

Operations Manual
Monkey
Hot Water Heater

Model # PWH-100/3

120VAC 60HZ 20AMP

**Manufactured By: Custom Design &
Fabrication**

Do Not Remove
This Page



Read this Manual and Understand
Completely Before Start Up



Check System Function for Safety
Before Each Start Up



Do Not Use Heater Where System Failure
Could result in a Threat to Divers Life



Do Not Operate If Any Part of the System
Does Not Function Properly



Manufacturer and Distributors are not
Responsible for Misuse of this Equipment



Monkey Heater Specifications

The Monkey Hot Water Heater System is a complete, lightweight, portable, diver's water heating system. The system uses a positive displacement submersible pump to provide water to the inlet side of the heater during operations. The system comes ready to operate

with the exception of an electrical power source and fuel. The electrical power required to operate the system is 120 VAC, 60Hz, 20 amp, single phase.

The heating unit is mounted and enclosed in a steel, welded, square tubular frame, measuring 46" x 26" x 30.5", weighing approximately 300lbs. The submersible water pump with a 25 foot umbilical is packed in the frame with the fuel tank. The heating unit is designed to operate on a 120 VAC, 60Hz, 20 amp, single-phase power source, using #1 or #2 diesel oil.

The unit is rated at 350,000 B.T.U. an hour output and is capable of heating the outlet water to temperatures in excess of 200° F., depending on the size of the fuel nozzle used and the inlet water temperature. The heater will maintain the set operating output temperature to +/- 1° F. Do not heat salt water in excess of 135 degrees F for it may crystallize inside the coils.

Fuel consumption is dependent on the size of the fuel nozzle in use. For example a 0.75 size nozzle will use approximately 3/4 gallons of fuel per hour, while a 2.0 nozzle will use approximately 2 gallons of fuel per hour.

Inlet water is provided to the heater by means of the 11-g.p.m. positive displacement submersible pump, provided with the system. The pump has a maximum combined pumping-lift head capability of 600 feet at 40 psi.

The submersible pump is designed to operate from a 120 VAC, 60Hz, 15 amp, single phase power source. A 15-amp switched outlet is mounted on the heater unit for use with the submersible pump only.

CAUTION!

It is required that the diver uses a hot water suit liner. This will help to eliminate hot spots which could cause burns and provide thermal protection in case of hot water heat loss.

Recommended Suit Injection Temperature At 2 G.P.M. Flow Rate

For depths of 0 to 100 feet:

Water Temperature to 50° F. = 96° - 98° F.
Water Temperature to 30° F. = 100° - 102° F.

For Depths of 100 to 240 feet.

Water Temperature to 50° F. = 100° - 103° F.
Water Temperature to 30° F. = 103° - 105° F.

The recommended injection temperature is a base line and will need to be adjusted depending on the following factors.

- a. Flow Rate (g.p.m.) to the diver. (Higher the rate, lower the temperature.)

NOTE!

*The minimum recommended flow rate for 1/2 ID hose is 2 g.p.m.
For 5/8" and 3/4" ID hose, the minimum recommended flow rate is 4
g.p.m.*

- b. Heat Loss from hot water hose.

NOTE!

*The heat loss is dependent on: ID and OD of hose, length of hose,
ambient air and water, and length of hose in the water.*

- c. Ambient water temperature.
- d. Breathing medium.
- e. Breathing gas temperature.
- f. Physical condition of diver.
- g. Work diver is performing.

Hot Water Hose Heat Loss

On an average, the heat loss for a 300 foot, 1/2" ID, 1 1/4" OD hot water hose with an injection water temperature of 110° F. and a flow rate of 2 g.p.m., in an ambient water temperature of 35° F., will be about 18° F. (Base Line). The heat loss for a 1/2 ID, 7/8" OD hose, will be about 36° F. (Base Line).

Heat loss for the 5/8" and 3/4" ID hot water hose, under the same conditions, will be about 12° F. (Base Line).

If the flow rate is increased by 2 g.p.m., the heat loss will decrease by about 4° F. from the above base line temperature loss.

As the ambient water temperature increases, the heat loss will decrease. The percent of decreased heat loss to water temperature is 40° = 94%, 50° = 86%, 60° = 65%, and 70° = 40%.

Example

To figure the heat loss for a dive in 50° ambient water using 1/2" x 7/8" hot water hose, with a flow rate of 4 g.p.m.:

$$36° - 4° = 32° \times 86\% = 27.5° \text{ F. heat loss.}$$

To figure what the heater output should be set at, add the recommended suit injection temperature and the hot water heat loss.

These figures are based on extreme ambient weather conditions. If the ambient air is warm, then heat loss will be less and heater output should be decreased.

Nozzle Size

Subtract input water temperature from the final recommended heater output temperature, multiply by the gallons per minute output, multiply by 510 (salt water) or 495 (fresh water), and divide by 100,000. Use the next smaller nozzle if answer does not come out to a nozzle size in the spare parts kit.

PUMP SET UP (Before Set-Up Procedures)

1. Remove pump from case.
2. Inspect the water tight electrical connection at the pump and the power cord for damage. If damage is evident, have a qualified electrician repair it before use.

WARNING!
***DO NOT OPERATE ANY ELECTRICAL COMPONENT
IN THIS SYSTEM WITHOUT USING A
GROUND FAULT CIRCUIT INTERRUPTER (GFCI)***

3. It is recommended that the pump is operated at a depth of 3 to 5 feet below Mean Low Water (MLW) or 2 feet from the bottom to prevent pump clogging.

WARNING!
***DO NOT OPERATE PUMP IN THE VICINITY
OF WORK LOCATION IF PUMPING CONCRETE OR
OTHER HAZARDOUS MATERIALS ARE PRESENT IN
THE WATER. SUCH MATERIALS CAN DAMAGE THE
PUMP AND HEATER SYSTEM AND CAUSE SEVERE
BURNS AND SKIN IRRITATIONS TO THE DIVER.***

WARNING!
***ALWAYS DISCONNECT THE PUMP FROM THE
POWER SUPPLY BEFORE SET UP OR REMOVAL
FROM THE WATER.***

Set-Up Procedures

1. Set up the unit in the are to be used.
2. Pump must be plugged into the outlet provided on the unit, for the unit to function correctly.
3. Make all of the necessary connections.
 - a. Water from the submersible pump or other external source.

1. If external source is used, electric valve must be installed at the unit intake and connected to the power outlet provided. (Electric Valve must fail closed.)
- b. Connect hose(s) from heater outlet valve(s).

WARNING!

***DO NOT OPERATE ANY ELECTRICAL COMPONENT
IN THIS SYSTEM WITHOUT USING A
GROUND FAULT CIRCUIT INTERRUPTER (GFCI)***

- c. Electrical connections from a portable generator, 3kw minimum output or any other 120 VAC, 20 amp electrical source. The 15 amp electrical outlet provided on the back circuit panel box is for use with the submersible pump. (5kw generator is recommended.)
4. Fuel unit with either #1 or #2 diesel oil.
5. Make sure a flow of water is present through the system.

WARNING!

***NEVER OPERATE THE FUEL PRESSURE AT THE
REGULATOR LESS THAN 100 PSI. FAILURE TO
OBSERVE THIS WARNING WILL RESULT IN
INCOMPLETE COMBUSTION, CAUSING EXCESSIVE
COIL SOOTING, HARMFUL VAPORS, EXCESSIVE
SMOKE AND POSSIBLE FLASHING.***

6. Turn unit on, check to make sure burner has fired, and temperature display is functioning.
 - a. Test flow switch.
 - b. To properly test flow switch function, shut down the water flow to the heater. The unit should shut down if the switch is functioning properly.

NOTE

Once burner has fired, observe smoke color. If smoke is white, slightly close vent opening on the burner assembly until smoke disappears. If smoke is black, reverse procedure, slightly opening vent until smoke disappears.

7. Crack open by-pass valve. Set the water flow pressure at 10 psi., using the valve at the units water inlet.
8. Set fuel pressure at the fuel regulator to 120 psi.
9. Allow unit to run 5 minutes or until temperature remains constant on the digital display.

NOTE

Starting operating temperature is recommended to be at 100° F. and is only a guideline for starting procedure. Fine-tuning of the temperature will be when in actual use. It can be set or changed using the water flow controls or the fuel pressure, set at the regulator.

WARNING!

DO NOT OPERATE THE SYSTEM WITHOUT A DIVER BY-PASS VALVE THAT CAN BE OPERATED BY THE DIVER TO ELIMINATE WATER FLOW IF NECESSARY. IN THE EVENT OF A UNIT MALFUNCTION, SEVERE BURNS MAY OCCUR.

10. Once a comfortable working temperature has been achieved, fine adjustments can be made at the fuel pressure regulator.
11. If all set-up procedures have been followed, you should be able to maintain your operating temperature at +/- 1° F.

WARNING!

A SCALD SAFE® VALVE IS HIGHLY RECOMMENDED TO BE INSTALLED AT THE DIVERS END, IMMEDIATELY BEFORE THE DUMP VALVE, AS A SECONDARY LINE OF DEFENSE AGAINST SCALDING.

HIGH-POINT TEMPERATURE CUT-OFF

After temperature has remained constant on the digital display for 3 minutes, depress the set point button on the control panel. This changes the display to read the present high-point temperature cutoff temperature. Adjustments can be made as follows:

For the primary digital readout

- A. Press the center button and release. The display will read SP, wait approximately two seconds, press the up or down button and the set points will be displayed.
- B. Press and hold the up or down button until the desired set point is displayed. 3 degrees F over the working temperature is recommended.
- C. Wait approximately 10 seconds. If the set point was changed, the display will flash then the SPC will return to display the sensor temperature. (If you do not want to wait 10 seconds, press the center button once to adjust the differential or press the center button twice to immediately display the sensor temperature.)

For your added safety C.D.F. has installed a Secondary High Limit Circuit. This circuit will trip the unit, the pump receptacle, and stop water flow through the unit in the event of a secondary high-limit trip.

NOTE!

