor 441.</td>
<td></td>
</tr>
<tr>
<td>BURNER STATUS Indicator Lights</td>
<td>Light in accordance with heat output as follows: Heat Output</td>
<td>Light Pattern</td>
</tr>
<tr>
<td>High</td>
<td>8 indicators-ON</td>
<td></td>
</tr>
<tr>
<td>Medium High</td>
<td>6 indicators-ON</td>
<td></td>
</tr>
<tr>
<td>Medium Low</td>
<td>4 indicators-ON</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2 indicators-ON</td>
<td></td>
</tr>
</tbody>
</table>
# MONITOR HEATING SYSTEMS

## Section 3: Operation

<table>
<thead>
<tr>
<th>FIGURE AND ITEM NO</th>
<th>CONTROL OR INDICATOR</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 3-1, Item6</td>
<td>TEMP Indicator Light</td>
<td>Lights when heater is running and Digital Window is showing the temperature.</td>
</tr>
<tr>
<td>Figure 3-1, Item7</td>
<td>AM Indicator Light</td>
<td></td>
</tr>
<tr>
<td>Figure 3-1, Item8</td>
<td>PM Indicator Light</td>
<td></td>
</tr>
<tr>
<td>Figure 3-1, Item9</td>
<td>Digital Display</td>
<td>Indicates 'SET' and 'ROOM' temperature when heater is running, and indicates time when heater is Off. Indicates time and temperature for automatic operation setting.</td>
</tr>
<tr>
<td>Figure 3-2, Item10</td>
<td>TIMER SELECTOR push-button switch</td>
<td>The automatic function allows the programming of different temperatures for different times of the day. Two, three or four settings can be used.</td>
</tr>
<tr>
<td>Figure 3-2, Item11</td>
<td>CLOCK SET Indicator Light</td>
<td>Allows programming of current time when illuminated.</td>
</tr>
</tbody>
</table>

**NOTE:** Prior to programming current time, Digital Display shows 00:00.

**IMPORTANT:** Once time has been programmed, the SET push but- ton switch must be pressed within 60 seconds. Otherwise, display will re-play previously programmed time.

When programmed, heater automatically operates at specified time and temperature (i.e. 6:00 a.m., 70°F), if set for AUTO, providing that heater has been set for automatic mode of operation.

**TIME, TEMP, HOUR(UP), MINUTE(DOWN) and SET push-button switches are used to program first operated time and temperature.**

**IMPORTANT:** Once time and temperature have been programmed, the SET button switch must be pressed within 15 seconds. Otherwise, time and temperature will revert to previously programmed time, if any.

When this Light illuminates, it indicates programmed time and temperature displayed.

<table>
<thead>
<tr>
<th>Figure 3-2, Item12</th>
<th>1st Indicator Light</th>
<th>Allows programming of first automatic time and temperature selection when illuminated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 3-2, Item13</td>
<td>2nd Indicator Light</td>
<td>Allows programming of second automatic time and temperature selection when illuminated.</td>
</tr>
</tbody>
</table>
## FIGURE AND ITEM NO | CONTROL OR INDICATOR | FUNCTION
--- | --- | ---
Figure 3-2, Item14 | 3rd Indicator Light | Programs 3rd automatic heater operation as same as 1st Indicator Light.
Figure 3-2, Item15 | 4th Indicator Light | Programs 4th automatic heater operation as same as 1st Indicator Light.
Figure 3-2, Item16 | TIME push-button switch | This switch is used to set time and change display over.
Figure 3-2, Item17 | TEMP push-button switch | This switch is used to set temperature and change display over, in 2 degree increments.
Figure 3-2, Item18 | HOUR UP, MINUTE DOWN repetitive-action push-button switch | Programs time or temperature. NOTE: Each time push-button switch is pressed, the digit advances in increments of one digit. If push-button is pressed and held, the digits are advanced repetitively.
Figure 3-2, Item19 | SET push-button switch | “Sets” time and or temperature. If this control is not pressed after time and or temperature have been programmed, the time and or temperature programmed (as indicated by display window) will not be accepted, and will revert to previously programmed time and/or temperature.
Figure 3-2, Item20 | CLEAR push-button switch | Erases any programmed time and temperature. When cleared, time and/or temperature previously programmed and displayed disappear(s) from window. IMPORTANT: Both current time and automatically programmed time(s), temperature(s) will have to be reprogrammed if electrical operation is interrupted by power failure or by disconnecting heater plug from wall outlet beyond 5 minutes. If this occurs, the heater will go into MANUAL mode of operation and maintain room temperature according to the setting temperature you’ve selected by using the slide selector for the reset temperature at the lower right hand side of the cabinet.
Figure 3-2, Item21 | ON OFF push-button switch | ON position (push-button is “in”) applies power to the unit. When this occurs, the RUN indicator lights to indicate that heater operation has begun. OFF position (push-button is “out”) remove power from the heater. All circuits-except for Clock and Air Flow — are shut down.
MONITOR HEATING SYSTEMS
Section 3: Operation

<table>
<thead>
<tr>
<th>FIGURE AND ITEM NO</th>
<th>CONTROL OR INDICATOR</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 3-2, Item22</td>
<td>AUTO push-button switch</td>
<td>Places heater in automatic mode of operation. AUTO indicator lights to confirm automatic operation. Assuming that the heater has been properly programmed and heater is in ON position, heater will operate automatically. When pressed again, AUTO indicator goes out and then heater will operate in MANUAL mode. During manual operation, heater turns heater ON and OFF, at will. When AUTO is disengaged, the unit will operate on a manual temperature determined by the AUTO setting for that time of day.</td>
</tr>
<tr>
<td>Figure 3-2, Item23</td>
<td>ECONOMY PLUS push-button switch</td>
<td>Places heater in Economy Plus mode of operation. ECONOMY PLUS indicator lights to confirm Economy Plus operation. When pressed again, ECONOMY PLUS indicator goes out and then Economy Plus mode will be cancelled. <strong>NOTE</strong>: Economy Plus mode is accepted only in the MANUAL mode.</td>
</tr>
</tbody>
</table>

3-4 PRE-OPERATION CHECK LIST
After heater installation, but prior to Monitor heater start-up, inspect the system for operational readiness. The following check list specifies those items that should be inspected on a routine basis:

