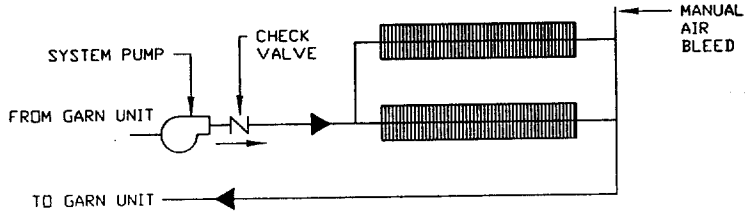
INSTALLATION MANUAL

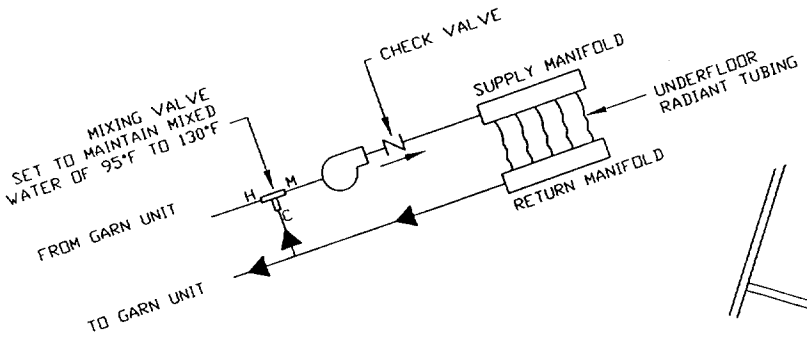
FOR

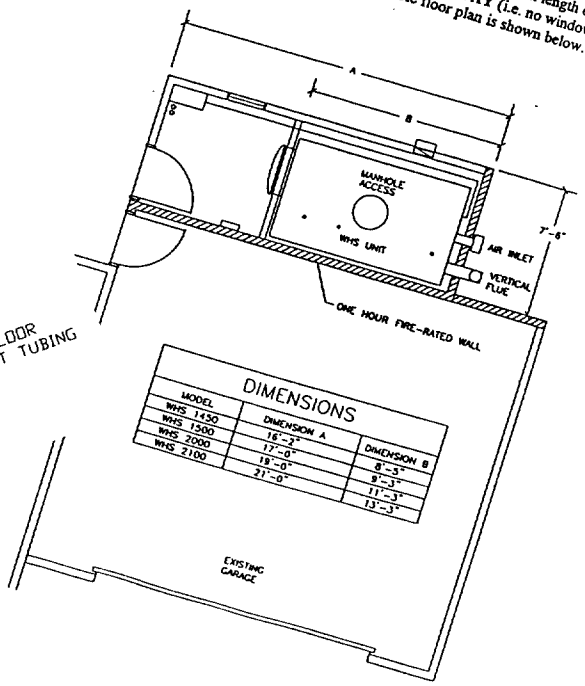
GARN® MODELS WHS 1450, 1500, 1900 and 2000



State and local codes, do not allow solid fuel appliances to be located in a garage. Gasoline fumes are heavier than air, thus settle on the floor of any garage and mix with the oxygen in the garage. One spark or hot ash from any wood unit could explosively ignite the fumes causing extensive property damage and personal injury or death.

Therefore, locate the GARN WHS unit outside the garage within a "lean to" type of addition to the garage. Provide a fully sealed 1 hour fire rated 5/8" sheetrock wall between the "lean to" and the garage. Firewall must extend from floor to ceiling and for the full length of the addition. There must be NO DIRECT CONNECTION OR PASSAGEWAY (i.e. no window or personnel door) between the garage and the "lean to." One possible floor plan is shown below.





DIMENSIONS

MODEL	DIMENSION A	DIMENSION B
WHS 1450	16'-2"	6'-5"
WHS 1500	17'-0"	9'-3"
WHS 2000	19'-0"	11'-3"
WHS 2100	21'-0"	13'-3"

GARN®

Innovators in affordable energy systems.

WARNOCK HERSEY LISTED

INSTALLATION INSTRUCTIONS

GARN® MODELS WHS 1450, 1500, 1900 and 2000

The **GARN®** unit, all related heating equipment (including pumps, piping, fan coils, hot water baseboard, radiant floor heating systems, etc) and all electrical equipment (including power wiring, controls, control wiring, back up electric heating, etc) must be installed by a qualified installer or competent **licensed** personnel in **strict compliance** with all Federal, State and local codes. All electrical equipment, devices and wiring installed with the **GARN®** unit must be **UL listed**. Installer to supply and install all code required electrical over current and disconnect devices.

A. Codes and Insurance

B. Unit Placement

* Plans for a typical **GARN BARN Energy Center**

C. Combustion Air Inlet Installation

D. Exhaust flue Installation

E. Flue Gas Discharge Clearances

F. Flue Caps

G. Insulation of the Unit

H. Water Treatment Chemicals

I. Suggested Water Treatment Procedures

J. Rules of Thumb for Estimating

K. Piping and Pumps to Distribute the Heat

L. Building Heat Distribution Systems

M. Check out and start up procedures

N. Copy of the Listing Label

O. Terms and Conditions with Warrantee Information

SAVE THIS MANUAL FOR FUTURE REFERENCE

DECTRA CORPORATION @ 3425 33rd Avenue Northeast, St Anthony, Minnesota 55418
Phone: 612-781-3585 **Fax: 612-781-4236** **Web Site: www.garn.com**

A. CODES AND INSURANCE

The **GARN WHS** Wood Heat Storage system is a direct-vented wood-burning appliance that stores heat in a **NON-PRESSURIZED** vessel. It is listed by ITS/Warnock Hersey Testing Laboratory, Madison, Wisconsin according to **CSA standard B366.1-M91** and **ETML 78-1.** It is to be installed according to this manual, the Unpacking and Assembly Manual, State and local codes, and your insurance underwriter's guidelines.

Local building and fire inspectors are given discretion to determine if construction and heating installations are safe. They use recommended guidelines developed by various national organizations, such as NFPA (National Fire Protection Association). Your insurance company may also have specific guidelines concerning the installation of wood heating equipment.

Notice: Follow all local and national codes. The installation must comply with applicable sections of Canadian CSA Standard B365 or U.S. NFPA Standard 211.

The design of the **GARN® Wood Fired Heat Storage Device** is unique and is covered by one or more of the following patents: United States Patents # 4,401,101 and # 4,549,526; Canadian Patents # 1,163,880 and # 1,220,686

B. UNIT PLACEMENT

All **GARN WHS** equipment must be placed in a sheltered enclosed space; however, it is not necessary for it to be a heated space. When locating the **GARN WHS** unit, consider the following carefully:

- Clearance to all combustibles must be in compliance with the listing and labeling.
- A full 24" clearance is required between the **left side** of the door and nearest wall to the left of the unit, in order to allow the fuel-loading door to fully open.
- Traffic patterns past unit, i.e. service door, any overhead door, pump locations, etc.
- Source of electrical power and location of electrical panel.
- The routing and insulation of piping to the heating system.
- The vertical space requirements for access to the manway cover and anode rods on top of the unit.
- Location of the wood fuel storage.
- Unit position with regard to where heat is to be delivered (i.e. distance to other buildings, etc).
- Sufficient space for heating system pumps and controls.
- Position and type of flue (horizontal or vertical) with reference to other nearby buildings.

CAUTION: If unit is located within 10 feet (all models) of an 8-foot deep basement wall, this wall will need to be reinforced in order to prevent collapse of wall due to total weight of the **GARN WHS** unit plus water. Check with your local code official if you have any questions concerning proper placement of the unit. **Clearance to Combustibles**

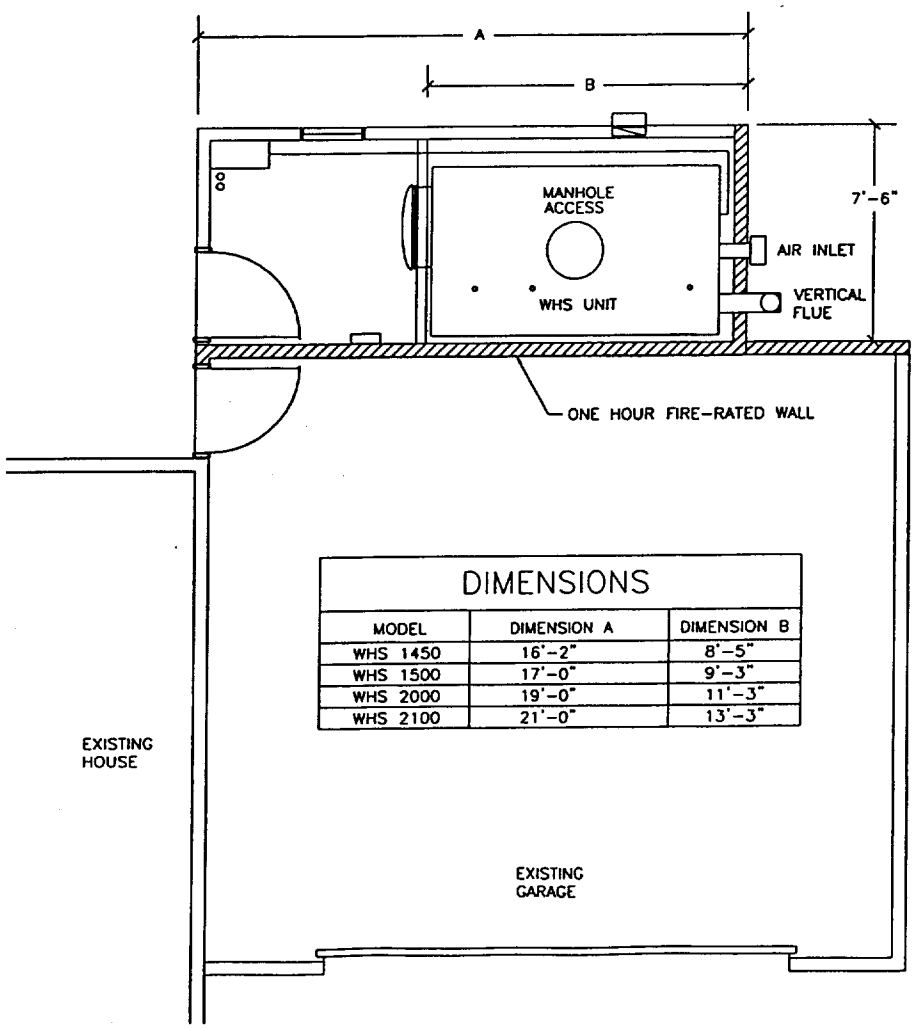
Unit must be placed on a non-combustible floor. Clearance to combustibles are listed below. The clearances shown are minimum clearances and must be adhered to during installation.

Rear	**2" (6" recommended for pipe clearance)**
Sides and top	**2"**
Draft inducer housing	**½"**
Front	**60" (allows for door swing and loading)**
Class A flue	**2"**

Garage Location

State and local codes, **do not allow solid fuel appliances to be located in a garage.** Gasoline fumes are **heavier** than air, thus settle on the floor of any garage and mix with the oxygen in the garage. One spark or hot ash from any wood unit could **explosively ignite** the fumes causing extensive property damage and personal injury or death.

Therefore, locate the **GARN WHS** unit **outside** the garage within a "lean to" type of addition to the garage. Provide a fully sealed 1 hour fire rated 5/8" sheetrock wall between the "lean to" and the garage. Firewall must extend from floor to ceiling and for the full length of the addition. There must be **NO DIRECT CONNECTION OR PASSAGEWAY** (i.e. no window or personnel door) between the garage and the "lean to." One possible floor plan is shown below.



DIMENSIONS

MODEL	DIMENSION A	DIMENSION B
WHS 1450	16'-2"	8'-5"
WHS 1500	17'-0"	9'-3"
WHS 2000	19'-0"	11'-3"
WHS 2100	21'-0"	13'-3"

Remote Building Location

Units may be installed in either heated or unheated buildings such as pole barns, sheds, or shops. The unit must be completely sheltered with enough room in front of it for fuel loading, periodic maintenance and clearance to combustibles.

Schematic plans for a stand alone, remote "**GARN BARN**" Energy Center have been included on the next two pages. The plans are **one suggestion** as to how to enclose your unit. The **GARN BARN** provides an attractive shelter that allows one to correctly store 4+ full cords of fuel wood under a protective roof. It also allows the unit to be fueled without being exposed to bitterly cold winter weather and provides a safe location for pumps and controls.

Slab Recommendations

The **GARN WHS** unit must be set on a concrete slab on grade. The tables below provide data regarding skid pressures and standard allowable soil bearing capacities:

Skid pressure applied by each unit, by model:

WHS 1450	1710 psf
WHS 1500	1755 psf
WHS 2000	1810 psf
WHS 2100	1705 psf

Various soil types and their allowable bearing capacities:

Rock	8000 psf
Gravel	4000 psf
Sand	2000 psf
Loose sand, clay	1000 psf

- For most average soils with an allowable bearing capacity equal to or **greater than 2000 psf**, use a 4" thick 3000 psi concrete slab with 6 x 6 x 10/10 welded wire mesh reinforcement.
- For soils with an allowable bearing capacity **less than 2000 psf** use a 5 1/2"" thick 3000 psi concrete slab with 6 x 6 x 10/10 welded wire mesh reinforcement.
- The slab width and length should at least equal the **enclosure size** and have reinforced edges.
- Consider trenching for and location of pipes (depth, direction) and other underground utilities.