IF THE SECONDARY HIGH LIMIT CIRCUIT TRIPS THE WATER TEMPERATURE IN THE SYSTEM MUST DROP 15 DEGREES F BEFORE THE SYSTEM WILL RESTART

The secondary high limit should be calibrated with the primary at the beginning of each dive day or at each time the unit is restarted. Follow the operations manual start up procedures as always and follow these additional steps:

- A. After a constant divers working temperature has been achieved set the primary high-limit as described in the manual.
- B. Set the secondary high-limit in the same manner as the primary, changing the set point temperature to 5 degrees F over the working temperature instead of 3 degrees F.
- C. Complete the remaining daily safety systems checkout as described in this operations manual.

WARNING!

SUPPLY PUMP MUST BE CONNECTED TO THE OUTLET PROVIDED ON THE UNIT FOR THE SECONDARY HIGH

LIMIT TO FUNCTION CORRECTLY.

WARNING!

HIGH-POINT CUT-OFF TEMPERATURE SHOULD BE SET NO HIGHER THAN 2°- 3° F. MAXIMUM OVER WORKING TEMPERATURE TO PREVENT INJURY TO THE DIVER.

FAILURE TO OBSERVE THIS WARNING COULD RESULT IN HEAT EXHAUSTION OR SEVERE BURNS TO THE DIVER.

WARNING!

ALWAYS KEEP CONTROL PANEL COVER CLOSED DURING INCLEMENT WEATHER TO PREVENT DAMAGE TO ELECTRICAL COMPONENTS IN THE SYSTEM.

WARNING!

SHOCK HAZARD! DO NOT TOUCH ANY ELECTRICAL COMPONENTS IN THIS SYSTEM WHEN WET. SEVERE SHOCK OR ELECTROCUTION COULD OCCUR.

WARNING!

COMBUSTIBLE MATERIAL PRESENT. KEEP AWAY FROM SPARK OR OPEN FLAME.

FUEL HOOK-UP PROCEDURE

1. Portable fuel containers are provided for your convenience. Each fuel tank has quick connect snap fittings.

2. Connect fuel hose to the tank. Connect the fuel by-pass line to the female quick disconnect
3. *OPEN FUEL VENT ON THE FILLER CAP.*
4. Unit is self-priming.

SHUTTING THE SYSTEM DOWN

1. Shut the heater off at the control panel.
2. Allow the submersible pump to run until outlet water temperature is between 80° - 90° F.
3. Shut off and unplug the submersible pump.
3. Remove the pump from the water and disconnect all pump fittings. Invert the pump to remove all water.
5. Submerge the pump in a BIO safe solution of anti-freeze.
6. Reconnect the pump to the power supply to flood the system with anti-freeze.
(Pump umbilical and unit require approximately three gallons of anti-freeze.)
7. Free divers umbilical of water and/or flood with anti-freeze.
(An evacuation unit can be used to simplify this procedure. Evacuation units are available in 3 or 6-gallon capacities.)

DAILY MAINTENANCE

1. Always check high point cut-off setting on display to ensure that it is properly set, 2 - 3 degrees F above the working temperature

2. Check outlet water temperature to verify that sensor is functioning properly.
3. Calibrate secondary high limit 3 - 5 degrees F above working temperature
4. Test trip your safety valve.

NOTE

These daily checks will ensure the unit is functioning correctly.

WARNING!

DO NOT OPERATE UNIT IF ANY COMPONENT IN THE SYSTEM IS NOT FUNCTIONING CORRECTLY. TO DO SO COULD CAUSE SEVERE BURNS TO THE DIVER OR CAUSE DAMAGE TO THE SYSTEM.

WEEKLY MAINTENANCE

1. Disconnect Power Supply
2. Replace any non-working parts, valves, gauges etc.
3. Review safety checklist for unit function.
4. Change fuel filter.

WARNING!

WHEN SERVICING, BE SURE HEATER IS DISCONNECTED FROM POWER SOURCE TO PREVENT ELECTRICAL SHOCK OR FIRE.

MONTHLY MAINTENANCE

1. Disconnect Power Supply.
2. Replace any non-working parts.
3. Review safety checklist for unit function.
4. Change fuel filter.
5. Replace fuel nozzle
6. Inspect coils for soot build up.
7. Inspect fuel tank and fittings for dirt and water inside.
8. Inspect electrodes for damage.
9. Inspect circuits for corrosion and damage through the see-through widow.
Do not remove switch panel

YEARLY MAINTENANCE

1. Change fuel filter.
2. Change fuel nozzle.
3. Inspect blower for corrosion.
4. Wash heater coil free of soot, using a wire brush or vacuum.
5. Remove 3 nuts from burner mounting flange.
6. Carefully remove burner and set aside. Leave electrical connections and fuel hose intact.
7. Cover with waterproof plastic.
8. Replace gasket on burner flange.
9. Check parts inventory.
 - a. New fuel filter.
 - b. Replace lost or used fuel nozzles.
 - c. Replace hose fitting washers.
 - d. Replace any lost or worn fittings.

WARNING!

***DO NOT OPEN ELECTRICAL CLOSURE FITTINGS OR
PANEL COVERS. THIS PROCEDURE SHOULD ONLY
BE DONE BY A QUALIFIED ELECTRICIAN.***

NOZZLE CHANGING PROCEDURE

1. Disconnect Power Supply.

2. Close air vent on burner adjustment band.
3. Loosen the flare nuts and remove the fuel line between the solenoid valve and nozzle pipe. Set aside. ***Caution! Be careful not to drop the nut into the air vent!***
4. Remove nozzle pipe retaining nut from nozzle pipe and set aside.
5. Loosen the coil clamp located on the other side of the coil and open the burner lid. Carefully slide the nozzle pipe assembly downward and out until the assembly becomes free and lifts out.

Caution! Be careful not to damage the ceramic insulators on the electrodes.

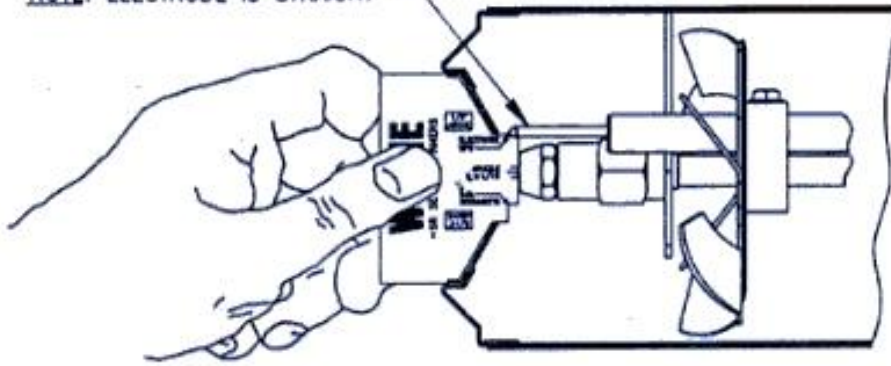
6. Replace the nozzle with the desired size.
7. Reset the electrodes or replace if damaged.
8. Replace the nozzle pipe assembly. Re-assemble all components by reversing the disassembly procedures. Open air band on the burner assembly. Make air adjustments following set-up procedures.

BE CAREFUL NOT TO MOVE ELECTRODE SETTINGS

GUN SETTING GAUGE INSTRUCTIONS
FOR BOTH 1/2" AND 5/16" ABOVE ϕ
(FOR "SR" SERIES BURNERS ONLY)

INSERT "SR" SERIES GUN SETTING GAUGE (AS SHOWN BELOW) TO
CHECK NOZZLE POSITION AND ELECTRODE SETTING

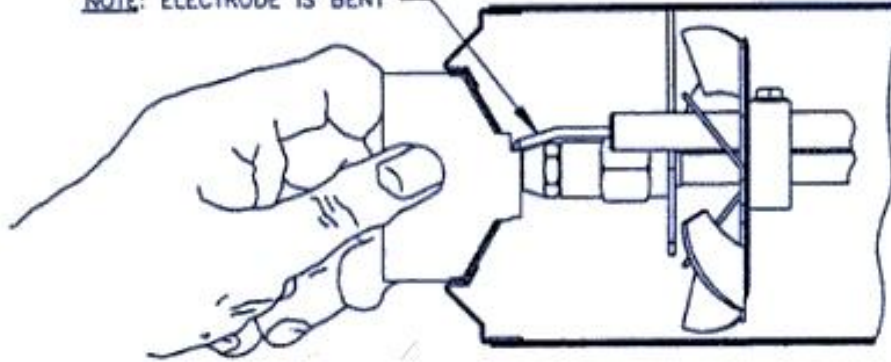
NOTE: ELECTRODE IS STRAIGHT



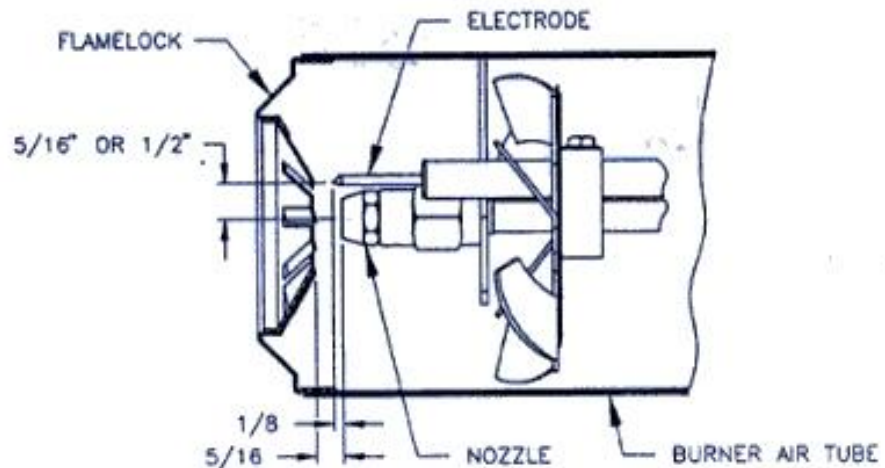
1/2" ELECTRODE SETTING ABOVE ϕ OF NOZZLE

-OR-
FLIP GUN SETTING GAUGE FOR 5/16" SETTING

NOTE: ELECTRODE IS BENT



5/16" ELECTRODE SETTING ABOVE ϕ OF NOZZLE



TROUBLESHOOTING

1. No water flow.
 - a. Check connection at outlet.
 - b. Pump may be frozen.
 - c. Pump may be burned out.
 - d. Check electrical circuit.
 - e. Check secondary high limit adjustment.