- Check that the Monitor heater is plugged into wall outlet (120 Vac, 60 Hz)
- Verify that adequate supply of kerosene is available in fuel tank
- Confirm that fuel is free of water or other contaminants
- Check fuel tank for good operating condition; it must be free of rust, corrosion, and or leaks
- Inspect Fuel Line for signs of leaks, loose connections, cracks, air pockets or blockages
- Confirm that Fuel Valves on Fuel Tank and Fusible Link Valve are open so fuel can flow freely
- Outside dwelling, check area immediately around Flue Pipe for combustibles or obstructions to free air circulation
- Inspect Air Line for cracks, loose connections or blockage
- Check Exhaust Line for cracks, loose connections or blockage
- At rear of heater, verify that air flow to the Air Circulation Fan is not blocked

Inspect dwelling interior and confirm that immediate area near heater is free of combustible and objects that might interfere with free air flow.

Make certain that Heat Sensor is not exposed to drafts, direct sunlight, nor direct heat from the Monitor.

Confirm that heater is level.

If this inspection reveals any system deficiencies, correct the problems before operating the heater.

3-5 OPERATION
Operation of Monitor heater can be controlled manually by the user, or run automatically by the microprocessor.

Paragraphs 3-6 through 3-10 provide the details of heater start-up, operation, and shutdown. The controls and indicators illustrated by Figure 3-1 and 3-2 are used to operate the system and to monitor the heater's performance.
3-6 MANUAL HEATER OPERATION

Operation of the heater is under the direct control of the user. The heater will not operate automatically. The heater will, however, automatically respond to changes in room temperature signaled by the Heat Sensor to maintain the temperature of the room at a comfortable level.

NOTE: Resetting the Fuel Constant Level Valve is necessary only if the heater is being started for the first time, hasn't been used for an extended period of time, or if tank has run empty. If priming, it is unnecessary to skip to step 2.

STEP 1: Prime the Heater
Gently press and release the Fuel Constant Level Valve Reset Lever four or five times.

STEP 2: Select Manual Operation
If heater operation is in AUTO mode, press the AUTO push-button switch and change AUTO to Manual mode.

STEP 3: Select Temperature Setting
Press the TEMP push-button switch and press either the UP or DOWN push-button switch to set the desired temperature. Then press the SET push-button switch.

IMPORTANT: In case no temperature is set, temperature will automatically be set at the set temperature selected by using the slide selector for the reset temperature.

STEP 4: Turn Monitor On
Press the ON OFF push button switch to position ON. The RUN indicator light indicates that power has been applied to the instrument and the heater is cycled for manual mode of operation.

INSTRUCTIONS FOR ECONOMY PLUS MODE

To engage the economy plus mode, simply press down the button labeled "Economy Plus", to disengage press again.

NOTE: Operation switch must be "ON" and in MANUAL mode.

This feature minimizes the "ON" and "OFF" cycling of the unit by allowing it to overshoot the set temperature by 12 degrees instead of the normal 4 degrees.

The advantages of this feature are to increase the overall efficiency of the unit by:

1. Decreasing electrical consumption by decreasing the frequency of ignition cycles.
2. Reducing heat loss during the prepurge and postpurge cycles.
3. Reducing inefficient combustion associated with start up and shut down.
4. Prolonging component life by decreasing expansion and contraction of internal parts.

NOTE: This feature could be compared to driving an automobile in stop and go traffic (regular mode) versus highway driving with cruise control engaged (Economy Plus mode).

3-7 AUTOMATIC HEATER OPERATION

Automatic operation is established by programming the time temperature settings for specific times. On a daily basis, a maximum of four time temperature settings can be programmed.

If, subsequently, it should be desired to switch to manual mode of operation, the changeover can be made at any time.

Proceed with automatic mode of operation in the following manner:

STEP 1: Program Clock for Current Time
A. Press the TIMER SELECTOR push-button switch, at which time the CLOCK SET indicator light will illuminate.
B. Press HOUR push-button switch to program current hour on the Clock.

IMPORTANT: Be sure to set clock for AM or PM, as appropriate.

NOTE: Both hour and minute digits on Display Window are advanced in increments of one by pressing the appropriate push-button switch one time for each digit. Digits can also be advanced repetitively by pressing and holding the appropriate push-button switch.

C. Press MINUTE push-button switch to program the current minute(s) on Clock.
D. Immediately after programming current time in terms of hours and minutes, press the SET push-button switch.

STEP 2: Program the 1st Time Temperature
A. Pressing the TIMER SELECTOR push-button switch will illuminate the 1st indicator light.
B. Press TIME push-button switch.
C. Press HOUR and MINUTE push-button switches to program 1st desired time.

IMPORTANT: Be sure to set the clock AM or PM, as appropriate.

D. Immediately after programming the 1st desired time, press the SET push-button switch. This step must be completed within fifteen seconds after programming the time.

E. Press TEMP push-button switch.

F. Press UP and/or DOWN push-button switches to program 1st desired temperature.

G. Immediately after programming the 1st desired temperature, press the SET push-button switch. This step must be completed within fifteen seconds after programming the temperature.

STEP3: Program the Remaining Times
By pressing the TIMER SELECTOR push-button switch again, the 2nd Indicator Light will illuminate, at which time the 2nd setting can be programmed. Press again to set 3rd and again to set 4th.

IMPORTANT: The SET push-button switch must be pressed after each setting to lock into memory.

Should heater power be interrupted by a power failure or by disconnection of the power cord beyond 5 minutes, heater reverts to MANUAL operation, and all AUTO programming is erased.

STEP4: Select Automatic Operation
Press AUTO push-button switch. The AUTO indicator light will illuminate.

STEP5: Turn Monitor ON
Press ON OFF push-button switch to position ON. The RUN indicator light will illuminate to indicate that power has been applied to the heater.

