INSTALLATION INSTRUCTIONS

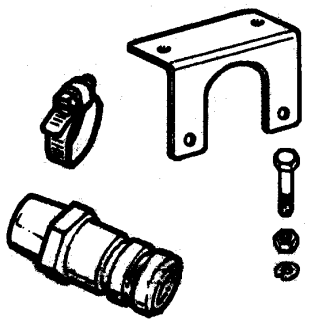
INDUSTRIAL CIRCULATION-TYPE ENGINE PRE-HEATER

NTRL/C

OPERATING PRINCIPLE: The heater operates on the principle of thermosyphoning by which cold coolant is drawn from the bottom of the engine block, heated in the tank, and returned to the top of the engine block.

Verify the contents of the package with the following parts list before proceeding with installation.

Description	Qty.	Part No.
Heater	1	
Mounting Bracket	1	N/A
Mounting Kit		
- Hex Bolt 1/4" - 20 x 3/4"	2	N/A
- Hex Nut 1/4" - 20	2	N/A
- Split Lock Washer 1/4"	2	N/A
- Hose Nipple (1/4" NPT)	1	220-2093
- Hose Clamp	6	N/A



Kit Components

DANGER: ELECTRIC SHOCK. DO NOT OPERATE HEATER WITHOUT PROTECTIVE COVER. DEATH OR SERIOUS INJURY MAY RESULT.

WARNING: FIRE HAZARD. USE COOLANT ONLY. EXPLOSION COULD RESULT IN DEATH OR INJURY.

ELECTRIC SHOCK. DO NOT OPERATE THE HEATER WITH ANY FOREIGN MATERIALS ADJACENT TO IT. THIS COULD RESULT IN DEATH OR INJURY.

ELECTRIC SHOCK. NO OPERATOR SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL. DISCONNECT HEATER FROM POWER BEFORE SERVICING TO PREVENT DEATH OR INJURY.

CAUTION: NEVER ENERGIZE HEATER IF ELEMENT IS NOT IMMERSED IN COOLANT OR SHORTENED HEATER LIFE WILL RESULT.

NEVER RUN ENGINE WHILE HEATER IS ENERGIZED AS ELEMENT BURN-OUT WILL RESULT.

1.0 HEATER INSTALLATION INSTRUCTIONS

1.1 Preparation

1.1.1 Drain and flush cooling system to remove contaminants. Recycle or dispose of engine coolant properly to prevent environmental contamination.

1.1.2 Determine Heater Inlet Connection - Preferred heater inlet connection is to the engine block drain hole. When block drain is inaccessible, this connection can be made to the lowest accessible point in the engine block or by installing the proper size hose fitting in the lower radiator hose.

1.1.3 Determine the Heater Outlet Connection - Heater outlet should be connected to the highest accessible point in the engine block on the pressure side of the cooling system pump. Plan to keep the outlet hose length as short as possible but maintain a minimum rise of 12 inches to ensure proper circulation. Do not select a location that requires the hose to be routed in a manner that will restrict coolant flow such as routing over the top of the engine block. Avoid sharp bends or loops to ensure against airlocks. Coolant will not circulate if airlocks are present.

1.2 Mounting - See Figures 2 through 6.

1.2.1 Once heater inlet and outlet connections have been determined, select a location to mount the heater that meets the following conditions:

1) Heater must be mounted below the lowest point of the cooling system to ensure that adequate pressure head is provided to the heater inlet and that thermosyphon coolant flow is maximized. Do not mount the heater too high

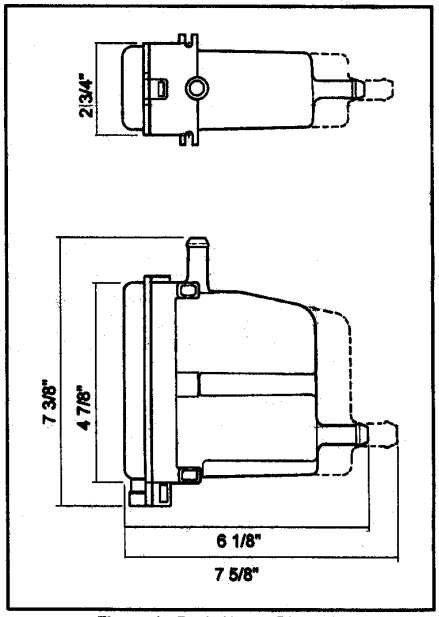


Figure 1 - Basic Heater Dimensions

as coolant flow will be restricted.