2. GFCI keeps tripping. (LED blinks, clicking sound is heard.)
 - a. Pump may be frozen.
 - b. Power surge.
 - c. Short in circuit.
 - d. Insufficient power supply.

3. Black smoke.
 - a. Not enough air.
 - b. Faulty solenoid valve.
 - c. Dirty fuel.
 - d. Electrodes misaligned.
 - e. Weak high voltage coil. (clean contacts.)

4. White smoke.
 - a. Too much air.
 - b. Not enough fuel.

5. Relay indicator blink. (Clicking is heard.)
 - a. Not enough electrical power. (Minimum 110 VAC.)

6. No fuel pressure.
 - a. Faulty regulator.
 - b. Clogged fuel filter.
 - c. Clogged fuel line.
 - d. Snap fitting not coupled properly.
 - e. Leak in fuel line or prime bulb.
 - f. Vent cap closed on fuel tank.

7. Burner won't fire.
 - a. Same as above for fuel pressure.
 - b. Electrodes misaligned.
 - c. Weak voltage coil / dirty contacts.
 - d. Cracked ceramic on electrodes.
 - e. Water in fuel.
 - f. Not enough electrical power. (Minimum 110 VAC.)
 - g. Re-set button tripped. (Located on motor case.)

8. Snap fitting leak.
 - a. Replace o-ring.
 - b. Replace fitting.

9. System freezes.
 - a. Shut system off. Turn pump off.
 - b. Slowly thaw with forced air heat.

WARNING!

DO NOT ATTEMPT TO THAW WITH OPEN FLAME

10. Overheating.
 - a. Faulty sensor.
 - b. Faulty relay(s).
 - c. Insufficient flow of water. (Check flow requirements for size of hose.)

11. Underheating.
 - a. Too much water flow. (Check flow requirements for size of hose.)
 - b. Low fuel pressure. (120 psi at the regulator.)
 - c. Fuel nozzle too small.
 - d. Soot on coil.

12. No PSI on manifold.
 - a. Open gate valve.
 - b. System frozen.
 - c. Cracked coil.

13. No power to heater.
 - a. Check electrical connection.
 - b. Push system by-pass switch.

WARNING!

***IF SYSTEM FIRES, THERE IS A FAULTY CIRCUIT.
DO NOT OPERATE!***

14. LED erratic.
 - a. Faulty sensor.
 - b. Damp circuit. (Dry with forced air heat.)
 - c. Fluctuating supply water pressure.
15. Fuel tank collapse.
 - a. Open tank vent.
 - b. Vent may be plugged.
16. Low water pressure.
 - a. Insufficient water supply.
 - b. Kink or obstruction in water hose.
 - c. Pump by-pass opened too much.
17. Fuel pump won't prime.
 - a. Obstructed fuel line.
 - b. Air leak in fuel line.
 - c. Fuel filter cap loose.
 - d. Faulty fuel pump.
18. Drip from bottom of combustion chamber.

Note! Check smell and/or feel of liquid

If diesel is present:

- a. Faulty solenoid valve.
- b. Loose nozzle.
- c. Misaligned electrodes.

If diesel is not present:

- a. Normal condensation from coil.

19. Motor hiss.
 - a. No lubrication in motor.
20. Thermal re-set on the motor trips.
 - a. Snap fittings on the fuel supply are not correctly engaged.
 - b. Fuel pump is not functioning.

Frozen coil thawing procedure

WARNING: Steam may exit the system!!! Cover valve manifold to safely divert a possible steam discharge away from operator and any bystanders.

WARNING: All valves on the TPU must be in the open position. All hoses must be disconnected from the system.

When you have determined that a frozen coil is the cause of a system malfunction, you can use the system's bypass switch to intermittently fire the burner to internally thaw the system.

Depress the system's bypass switch intermittently at 30-40 second intervals after you here the burner fire

Stop and wait for 5-7 minutes to allow the heat to dissipate into the coils.

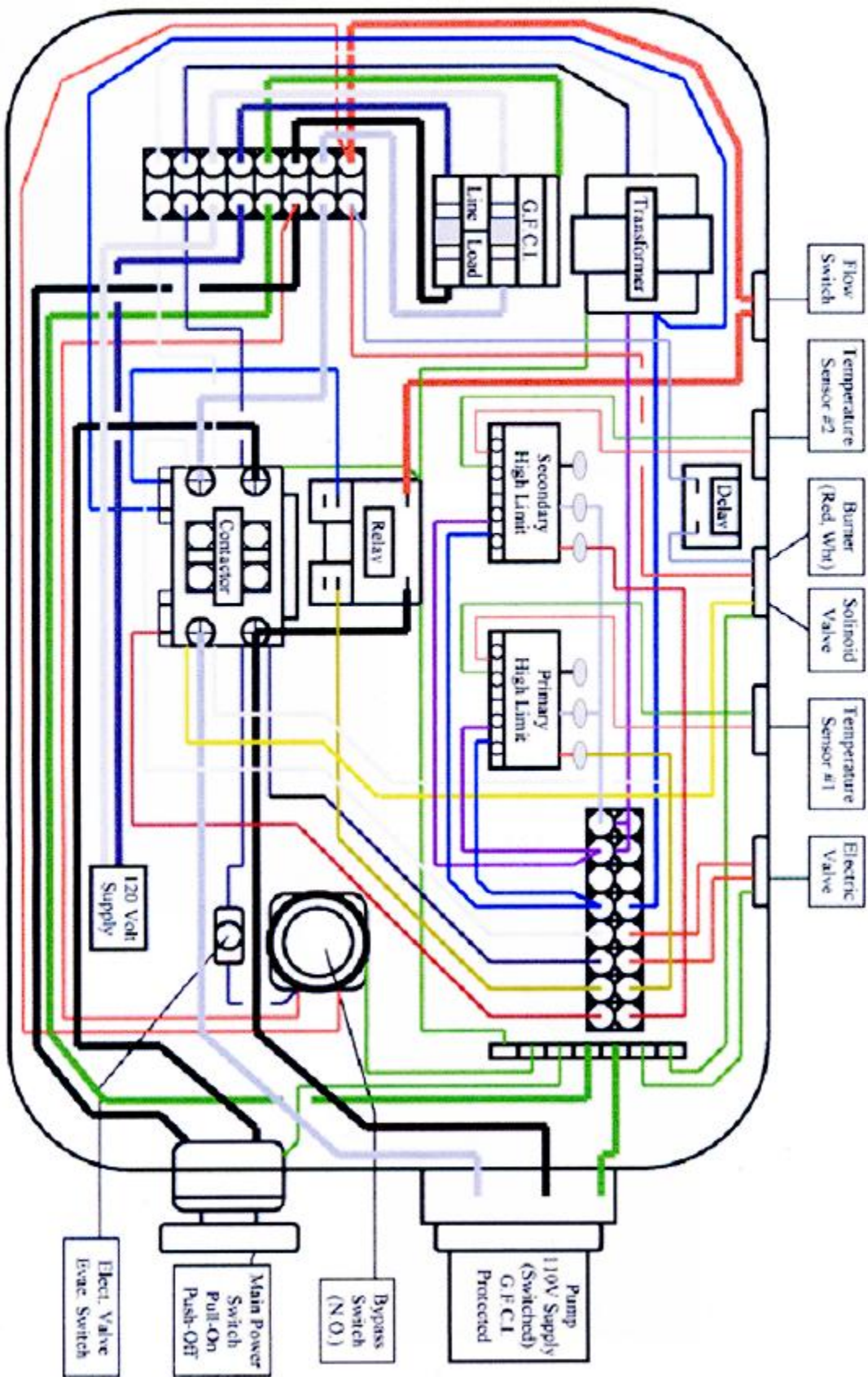
WARNING: Do not exact this procedure more than 5 cycles. STEAM MAY BUILD UP IN THE SYSTEM & CAUSE PERSONAL INJURY, RUPTURED PIPING, OR TEMPERATURE SENSOR BURNOUT.

If this procedure is not successful the unit must be placed in a warm place overnight to slowly thaw the system out.

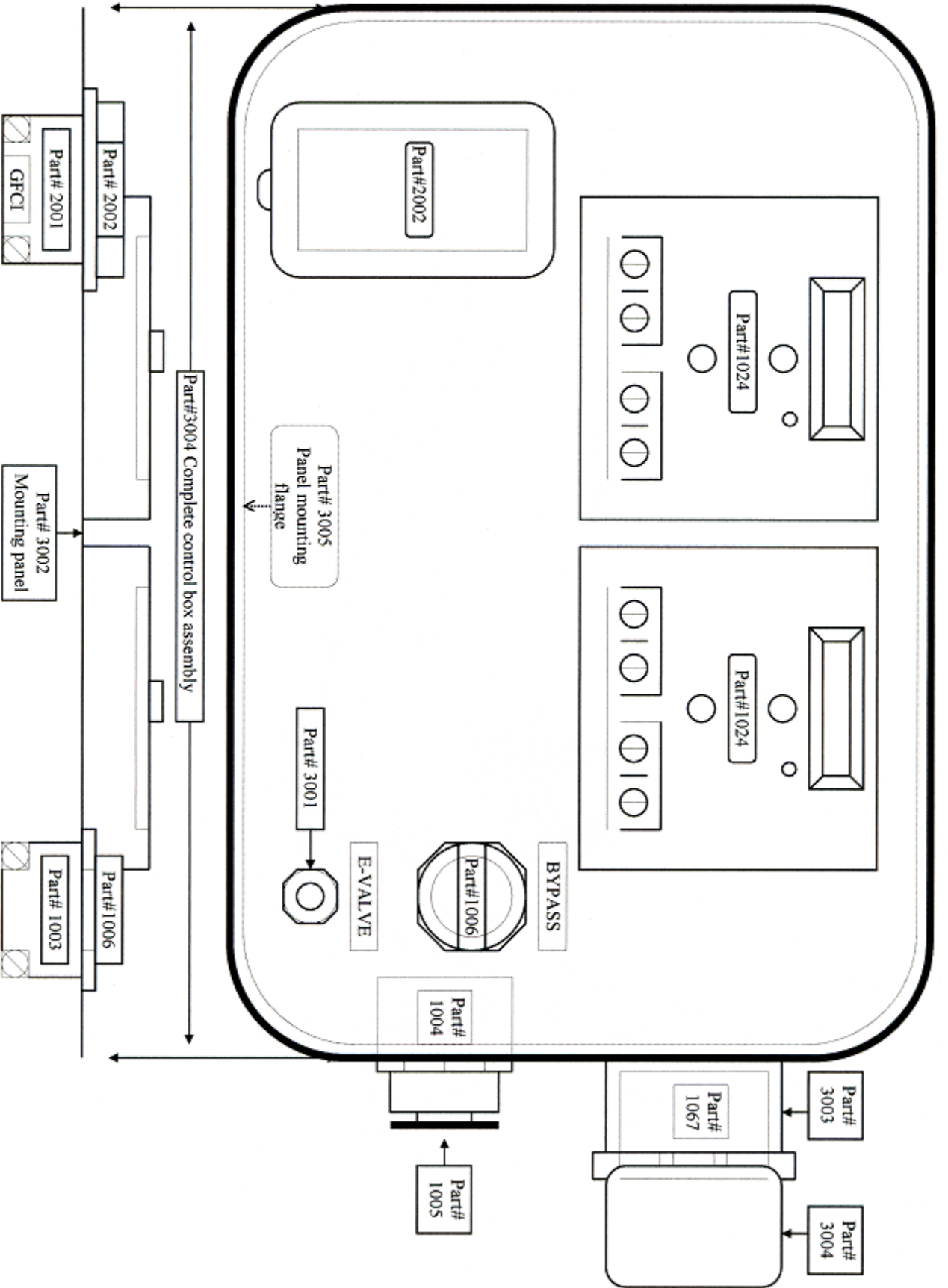
Proper daily system evacuation is the best SAFE method to ensure the coil does not freeze.