Setting of the Unit

Once the location is determined, set and center each skid on 1-1/2" thick x 16" wide blue, yellow, green or pink foam board (**extruded** polystyrene foam – minimum of 1.6 PCF density, per ASTM C 578-95 specification). **DO NOT USE WHITE BEAD BOARD.** The foam should be cut to the length of the skids plus 2". Lever each side of the tank off the ground and slide the foam under the skids. The compressive strength of this type of foam board is approximately 3,100 psf.

The concrete slab that supports the GARN unit must be relatively FLAT. The entire flat surface may slope *slightly*, but skids under the unit must be fully supported over their entire area.

THE GARN WHS MAY BE LOCATED WITHIN THE BUILDING TO BE HEATED OR WITHIN A SMALL REMOTE BUILDING AS DETAILED IN A.1, A.2 AND A.3

DIMENSIONS		
MODEL	DIMENSION A	DIMENSION B
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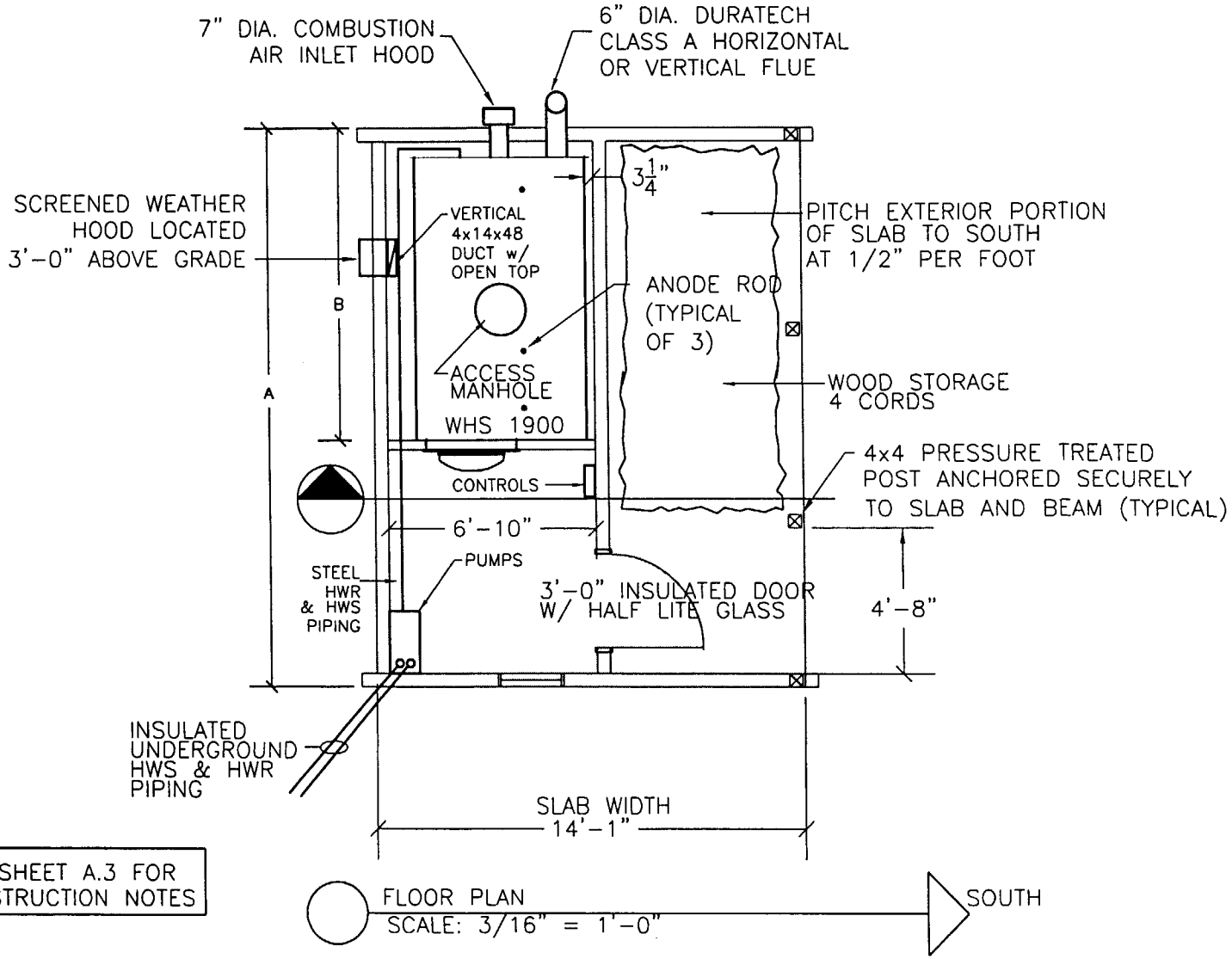

SEE SHEET A.3 FOR CONSTRUCTION NOTES

A.1 GARN® 1450/1900 WHS ENERGY CENTER

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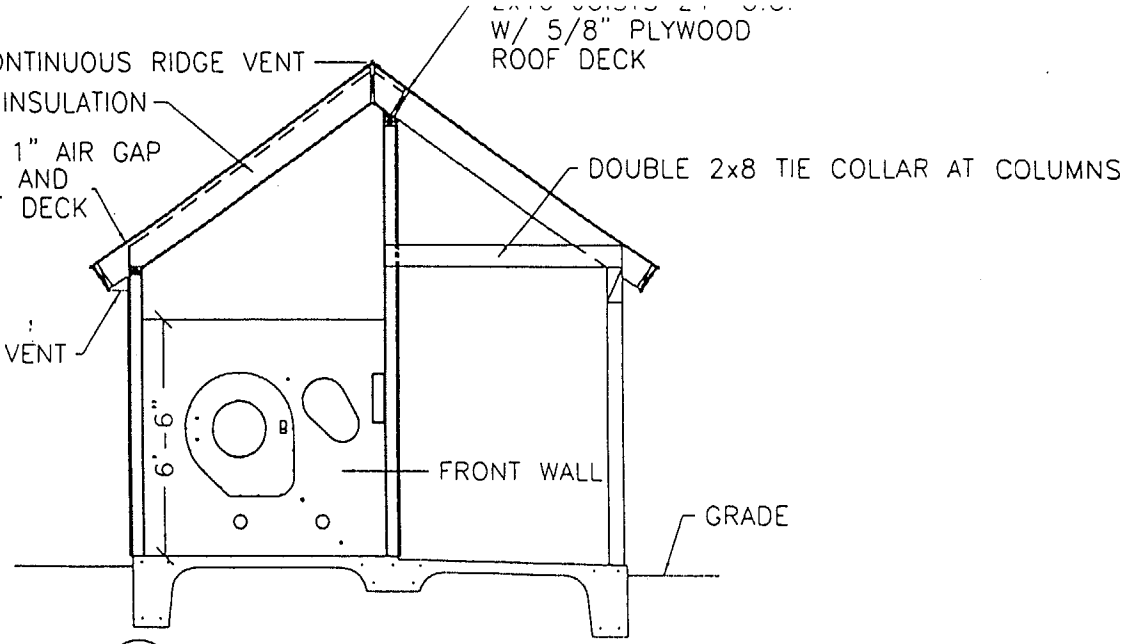
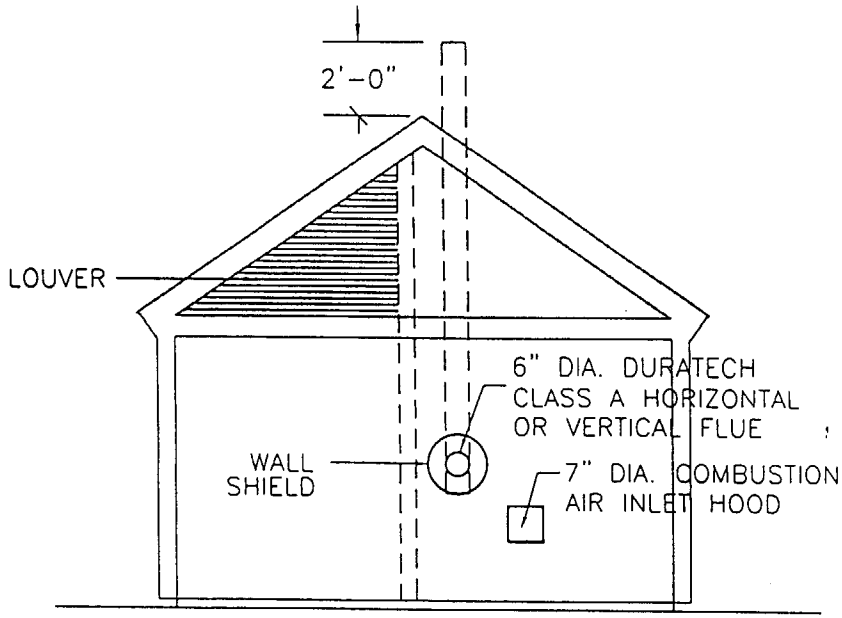
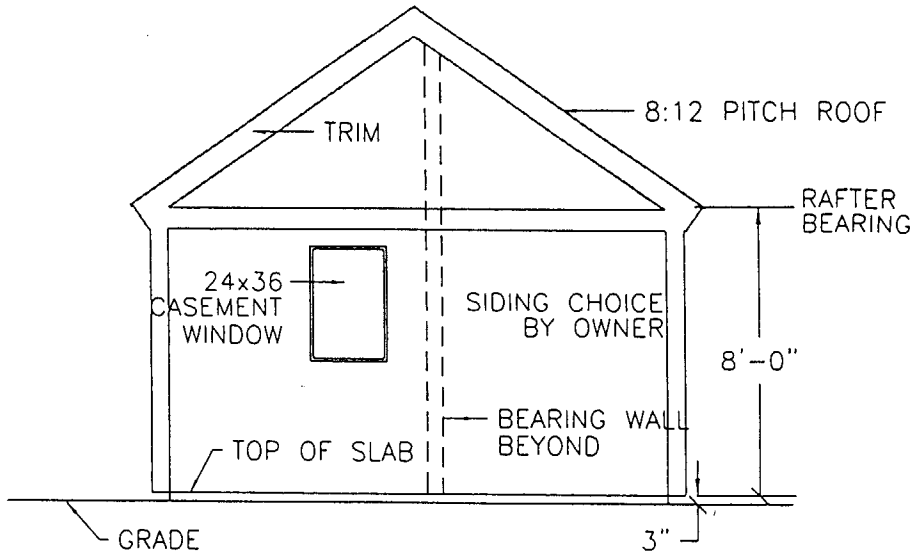


SECTION
SCALE: 3/16" = 1'-0"

SEE SHEET A.3 FOR
CONSTRUCTION NOTES



EAST ELEVATION
SCALE: 3/16" = 1'0"



WEST ELEVATION
SCALE: 3/16" = 1'-0"

A.2

GARN® 1450/1900 WHS
ENERGY CENTER

Dectra

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CORPORATION

CONSTRUCTION NOTES

Drawings A.1 and A.2 represent one option for a Micro Energy Center building. Other arrangements are possible; however, the design and construction of any such facility **must comply** with all local, state and national codes. It is the contractor's sole responsibility to ensure compliance with such codes.

All electrical wiring shall be in **strict compliance** with the National Electric Code (NEC).

Installation of the **GARN WHS** unit shall be in **strict compliance** with the manuals provided with the unit.

The footing/foundation may be constructed as a floating slab (schematically shown) or may utilize spread footings and a conventional slab. Assuming reasonable soils (bearing capacity of 2000 PSF or greater), a 4" thick concrete slab is sufficient to carry the weight of **GARN** unit. In all cases, standard good engineering practice dictates pouring the slab upon 6" to 10" of well-compacted class 5 highway gravel. Final foundation and slab design is the sole responsibility of the local engineer or contractor.

Exterior walls are constructed as follows: siding, Tyvek, ½" sheathing, 2 x 4 wood studs @ 16" on center, 3.5" fiberglass insulation, 6 mil vapor barrier and 5/8" sheetrock.

Front wall at the **GARN WHS** unit is constructed as follows: 5/8" sheetrock over 16 gauge metal studs. **Do not** install sheetrock between the metal studs and the face of the **GARN** unit. **Do not** use wood studs for framing the front wall. The front wall is to be constructed to a height of 7'-0" to allow access to the top of the **GARN** unit.

Roof is constructed as follows: shingles, tar paper, 5/8" plywood or OSB, 2 x 10 joists @ 16" on center, a maximum of 8" fiberglass insulation where appropriate, 6 mil vapor barrier and 5/8" sheetrock. Maintain a 1" air space over the insulation and install proper soffit and ridge vents. The vaulted roof/ceiling allows access to the manway on the top of the **GARN** unit.