From this point, heater operation is as follow example:

<table>
<thead>
<tr>
<th>6:00AM</th>
<th>9:00AM</th>
<th>5:00PM</th>
<th>10:00PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 F</td>
<td>68 F</td>
<td>80 F</td>
<td>64 F</td>
</tr>
</tbody>
</table>

Example

3-8 REPROGRAMMING THE MONITOR HEATER
On occasion, it may be necessary to reprogram the Monitor. Reprogramming is performed as specified below:

STEP1: Reprogramming Current Time
If necessary:
A. Press the TIMER SELECTOR push-button switch to illuminate the CLOCK SET indicator light.
B. Press HOUR and MINUTE push-button switches to program new current time. Set applicable time by watching Clock display.
C. Press SET push-button switch.

IMPORTANT: If SET push-button switch is not pressed, current time will revert to previously programmed time.

STEP2: Reprogramming Automatic Operation
A. Press the TIMER SELECTOR push-button switch to illuminate the appropriate indicator light. (1st, 2nd, 3rd, or 4th)
B. Press TIME push-button switch.
C. Press CLEAR push-button switch. Time displayed on window will disappear.
D. Using HOUR and MINUTE push-button switches program new desired time by watching the Display Window.
E. Press SET push-button switch.
F. Press TEMP push-button switch.
G. Press CLEAR push-button switch. Set Temperature displayed on Window will disappear.
H. Using UP and DOWN push-button switches program new desired temperature by watching the Display Window.
I. Press SET push-button switch.

3-9 HEAT SENSOR
Heat Sensor is located on the rear of the cabinet. It is recommended to leave the sensor in its original mounted position. However should relocation be necessary, choose a location for the sensor that is not in the path of direct sunlight, drafts, or the flow of warm air from the heater. Loosen the screw and release the sensor from the rear of the cabinet. Fasten the sensor to the wall with the screw.

3-10 MONITOR SHUTDOWN
A simple one-step procedure is utilized to shutdown the Monitor:
Press ON OFF push-button switch to position OFF; the RUN indicator will extinguish.

IMPORTANT: Once heater has shut down, it cannot be restarted until post-purge cycle has been completed. If ON/OFF switch is left in position ON, Monitor operation will automatically restart upon completion of post-purge.
3-11 OUT OF FUEL
During either manual or automatic operation of heater fuel in the tank may be depleted.
The Monitor in case of using external fuel tanks is known to be out of fuel when all of the following
symptoms are present:
- Burner Status indicator lights blink.
- Absence of flame (visually verified through view
plate on wall of Combustion Chamber).

STEP 1: Turn Heater OFF
Press ON OFF switch to OFF.

STEP 2: Fill Fuel Tank
A. Close shut-off valve at outlet of Fuel Tank.
B. Drain Fuel Tank (from bottom, if possible) to
remove all condensation, debris, and old fuel.
C. Fill Fuel Tank with fresh, crystal clear kerosene.
D. Upon completion of step C, open shut-off valve
which was closed in step A above.

STEP 3: Turn Heater ON
Press ON OFF switch to ON. Proceed with normal
heater operation.

The Monitor 422 (in case of using capsule fuel tank) is
known to be out of fuel as follows:
When the EMPTY indicator light illuminates
and flashes, a buzzer will sound for twenty
seconds. The burner mode is changed to “Low”
automatically, and then, the heater will shut off
after 30 minutes.
The remaining burning time is indicated at the
Display Window.

Refueling:
STEP 1: Turn Heater OFF
Press ON OFF switch and wait 15 minutes for the
heater to cool.

STEP 2: Lift Out the Capsule Fuel Tank
Open the tank cover and lift out the capsule fuel
tank.
Turn the tank upside down, and remove the fuel
cap.

STEP 3: Fill the Capsule Fuel Tank
Fill the capsule fuel tank with fresh, crystal clear
kerosene by using a siphon.

STEP 4: Reinstall the Capsule Fuel Tank
Replace and tighten the fuel cap. To insure proper
fuel flow, be sure the cap is secured correctly.

Install the tank with the arrow pointing forward, and
close the tank cover.

STEP 5: Turn Heater ON
Press ON OFF switch to ON. Proceed with normal
heater operation.

3-12 RECOVERY FROM A-POWER FAILURE
For the power interruption of up to 5 minutes, the
set memory is kept and will resume operation automatically with the set memory.
For power interruptions beyond 5 minutes, heater will resume operation (after 3 minutes cool down
period) in the MANUAL mode and maintain room temperature according to the setting temperature
selected by using the SLIDE SELECTOR for the reset temperature at the lower right hand side of the
Cabinet.
When the TIME push-button switch is pressed or
the TIMER SELECTOR push-button switch is pressed
and illuminated the CLOCK SET indicator light, the
Display Window will show 08:08 indicating the
need to reset the clock and re-program the heater for
automatic operation.

REMARK: In order to display reset temperature, it
should be set before the heater is plugged in and energized.
New reset temperature selected after plugged in will take effect only after a
power loss.

3-13 RECOVERY FROM OVERHEAT CONDITION
The Monitor is protected against damage resulting
from an overheat condition by two 110°C (Monitor
422), 115°C (Monitor 441) automatic reset thermostats.
In the event of an overheat the thermostats are
triggered to cut off the flow of kerosene to the
Burner Pot, the flame is extinguished automatically,
and user is alerted to the overheat condition by
blinking of the Burner Status indicators.
To recover from an overheat condition, proceed as outlined below:

STEP 1: Turn OFF Heater

STEP 2: Allow Monitor Heater to cool

NOTE: Be sure that heater is cool to touch.
A period of 30 to 45-minutes should be sufficient to
permit heater to cool completely.

STEP 3: Unplug Heater
Disconnect heater power cord from wall outlet.
MONITOR HEATING SYSTEMS
Section 3: Operation

STEP4: Check for Cause of Overheating
NOTE: Overheating is usually caused by objects that impede free air circulation.

STEP5: Remove Louver Assembly
STEP6: Clean Heater Interior

WARNING:

BEFORE PROCEEDING TO CLEAN HEATER, BE SURE THAT HEATER INTERIOR IS COOL ENOUGH TO TOUCH.

With a clean, lint-free, damp rag or other appropriate cleaning material, wipe up all dust, dirt and debris from exterior of cabinet, including exterior of Combustion Chamber and Heat Exchanger.