C. D.F.

Model "D" Wiring Diagram

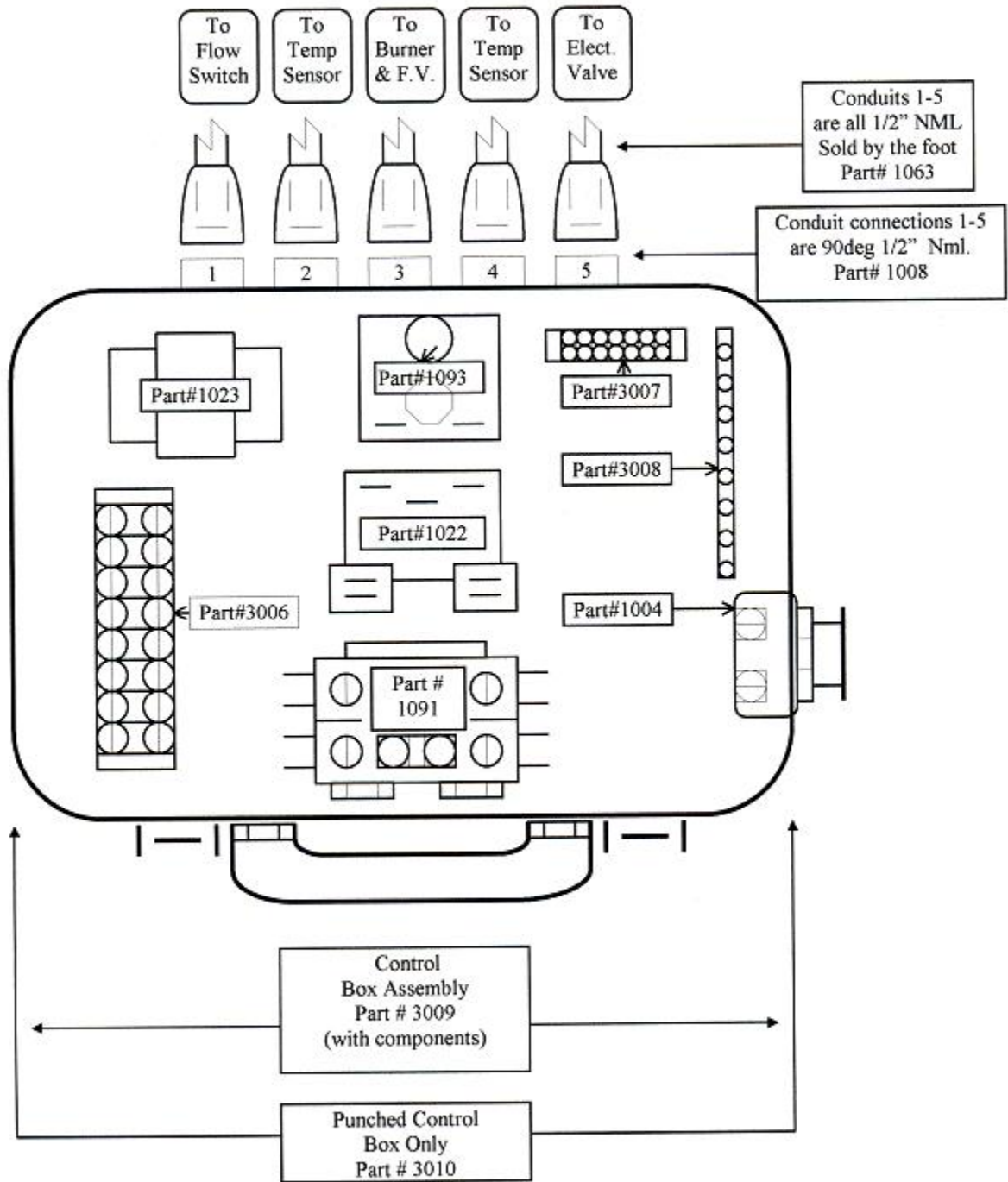


SWITCH PANEL DIAGRAM & PARTS LIST

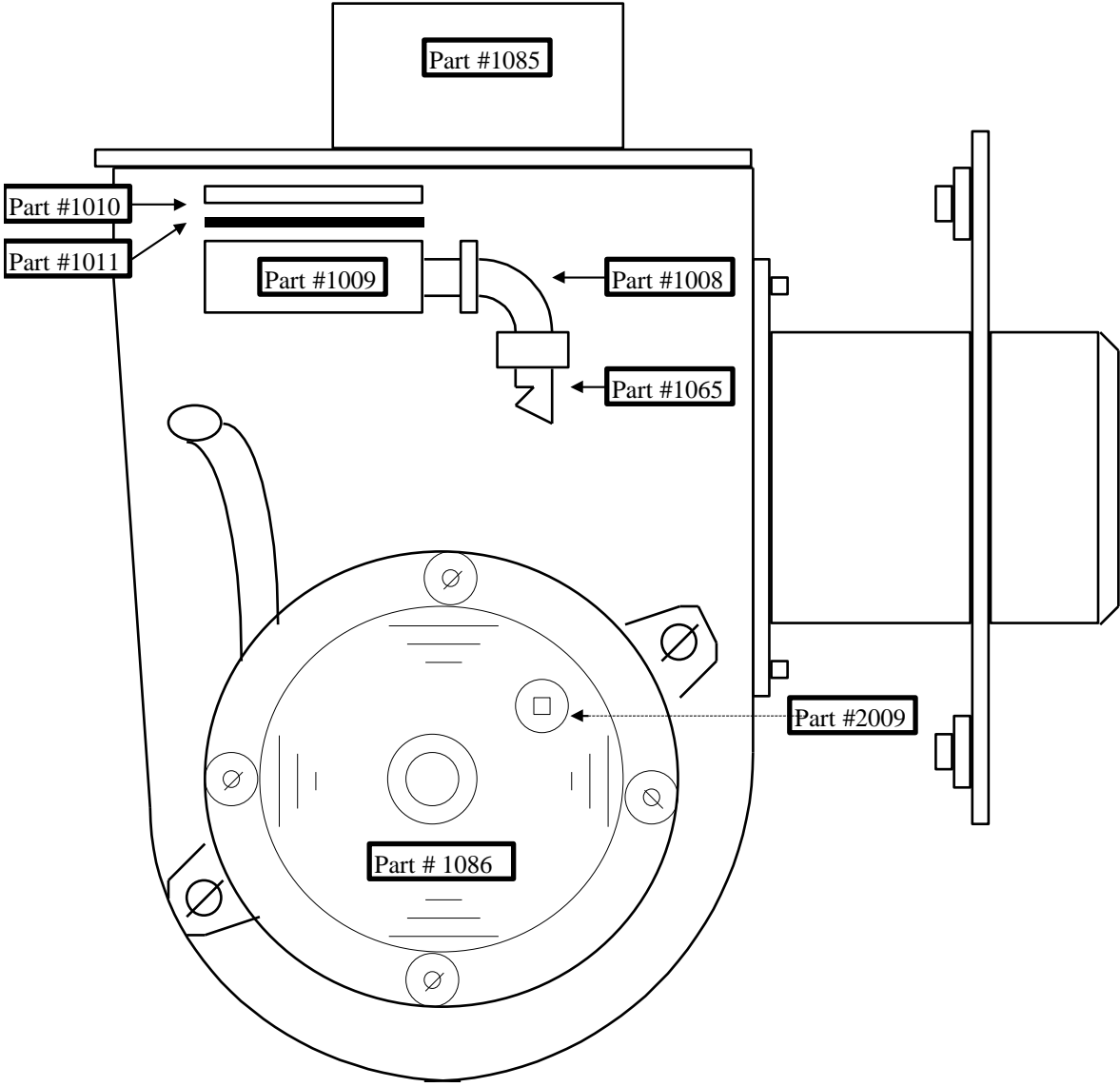


ELECTRIC PANEL DIAGRAM

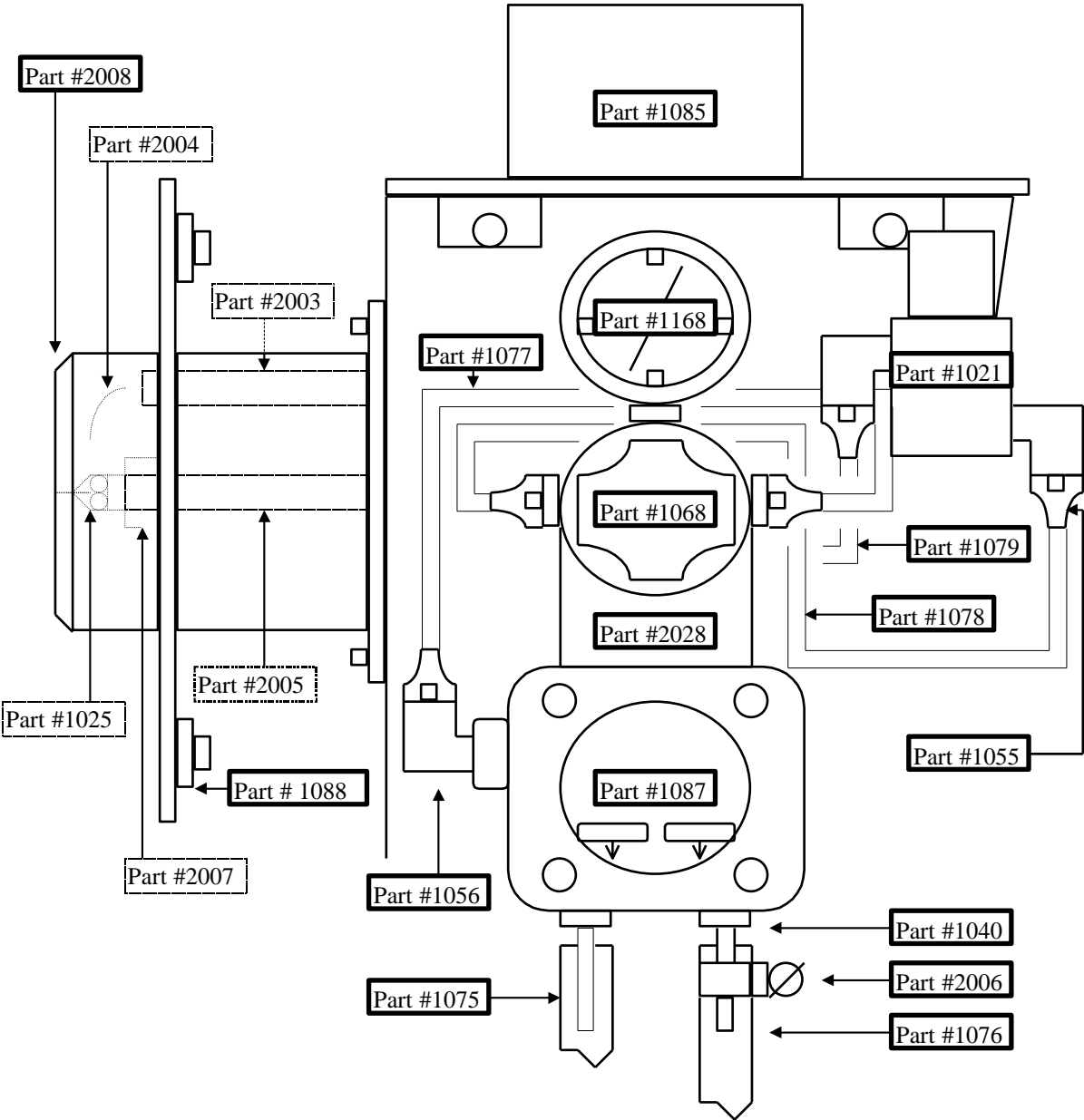
Model D&E



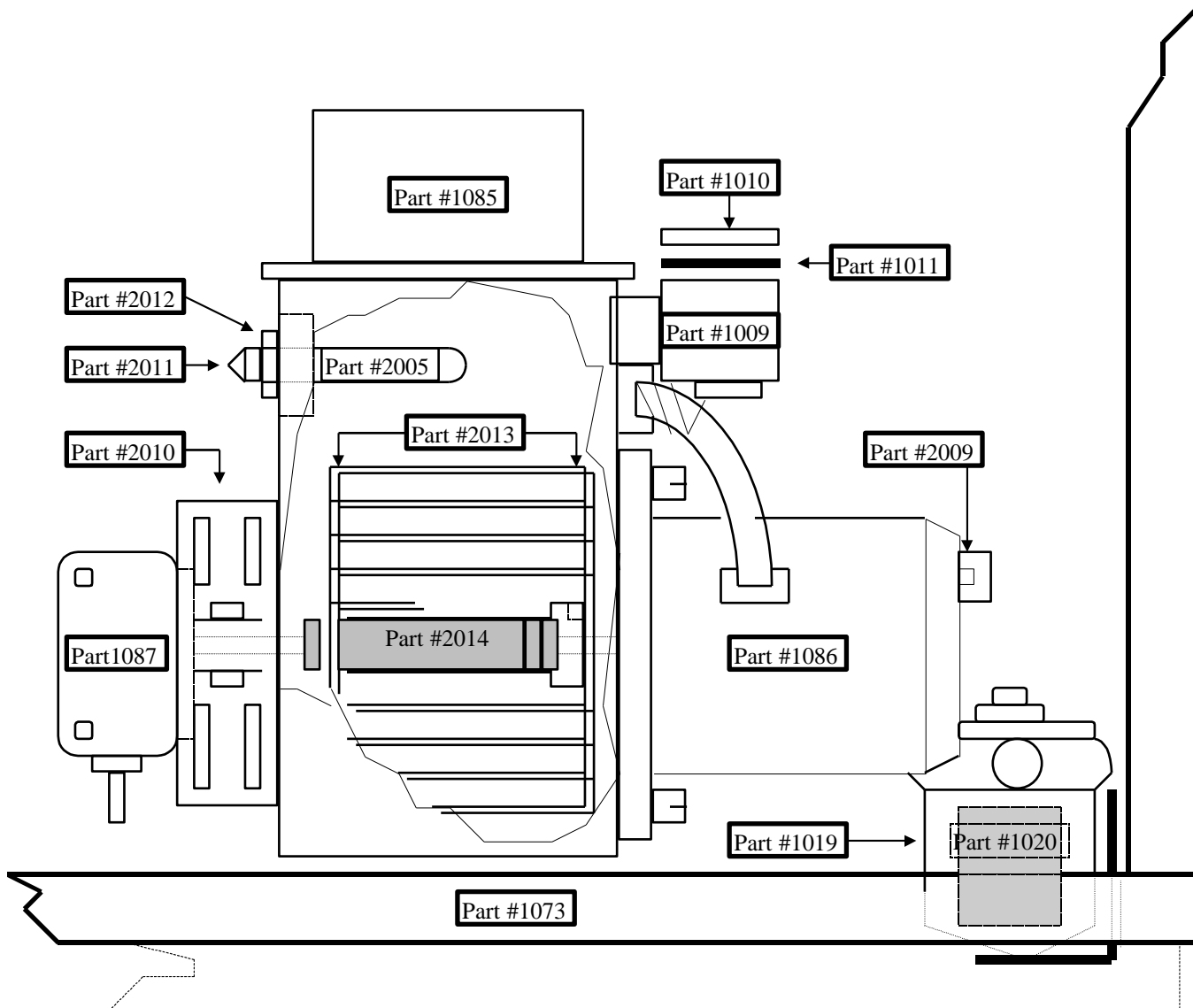
FUEL SYSTEM DIAGRAM AND PARTS LIST



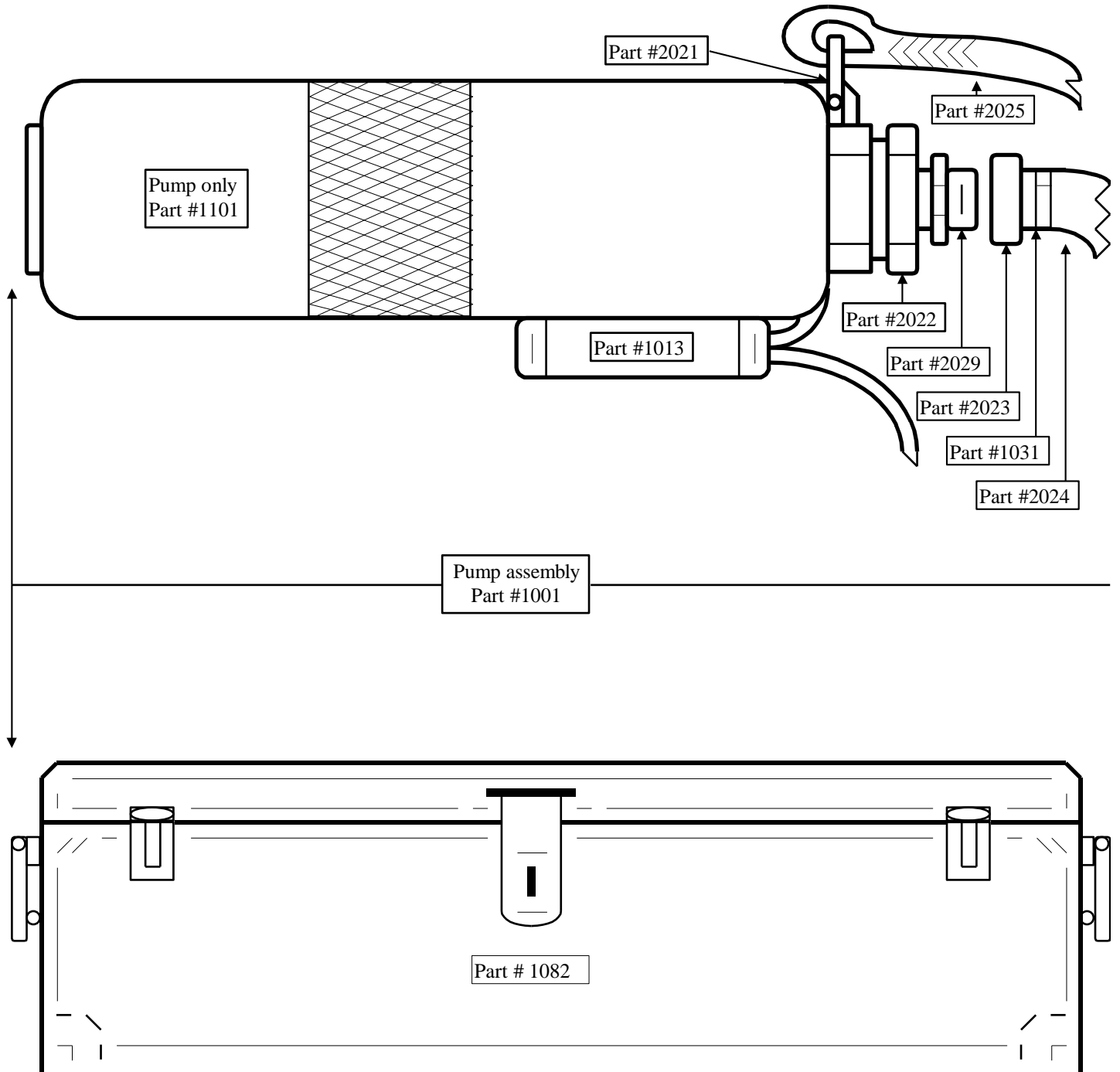
FUEL SYSTEM DIAGRAM AND PARTS LIST



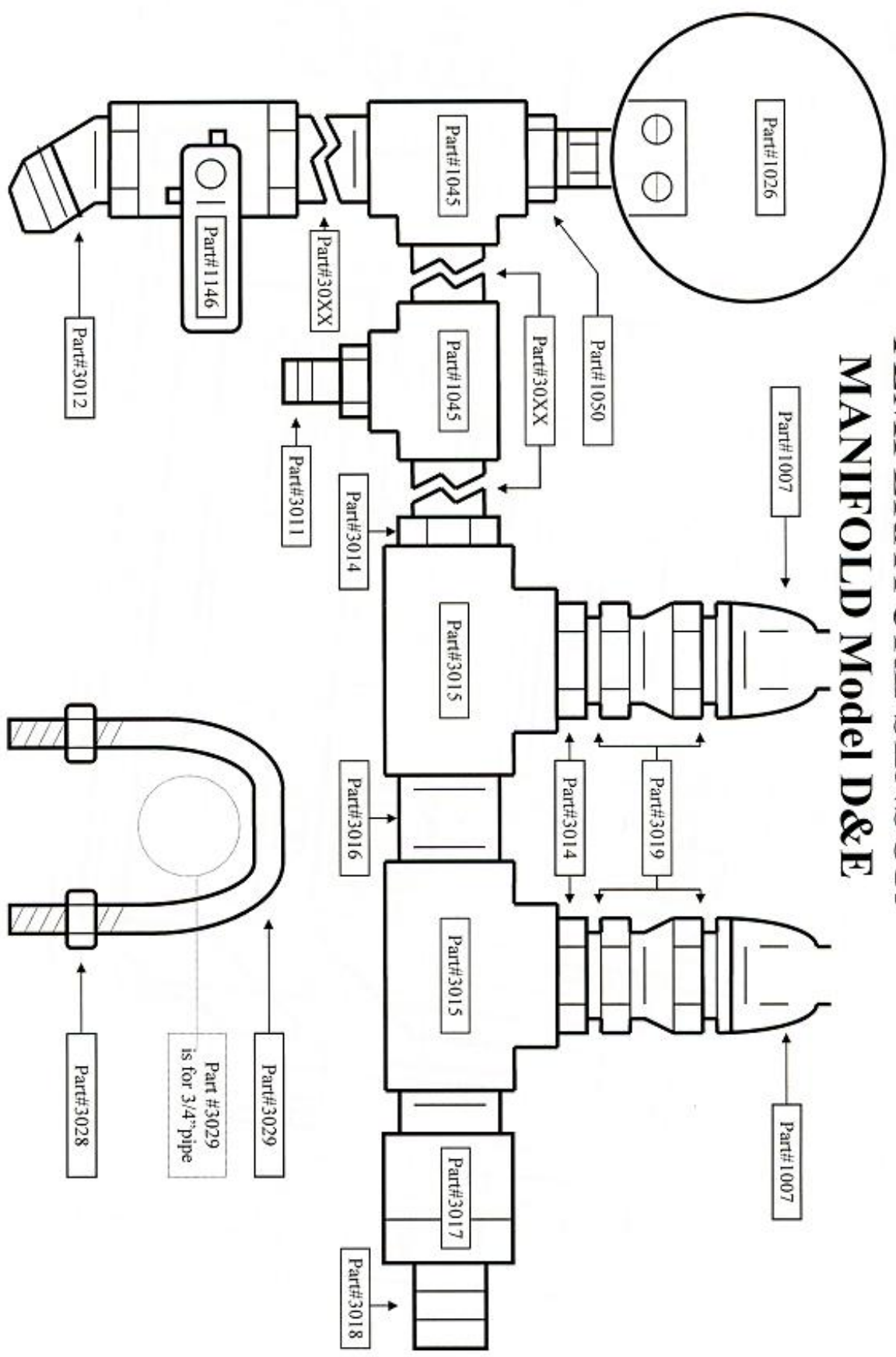
FUEL SYSTEM DIAGRAM AND PARTS LIST



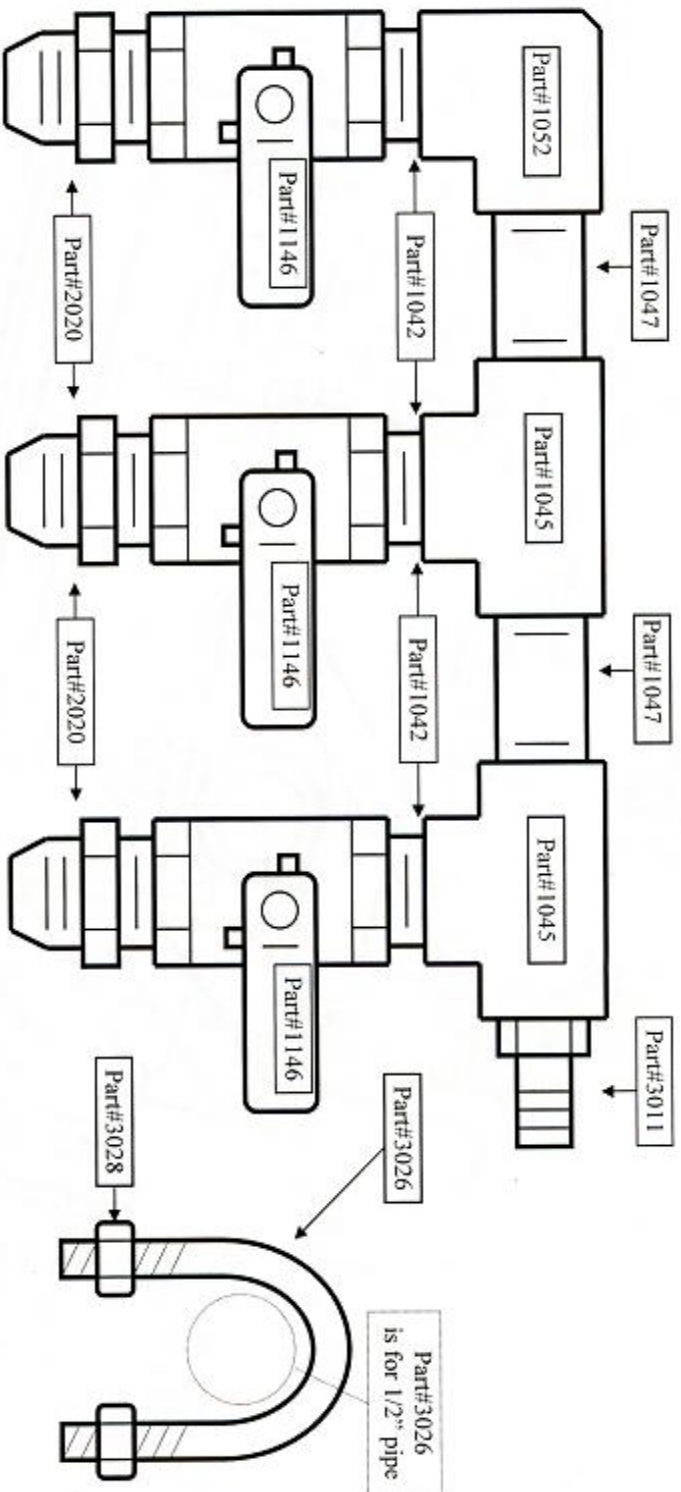
WATER PUMP DIAGRAM AND PARTS LIST



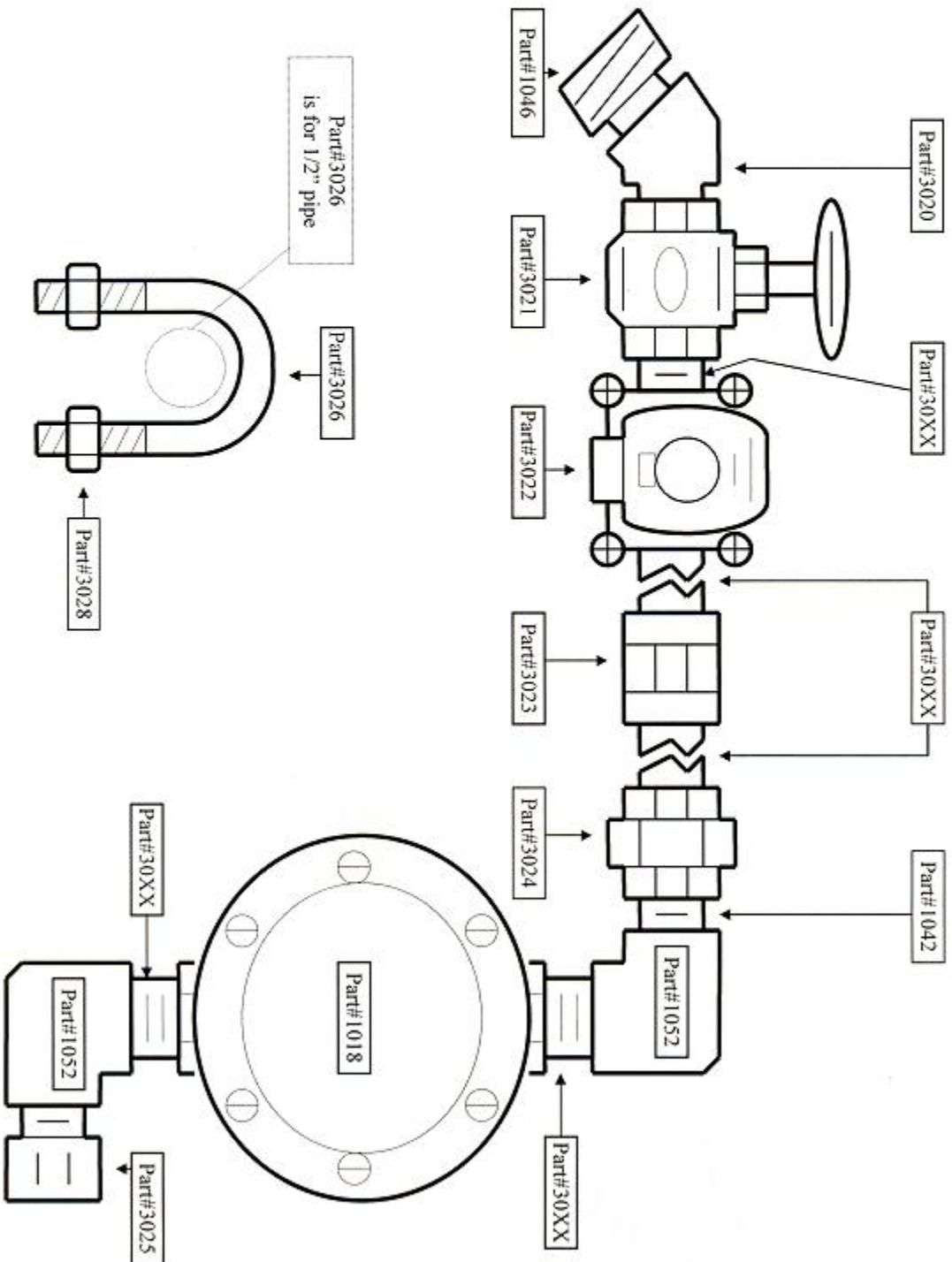
TEMPERATURE SENSOR MANIFOLD Model D&E



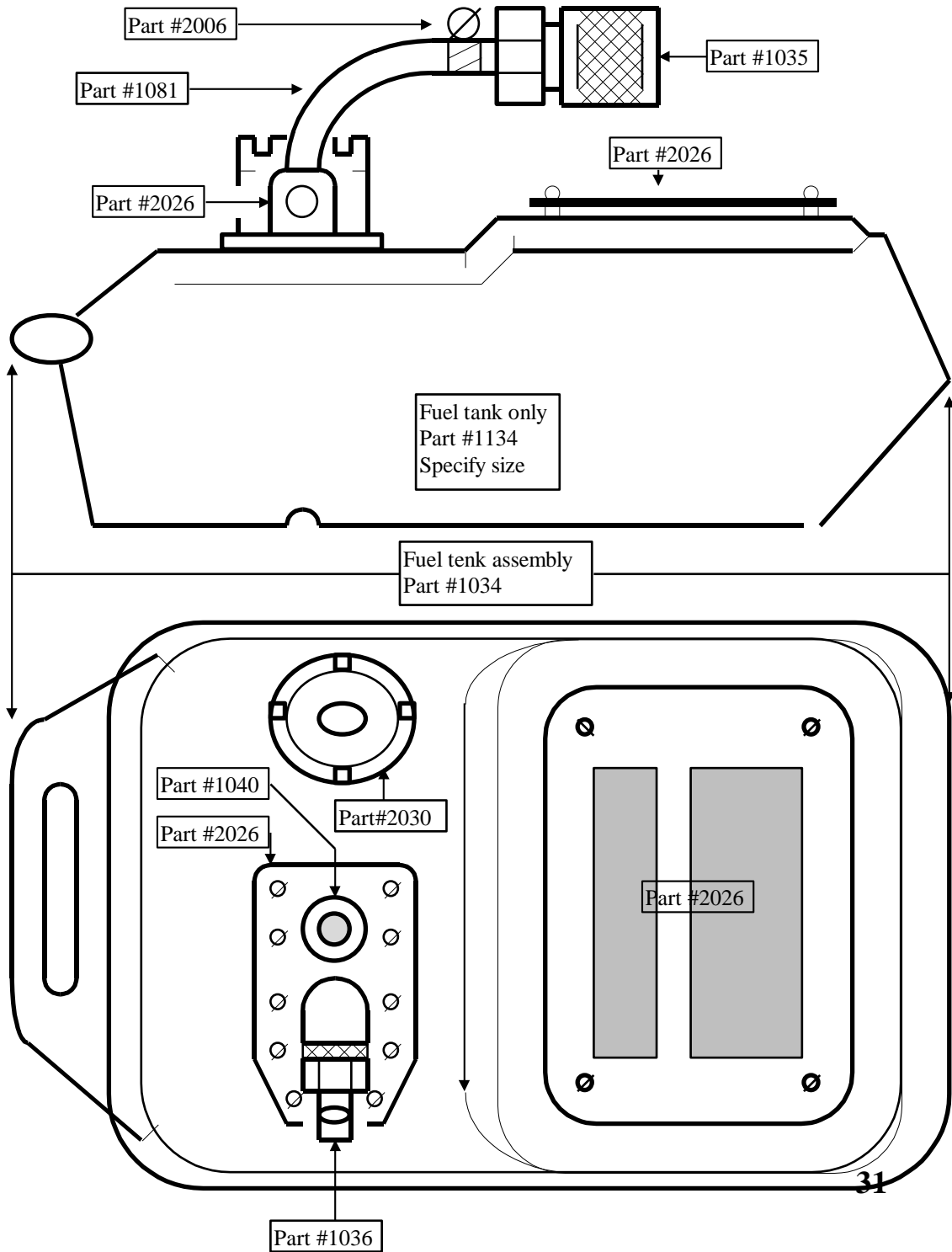
HOT WATER DISTRIBUTION MANIFOLD MODEL D&E



COLD WATER INTAKE MANIFOLD MODEL D&E



FUEL TANK DIAGRAM AND PARTS LIST



PARTS LIST

ITEM #	DESCRIPTION
1001	SUBMERSIBLE PUMP WITH UMBILICLE
1001B(1101)	SUBMERSIBLE PUMP ONLY
1003	NORMALLY OPEN SWITCH MODULE