Insulated the GARN WHS unit in strict compliance with the manuals provided with the unit.

Install **only** Security brand class A flue components (this is a listing requirement) including a wall shield at the rear of the **GARN** unit. Install all flue components in strict compliance with manufacturer's manual.

Because the **GARN WHS** unit utilizes an induced draft combustion blower a vacuum relief duct is required. Thus a vertical 3 ½" x 14" sheet metal duct is installed within the north wall (refer to drawing A.1) between wall studs. The outdoor portion consists of a screened weather hood positioned 36" above grade. The top of the duct is open-ended and terminates above the insulation that surrounds the **GARN** unit. The upper end may also be screened. No damper is required.

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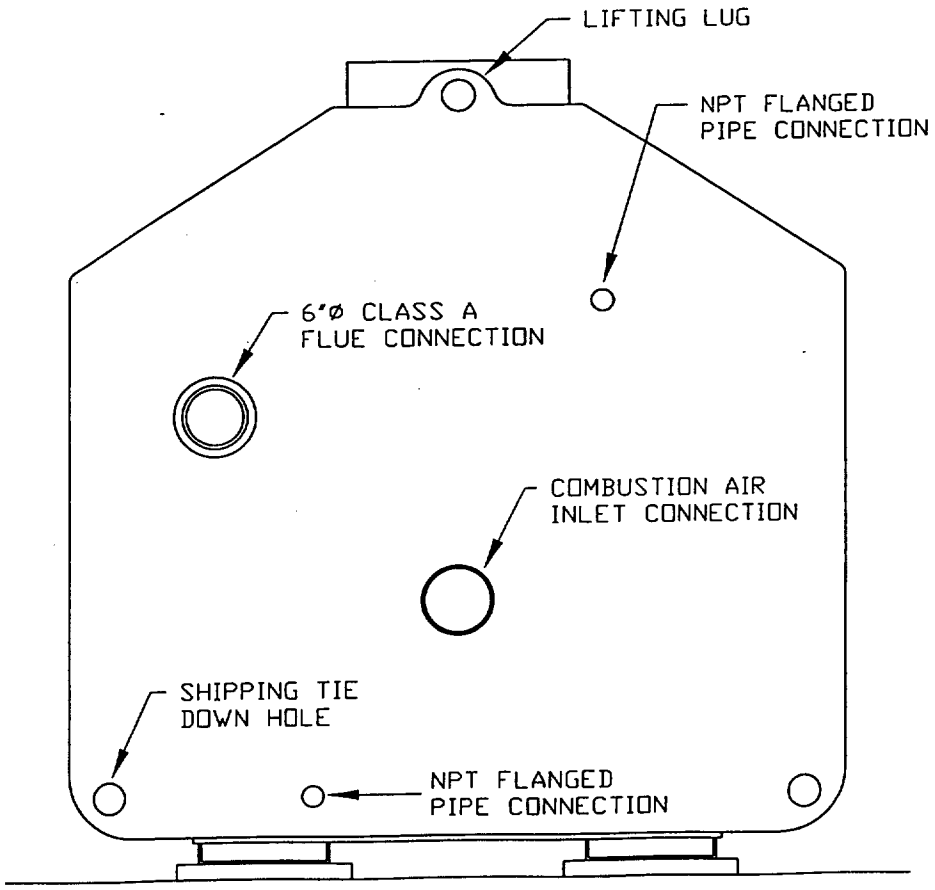
GARN WHS
ENERGY CENTER

A.3

C. COMBUSTION AIR INLET INSTALLATION

As a direct-vented appliance, the **GARN WHS** unit complies with NFPA 211 that states in section 6-6.1.1, "Direct vent appliances shall be listed and shall be installed in accordance with their listing and the manufacturer's instructions." Refer to NFPA sections 6-3.5 and 6-6.1.2. Venting recommendations are discussed in **section E.**

The drawing below shows the location of the various fittings on the rear head of the unit. Specifically, note the location of the combustion air inlet connection and the Class A flue connection as these will be discussed in the following paragraphs.



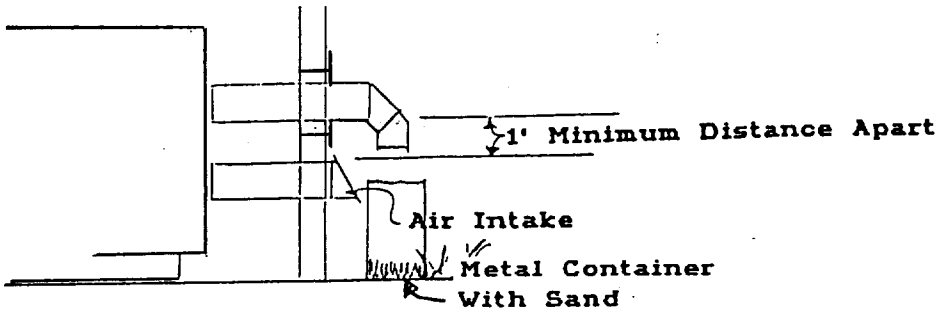
Air Inlet Installation – Models WHS 1450, 1500, 2000 AND 2100

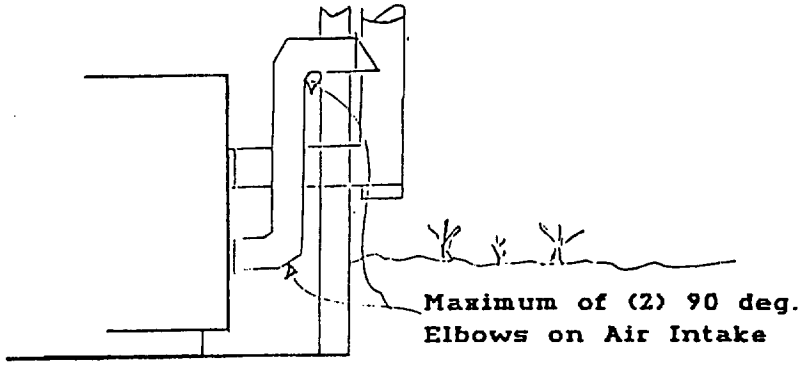
Combustion air for the **GARN WHS** unit is brought in from the outdoors through a 7" diameter single walled duct. The unit is to be operated **ONLY** when connected to an outside air source. The air duct may have no more than two (2) 90 degree bends and its total length cannot exceed 12 feet when using 7" diameter duct. It is connected to the lower 6" diameter pipe extending from the back of the **GARN WHS** unit with a 7" x 6" reducer fitting and a collar clamp. The combustion air inlet duct does not require a wall thimble. The air inlet should extend above any obstructions and possible snow drifts. The outdoor portion of the inlet duct **must** consist of a 7" diameter fresh air intake hood (similar to a dryer vent **without** a back

draft damper) with a galvanized ¼ or ½ inch mesh screen. The hood is provided as part of your **GARN WHS** unit; the other items are available from your local hardware store or heating contractor.

The **total** air pressure drop through the air intake duct must not exceed 0.10 inches of water at 70 degrees air temperature at a flow rate of 300 CFM. Inlet screens must be checked for freeze over during cold weather.

NOTICE: The air intake should be at least 12 inches lower than the exhaust vent if both terminate on the same surface or 24 inches lower than the exhaust vent if exhaust is not terminated on the same surface.





Operating the GARN WHS unit without an inlet hood or without the specified inlet hood will significantly decrease airflow into the unit resulting in inefficiency and the creation of creosote.

D. EXHAUST FLUE INSTALLATION

DO NOT CONNECT THE GARN WHS PRESSURIZED FLUE TO A CHIMNEY FLUE THAT SERVES ANOTHER APPLIANCE.

The exhaust outlet on the back of the **GARN WHS** system comes with a **DuraTech brand Class A** flue connector. DuraTech Class A 2100 F HT stainless steel flue sections are affixed to this connector to carry away the flue gases. **NO** other flue (brand, size or material) is to be connected to a **GARN WHS** unit. The flue gases coming from the Draft Inducer are pressurized. This means that all joints, both inside and outside of the building, must be caulked with silicone caulk and/or sealed with aluminized self-adhesive flue tape. The first section connected to the back of the **GARN WHS** unit **MUST BE SILICON SEALED TO THE CONNECTOR and TANK.** In addition, three #10 x ¾" long self drilling/self tapping SS screws are to be driven thru the flue flange into the tank mounted receiving flange to prevent separation of the flue.

Strictly follow DuraTech's installation instructions. A 2 inch clearance must be maintained between the Class A flue and any combustible material; however, **non-combustible** insulation may be in direct contact with the outside surface of the flue if passing through a non-combustible material. Once outside the building the flue may be terminated either horizontally or vertically (see below).

GARN WHS 1450, 1500, 2000 and 2100 models utilize a 6" diameter flue. Shown below is the "**Flue Warning**" label that is placed on every **GARN WHS** unit near the DuraTech brand Class A flue exhaust connection.

FLUE WARNING

Use only DuraTech brand Class A 2100 F HT flue and accessories. All other brands or types of flue will not safely connect to the GARN® unit, and will void the ITS/Warnock Hersey listing. Refer to the Installation Manual and flue manufacturer's instructions for flue installation details.

Horizontal Sidewall Flue

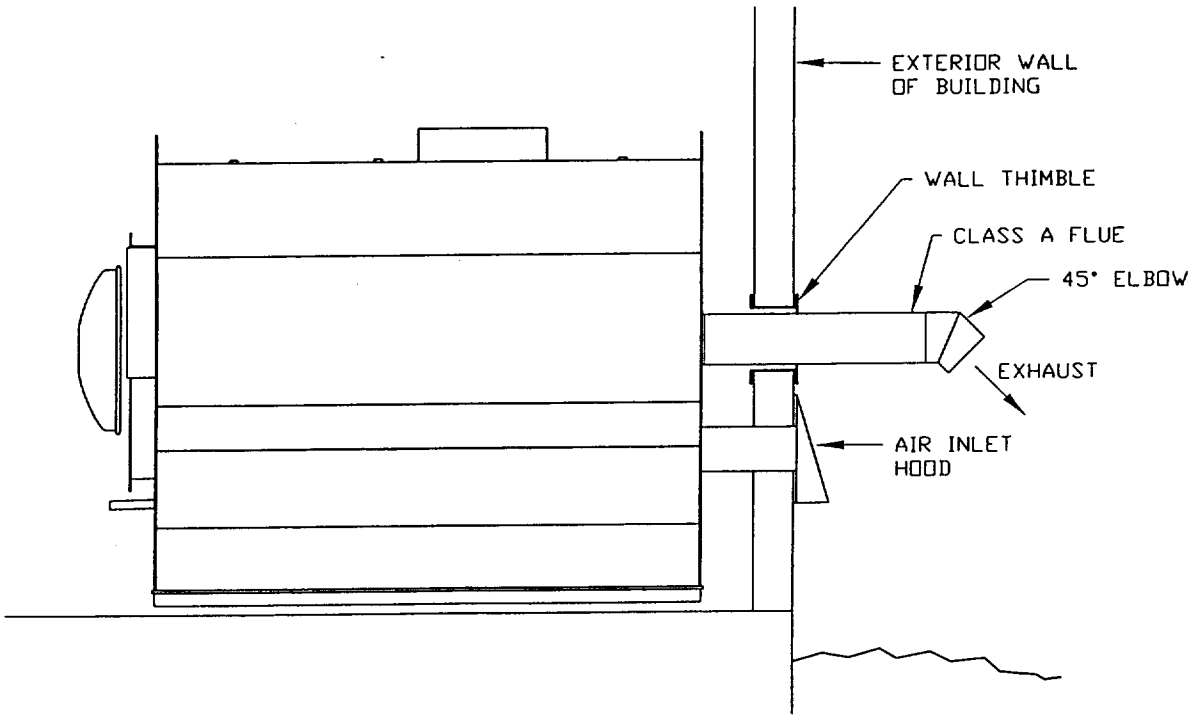
The flue can extend horizontally through the wall using the **DuraTech brand Wall Radiation Shield** to maintain safe clearances to combustibles. The end of the flue should terminate **not** closer than 18" from building siding. A single wall, 6" diameter, adjustable stainless steel elbow is used to divert the flue gases downward (screwed to the class A flue.) Run a bead of Hi-Temp Silicon around the elbow where it contacts the Class A flue to prevent separation. A ½" mesh screen should be placed in the end as a spark arrester and animal barrier. If no screen is used, birds or small animals may enter the flue system during periods of non-use (the system should be checked prior to start-up each season). Exhaust screens must be checked for freeze over during cold weather.

CAUTION: When the sidewall discharge is used, care should be taken that the hot surfaces and gases do not present a hazard to any person who might frequent the area.

Depending on the fuel used and frequency of firing, the volume of initial smoke coming from a horizontal sidewall flue may be a nuisance. If windows or doors are in or near the smoke path, a vertical flue should be used. Likewise, if the horizontal sidewall flue discharges into a confined space between two buildings, a vertical flue should be used.