STEP7: Replace Louver Assembly
STEP8: Reconnect Monitor Heater Power Plug to the Wall Outlet.
STEP9: Turn Heater ON
STEP10: Reprogram Heater Microprocessor
STEP11: Select Mode of Operation

CAUTION: If after the completion of recovery procedure, the heater overheats again, something is wrong. Do not operate heater until problem has been diagnosed and corrected.

3-14 RECOVERY FROM BLOWN FUSE
All electrical components of the Monitor heater are protected against power overloads and electrical malfunctions by two 2-amp fuses and a 10-amp fuse. Should fuse blow, the recovery procedure is outlined below:

STEP1: Turn Monitor OFF
STEP2: Unplug heater
STEP3: Remove louver assembly
STEP4: Remove front cover

NOTE: As the Front Cover of the Monitor 441 is connected to the Printed Circuit Board by Lead Wires, pull the Front Cover to the front side slightly and remove the Connector of the Lead Wires from the Printed Circuit Board, and then, remove the Front Cover.

STEP5: Locate and replace fuse(s)
STEP6: Reattach front cover (In case of the Monitor 441, be sure that the connector is connected to the printed circuit board.)
STEP7: Reattach louver assembly
STEP8: Plug heater power cord into wall outlet
STEP9: Turn Monitor ON
STEP10: Reprogram heater
STEP11: Program Automatic operation cycles (if applicable)
STEP12: Select Automatic operation (if applicable)
4.1 INTRODUCTION
Heater maintenance is divided into two classifications: periodic maintenance is required to maintain the heater in good operating condition; corrective maintenance is necessary to repair a malfunction.

4.2 PERIODIC MAINTENANCE
The Maintenance Schedule provided in Table 4-1 describes the tasks that must be performed periodically in order to sustain the efficiency of the Monitor Heating Systems. At the time of the demonstration or installation, heater maintenance should be discussed with the user; emphasize that a clean heater and proper fuel are the keys to optimum heater operation and performance.

### Table 4-1 SUGGESTED MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Activity</th>
<th>Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check all fuel pipes for leaks and</td>
<td>3&quot; OD copper tubing</td>
<td>Fuel piping must be secure and free of leaks. Replace tubing when necessary.</td>
</tr>
<tr>
<td>loose connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect exhaust piping for leaks or</td>
<td></td>
<td>All exhaust pipes must be covered by a cloth insulation cover.</td>
</tr>
<tr>
<td>loose connections</td>
<td></td>
<td>If cloth cover shows signs of discoloration at joints, check o-rings.</td>
</tr>
<tr>
<td>Check fuel for water and/or other</td>
<td></td>
<td>Fuel color should be crystal clear. If fuel is contaminated, see Corrective Maintenance procedure, paragraph 4-9.</td>
</tr>
<tr>
<td>contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the capsule tank is used on the Monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>422 the capsule tank filter should be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>checked, cleaned or replaced, as well as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the constant level valve strainer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect Fuel Pipe for obstruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect electrical wiring for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cracks, signs of deterioration, bare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wires and or loose connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean heater</td>
<td>Clean, lint-free cloth and a mild</td>
<td>Wipe down exterior of heater cabinet. Vacuum heater interior (if necessary).</td>
</tr>
<tr>
<td>Clean, lint-free cloth and a mild</td>
<td>non-abrasive household cleaning</td>
<td></td>
</tr>
<tr>
<td>non-abrasive household cleaning agent. USE</td>
<td>agent. USE ONLY NON-PETROLEUM</td>
<td></td>
</tr>
<tr>
<td>ONLY NON-PETROLEUM DISTILLATE CLEANERS.</td>
<td>DISTILLATE CLEANERS.</td>
<td></td>
</tr>
<tr>
<td>Clean Air Circulation Fan (Monthly)</td>
<td></td>
<td>Vacuum fan cage. Wipe fan blades.</td>
</tr>
<tr>
<td>Inspect air piping for leaks or loose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>connections.</td>
<td></td>
<td>Look for cracks, wear, or signs of deterioration; replace if necessary.</td>
</tr>
<tr>
<td>Inspect rubber Air Hose at rear of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>heater.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean fuel constant level Valve filter</td>
<td>Clean Kerosene</td>
<td>Refer to paragraph 4-5. Procedure is described in paragraph 4-6.</td>
</tr>
<tr>
<td>Clean only if necessary, Verify that</td>
<td></td>
<td>Check Leveling Guide.</td>
</tr>
<tr>
<td>heater is level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect flue pipe for obstruction or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>corrosion.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WARNING:**

UNPLUG HEATER BEFORE PROCEEDING. HEATER MUST ALSO BE COOL BEFORE STARTING.
MONITOR HEATING SYSTEMS
Section 4: Maintenance

<table>
<thead>
<tr>
<th>Activity</th>
<th>Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect Combustion Ring, Flame Sensor Rod, Ball, and Burner Cloth (Suggested frequency every 3 years).</td>
<td></td>
<td>Clean all carbon deposits. Replace if excessively worn, warped, or cracked.</td>
</tr>
<tr>
<td>Clean Combustion Chamber (every 3 years)</td>
<td></td>
<td>Vacuum all carbon deposits from interior of chamber.</td>
</tr>
<tr>
<td>Inspect air holes in Burner Pot</td>
<td></td>
<td>Use a small, stiff brush or a short length of soft copper wire to clean any blocked holes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The M422 may need air holes reamed with a torch tip cleaner if partially block on a 5 to 7 year basis.</td>
</tr>
<tr>
<td>Clean Igniter</td>
<td></td>
<td>Scrape any carbon deposits from igniter.</td>
</tr>
<tr>
<td>Check air piping that interconnect Combustion Blower and Air Pressure Switch.</td>
<td></td>
<td>Replace air piping that is worn, broken or brittle.</td>
</tr>
<tr>
<td>Check for carbon build up in fuel inlet going into burn chamber (every year)</td>
<td></td>
<td>Disconnect copper fuel piping from burn chamber and clear fuel inlet line by reaming with a solid piece of wire (such as copper, bailing wire, or coat hanger) which should be able to go in approximately 3&quot; without obstruction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOTE: Removing and retightening burner fuel connection must be done when the burner cools down completely. If it is done when the burner is hot, the welding on the fuel joint may break. Fixing torque for nut: 30 ~ 40 kg-cm (26 ~ 35 lb-in)</td>
</tr>
</tbody>
</table>

4-3 INSPECT EXHAUST/AIR PIPING
Verify that all exhaust and air pipes are free of leaks and loose connections, as specified below:

STEP1: Remove Protective Cloth
Remove cloth insulation cover(s) from all exhaust pipes.