1004	NORMALLY CLOSED SWITCH MODULE
1005	MUSHROOM PULL SWITCH BODY
1006	MOMETARY SWITCH ON BODY
1007	LIQUID TIGHT STRAIGHT CONDUIT CONNECTION 1/2 INCH
1008	LIQUID TIGHT 90 DEGREE CONDUIT CONNECTION 1/2 INCH
1009	90 DEGREE ELECTRICAL BOX LEFT 1/2 INCH
1010	BOX COVER
1011	COVER GASKET
1013	WATER TIGHT SPLICE KIT
1015	ELECTRICAL BOX TEE 1/2 INCH
1016	15 AMP MALE ELECTRICAL CONNECTOR 110 VOLT
1017	LEXAN SWITCH PLATE 1/4 INCLUDE
1018	FLOW SWITCH 1/2 INCH
1019	FUL-FLO FUEL FILTER
1020	FUL-FLO FILTER REPACEMENT CARTRIDGE
1021	DELAYED MAG VALVE
1021B(1121)	MAG VALVE NEMA-4 ENCLOSURE
1022	SINGLE POLE SINGLE THROW RELAY
1023	24 x 110 VOLT TRANSFORMER
1024	DIGITAL READOUT WITH SENSOR
1024B(1102)	TEPERATURE SENSOR (PRIMARY)
1025	NOSE ASSORTMENT 80 DEGREE NS
1025B	
1026	GAUGE 0-100 PSI
1027	FLANGE GASKET
1028	COIL ASSEMBLY
1029	OIL BURNER ASSEMBLY
1030	3/8 INC STAINLESS STEEL BAND
1031	1/2 INCH BARB x 3/4 INCH GARDEN HOSE FEMALE