A **METAL** container partially filled with sand may be placed below the angled stainless steel elbow to catch any fly ash or sparks that may exit the exhaust. The container should be at least 2 feet laterally from any combustible surface and 6 feet from any combustible surface above it. **DO NOT USE A PLASTIC CONTAINER.** Fasten a ½" to ¾" mesh wire screen over the top of the container to prevent the entrance of dry leaves, animals, birds, etc into the container. Delete the screen where the flue enters the container.

CAUTION: Depending on your firing rate and fuel type, the cool surfaces of the metal container may become lightly coated with ash and creosote. The accumulated ash and creosote should be removed periodically to minimize the potential of a creosote fire.

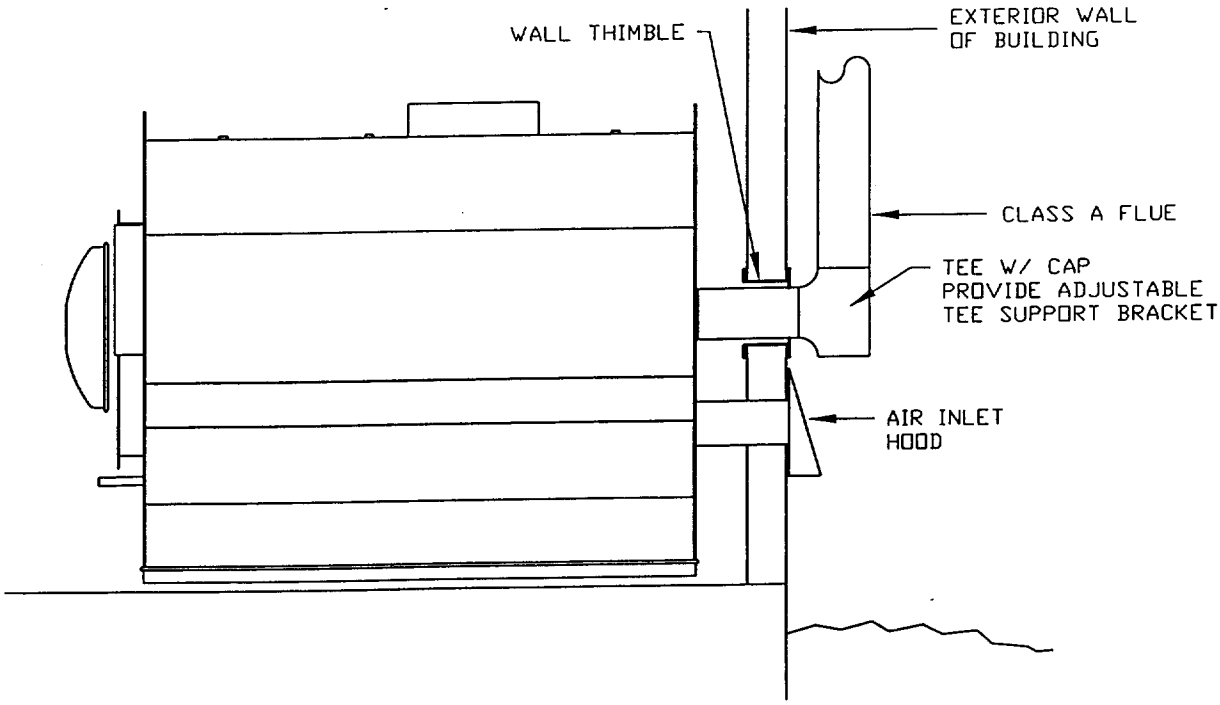


Vertical Flue

If a vertical flue is required or desired, utilize only **DuraTech Class A 2100 F HT** flue components installed in strict accordance with DuraTech installation instructions. Mount the vertical flue on the exterior of the building. **DO NOT** install a vertical flue **within** a building. Installation will require the use of the following additional DuraTech Class A 2100 F HT components:

- Tee with bottom clean out cap
- Adjustable tee support bracket
- Wall thimble
- Adjustable wall support strap

radiation shield and Adjustable roof flashing will also be required. The vertical flue must extend at least 3 feet above the roof surface where it penetrates the roof. **DO NOT INSTALL A FLUE CAP** as it will unduly restrict the flow of pressurized exhaust gases.



Connection to an Masonry Chimney

Only under limited circumstances may a **GARN WHS** unit be connected to a masonry chimney. Masonry chimneys are designed for heating devices that burn continuously in cold weather. Because the **GARN WHS** unit is only burned periodically, the masonry chimney must have a continuous, insulated **minimum** 6" diameter stainless steel liner. It must be surrounded with **fireproof** insulation and it must be no taller than 24 feet. The maximum total static pressure loss in the vertical portion of the existing flue must not exceed .10" of water column at a flow rate of 375 CFM.

ONLY STAINLESS STEEL LINER COMPONENTS ARE TO BE USED. The performance of the **GARN WHS** unit can be seriously hampered by an improper connection to a (or an improperly constructed) masonry chimney and a **DEADLY** condition may result.

Existing chimneys **must be inspected and certified safe** for use as a **pressurized chimney** by a licensed Professional Engineer or licensed chimney specialist. In addition, the installation must comply with all state and local codes. If the **GARN WHS** unit is located within a recessed area such as a basement, a carbon monoxide detector mounted close to the floor is required.

CAUTION: In any flue configuration, failure to seal **ALL** flue joints inside a building **WILL** result in harmful levels of carbon monoxide and carbon dioxide being introduced into the space. If strong smell of wood smoke is noticed – **LEAVE THE ROOM AND VENTILATE THE SPACE IMMEDIATELY.**

E. FLUE GAS DISCHARGE CLEARANCES

Flue gas discharge clearances are defined in NFPA 211, national and state codes. The following is a partial summary of those codes as they apply to **GARN WHS** equipment:

- Flue gas shall be discharged a minimum of 12 inches **above** ground (NFPA 6-6.1.2).

Flue gas shall **NOT** be discharged **horizontally:**

- Within 15 feet of a powered air inlet into any building or structure (except for the **GARN WHS** combustion air inlet).
- Within 12 feet of any door, window or gravity air inlet into any building or structure.
- Less than 7 feet above grade when located adjacent to public walkways.
- Into a confined space between two buildings or structures.
- Into an area that naturally collects leaf, paper or other air borne debris that is combustible.
- Onto a parking lot or into an area where vehicles may park.
- Closer than 1 foot from building siding when the discharge is aimed **away from** the building.

In addition, flue gas shall **NOT** be discharged **vertically:**

- Less than 2 feet above any building component within a 10 feet radius of the flue. The vertical flue must extend at least 3 feet above the roof surface where it penetrates the roof.

CAUTION: Failure to follow the above installation directions will cause reduced unit performance and a possible hazardous condition may develop.

F. FLUE CAPS

DO NOT INSTALL A FLUE CAP on a vertical chimney as the cap will unduly restrict the flow of exhaust gas due to increased back-pressure. Restricted exhaust gas flow will decrease overall efficiency and may create a creosote condition within the GARN unit.

G. ADDITIONAL COMMENTS

If burned correctly, wood is a wonderful **rural** fuel that unlike coal or fuel oil is "carbon neutral." Carbon neutral means that if wood is combusted properly, it produces the exact amount of carbon dioxide required to grow another tree equal to the tree that was either burned or allowed to rot on the forest floor. Wood is generally not recommended as a primary fuel for housing:

- In most suburban locations.
- In most city locations.
- To heat an outdoor swimming pool during the summer months.

- To heat domestic water.

Improperly combusted wood fuel produces emissions that are toxic to humans and animals. These emissions include, but are not limited to: finely atomized liquid oils (creosote), very fine particulates, aromatic hydrocarbons, polycyclic organic matter, carbon dioxide, carbon monoxide, etc. Most of these are easily drawn into one's lungs during normal breathing. However, complete combustion can reduce these by products significantly as most of these chemicals are fuels.

Population densities in suburban and urban locations create significant local air shed pollution issues that essentially and reasonably preclude the use of coal, wood and even some oil fuels even if combustion is mostly complete. Housing in such locations must do the following in order to help curb the concentration of unwanted emissions:

- Conserve energy by installing good insulation and caulking.
- Install only double glazed, argon filled energy efficient windows.
- Install insulated thermally efficient doors and storm doors, with good quality weather stripping.
- Install an air-to-air heat exchanger to provide ventilation.
- Insulate and caulk all rims joists.
- Insulate basements walls from floor to ceiling with methods that prevent the formation of mold and mildew.
- Utilize passive solar techniques whenever possible.
- Install water saving toilets, showers and faucets through out the residence.
- Utilize a high efficiency natural gas condensing furnace or boiler to provide space and domestic water heating.
- Install only high SEER air conditioning equipment with variable speed fans to effectively control indoor relative humidity.

The above items alone or as a group will reduce fuel usage and yearly fuel costs. At the same time they create a very comfortable healthy housing unit for the occupants as well as a healthier local air shed. And the above items will provide the user a reasonably quick return on his/her energy investment dollar. Not only because of the fuel savings, but also because of less expensive heating, ventilation and air conditioning systems due to reduce heating and cooling loads.

So what about swimming pool heating? This is best accomplished utilizing solar heating and/or an evaporation prevention blanket. Solar heating has proven cost effective, dependable and efficient for many years in many countries. Solar heating is not an "outside the mainstream" idea. In fact, it is efficient in almost every area of the US. Most people do not realize that a swimming pool requires a heater that may be several times the size and capacity of their residential space heater. However, during the spring, summer and fall the amount of energy required to heat a pool is easily provided by solar panels. All without emissions that exacerbate the local air shed pollution problem.

Remember this: Eliminating fuel usage is the same as burning fuel with absolutely **zero emissions** - impossible for any fuel even natural gas! A well designed and constructed energy efficient residence can reduce heating demand (thus fuel usage) by at least half, and sometimes by two-thirds when compared to a present day "code built house." This is critical in urban or suburban location.

G. INSULATION OF GARN WHS EQUIPMENT

CAUTION: Construction of the insulation enclosure around the GARN WHS unit shall utilize **ONLY NON-COMBUSTIBLE MATERIALS** such as sheetrock, galvanized metal studs and sheet metal for all wall surfaces. **DO NOT USE WOOD, PLYWOOD, PARTICLE BOARD, ORIENTED STRAND BOARD, ETC.**

Minimum clearances between any surface and the GARN WHS unit are:

Rear	**2" (8" recommended for pipe clearance)**
Sides and top	**2"**
Draft inducer housing	**½"**
Front	**60" (allows for door swing and loading)**
Class A flue	**2"**

MAINTAIN A CLEAR AND CLEAN 60" MINIMUM DISTANCE THE FULL WIDTH OF THE GARN UNIT IN FRONT OF THE GARN UNIT.

DO NOT STORE COMBUSTIBLE MATERIALS INCLUDING MATCHES, PAPER, KINDLING, WOOD, OIL, GASOLINE, RAGS, CLOTHING, ETC WITHIN THIS AREA OR ABOVE THE GARN UNIT. DO NOT ALLOW THE ACCUMULATION OF BARK, SAWDUST, SHAVINGS, KINDLING, ETC WITHIN THIS AREA.

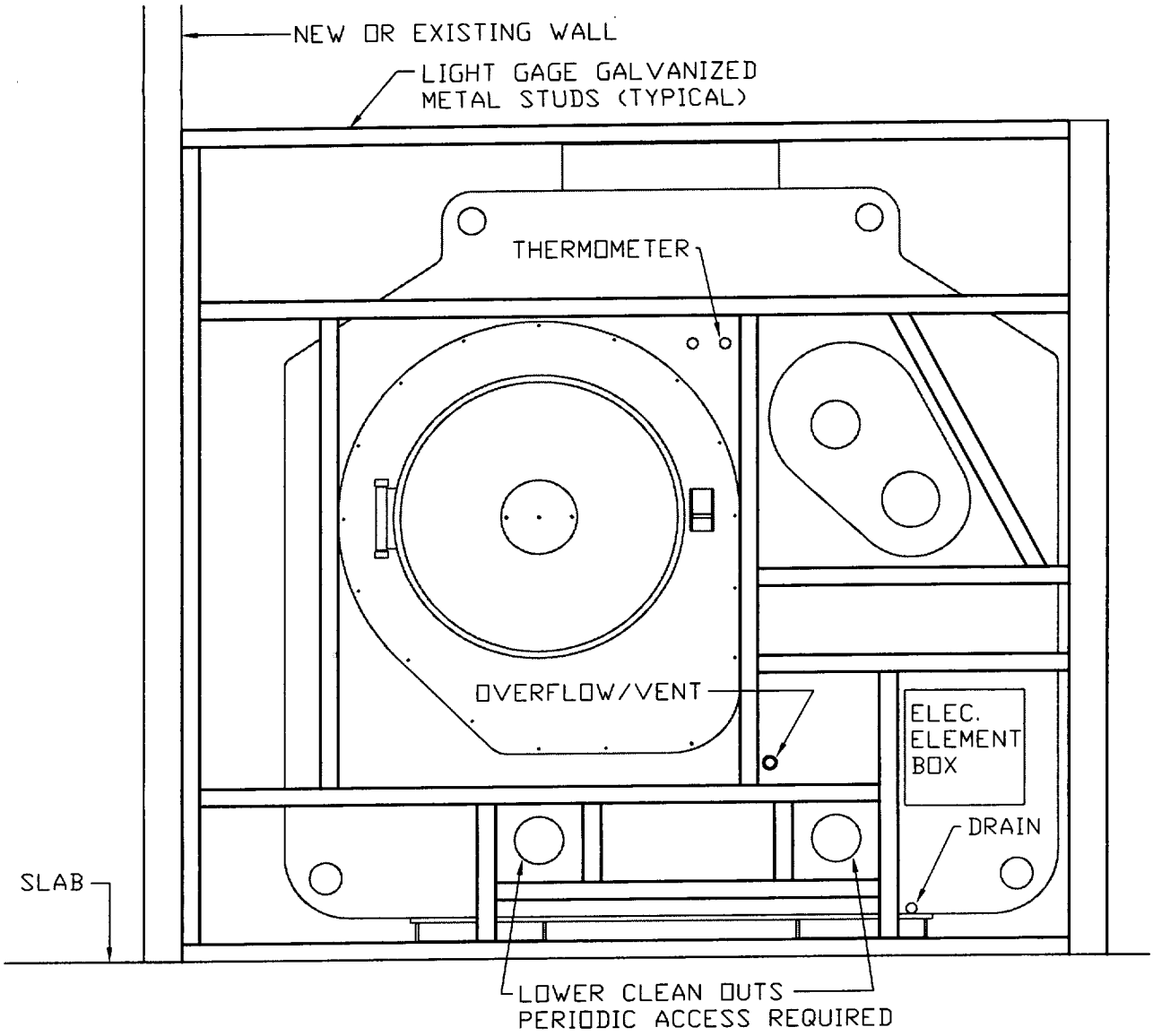
Construct the insulation enclosure around the **GARN WHS** unit utilizing 3" x 1 5/8" x 18 gauge galvanized steel studs and 5/8" sheetrock. Install per stud manufacturer's directions. Tape all joints after the sheetrock is securely fastened into final position.