STEP2: Inspection of Exhaust/Air Piping
A. Visually inspect both air and exhaust piping for obvious cracks, leaks, or loose connections. Black carbon deposits may be evidence of these leaks, and o-rings may need to be replaced.
B. Be sure that all pipes are installed tightly and securely, especially at joints.
C. Turn heater ON.
D. Carefully apply a small amount of soapy water (with a paint brush) to the surface areas of the air/exhaust piping.
Any leaks that may exist will be readily identified by the appearance of bubbles.

STEP3: Return to Operating Condition
A. Turn heater OFF.
B. Dry all pipes with paper towels.
C. Repair any leaks that have been found (if necessary, replace the tubing).
D. Replace cloth insulation covers.
4-4 VERIFY IGNITER OPERATION
Visually inspect igniter operation.

**WARNING:**

HEATER IS OPERATIONAL DURING THIS INSPECTION. AVOID DIRECT CONTACT WITH ANY HEATED OR ELECTRICAL COMPONENT.

**STEP1:** Prepare for Inspection
Remove Louver Assembly.

**STEP2:** Visual Inspection
A. Turn heater ON.
B. Look (downward) through window on the Combustion Chamber. Verify that igniter is glowing.
   If igniter does not glow, something is wrong. Refer to the Troubleshooting Chart in Section 6 of this Service Manual to diagnose the problem.
C. An alternate inspection is to feel the igniter cover after the unit has been in the ignition stage for about 5 minutes. It should be warm.

**CAUTION:** If igniter is broken, do not operate the "ON OFF" switch button repeatedly.

**STEP3:** Reassembly of Heater
Turn the heater OFF and replace the Louver Assembly.

4-5 CLEAN FUEL CONSTANT LEVEL VALVE FILTER
Contaminants are trapped by the filter to prevent them from clogging the Fuel Constant Level Valve.
The filter itself has a great number of small pores. Whenever a filter is torn or disfigured (enlarged pores), it should immediately be replaced.
Inspect and clean the filter as indicated by the procedure below:

**WARNING**

CLOSE FUSIBLE LINK VALVE ON M-422 OR CLOSE SHUT-OFF VALVE OF THE EXTERNAL FUEL TANK ON M-441 TO AVOID DRAINING ALL FUEL FROM TANKS.

**NOTE:** Power should be OFF during the performance of this procedure.

**STEP1:** Disassembly
A. Use a phillips head screwdriver, unscrew the screws holding the rounded diamond-shaped cover plate at the bottom of the Fuel Constant Level Valve. Remove the cover plate.

**NOTE:** Position a six inch U shaped piece of metal or cardboard under strainer cover to drain fuel into a pan.

B. Carefully remove the rubber gasket which is located behind the cover plate.

**STEP2:** Inspection and Cleaning
A. Pull the filter straight out of the fuel reservoir.
B. If the filter is dirty (but undamaged), rinse the filter in fresh, clean kerosene to remove all particles. Replace damaged filters.
C. To drain off upper portion of fuel constant level valve, back out phillips head screw which is located slightly above and to the left of filter cover plate. (See Fig 4-1)
D. If upper portion drain is dirty or containing water, then remove pump and inspect and clean its screen.

**STEP3:** Reassembly
A. Push the (new or cleaned) filter back into the bottom of the fuel reservoir.
B. Replace both the rubber gasket and the cover plate. (Take care to properly align the screw holes in the gasket and cover plate).
C. Wipe up any spilled fuel.

![Figure 4-1 CLEAN FUEL CONSTANT LEVEL VALVE](image-url)
4-6 CLEANING FUSIBLE LINK VALVE INTAKE FITTING ON M-422
At periodic intervals, the fitting on the Fusible Link Valve should be cleaned to prevent any accumulation of foreign materials from clogging the inlet. This is accomplished as follows:

**WARNING**

UNPLUG THE HEATER. POWER TO THE HEATER SHOULD BE OFF DURING THE PERFORMANCE OF THIS PROCEDURE.

**STEP1:** Close off Fuel Supply
A. Shut off fuel at the Storage Tank or remove fuel from the fuel sump tank with siphon and syringe if using the capsule fuel tank.
B. Manually turn handle to close Fusible Link Valve.

**NOTE:** Place paper towels underneath the Fusible Link Valve to catch any spilled fuel.

**STEP2:** Clean Valve
A. Loosen hex nut on Fusible Link Valve inlet fitting at rear of the heater. Disconnect the copper tubing which delivers the fuel from the storage or the fuel sump tank.
B. Using a small, straight piece of wire carefully and slowly reel-out the inlet fitting on the Fusible Link Valve.
C. Avoid scratching the inside wall of the fitting.
D. With a cotton swab, wipe the interior area of the inlet fitting.

**STEP3:** Reconnect Fuel Line
A. Reconnect the copper tubing to the intake fitting and tighten the hex nut.
B. Turn ON fuel at Fusible Link Valve and at storage tank or fuel sump tank.
C. Check for leaks.

4-7 CORRECTIVE MAINTENANCE
The two procedures below are remedies for very generalized types of operating difficulties.

4-8 REPLACEMENT OF FUSES
A short circuit or similar electrical malfunction could cause the fuse to blow. Troubleshoot the cause of the blown fuse.

Replace the fuse as follows:

**WARNING**

DO NOT REPLACE FUSE WHILE POWER IS ON.

**STEP1:** Removal of Fuse
A. Unplug heater. Remove Louver Assembly and Front Cover.
B. Remove the fuse from fuseholder on the Printed Circuit Board.

**STEP2:** Installation of New Fuse
A. Install a new fuse into the fuseholder. The fuse must be a 250-V, 2 amp or a 250-V, 10 amp type as marked on the printed circuit board. Do not use oversized fuses.
B. Replace the Front Cover and the Louver Assembly and plug the heater into the wall outlet.