1032	1/2 INCH ID-300 WORKING PRESSURE HOSE
1033	LABLE PACKAGE
1034	FUEL TANK (SPECIFY SIZE)
1035	FEMALE QUIK DISCONNECT 1/4 INCH
1036	MALE QUICK DISCONNECT 1/4 INCH NPT
1037	PRIME BULB
1038	1/2 INCH BRONZE GATE VALVE
1039	1/2 90 DEGREE STREET ELBOW BRASS

1040	1/4 INCH BARB x 1/4 INCH MALE NPT BRASS
1041	1/2 INCH BARB x 3/8 INCH MALE NPT BRASS
1042	1/2 INCH CLOSE NIPPLE BRASS
1043	1/4 INCH 90 DEGREE STREET ELBOW BRASS
1044	1 1/4 INCH x 3/4 INCH BUSHING BRASS
1045	1/2 INCH FULL FEMALE T BRASS
1046	3/4 INCH GH x 1/2 INCH NPT BRASS
1046B(1146)	1/2 INCH IPS BALL VALVE BRASS
1047	1/2 INCH x 3 1/2 INCH LONG NIPPLE BRASS
1050	1/2 INCH x 1/4 INCH BUSHING BRASS
1051	3/8 INCH NPT x 1/4 INCH HOSE BARB BRASS
1052	1/2 INCH FULL FEMALE 90 DEGREE ELBOW BRASS
1053	1/2 INCH x 2 INCH LONG NIPPLE
1054	1/2 INCH x 11 INCH LONG NIPPLE BRASS
1055	3/16 INCH FLARE NUT BRASS
1056	FLARE BY MALE ELBOW BRASS