1. Utilize a layer of tarpaper between the concrete floor and the bottom steel stud plate to minimize possible corrosion of the bottom plate. Use power driven fasteners to attach the plate to the floor.

2. At the front of the unit, the sheetrock is to be cut around the air collar, draft inducer housing and electric element box. Maintain a dimension of 4" from the surface of the tank to the exposed (exterior) surface of the sheetrock. This will allow the sheetrock to slip behind the 2" steel flange that surrounds the air collar. Fasten the sheetrock to the flange utilizing the predrilled air collar holes and short lengths of steel studs behind the sheetrock (essentially forming a sandwich that will draw the sheetrock to the flange). Maintain a minimum 3/4" clear dimension between the edge of the sheetrock and the barrel of the air collar and ½" clear around the draft inducer housing. Install galvanized steel stud framing as necessary to safely support the sheetrock face. Tuck **ONLY UNFACED** rock wool or non-binder fiberglass insulation between the sheetrock face and the front of the **GARN WHS** unit. (Review the drawing on the next page).

3. Provide access to the two lower cleanout covers as access for flue cleaning will be required on a routine basis. Simply construct a box from non-perforated metal studs large enough to accommodate the cleanouts, extending from the tank face to the rear surface of the sheetrock face. Install as part of the framing; however, do not cover with sheetrock and do not insulate.

4. If the **GARN WHS** unit is positioned against a concrete or block wall (with the block wall forming one portion of the insulation enclosure), install a 6 mil poly vapor barrier against the concrete or block wall before installing any insulation. The poly will prevent the insulation from absorbing water from the concrete or block wall.



SECTION "G" INSTALLATION MANUAL

FRONT FRAMING REVISION

MAY 2005

Dectra

CORPORATION

3425 33RD. AVE. N.E., ST. ANTHONY, MN. 55418 612-781-3585

CAUTION: **DO NOT USE FOAM BOARD OR FOAM BEADS AS BOTH WILL MELT AND ARE A FIRE HAZARD. DO NOT USE CELLULOSE INSULATION AS THE ACID TREATMENT OF THE CELLULOSE INSULATION WILL CORRODE THE STEEL TANK. DO NOT INSTALL INSULATION WITHIN THE ELECTRIC ELEMENT BOX.**

8. Fill the insulation enclosure to a level about 6" above the tank portion of the **GARN WHS** unit. Steel studs may be extended across the top of the tank to fasten opposite enclosure walls together. Prevent loose insulation from falling into the manway opening. The manway cover does not need to be insulated as the heat loss through it is minimal.

9. In an industrial setting, the **GARN WHS** unit may be wrapped with pre-formed, high density non-combustible fibrous insulation covered with a fireproof canvas and plaster overcoat. This would eliminate the construction of an insulation enclosure and allow ongoing easy access to all sides of the unit.

CAUTION: **The GARN WHS unit is non-pressurized. As such, the manway cover should just rest on the manway opening. In a case of rapid boiling, the manway cover is designed to allow for the rapid escape of water vapor. Therefore, DO NOT FASTEN, BRACE OR ADD WEIGHT TO THE MANWAY COVER SO THAT IS UNABLE TO FUNCTION PROPERLY.**

H. WATER TREATMENT CHEMICALS

Prior to 1989, it was felt that oxygen corrosion was the primary concern that needed to be addressed with **GARN WHS** and **ETS** equipment.. Therefore, an initial boil out/pretreatment using a trisodium phosphate (TSP) solution was recommended, followed by an ongoing nitrite-based chemical treatment program to minimize oxygen pitting.

BACTERIOLOGICAL CORROSION

In recent years, bacteriological corrosion has become one of the major corrosion issues. Specific bacteria can react under certain conditions with the sulfate in water. This reaction forms a strong acid (hydrogen sulfide) under deposits or blisters, which results in corrosion of the steel.

These bacteria do **not** require oxygen to live; in fact they prefer an anaerobic (without oxygen) environment typical of boilers and hot water systems. These bacteria are present in virtually all soils and are easily transported by air. Twenty years ago most water treatment programs used toxic chromate chemicals, which killed **all** bacteria. Today, treatment programs for boilers and hot water systems are more environmentally compatible and do **not** automatically contain ingredients to prevent this bacterial growth.

Only about 11% of **GARN WHS** and **ETS** owners have had a corrosion problem; it appears that most of those have been bacteriological in nature. Bacteriological corrosion is highly unpredictable; however, once active it can corrode through a tank in a few months. As indicated in the past: visual inspection, periodic testing and periodic cleaning coupled with ongoing chemical treatment is one of the most effective programs for corrosion prevention.

WATER POLLUTION

There exists a wide range of "normal" water available to **GARN WHS** and **ETS** owners. Generally, **GARN** equipment is filled with water from a local, rural well. The pH level and the amount of iron, hardness, suspended particulates, dissolved chemicals, organics, etc. vary greatly in "normal" water. During the past 12 years, national surveys have shown a significant increase in the number of polluted rural wells, thus compounding the already complex corrosion problem. As a result, it has become obvious that corrosion is a complicated issue requiring professional attention and ongoing owner maintenance.

COMMON TYPES OF BOILER CORROSION

General surface corrosion - this is similar to the rust you would find on bare steel that has been outdoors for a period of time. Surface rust **without** pits. This type of corrosion is not critical, but should be monitored on a regular basis to detect any changes.

Under deposit corrosion - occurs **under** any material that prevents water treatment chemicals from plating a bare steel surface. This will occur under sludge that may form on the floor of the tank or other horizontal surfaces. Note any corrosion (refer to Appearance section below) and wire brush or sand blast to bare steel. Recently manufactured equipment has an epoxy coated floor to help minimize this problem.

Bacteriological corrosion - discussed in detail above. Refer to Appearance section below.

Blisters over pits - is pitting type corrosion and it is not always apparent what causes this to occur at a particular location. Note any corrosion (refer to Appearance section below) and wire brush or sand blast to bare steel.

Crevice corrosion - essentially a form of under deposit corrosion. Occurs where two pieces of steel lie against each other (but are **not** welded together) effectively preventing water treatment chemicals from plating the adjacent bare steel surfaces. Does **not** occur in **GARN** equipment as **all** internal joints are seal welded. Generally cannot be visually inspected as the steel surfaces lie very close together.

Electrolysis - results from a "noble" metal (i.e. copper, bronze, brass, etc.) in close proximity to steel (a sacrificial material). Can also result from improperly grounded equipment and/or an improperly grounded electrical service to a building. No known water treatment program can prevent this form of corrosion. Connect only non galvanized steel pipe to **GARN WHS** and **ETS** units, and install dielectric couplings where copper pipe connects to steel pipe. Sacrificial anode rods further help reduce the potential for this type of corrosion (refer to Appearance section below).

Appearance of corrosion - blisters formed by bacteriological action will have either: a shiny, dime color or charcoal color underneath, with a **slimy** substance within the blister. Oxygen pits are characterized by a black powder inside a blister. Corrosion underneath a sludge may be of either type. Shiny dime colored pitting (especially in the vicinity of a tank discontinuity or pipe fitting) is generally electrolysis.

OWNER RESPONSIBILITIES

GARN equipment has always been fabricated from quality materials, utilizing quality methods that inherently reduce corrosion potential. Each unit must pass a final, in factory Quality Control check before it is released for delivery. Once delivered, the manufacturer is not able to control the installation, the quality of the fill water, the chemicals added to reduce corrosion potential nor the level or frequency of ongoing chemical testing and maintenance. Therefore, corrosion protection is the sole responsibility of the owner. To this end, it is strongly suggested that every owner become a "proactive participant" in the protection of their investment. Refer to the "**Water Treatment Procedures**" section.

There is no warrantee regarding corrosion or corrosion induced failures of any component of **GARN WHS, ETS** or **WHS/ETS** equipment or any components attached to the **GARN** equipment.

Although your **GARN** dealer cannot and does not guarantee the performance of any water treatment program, it is strongly suggested that every **GARN** owner investigate using a program that addresses both oxygen and bacteriological corrosion. A number of chemical companies are familiar with such issues and can provide chemicals for a **GARN** unit. **GARN** equipment is considered a "closed loop hot water boiler" with respect to water treatment. As such, water treatment chemicals are commonly available in several forms: liquid; crystal and powder. Both the liquid and crystal forms do not require premising. **However, the powder form of treatment chemicals does require premixing.** Contact your **GARN** dealer for additional specifics and pricing.

Biocides are also available to treat extreme cases of bacterial corrosion. Generally, biocides are liquid and are slug fed to the **GARN** unit when required. Because biocides are very dangerous, such products are **only available** to commercial, institutional, industrial and farm owners in accordance with current EPA regulations. Contact your **GARN** dealer for additional specifics and pricing.

Residential users can prevent most biological corrosion issues by heating the **GARN** unit up to 185 F at least once every two or three weeks during the heating season. High temperatures will kill all of the biologicals within the tank. The system pump should be activated for approximately 30 minutes to "flush" the bacteria contained within the piping system into the **GARN** unit. During extended periods of non-use (ie – summer, etc) the **GARN** unit should be heated up to 185 F once every four to six weeks. Once the unit is heated, activate the system pump for approximately 30 minutes and then let the tank sit idle, naturally decreasing in temperature over a period of time.

I. SUGGESTED WATER TREATMENT PROCEDURES

CORROSION PROTECTION IS THE SOLE RESPONSIBILITY OF THE OWNER

GARN equipment has always been fabricated from quality materials, utilizing quality methods that inherently reduce corrosion potential. Each unit must pass a final, in factory Quality Control check before it is released for delivery. However, after delivery the manufacturer is **not** able to control the installation, the quality of the fill water, the quantity or type of chemicals added, or the level or frequency of ongoing chemical testing and maintenance. Thus, **corrosion protection is the sole responsibility of the owner.**

In addition to using a chemical treatment program that addresses **both** oxygen and bacteriological corrosion, every **GARN** owner should become a **proactive** participant in the protection of their investment. A number of common sense procedures exist to help reduce the corrosion potential of your **GARN** unit. These procedures are split into two categories: Initial Installation Procedures and Maintenance Procedures. The items listed are suggested, minimum baseline procedures.

There is no warrantee regarding corrosion or corrosion induced failures of any component of GARN WHS, ETS or WHS/ETS equipment or any components attached to the GARN equipment.

INITIAL WATER TREATMENT INSTALLATION PROCEDURES

1. Upon delivery of a **GARN WHS** unit, cover the manway access to prevent the unwanted entrance of dirt, debris and water. Inspect the unit and notify the delivery driver and your GARN dealer of any problems.

2. Install the unit in full compliance with all federal, state and local codes and this Installation Manual. Do not insulate the unit until it has operated successfully for a few days.

3. Properly ground the **GARN WHS** unit to help avoid electrolytic corrosion due to a "floating ground." **DO NOT USE THE STEEL CONDUIT AS A GROUND CONDUCTOR.** The National Electric Code **requires** the utilization of a dedicated, green electrical ground wire when connecting the unit to the service panel ground. An additional driven ground rod may be required to help establish proper grounding; your licensed electrician can advise you on this.