**IMPORTANT:** Whenever the heater is unplugged, the Microprocessor must be reprogrammed when power is restored.

4-9 FUEL CONTAMINATION
Fuel contamination is often difficult to diagnose, even though it will adversely affect heater operation and performance. The best course of action to take when fuel contamination is suspected is to examine all of the system's fuel filters, beginning with the fuel storage tank. If a Monitor Kerosene Lifter is part of the fueling system, examine and clean that unit's filter, as well as the filter located in the Fuel Constant Level Valve. When it has been determined that water or some other contaminants have infiltrated the fuel, the following action must be taken:

**WARNING**

BEFORE PROCEEDING FURTHER, UNPLUG THE HEATER.

**STEP1:** Remove Contamination
A. Shut OFF the fuel supply at the storage tank or at the Fusible Link Valve.
B. Drain off the contaminants from the fuel storage tank or the fuel sump tank(M-422). Fill with fresh, clean fuel.

**STEP2:** Clean the Heater
A. Clean fuel constant level valve filter and filter compartment.
B. Remove the Louver Assembly and Solenoid Pump on the constant level valve. Clean the Solenoid Pump filter.

**STEP3:** Reinstall Cleaned Components
A. Replace the components correctly and install new gasket.
B. Turn on the fuel at the storage tank and at the fusible link valve, and apply power to the heater. If problem still exists and contaminated fuel is suspected it can be checked by
A. Shutting off the fuel supply at the storage tank and at the fusible link valve.
B. Drain off fuel at constant level valve.
C. Disconnect fuel line at back of heater and hook up a 5 gallon quick tank with proven good fuel.
D. Test run heater to see if problem clears up with use of new fuel.
5-1 INTRODUCTION
Servicing is required when the Monitor Heater is not running at proper efficiency. This section covers possible causes and corrective procedures for efficiency loses.

Signs of improper heater efficiency and performance would be:
- Yellowish lazy flame
- Smoke from flue pipe exhaust
- Heavy soot and carbon build up in combustion chamber
- Lowered heat output.

5-2 MEASUREMENT OF FUEL FLOW RATE
Fuel flow rates are preset and sealed. These rates should not and we recommend they do not be readjusted.

5-3 REMOVAL OF WATER DEPOSITS AND CONTAMINANTS FROM FUEL CONSTANT LEVEL VALVE AND FUEL LINES

NOTE: Disconnect the Monitor from power supply (unplug) before proceeding.

1. Use a syphon pump and a syringe to drain off any fuel in the fuel sump (in case of capsule tank use on the Monitor 422).
2. If using separate tank on the Monitor 422 shut off fusible link valve. On the Monitor 441 shut off valve of separate tank.
3. Bend a piece of sheet metal or cardboard into a U shape and place it under the fuel constant level valve strainer cover to drain bad fuel into a 1-2 liter pan. (Figure 4-1)
   A. Remove strainer cover and drain.
   B. With strainer cover removed, inspect, clean and or replace strainer if damaged.
   C. Remove drain port screw and drain.
   D. Replace strainer, cover and screw.
   E. Open fusible link valve or shut-off valve to refill system with fresh crystal, clear kerosene.
   F. Repeat steps 1-3 until all contaminated fuel is drained off.
4. Remove fuel feed pipe from burner pot and solenoid pump, and drain fuel into pan.
5. Once lines are clear, reconnect fuel feed pipe, turn operation switch ON and start a test run.

NOTE: Removing and retightening burner fuel connection must be done when a burner cools down completely. If it is done when a burner is hot, the welding on the fuel joint may break. Fixing Torque for nut: 30 - 40 kg • cm (26 - 35 lb. in).

5-4 CLEANING THE BURN CHAMBER & BURNER POT
Under normal running conditions, soot will not deposit in great quantities inside the burner, and a light covering of soot will not affect the performance of the unit thus it need not be cleaned. However, if heavy soot built up does occur the unit should be opened and cleaned.

The burner is assembled using gaskets to maintain its air tightness. If these gaskets leak, the extra air can cause a serious soot problem and or exhaust gases to escape into the area being heated.

NOTE: If any gaskets are torn when components are removed, replace. Disconnect power supply to unit.

If cleaning is necessary, use the following method:
1. On the Monitor 422
   A. Remove louver assembly.
   B. Remove front cover.
   C. Remove top cover and lead wire connectors.
   D. Remove front and top heat shields that cover the burn chamber and their lead connectors.
   E. Remove fuel piping from burn chamber.
   F. Remove igniter.
   G. Remove flame detective rod lead from PCB (DO NOT REMOVE FROM BURN CHAMBER).
   H. Remove screw at top of burner cap which attached it to cabinet. Remove screw at back of cabinet from exhaust duct and remove the 4 screws holding the burn chamber to base.
   I. Rock chamber back and forth lightly, raise about 1/2" and remove burn chamber and heat exchanger, as one assembly from unit.
   J. Set chamber upside down and remove the 4 screws which secure the burner pot to the burn chamber. Pull the burner pot up and out.
2. On the Monitor 441
   A. Remove louver assembly.
   B. Remove front cover and wire connectors.
   C. Remove top cover.
   D. Remove heat shield that covers combustion chamber.
   E. Remove service panel.
   F. Remove Flame detector rod.

For a more thorough cleaning, use the same procedure as for the M422 above.
3. Turn counter-clockwise to remove combustion ring. If ring does not turn, pull up slightly to loosen retaining clips.
4. Use wire brush to clean inside of combustion chamber. Vacuum and wipe clean with a waste cloth.
5. If tar is present on the burner bottom, remove the tar by using a flat-bladed screw driver or wire brush, then clean the area by using a vacuum cleaner etc.

**NOTE:** Make sure all air inlet openings are clear.

6. When cleaning the inside of the burner pot, remove the igniter and change the burner cloth by the following procedure.

7. On the Monitor 422
   A. Apply glue(P No. 8217) on the burner bottom as shown in Figure 5-1.
   B. Put the burner cloth on the burner bottom, afterwards press and straighten out the burner cloth so that it is glued flat and even on the burner bottom.