2) Heater must be mounted with the heater outlet pointing upward as indicated by the arrow on the tank body. Otherwise, coolant flow will be impeded and the heater will be prevented from maintaining the desired engine temperature. Also, excessive cycling of the heater may occur causing shortened heater life.
3) Minimize the hose length required to connect the heater inlet to the engine.
4) Heater must be mounted a minimum of 3" away from components which are sensitive to heat.
5) Heater must be mounted to the engine frame.

CAUTION: DO NOT MOUNT THE HEATER DIRECTLY TO THE ENGINE BLOCK AS A SHORTENED HEATER LIFE WILL RESULT FROM EXCESSIVE VIBRATION. USE INDUSTRY-ACCEPTED METHOD OF VIBRATION ISOLATION IF ENGINE IS RIGIDLY MOUNTED TO FRAME.

PROPERTY DAMAGE. MAINTAIN A MINIMUM CLEARANCE OF 3" BETWEEN HEATER AND OTHER ENGINE COMPONENTS. FAILURE TO MAINTAIN MINIMUM CLEARANCE MAY RESULT IN HEAT DAMAGE.

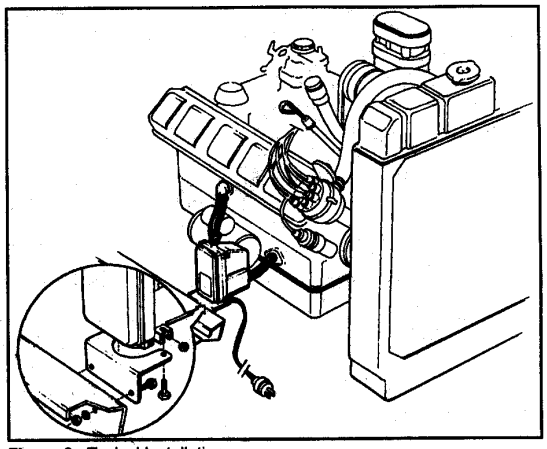


Figure 2 - Typical Installation

1.2.2 The heater has a unique multi-point mounting system that accommodates different applications as shown in Figure 7. Select a mounting surface that is smooth and free of fasteners or obstructions. Secure the heater in the selected location using the bolts, nuts, and lock washers provided. Tighten the fasteners to 10-12 ft-lbs.

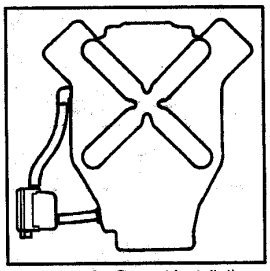


Figure 3 - Correct Installation

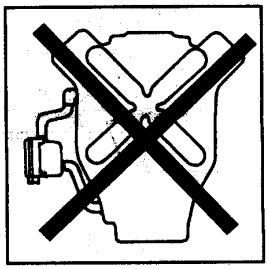


Figure 4 - Incorrect: Heater Mounted Too High

1.3 Plumbing - Recommended hose size for both inlet and outlet connections is 5/8" for 750-1000 watt heaters and 3/4" for 1500- 2250 watt heaters.

CAUTION: DO NOT USE HOSE SMALLER THAN THE MINIMUM RECOMMENDED SIZE HOSE AS COOLANT FLOW WILL BE RESTRICTED AND SHORTENED HEATER LIFE WILL RESULT.

ENSURE HOSE CONNECTIONS ARE ROUTED AS PER INSTRUCTIONS OR COOLANT FLOW MAY BY-PASS THE ENGINE RADIATOR DURING NORMAL ENGINE OPERATION AND CAUSE THE ENGINE TO OVERHEAT. CONSULT THE VENDOR FOR DIFFICULT APPLICATIONS.