4. **Do not** install a copper, domestic water-heating coil **within the tank** as this may cause corrosion of the steel shell.

5. Attach only **non**-galvanized, black steel pipe to the **GARN** unit. Die-electric couplings **must** be installed between any metallic pipe and the **GARN WHS** unit. If copper pipe is being used, please refer to item 6 below.

6. Maintain 4' to 6' of non-galvanized, black steel pipe between the **GARN** unit and **any copper pipe**; install dielectric couplings where copper pipe connects to steel pipe. Flush all steel pipe with a mixture of tri-sodium phosphate (TSP) and warm water to remove manufacturing oil, dirt and debris prior to final connection to the **GARN** unit. Mix approximately 4 lbs of TSP with each 100 gallons of water.

7. Remove any internal accumulated dirt (from manufacturing, trucking, or on site construction) and thoroughly **flush wash** the entire inside of the tank with a mixture of tri-sodium phosphate (TSP) and clean, filtered water. Drain all water and dirt. Visually inspect the interior of the tank (from the manway **without** climbing into the tank) to ascertain that the unit is OK to be filled with clean water.

8. Order water treatment chemicals **prior** to filling the unit. Carefully read and follow the instructions provided with the chemicals. Follow **all** safety procedures and retain the **Material Safety Data Sheets**. Store all unused material in a **locked** and safe location away from children and animals.

9. Fill the unit (using the water filter) to a water depth of 12". Add the initial quantity of treatment chemical according to the manufacturer's instructions and continue to add **filtered, clean water** until the unit is full (8" below the crown at the top of the tank). Check for and repair any pipe leaks.
10. Run all system pumps for at least four (4) hours to distribute the water and chemicals. Inspect and add **filtered, clean water** if the water level has dropped significantly.

11. Obtain a treated water sample from the manway access after #8 above has been completed. Forward it to the water treatment supplier for an initial chemical test. Use standard sampling procedures in obtaining the sample.

    Every water treatment sample must be tested for at least the following: residual chemical concentration for each chemical additive; conductivity; pH; total dissolved solids; total iron; copper as Cu; and the concentration of bacteria (including both iron reducing and sulfur reducing strains) if bacteria tests positive in the sample. Upon receipt of the test results, **adjust the chemical concentration as advised by the water treatment supplier**.

MAINTENANCE PROCEDURES TO MINIMIZE CORROSION POTENTIAL

Water treatment chemicals are both consumed in the process of providing corrosion protection. Most treatment chemicals incorporate a semi-transparent tracer dye that changes color as the chemicals are depleted or the pH drops below a critical level (<8.3). Note the original color of the **treated** water shortly after filling the **GARN** unit. The bottom of the **GARN** unit should be visible through the full water depth in the tank. One of the major features of **GARN WHS** and **ETS** product is the manway access on the top of the tank. Its benefit is the ease with which **GARN** products can be inspected and repaired if necessary.

1. If possible, examine the water in the **GARN** unit several times per year. If a color change has taken place, immediately take a sample and forward it to the water treatment company. Upon receipt of the test results, **adjust the chemical concentration as advised** by the water treatment company.

2. At the end of each heating season, "top the tank off". Whenever additional water is added to the unit, utilize the water filter provided so that sediment is **not** carried into the system. Add water treatment chemicals (based upon the volume of water added).

3. For commerical, institutional, industrial and farm systems add biocide at the following times: whenever makeup water is added to the unit; a few days before the end of the heating season; and at the beginning and/or middle of the heating season. Dusty or dirty locations require more frequent biocide additions to minimize sludge build-up and under-deposit corrosion potential.

   For residential systems, it is necessary to heat the **GARN** unit up to +185 degrees F once every three weeks during the heating season and once every four to six weeks whenever the **GARN** unit stands unused for a period of time (summer). This high temperature will kill most bacteria living **within** the tank proper (it will **not** kill the bacteria in the remainder of the system).

4. Draw **two samples** of the treated water **per year** and send them to the water treatment company for testing and analysis. Upon receipt of the test results, **adjust the chemical concentration as advised** by the water treatment company.

5. Once per year unscrew one of the anode rods, remove it and examine it for degradation (anode rods are also consumed while providing protection). If the rod is "in poor condition" contact **DECTRA** to order replacement rods. Install new **magnesium** anode rods **without** thread compound or Teflon thread tape.

The rod thread **must** develop a good electrical contact with the tank fitting into which it is screwed. **Do not install aluminum anode rods. Accelerated anode rod degradation** may be a sign of electrolysis. Accelerated anode rod degradation may indicate the presence of a poor ground connection, a "floating ground condition" or stray voltage within the building wiring or electrical service to the building. Installation of a proper ground will help to minimize this condition. Contact a local electrician for additional grounding and stray voltage information.

6. Every three (3) to five (5) years drain you **GARN** unit and heating system. Check with local officials to ascertain the safety of draining the treated water onto the ground or into a city sewer system. **DO NOT DRAIN:** hot water (allow it to cool to 75 F or lower); water recently treated with biocide (wait 4 to 6 months); **GARN** water into a septic system (it will overload the system and possibly destroy it). Prevent animals from drinking the water; simply allow it to be absorbed by the soil. Before draining the unit, draw a treated water sample and set it aside (for testing if required).

   Flush the tank with clean water. Like the cooling system of a car, all chemical suppliers recommend a periodic flushing of the system. Hose down the entire inside of the tank. Flush out any and all sludge that has accumulated in the bottom of the tank. All dirt and sludge **must** be removed.

   Inspect the cleaned tank. This simple visual inspection is more informative than hundreds of lab tests. Look for and identify any type of corrosion. Save samples of any sludge and corrosion residuals. Forward the water sample, sludge sample and corrosion residual sample to your water treatment company. Upon receipt of the test results, adjust the chemical concentration as advised during refilling. Depending upon the type of corrosion found, check the tank ground, building electrical ground and anode rods. Clean all corrosion spots thoroughly by wire brushing and flushing with clean water.

7. Refill the **GARN** unit in compliance with **Initial Water Treatment Installation Procedures**, above. Obtain a treated water sample from the manway access and forward it to the water treatment company for an initial chemical test. Use standard sampling procedures in obtaining the sample. Upon receipt of the test results, **adjust the chemical concentration as advised.**

WATER FILTER INSTRUCTIONS

Printed below is the text of the label supplied with the water filter. Before filling the **GARN** unit with water, carefully and thoroughly read the above section titled **"Suggested Water Treatment Procedures".**

WATER FILTER INSTRUCTIONS

After installation of the **GARN** unit, thoroughly wash (with clean water) all inside surfaces of the tank to remove any foreign matter, dirt, scale or debris that may have accumulated during storage, shipping or installation. Flush all residuals out of the tank leaving all surfaces clean, including the bottom. Inspect the tank to ascertain that the unit is OK to fill with clean water.

Connect this **water filter** to a standard garden hose with a brass fitting (MPT to hose thread). Use the filter and hose to fill the unit to a water depth of approximately 12". Add the water treatment chemicals, then continue to add **filtered, clean water** until the **GARN** unit is full (water surface is 8" below the crown at the top of the tank). The above procedures are most easily accomplished through the manway on top of the tank.

Whenever additional water is added to the unit, utilize this filter so that sediment is **not** carried into the system. Replacement 5 micron filter elements are available from **DECTRA @ 1-612-781-3585.**

J. RULES OF THUMB FOR AN INTITAL ESTIMATE OF EQUIPMENT SIZE

The following "rules of thumb" are just that – **approximate values** that may be used to **estimate** the initial size of a GARN WHS unit and a heating system. Once a project is given the "go ahead" an **exact heat loss should be calculated** according to ASHRAE methods to ensure the correct sizing of the various components and selection of the correct GARN WHS unit. Over sized equipment leads to excessive first cost. An under sized system may not maintain proper indoor temperatures during winter operation or may require significant back up energy to maintain comfortable indoor temperatures.

Residential Heat Loss excluding ventilation:

- Old houses or poorly insulated houses – 20 to 35 BTUH/sq. ft. of **above** grade floor area.
- Uninsulated, but heated basements – 18 to 30 BTUH/sq. ft. of **below** grade floor area.

- Newer houses – 13 to 22 BTUH/sq. ft. of **above** grade floor area.
- Insulated, heated basements – 10 to 20 BTUH/sq. ft. of **below** grade floor area.

- Energy efficient houses – 8 to 15 BTUH/sq. ft. of **above** grade floor area.
- Insulated, heated basements – 8 to 12 BTUH/sq. ft. of **below** grade floor area.

Residential Ventilation:

- In newer tighter energy efficient houses, mechanical ventilation is required at a generally accepted rate of 15 cfm per person. This calculates to about 6,800 BTUH if an energy recovery device is NOT used; and 3,000 BTUH if an energy recovery device is installed.
  This should be added to the heat loss figure for newer houses, but not added to the heat loss figures of older houses.

Residential Domestic Water Heating:

- For a normal family of 4 in a modest house generally 40,000 BTUH of heating will provide a reasonable recovery rate when used with a 50 to 75 gallon water heater.

- For a larger family in a larger house it is recommended that a recovery rate of 75,000 BTUH be used coupled with a larger 100 to 120 gallon water heater.

- Maximum delivered water temperature must be 120 F or less; thus an anti-scald valve is required by most codes on the discharge of the water heater. Maintain the water heater at 140 F or higher to kill bacteria and virus.

Hot Tub Heating:

- Small (7' to 10' square x 4' deep) insulated outdoor hot tubes with an insulated cover generally require only 2,000 to 2,500 BTUH maintain temperature when the tub is covered at OD temperatures of –20F. It is assumed that the hot tub is used for brief periods (say 1 to 2 hours per day) during which time the evaporative cooling of the waters surface is the primary heat loss and may equal 6,000 to 9,000 BTUH. Hence, any heat exchanger used to heat a hot tub should be sized for 8,000 to 11,500 BTUH.

Radiant Floor Heating:

- Maximum flow for ½" PEX tubing is 5/8 gpm, maximum length of individual tube is 300' and maximum number of tubes per mini manifold is 8 (assumes 100% water).

- Maximum flow for 5/8" PEX tubing is 1 gpm, maximum length of individual tube is 450' and maximum number of tubes per standard manifold is 12 (assumes 100% water).

- Normal temperature drop is 10F to 20F per tube length and try not to exceed a floor surface temperature of 85F (comfort and finish materials limitations).

- **Always insulate** beneath a radiant floor system whether on grade or above grade.

Forced Air Heating:

- Size a coil that increases the air-side pressure drop by only .25" to .33" WC. Increase blower RPM to offset this increased static pressure and maintain CFM. Also, select a coil that will provide a supply air temperature of 110F or slightly greater. Code limit is 140F.

- Pipe all coils in a **counter flow** pattern. The "normal" range of water temperature drop through a coil is 8 F to 20F.

- Mount a new hot water coil (flat and A type) on the discharge side of the furnace. In almost all cases the coil will be physically larger than the existing supply air plenum: thus the plenum size will have to be increased. Sheet metal work must be designed and fabricated in accordance with SMACNA guidelines.

- **Unless specifically approved by the furnace manufacturer**, do not mount a hot water coil on the return side of the furnace as warm air will be flowing over the blower motor and may not provide sufficient motor cooling. Doing so without the furnace manufacturers specific approval may void the furnace warrantee and the UL listing of the furnace.

- IF the furnace is more than 12 years old, consider installing a new unitized **fan coil unit** that provides a motorized fan, filter, 3 or 4 row hot water heating coil, DX cooling coil and controls all within one insulated sheet metal unit. Such units are manufactured to match residential furnaces in overall length, width and height.

Hot Water Baseboard Heating:

- HWBB output ratings are based upon a 1 gpm to 4 gpm flow rate and a 215F entering water temperature (EWT) for most ¾" and 1" standard sizes. Derating correction factors are to be applied to the 215F ratings when a lower EWT is utilized. Refer to the Section L for additional information regarding this issue.

- Normal temperature drop is 10F to 20F per HWBB run. Many **non-wood** systems today are based upon an EWT of 140F and a RWT of 120F to take advantage of condensing boilers.

- Combining a radiant floor manifold and PEX tubing with HWBB, can yield individual room control with wall mounted, night set back thermostats.

- Modern European flat panel wall mounted steel radiators (such as Runtal, etc) are similar in flow requirements as HWBB.

K. PIPING and PUMPS TO DISTRIBUTE THE HEAT

The **GARN WHS** unit is non-pressurized. As such, the gasketed manway cover is simply set upon the top surface of the manway access ring. **DO NOT FASTEN OR OTHERWISE ADHERE** the cover to the tank or access ring; likewise, do not add weight to the cover after the cover is in its final position.

An internal overflow/vent will prevent the development of internal pressure that could result from the gentle expansion and contraction associated with the varying temperature of water storage. In cases when accidental over firing results in rapid boiling, the manway cover is designed to rise slightly to relieve internal pressure and vent water vapor.

Correctly sized piping and pumps are necessary for the efficient and safe transport of heated water from the **GARN WHS** unit to the building heating system.

All piping, pumps, wiring and controls, etc must be sized and installed by a qualified and licensed professional. All items are to be installed in full compliance with all national, state and local codes.