8. On the Monitor 441
   A. Apply glue around the burner cloth as shown in Figure 5-2.

   **Figure 5-1**

   **Figure 5-2**

   B. As shown in Figure 5-3 and 5-4, insert the Burner Cloth narrow between the Nozzle Collar and the Igniter Shield, then push the Burner Cloth, using your fingers or a screwdriver, so that it slips in under the Nozzle Collar. Afterwards press and straighten out the Burner cloth so that it is glued flat and even on the Burner bottom.

   **NOTE:** In some cases, pulling out the Fuel Nozzle and Collar may make this procedure easier. An easy out can be inserted into nozzle to help break loose and remove it.

9. Combustion ring may deform and deteriorate after several years use and should be cleaned and inspected before reinstallation. If combustion ring is warped, has cracked or is deteriorating excessively it should be replaced.

10. When reassembling the unit check that combustion ring is positioned with the correct side up and is sitting squarely on all three support screws (M-422) or pins (M-441) inside the burner pot.

11. Reassemble by reversing the procedure followed during disassembly.

   **NOTE:** Use of the economy plus feature can minimize service calls and extend component life.
NOTE: Make sure the position of flame detector rod is centered between combustion ring and burner pot before reassembling. (See Figure 5-6)

For minor adjustments of flame detector rod without disassembling any components:
1. Loosen the two retaining screws about half to one full turn.
2. Tightening down on the top screw first will cock the rod outward away from the combustion ring. Tightening the bottom screw first will cock the rod inward towards the combustion ring.

5-5 CLEANING THE FUEL INLET
When cleaning the combustion chamber and the burner pot, the fuel inlet nozzle should also be cleaned. This can be done as follows:

1. Disconnect copper fuel line at burn chamber.
2. Push a piece of wire (about the same size as the I.D. of fuel inlet pipe) into the fuel inlet nozzle.
3. If obstruction is felt twist wire back and forth (to brake up soot and carbon) so that wire ultimately penetrates igniter shield.

On M-422, also check air holes surrounding fuel inlet for blockage and clear if necessary.
## Monitor 422 441 Resistance values

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>APPROX. M-422</th>
<th>OHMS M-441</th>
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</thead>
<tbody>
<tr>
<td>Igniter (connector B. B)</td>
<td>16.8</td>
<td>12.7</td>
</tr>
<tr>
<td>Power Transformer - Primary (AC 120V)</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Power Transformer - Secondary (AC 12V)</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Power Transformer - Secondary (AC 120V)</td>
<td>647</td>
<td>647</td>
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<tr>
<td>Damper Solenoid (connector I I)</td>
<td>4.600</td>
<td>4.600</td>
</tr>
<tr>
<td>Resistor (connector G. G)</td>
<td>68</td>
<td>91</td>
</tr>
<tr>
<td>Circulation Fan (M-422:RD &amp; BK, M-441:WH &amp; BK)</td>
<td>235</td>
<td>115</td>
</tr>
<tr>
<td>Circulation Fan (M-422:BK &amp; YL, M-441:BK &amp; BL)</td>
<td>247.5</td>
<td>258.5</td>
</tr>
<tr>
<td>Combustion Blower (M-422:BK &amp; BK, M-441:WH &amp; GR)</td>
<td>22</td>
<td>78</td>
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<tr>
<td>Combustion Blower (M-441:GR &amp; OR)</td>
<td>-</td>
<td>92</td>
</tr>
<tr>
<td>Thermistor (connector Q Q. at 77° F)</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Fuse 2A (read with fuse out)</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Fuse 10A (read with fuse out)</td>
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<td>0.01</td>
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<tr>
<td>Solenoid Pump (coil)</td>
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<td>565</td>
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**WARNING:**

DISCONNECT HEATER FROM POWER SOURCE BEFORE MAKING ANY RESISTANCE TESTS.
### Monitor 422/441 Component Voltage Readings

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<th>AC</th>
<th>DC</th>
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<tbody>
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<td>Q on PCB Sensor disconnected</td>
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<td></td>
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<tr>
<td>Thermistor</td>
<td>Q on PCB Sensor connected</td>
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<td>1.5-3.2</td>
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<td>Air Pressure Switch</td>
<td>Connector J</td>
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<td>110</td>
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<tr>
<td>Overheat Protector Closed</td>
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<td></td>
<td></td>
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<td>Air Pressure Switch</td>
<td>Connector J</td>
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<td>Overheat Protector Open</td>
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<td></td>
<td>105</td>
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<tr>
<td>Solenoid Pump</td>
<td>K on PCB</td>
<td></td>
<td>pulse*</td>
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<tr>
<td>Circulation Fan High Speed</td>
<td>F to BK(M-422)</td>
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<td>110</td>
</tr>
<tr>
<td></td>
<td>WH to BK(M-441)</td>
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<td>110</td>
</tr>
<tr>
<td>Circulation Fan Low Speed</td>
<td>D to BK(M-422)</td>
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<td>93</td>
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<td></td>
<td>WH to BK(M-441)</td>
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<tr>
<td>Igniter</td>
<td>B on PCB</td>
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<td>(primary side)</td>
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<td>(secondary side)</td>
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<tr>
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<td>F on PCB</td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>High Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion Blower</td>
<td>F on PCB</td>
<td></td>
<td>92(M-422)</td>
</tr>
<tr>
<td>Low Speed</td>
<td>(Q1 is OFF)</td>
<td></td>
<td>88(M-441)</td>
</tr>
<tr>
<td>Resistor</td>
<td>G on PCB</td>
<td></td>
<td>18(M-422)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>22(M-441)</td>
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*Pulse can only be measured with a high impedance digital volt meter.
## Section 6: Troubleshooting