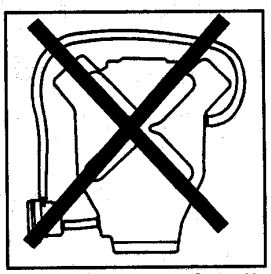


Figure 5 - Incorrect: Outlet Hose Looped Over Top of Engine

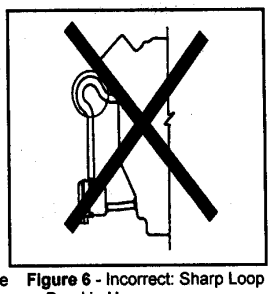


Figure 6 - Incorrect: Sharp Loop or Bend in Hose

1.3.1 Heater Connections - Use standard heater hose and hose clamps per standards SAE J20 & SAE J1508. Determine the lengths of hose required for the installation. Cut hose cleanly and squarely to length. Slide clamp onto hose. Push hose on fitting until hose bottoms against casting. Position hose clamp 1/8" from the end and secure with a screwdriver or wrench. Maximum recommended torque is 30 in. lbs. Do not over tighten.

WARNING: BURN HAZARD. ENSURE HOSE CLAMPS ARE PROPERLY TIGHTENED. OVER TIGHTENED HOSE CLAMPS MAY DAMAGE HOSES SO THAT THEY LEAK HOT COOLANT. UNDER TIGHTENED HOSE CLAMPS MAY CAUSE THE HOSES TO COME LOOSE DUE TO VIBRATION DURING ENGINE OPERATION AND SPRAY HOT COOLANT.

1.3.2 Inlet (bottom connection) - Remove engine block drain plug and clear the opening of any debris. Install hose nipple provided using a reducer/enlarger bushing if required. Use of pipe thread sealant (tape, paste, or anaerobic liquid) on threaded joints is recommended to assist in sealing and to reduce galling. Clamp hose into place as per instructions in 1.3.1..

1.3.3 Outlet (top connection) - Clamp hose into place as per instructions in 1.3.1..

1.4 Cord Installation Procedure - Connect the heater power cord to power supply as per the National Electrical Code. Using industry-accepted methods, secure cord to prevent contact with heated surfaces or moving parts.

WARNING: ELECTRIC SHOCK. ENSURE POWER CORD IS FASTENED SECURELY TO PREVENT DAMAGE FROM CONTACT WITH HOT OR MOVING PARTS.

ELECTRIC SHOCK. DO NOT ENERGIZE HEATER WHILE STANDING IN WATER OR IF POWER PLUG IS WET.

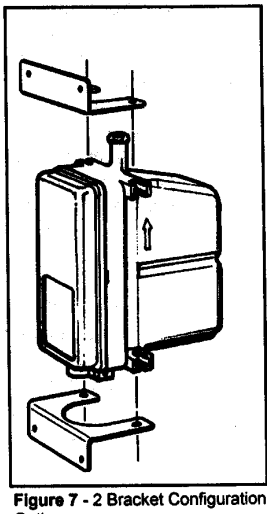


Figure 7 - 2 Bracket Configuration Options

ELECTRIC SHOCK. DISCONNECT POWER SUPPLY BEFORE PERFORMING ANY WIRING. ALL WIRING TO BE DONE IN ACCODANCE WITH THE "NATIONAL ELECTRIC CODE" AND OTHER APPLICABLE LOCAL CODES BY QUALIFIED PERSONNEL.

1.5 **Refilling** - Always pre-mix water, anti-freeze, and coolant additives before installing in engine. Refill the engine with the heater outlet hose disconnected at the engine until the outlet hose is full of coolant. Connect the outlet hose and continue refilling the engine. It may be necessary to bleed cooling system at highest point to eliminate airlocks. Tighten all hose clamps. Re-tighten all hose clamps after 2 weeks as the hoses may set.