For installations not covered in this manual contact your local GARN dealer or DECTRA CORPORATION for design assistance.

General Piping Guidelines

Size all **above grade and underground piping** per standard industry guidelines:

1. Maximum head loss of 4' per 100' of pipe.
2. Maximum velocity of 8' per second to minimize surface erosion potential in most pipes.
3. Maximum velocity of 6' per second to limit noise.

Incorrect pipe sizing will adversely affect the heating system performance, efficiency and cost of operation. Undersized piping may cost less to install; however, the pump size must be increased, adding significantly to the pump cost and the cost of operation. Head loss data for a specific pipe or tubing, and for various fittings is tabulated in manufacturer literature, plumbing manuals, state plumbing codes and local building codes. A representative sample of the head loss associated with various fittings for **copper or steel** is listed below. Recommended flow rates for various pipe materials are tabulated on the next page.

EQUIVALENT FEET OF PIPE FOR FITTINGS AND VALVES

Nominal pipe size, inches	1/2	3/4	1.0	1 1/4	1 1/2	2.0
45 Degree Elbow	0.8	0.9	1.3	1.7	2.2	2.5
90 Degree Elbow Long	1.0	1.4	1.7	2.3	2.7	3.5
Gate Vale. Open 0.7	0.7	0.9	1.0	1.5	1.8	2.3
Full port ball valve	0.3	0.4	0.5	0.7	0.8	1.0
Tee-Side Flow	3.0	4.0	5.0	7.0	9.0	12.0
Swing Check Valve	6.0	8.0	10.0	14.0	16.0	20.0

FLOW AT RECOMMENDED 4' OF HEAD LOSS PER 100' OF PIPE LENGTH

Size	Inside dia.	Flow, gpm	BTU/HR @ 20F delta T	BTU/HR @ 10F delta T
Oxygen Barriered PEX Tubing				
3/4"	.678"	4.5	45,000	22,500
1"	1.060"	8	80,000	40,000
1 1/4"	1.28"	15	150,000	75,000
1 1/2"	1.60"	27	270,000	135,000
2"	2.03"	52	520,500	260,250
Type L Rigid Copper Tube - max. vel = 6'/sec for noise; max. vel = 10'/sec for erosion				
3/4"	.785"	3.5	35,000	17,500
1"	1.025"	6.5	65,000	32,500
1 1/4"	1.265"	12	120,100	60,050
1 1/2"	1.505"	18	180,000	90,000
2"	1.985"	39	390,300	195,150
Schedule 40 Black Steel Pipe				
3/4"	.824"	4.2	42,000	21,000
1"	1.049"	8	80,000	40,000
1 1/4"	1.380"	17	170,100	85,050
1 1/2"	1.610"	25	250,000	125,000
2"	2.067"	48	480,400	240,200

- Die-electric couplings **must** be installed between any metallic pipe and the **GARN WHS** unit. If using copper pipe see the next paragraph.
- When installing copper distribution pipe use **ONLY:** long sweep elbows; 95-5 solder or brazing; and die-electric couplings where copper pipe joins steel pipe. **DO NOT CONNECT** copper pipe directly to the **GARN WHS** unit as electrolytic corrosion will occur. Install 4' to 6' of black steel pipe between the copper pipe and the **GARN WHS** unit.
- If installing steel pipe, use **ONLY** black steel pipe. **DO NOT USE** galvanized pipe.
- **DO NOT** install polybutylene or PVC plastic pipe.
- Provide pipe support according to plumbing code guidelines.
- After installation, flush all piping to remove, threading oil, solder flux, debris, etc.
- All check valves and ball valves shall match pipe size. Ball valves shall be full port, if possible.
- **DO NOT** install piping to produce a bull-headed tee condition.
- Install accessible shut-off valves on the supply and return pipes near the **GARN WHS** unit.
- Install a separate boiler drain at the designated fitting on the front head of the unit.

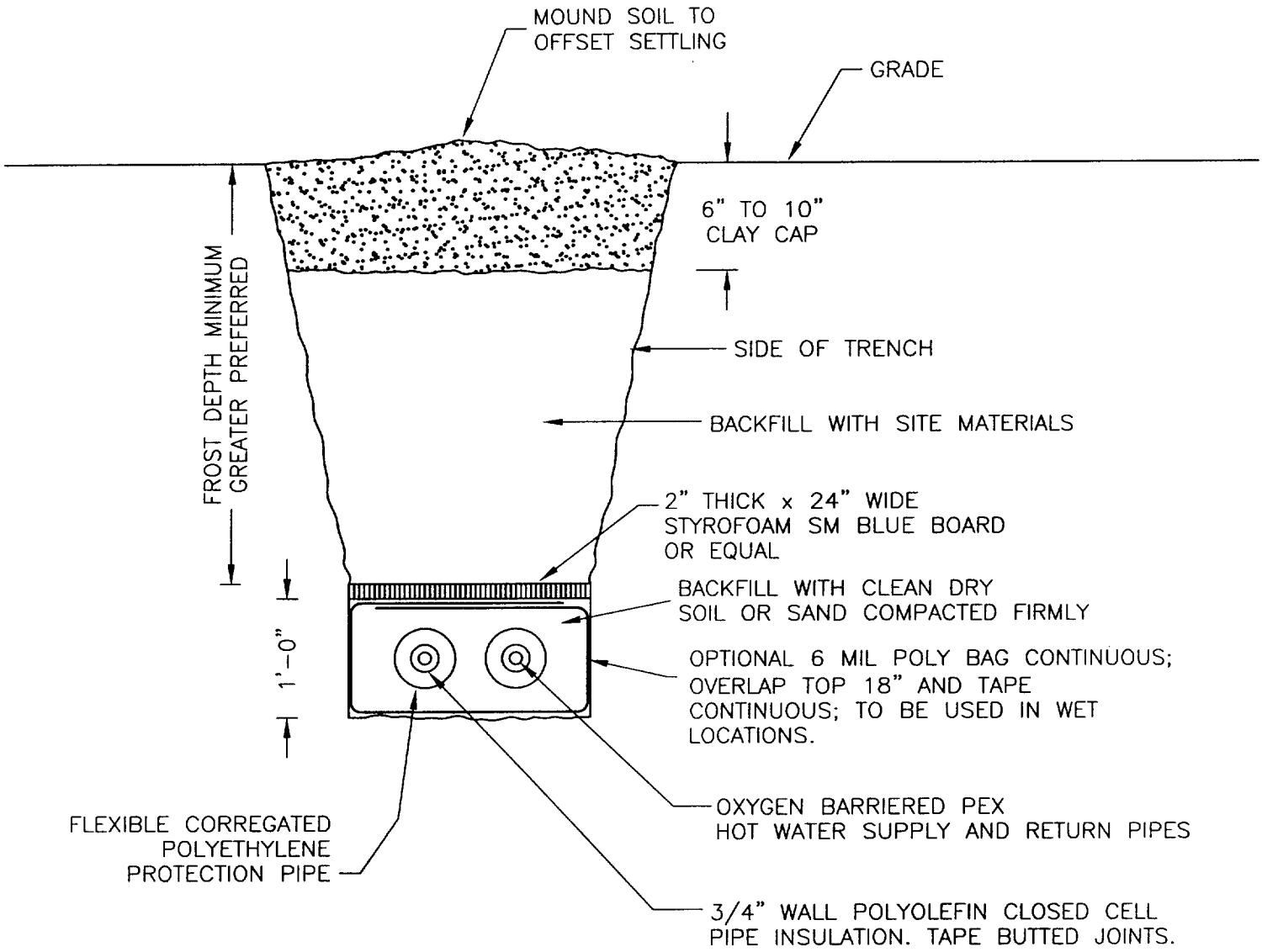
- Install drain valves where appropriate and required to allow future maintenance and equipment repair/replacement.
- **DO NOT** Install automatic air bleeds in a non-pressurized system. Install only manual air bleeds at all system high points.
- In new installations a floor drain should be provided to accommodate the over flow pipe and drain valve.
- Install a domestic water sill cock for adding water near the **GARN WHS** unit. A filter housing and filter is provided and should be mounted in series with, and adjacent to, the sill cock. Use a hose to fill the unit through the manway opening. **DO NOT** permanently connect the **GARN WHS** unit to a domestic water source.
- Insulate all above grade piping with ¼" to ½" wall polyolefin pipe or fiberglass insulation rated to 212 degrees (Thermocel, Imcolock, Imcoshield are preferred brands).
- Retrofitting a **GARN WHS** unit to an existing pressurized heating system will require the installation of a pressure rated flat plate heat exchanger. Contact your local **GARN** dealer or **DECTRA CORPORATION** for sizing, availability and pricing.

Underground Piping

Use only **oxygen barriered,** cross linked, high density polyethylene for underground installation. HeatLink, Wirsbo and pre-insulated Ecoflex are the preferred brands. Underground piping must be designed to allow for expansion and installed in strict compliance with the manufacturer's specific instructions. In addition:

- **DO NOT** install copper, steel, polybutylene or PVC pipe underground.
- **DO NOT** join pipe underground unless absolutely necessary. If required use **ONLY** materials provided by the pipe manufacturer and installed according to their specific directions.
- Insulate all underground pipe with at least ½" wall polyolefin pipe insulation rated to 212 degrees. Thermocel, Imcolock, Imcoshield are the preferred brands. **DO NOT USE** rubber based insulation (such as Rubatex) as it will absorb water and destroy the insulation value.
- Encase the pipe/insulation within flexible, black corrugated seamless **non-perforated** polyethylene drainage tubing. This is low cost and locally available in 4" to 8" diameters. This provides protection against ground water, inquisitive small animals and abrasion. Extend the encasement pipe to a point about 6" above grade to prevent the intrusion of unwanted surface water.
- In very cold climates place a sheet of 2" thick x 24" wide foam insulation (blue, pink, yellow or green) board immediately above the pipe, centered on the pipe before back filling the trench. Trench depth in cold climates should be 4 feet (grade to top of pipe) if possible.
- Deeper burial and additional insulation is required when below grade piping extends beneath a parking lot or roadway (frost will normally penetrate the soil to a greater depth in such areas).
- Pressure test for water leaks before back filling the trench.
- If the piping can only be positioned above frost depth, provide a pump timer to circulate water for ten minutes every hour.

On the following page is a drawing of a typical underground pipe installation with pertinent details. Note that the "poly bag wrap" is required only in location of **continuously wet soils.** However, it is always best to avoid such soil conditions if at all possible.



UNDERGROUND
HEATING PIPE
DETAIL

DRAWINGS\MDETAILS\HYDRONIC\MD03H02C

Dectra

CORPORATION

3425 33RD. AVE. N.E., ST. ANTHONY, MN. 55418 612-781-3585

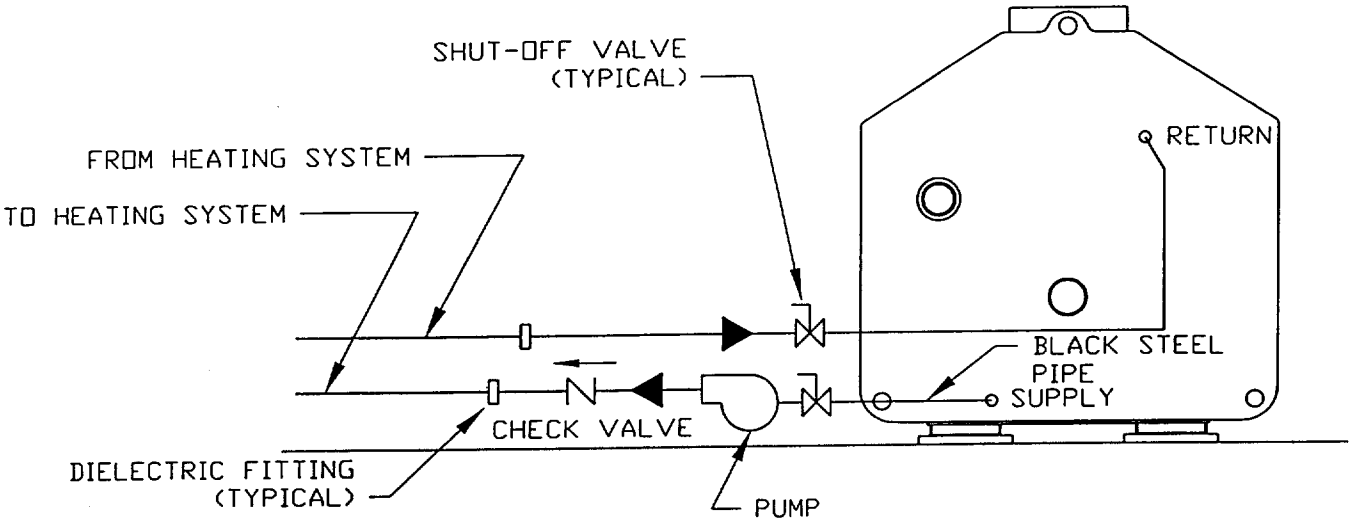
Pump Selection and Installation Guidelines

All pumps must be selected based on a **calculated total** static and frictional head loss of the piping connected to the pump as well as the calculated required system flow.