1057	FLARE BY MALE STRAIGHT CONNECTOR BRASS
1058	1/4 INCH x 3/16 INCH BUSHING BRASS
1059	1/4 INCH HOSE BARB x 1/2 INCH FEMALE NPT BRASS
1060	1/4 INCH HOSE BARB x 1/4 INCH FEMALE NPT BRASS
1062	PRIMARY SENSOR WET WELL
1063	ELECTRICAL CONDUIT 1/2 INCH NON METALIC PER FOOT
1064	ELECTRICAL CONDUIT 1/2 INCH NON METALIC PER FOOT
1065	ELECTRICAL CONDUIT 1/2 INCH NON METALIC PER FOOT
1066	ELECTRICAL CONDUIT 1/2 INCH NON METALIC PER FOOT
1067	120 VOLT RECEPTICE 15 AMP
1068	FUEL REGULATOR ASSEMBLY
1068B(1168)	0-200 FUEL GAUGE
1069	MANAFOLD FEED HOSE
1072	PUMP UMBILICAL
1073	CHASSIS
1074	FUEL LINE FEED 1/4 INCH PER FOOT
1075	FUEL PUMP FEED PER FOOT
1076	FUEL BYPASS LINE PER FOOT
1077	FUEL REGULATOR INLET
1078	FUEL REGULATOR DISCHARGE
1079	FUEL BURNER FEED
1080	FUEL TANK CAP
1081	BYPASS CONNECT HOSE PER FOOT
1082	PUMP CARRY CASE
1083	JUNCTION BOW ASSEMBLY
1084	UNIT ELECTRICAL FEED
1085	BURNER TRANSFORMER
1086	BURNER MOTOR