### Monitor Heating Systems (Continued)

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<th>Test Point Volts</th>
<th>Test Point Volts</th>
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<td>1.2V min.</td>
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<td>1.2V min.</td>
<td>1.2V min.</td>
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<td>1.2V min.</td>
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<td>Pulse</td>
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<td>Pulse</td>
<td>Pulse</td>
<td>Pulse</td>
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<td>Pulse</td>
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<tr>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
<td>1.5 - 3.2V</td>
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<td>12V + 30%</td>
<td>12V + 30%</td>
<td>12V + 30%</td>
<td>12V + 30%</td>
<td>12V + 30%</td>
<td>12V + 30%</td>
<td>12V + 30%</td>
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<tr>
<td>5V + 10%</td>
<td>5V + 10%</td>
<td>5V + 10%</td>
<td>5V + 10%</td>
<td>5V + 10%</td>
<td>5V + 10%</td>
<td>5V + 10%</td>
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<tr>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
<td>(C.F. Mod)</td>
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<tr>
<td>Pre-burning 1</td>
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<td>Pre-burning 1</td>
<td>Pre-burning 1</td>
<td>Pre-burning 1</td>
<td>Pre-burning 1</td>
<td>Pre-burning 1</td>
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<tr>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
<td>Pre-burning 2</td>
</tr>
</tbody>
</table>

### Notes
- Test Point Volts
- Operation Mode
- Preparation
- Pre-Test
- Post-Test
- Off
- Low
- Medium-Low
- Medium-High
- High
- Test Point
- Operation Point
The Overheat Thermostat is activated.

1. Is window curtain too close to the rear of unit? [Yes/No]
   - Yes: Curtain or other obstruction covers circulation air inlet.
     - CORRECTIVE MEASURE: Clean guard. Keep curtain from unit.
   - No: Does circulation fan operate properly? [Yes/No]
     - Yes: Obstacle covers circulating air outlet.
       - CORRECTIVE MEASURE: Remove obstacle.
     - No: Failure of P.C.B.
       - CORRECTIVE MEASURE: Replace or check P.C.B.
       - Circulation fan failed.
         - CORRECTIVE MEASURE: Replace Fan Motor.
       - Incorrect wiring.
         - CORRECTIVE MEASURE: Repair or replace wiring.
     - CORRECTIVE MEASURE: Replace Fan Guard shuts.
If problem is found to be in PCB, do not attempt to repair, replace and send PCB thru your distribu- tor to MSI for repair.
SYMPTOM | CHECK1 | RESULT | CHECK2 | RESULT | CHECK3 | RESULT | CHECK4 | RESULT | CHECK5 | RESULT | REASON | CORRECTIVE MEASURE
---|---|---|---|---|---|---|---|---|---|---|---|---|---

A

Yes: Failure of fuel supply parts

No: Is there 90% of diode D23? 

Yes: Failure of diode D3 

No: 

Failure of resistor R2 - R9 

Failure of capacitor C4 - C6 

Failure of series diode ZD1 

Failure of diode D3-D5 

Failure of thermistor R2, C3 

Failure of switch D3 

Failure of microprocessor IC1 

Failure of TR array IC9 

Failure of diode C7 

Failure of resistor R4 

Failure of photo transistor IC11 

Failure of transistor IC12, Q11.
FLAME NOOD BYPASS CIRCUIT

For testing purposes - A flame sensor rod bypass circuit can be made up, consisting of 2 insulated alligator clips, 2-6" pieces of insulated copper wire, 1-1/4" x 1/4" of insulated wire, and 1-1/4" x 1/4" of 100 OHM resistance. These components are to be soldered together in sequence as shown in diagram below (note component sequence and polarity).

Once the bypass circuit is made the unit is turned on immediately after the preheating cycle. When mode light comes on, the 0 and 1 area are disconnected off the PCB and replaced with the bypass circuit. The unit should then continue functioning as though it had a good flame inside the burn chamber, and service tests such as flame flow can be checked.

(Notice: WARNING, after all tests are completed, replace original flame rod sensor as it is a riot safety feature.)
## INDICATION OF FAILURE MODE

<table>
<thead>
<tr>
<th>Digital Display</th>
<th>The Reason of Indication</th>
<th>Trouble Point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EO1</strong></td>
<td>At pre-purge, Flame rod is sensing flame when there should be none.</td>
<td>Flame sensing circuit, grounded flame rod or pinched wire.</td>
</tr>
<tr>
<td><strong>EOS</strong></td>
<td>After power on, power supply to the microprocessor timing circuit is incorrect.</td>
<td>Timer clock circuit bad or power source to unit above or below acceptable levels.</td>
</tr>
<tr>
<td><strong>EO6</strong></td>
<td>At starting of operation, the circuit to drive photo triac of Solenoid Pump is malfunctioning.</td>
<td>Solenoid Pump control circuit has a malfunction.</td>
</tr>
</tbody>
</table>
MONITOR HEATING SYSTEM
Section 7: Electrical System
Schematics
CONNECTION OF LEAD WIRES

- Operation Timer Selector
- Time
- Time/Temp Set

Panel Printed Wiring Board

- Economy
- Run
- Auto
- Plus
- Empty
- Burner Status
- Temp Set Room

Lamp Printed Wiring Board

Main Printed Wiring Board

- Pump
- Air Pressure Switch
- Over Heat Thermostat
- Solenoid Valve
- Blower for Combustion
- Resistor
- Blower for Circulation
- Fan Thermostat
- Heater
- Junction Box

- Short Terminal
- Empty Lamp Switch (Float Switch)
- Sensor (Thermistor)
- Slide Switch
- Flame Detector
- Ground
- Power Cord

Figure 7-2 Monitor422
### MONITOR 441 SERVICE PARTS LIST

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>ITEM NO.</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>6400</td>
<td>SPILL TRAY</td>
<td>55</td>
<td>6204</td>
<td>PHOTO COUPLER IC12</td>
</tr>
<tr>
<td>2</td>
<td>5019</td>
<td>LEG</td>
<td>56</td>
<td>6251</td>
<td>POWER TRANSFORMER</td>
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<td>3</td>
<td>6301</td>
<td>AIR SUPPLY HOSE (A)</td>
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<td>AIR LINE</td>
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<td>4</td>
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<td>AIR SUPPLY HOSE (B)</td>
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<td>AIR PRESSURE SWITCH</td>
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<td>6303</td>
<td>CONSTANT LEVEL VALVE</td>
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<td>6136</td>
<td>RUBBER BUSH</td>
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<td>C.L.V. STRAINER</td>
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<td>OVER HEAT THERMOSTAT</td>
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<td>STRAINER GASKET</td>
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<td>FAN THERMOSTAT</td>
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<td>SOLENOID PUMP</td>
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