CAUTION: USE A 50/50 SOLUTION OF ETHYLENE GLYCOL (ANTI-FREEZE) AND WATER FOR OPTIMUM HEATER PERFORMANCE. DO NOT USE MORE THAN 60% CONCENTRATION OF ANTI-FREEZE. AS A SHORTENED HEATER LIFE WILL RESULT.

DO NOT USE HEATER IN COOLING SYSTEM CONTAINING ANY FORM OF ANTI-LEAK ADDITIVE. AS A SHORTENED HEATER LIFE WILL RESULT

1.6 **Installation Inspection** - Run engine up to operating temperature and check installation for leaks. Check all pipe fittings and hose connections at the heater as well as at the engine. Run the engine until all air is bled from the cooling system. Let engine cool down and add additional coolant if necessary.

1.7 **Operation Check** - The heater case will warm up quickly and become hot to the touch. The outlet hose should be warm and the inlet hose comparatively cool, if the coolant is circulating freely. If the inlet hose gets very warm before entire system is warm, the coolant is not circulating freely due to one or more of the following reasons:

1) airlock in hoses due to loops, kinks, excessive lengths, or routing over top of engine;
2) heater mounted too high;
3) heater not mounted with arrow pointing up;
4) dirt in cooling system; or
5) improper coolant mixture.

Leave the heater energized for a period of up to one hour, checking at regular intervals by feeling heater hose at both inlet and outlet. If the heater appears to be operating incorrectly or not at all, consult your vendor for further instructions.

2.0 HEATER MAINTENANCE INSTRUCTIONS

2.1 **Regular Maintenance** - Periodically check all hoses for damage due to aging, elevated temperatures (particularly the portion of hose immediately above the heater outlet), over-torqued hose clamps, abrasion, weathering, and engine fluids. Replace damaged hoses as required. Seasonally check hose clamp torque and adjust accordingly.

2.2 **Biannual Maintenance** - Engine manufacturers recommend that the coolant system be flushed and inspected once every two years. As part of this inspection, the heater should also be inspected according to the following guidelines to ensure heater life:

WARNING TO AVOID ELECTRICAL SHOCK, ENSURE HEATER IS DISCONNECTED FROM POWER SOURCE PRIOR TO PERFORMANCE OF ANY INSPECTION OR MAINTENANCE ON THE HEATER.

1) Disconnect heater from power source.
2) Drain and flush cooling system to remove contaminants. Recycle or dispose of engine coolant properly to prevent environmental contamination. Be sure to re-apply pipe thread sealant to the drain plug if it is removed.
3) Remove plastic terminal cap by inserting and twisting a large flat screwdriver in the tab receptacles. Remove the single small screw if applicable. Inspect cord for damage and make sure that electrical connections are tight and free from oxide or dirt build-up. Do Not remove electrical connections.
4) Unscrew six torx screws and remove element/flange assembly. Clean the element.
5) Inspect and clean any deposits from the tank interior.
6) Inspect gasket for damage.
7) Replace damaged or worn parts with Phillips & Temro Industries replacement parts.
8) Reassemble heater, tightening torx screws to 45 in. lb.'s torque in the fastener-tightening pattern shown in Figure 8. Ensure that thermostats are seated tightly against flange plate for proper temperature sensing.
9) Refer to Section 1.7 to test for proper operation.

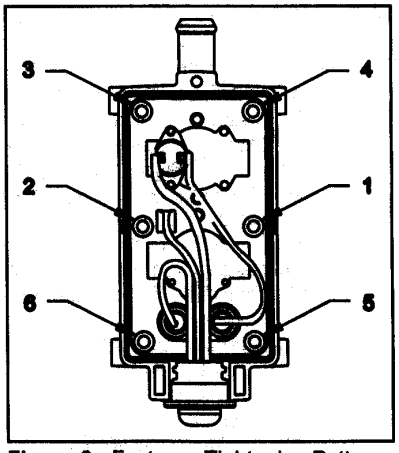


Figure 8 - Fastener-Tightening Pattern