1087	FUEL PUMP (1ST STAGE)
1087B(BUS	FUEL PUMP (2ND STAGE)
1088	BURNER MOUNT NUT
1089	SWITCH BOX ASEMBLY
1090	SECONDARY HIGH LIMIT CONTROLLER
1091	SINGLE PURPOSE CONTACTOR
1093	110 VOLT DELAY (MINIMUM 6 SEC)
1094	SECONDARY HIGH LIMIT COVER
1095	1/2 INCH 3 HOLE ELECTRICAL COVER
1096	SECONDARY SENSOR CONDUIT CONNECTION
1097	SECONDARY SENSOR CONDUIT 1/2 INCH NON METALIC PER
1098	1/2 INCH 3 HOLE 2x4 ELECTRICAL BOX OUTDOOR
1099	SRAIN RELIEF CONNECTION 1/2 INCH
2000	WEATHER TIGHT SINGLE 20 AMP RECEPTACLE COVER
2001	MOTOR CONTROL GFCI
2002	GFCI COVER OUTDOOR NON METALIC
2003	ELECTRODE CERAMIC
2004	ELECTRODE TUNSGON ONLY
2005	FUEL DELIVERY TUBE
2006	HOSE CLAMP
2007	NOZZLE HOLDER
2008	AIR DAM
2009	WATER TIGHT THERMAL RESET COVER
2010	AIR MIX ADJUSTMENT BAND
2011	BULKHEAD CONNECTOR
2012	BULKHEAD CONNECTOR RETAINING NUT
2013	SQUIRREL CAGE FAN
2014	DRIVE SHAFT
2015	1/2 INCH FULL FEMALE CROSS
2016	1/2 INCH NPT x 1/2 INCH SLIP CONNECT WET WELL
2017	TEMPERATURE SENSOR (SECONDARY)
2018	1/2 INCH FEMALE COUPLER
2019	ELECTRICAL CONDUIT 1/2 INCH NON METALIC PER FOOT
2020	1/2 INCH NPT x 45 DEGREE BEVEL
2021	STAINLESS STEEL SHACKLE
2022	1 1/4 X3/4 BUSHING BRASS
2023	1/2 INCH BARB x 3/4 INCH FEMALE GARDEN HOSE BRASS
2024	3/4 INCH 300 POUND WORKING PRESSURE WATER HOSE PER
2025	3/8 INCH POLYPRO ROPE PER FOOT
2026	FIBERGLASS "DANGER- DEISEL FUEL" TANK LABEL
2027	FUEL SENDING TANK UNIT
2028	FUEL REGULATOR MOUNTING BRACKET
2029	3/4 INCH NPT x 3/4 INCH GARDEN HOSE MALE ADAPTOR
2030	FUEL TANL FILL CAP

2031	END CAP BURNER
2032	END ACAP DISCHARGE
2033	OVERSEAS PARTS BOX
2034	OVERSEAS PARTS KIT
2035	STEP DOWN TRANSFORMER
2036	WHEEL KIT
2037	25 GALLON TANK MOBILE
2038	50 CYCLE CONVERSION KIT WITH SPARES
2039	INTEGRAL EVACUATION (PNEUMATIC)
2040	SECONDARY SENSOR MODEL C
2041	BUCKET EVACUATION RESEVOIR (FREE STANDING)
2042	FUEL SOLENOID VALVEAND BURNER ISOLATION SWITCH (2
3000	MODEL D/E CHASSIS
3001	EVACUATION SWITCH (MOMENTARY)
3002	CONTROL PANEL ONLY (LEXAN PLATE)
3003	2x4 SINGLE OUT PVC ELECTRICAL BOX
3004	CONTROL SWITCH ASSEMBLY (COMPLETE)
3005	PANEL FLANGE
3006	LARGE BARRIER STRIP
3007	SMALL BARRIER STRIP
3008	GROUND BAR
3009	CONTROL BOW ASSEMBLY WITH COMPONENTS
3010	PUNCH CONTROL BOX ONLY
3011	1/2 INCH NPTM x 1/2 INCH BARB
3012	1/2 INCH NPTM x 1/2 INCH JIC 45 DEGREE
3013	1/2 INCH LONG NIPPLLE ORDER BY MEASUREMENT
3014	1/2 INCH X 3/4 INCH BUSHING
3015	3/4 INCH FFM TEE
3016	3/4 INCH NIPPLE 2 INCH
3017	3/4 INCH 45 DEGREE STRAIGHT ELBOW
3018	3/4 INCH NPTM x 1/2 INBCH BARB
3019	TEMPATURE SENSOR WET WELL
3020	1/4 INCH 45 DEGREE ELBOW
3021	1/2 INCH GATES VALVE
3022	1/2 INCH WATER SOLNOID VALVE
3023	1/2 INCH HEX COUPLER
3024	1/2 INCH UNION
3025	1/2 INCH STEP UP
3026	1/4 INCH / 20 STAINLESS STEEL U-BOLT (1/2 INCH PIPE)
3027	1/4 INCH FLAT WASHER
3028	1/4 INCH /20 SAINLESS STEEL NYLOCK NUT
3029	1\4 INCH / 20 STAINLES STEEL U-BOLT (3/4 INCH PIPE)
FRK100/3	MONKEY HEATER SPARE PARTS KIT
HWDHM	DUAL HEATER MANIFOLD

**FUEL FILTER PRIMING PROCEDURE
REGULATIONS REQUIRE SYSTEMS TO BE SHIPPED FREE OF
COMBUSTABLES**

**THE FUEL FILTER MUST BE FILLED WITH DIESEL BEFORE
THE UNIT IS PUT INTO SERVICE. THIS IS REQUIRED THE
FIRST TIME THE UNIT IS PUT INTO SERVICE**

1. Remove large filter cap nut using an adjustable wrench. *Note: Be careful not to misplace nut sealing gasket
2. Set filter cap retaining nut aside
3. Remove filter top. *Note: Do not misplace rubber gasket
4. Fill filter body completely with clean diesel fuel allowing time for element to saturate filter
5. Replace rubber filter housing gasket
6. Reinstall filter housing lid
7. Reinstall large filter cap nut. *Note: Place sealing gasket under cap nut
8. Tighten securely
9. Upon starting unit the first time, observe the air bubbles in the clear fuel line located on the output side of fuel filter. The air bubbles should dissipate in a few minutes. If air bubbles do not dissipate

9a. Check rubber gasket position

9b. Tighten filter cap bleed nut

9c. Tighten large filter cap nuts

9d. Check QD fittings are secure

9e. Tighten all flexible fuel line screw clamps

Testing A Heater

1. Hook up water and check Airband
2. Plug in machine
3. Hook up fuel lines
4. Put on discharge hose
5. Open discharge
6. Make sure bypass is closed
7. Open water in gate
8. Turn on water
 - a. Load regulator about 2 ½ turns
9. Turn on unit
10. Check GFI
11. Check electric valve
 - a. Water should flow
12. Wait for output light to come on
13. Red lights come on
 - a. Check temperature, both should be within 1-2 degrees of each other
 - b. Unit must level
14. Set secondary differential to 15
15. Set secondary set point to 125
 - a. Output light should come on
 - i. Contactor should close
16. Set primary differential to 2
17. Set primary set point to 120
18. Check flow switch by turning off water using gate valve
 - a. Unit should shut down
19. Turn water back on

- a. Unit should fire in 6 seconds
- 20. Fuel pressure should be 100
 - a. No smoke
 - i. If black, open air 1/8" increments
 - ii. If while close 1/8" increments
- 21. Calibrate fuel pump to 200
 - a. Close regulator, dial up clockwise, pump with 1/8 allen to 200
 - b. Dial regulator back up and allen up 200
 - i. Shouldn't be able to pass
- 22. Dial back to 100
 - a. Check for fuel leaks
- 23. Check secondary
 - a. Dial down until unit shuts off
 - i. ALL functions should stop
 - ii. No flame
 - iii. No water
- 24. Dial secondary set point back up
 - a. Unit should resume operation to 120-125
 - b. Let unit run and let temperature level out
 - i. Should be within 2 degrees
 - c. If unit cycles raise primary and secondary SP 5 respectively until unit stops cycling hot exceed 170 on secondary
- 25. Reset primary SP to 120
- 26. Recheck differential to make sure it is 2
 - a. Burner should shut off
- 27. Reset secondary SP to 125

28. Recheck differential to 15
29. At some point when primary is off and secondary is on degrees bypass burner should fire
 - a. You can dial down primary to achieve this
30. Turn unit off
31. Cool down by pressing electric bypass and hold in discharge manifold until manifold is cool
32. Shut off water
 - a. Unhook water supply
33. Blow out with air
 - a. Not to exceed 100 psi
34. Open all ball valves
 - a. Drain and close Diver 1
 - b. Open discharge
35. Pump 1 gallon of antifreeze
 - a. Press electric bypass
36. Blow out unit
 - a. Not to exceed 100 PSI
37. Open all valves
 - a. Drain and close all valves except gates
38. Disconnect all lines
 - a. Shut off fuel supply
 - b. Plug fuel fittings in each other
39. TAKE OFF ATTACHMENT FOR WATER AND AIR