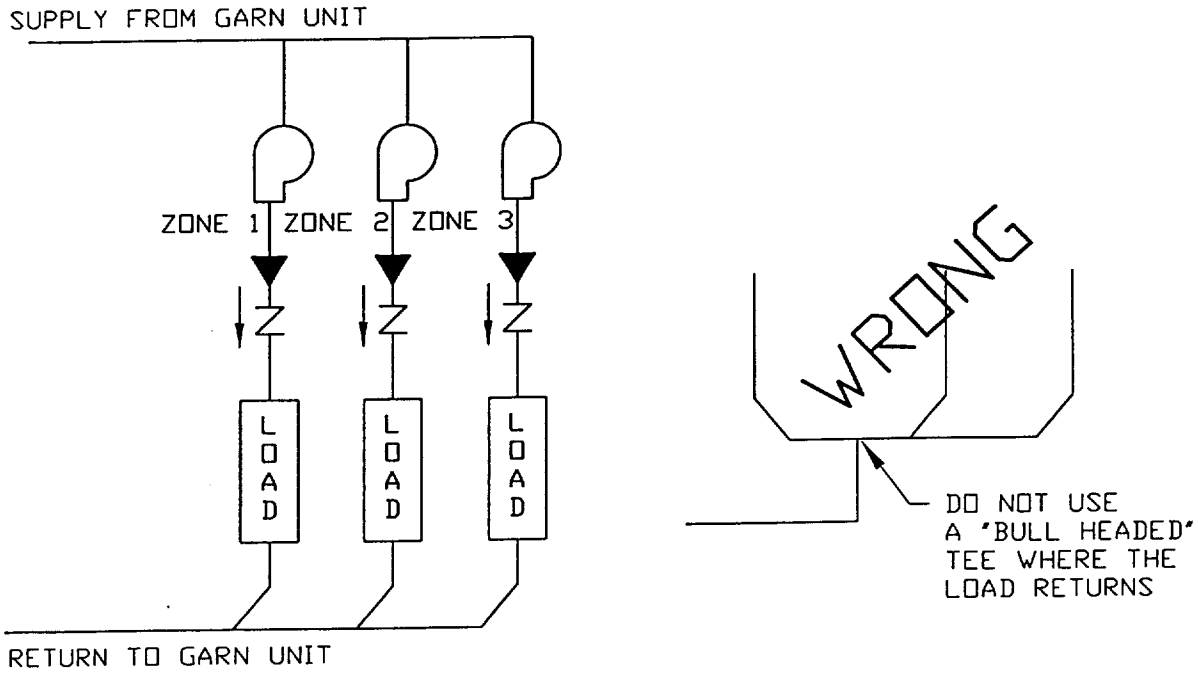
Preferred pump brands include: Grundfos, Bell & Gossett, and Taco.

- Select a pump that delivers a flow rate that does not violate the above listed General Piping Guideline for head loss and fluid velocity.
- All pumps shall be installed in strict compliance with manufacturers instructions, with particular attention to shaft orientation and the length of straight run of inlet and discharge pipe required to produce stated performance. In most cases, install pumps to discharge vertically up or horizontally.
- Provide isolation full port ball valves and flanges on the inlet and discharge of the pump.
- Pumps should be located adjacent to the **GARN WHS** unit if at all possible. Mount pumps at least 3' below the surface of the **GARN WHS** water level in order to prevent suction boiling at the pump inlet at higher water temperatures.
- A heating system may use several zones within a building. Likewise, one **GARN WHS** unit may supply heat to several buildings. Use individual pumps with check values for each zone (or building) and develop a common supply manifold to feed the pumps. Likewise, provide a common return manifold. **DO NOT** install manifold piping to produce a bull-headed tee condition.
- In a remote location, zone pumps may be mounted adjacent to the heating system **PROVIDED:** the total head loss (static and frictional) of the supply pipe is equal to or less than 3 feet; and the pump is mounted at least 4' **below** the surface of the **GARN WHS** water level. Again this is necessary to prevent suction boiling at the pump inlet.
- **Do not** select a pump to operate near the top of its pump curve as "cycling flow" may occur with resultant damage to the pump and substandard system heating performance.
- In an existing system, the pump size must be confirmed as adequate for the modified system.
- Under-sizing a pump will significantly reduce the performance of the heating system and may allow system piping to freeze.

Refer to the drawings on the next page for **general** schematics associated with a single **GARN WHS** unit heating a single building containing either a single zone system and a multiple zone system.



Typical Single Zone System



Typical Multiple Zone System

Another pump/piping strategy that can allow for a better control, smaller pumps and fewer design calculations is as follows (refer to the drawing on the following page). This drawing details a single GARN WHS unit providing heat to two separate buildings, a home and a shop. This type of system is termed a "primary secondary piping system." Note the following:

- Pumps P1 and P3 circulate water from the **GARN WHS** unit to a pair of closely spaced tees within each building and then back to the **GARN WHS** unit. The two pumps are sized based upon the head loss of the underground piping and the manifolds at the **GARN WHS** unit. The head loss for the piping **within** either building is **NOT** taken into account. This makes for simpler piping head loss calculations when interfacing with an existing system.

  The underground piping and the GARN manifold are considered the **"primary piping loop."**

- Pumps P2 and P4 simply circulate warm water (a mixture of cool system return water and hot **GARN WHS** water) to the heat delivery system within the building. The two pumps are sized based upon the piping and equipment head losses within the building **without** taking into account the head loss of the underground piping or the manifold at the **GARN WHS** unit. This allows a good match between pumps P2 and P4 and the heat delivery equipment (air coil, hot water baseboard, radiant floor, or any combination thereof). In fact multiple small pumps may be used to split the building into independently controlled heating zones. Again, this makes for simpler piping head loss calculations when interfacing with an existing system because the existing pump generally does not have to be replaced as it experiences no net change in its resistance to flow.

  This piping within the building is considered the **"secondary piping loop."**

One could further increase the energy efficiency of this system by utilizing variable speed pumps for P1 and P3. The speed of the pumps would be controlled by an optional temperature sensor or even an indoor outdoor reset temperature controller. Thus whenever the **GARN WHS** unit was hot (say 195F) P1 and P2 would run very slowly as only a small volume of hot **GARN WHS** water would be required to warm the water within the secondary piping loop. When the **GARN WHS** unit was cool (say 125F) the pumps would provide a greater flow to warm the water within the secondary piping loop.

Some specifics about the closely spaced tees:

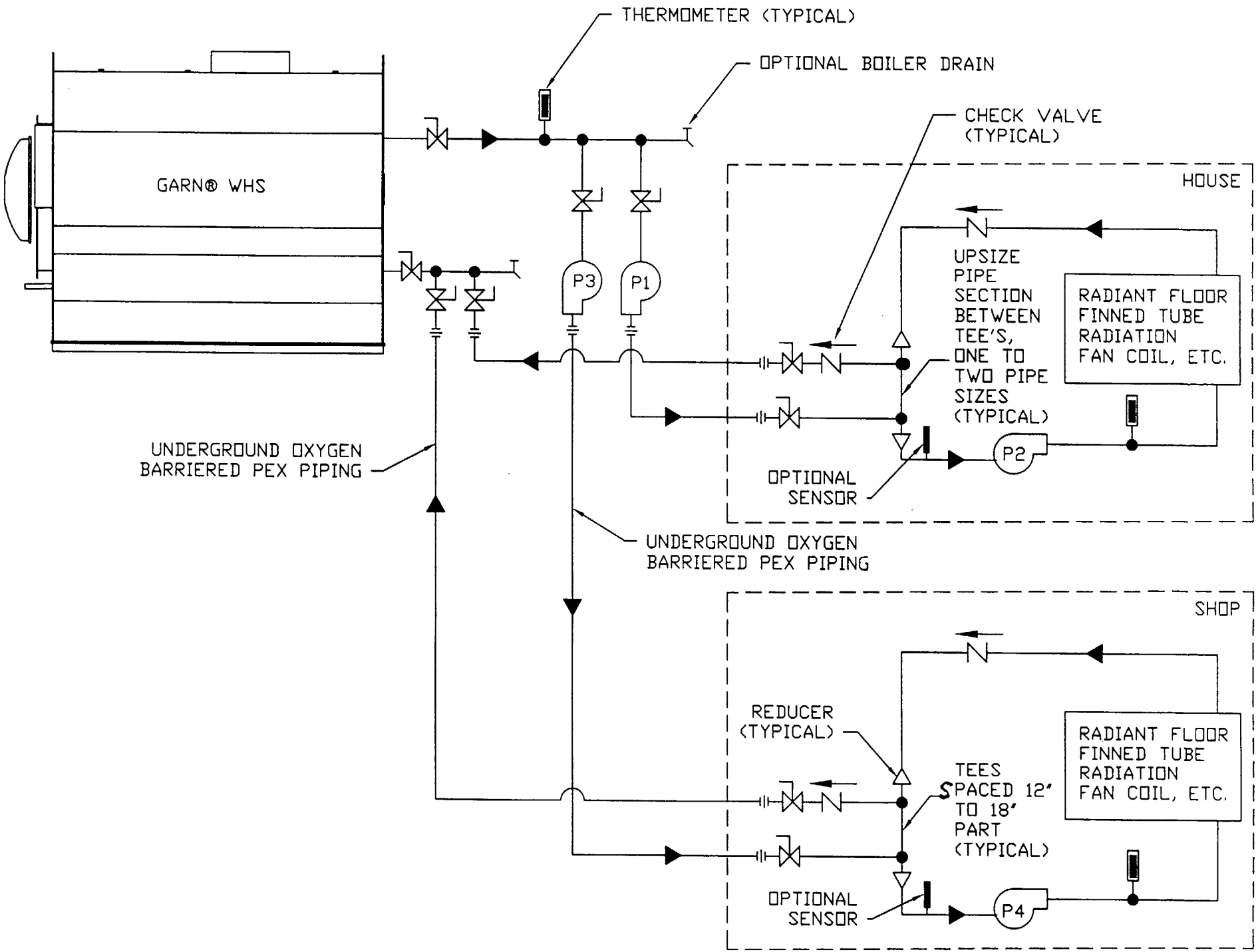
- The tees should be 12" to 18" apart and the pipe section between the two tees should be fabricated from pipe one to two sizes larger than the secondary system pipe.

- The tees should be located on the return side of any hot water heating system.

- Flow between the tees may reverse direction when the secondary system pumps (P2 and P4) are activated.

- The piping reducers are beyond the 12" to 18" of pipe and the two tees.

- Activation of P1 and P3 may be interlocked with P2 and P4 except when there is a possibility of the underground piping freezing.


THERMOMETER (TYPICAL)
OPTIONAL BOILER DRAIN
CHECK VALVE (TYPICAL)
GARN® WHS
HOUSE
UPSIZE PIPE SECTION BETWEEN TEE'S, ONE TO TWO PIPE SIZES (TYPICAL)
RADIANT FLOOR FINNED TUBE RADIATION FAN COIL, ETC.
P3
P1
P2
OPTIONAL SENSOR
UNDERGROUND OXYGEN BARRIERED PEX PIPING
UNDERGROUND OXYGEN BARRIERED PEX PIPING
SHOP
REDUCER (TYPICAL)
TEES SPACED 12' TO 18' PART (TYPICAL)
RADIANT FLOOR FINNED TUBE RADIATION FAN COIL, ETC.
OPTIONAL SENSOR
P4

L. BUILDING HEAT DISTRIBUTION SYSTEMS

All piping, pumps, wiring and controls, etc must be sized and installed by a qualified and licensed professional. All items are to be installed in full compliance with all national, state and local codes, as well as the manufacturer's manuals and specific instructions. For installations not covered in this manual contact your local GARN dealer or DECTRA CORPORATION for design assistance.

CONNECTION TO FORCED AIR FURNACE

Water/Air Coil

A water/air coil may be added to any forced air furnace or blower cabinet to serve as the primary source of heat. When the room thermostat demands heat, water from the **GARN WHS** unit is circulated through the coil and the blower moves air through the coil. In a two-fuel installation, the thermostat will activate the auxiliary heating unit if there is insufficient heat from storage.

When adding a water/air coil to any forced air furnace please note:

- **DO NOT** relocate, modify or rest any of the safety controls in the original furnace installation.
- Blower pulleys and motor pulleys may be changed, but the electrical current flowing through the motor is to be maintained within the nameplate rating. Under some circumstances a larger motor may have to be installed.
- Any water/air coil added to the system must be installed in accordance with the instructions of the manufacturer and in a manner acceptable to the regulatory authority by mechanics experienced in such services.

Coil Selection

- Check the nameplate on existing heating system for BTU/HR output, blower CFM and allowable external static pressure. Measure the external static pressure with a clean filter in position.
- Choose coil based upon desired BTU/HR output and LOWEST entering water temperature (usually 110—130 degree STORAGE water temperature).
- Choose circulating pump based upon required water flow and total system pressure drop,
- Determine if EXISTING furnace blower is adequate. If NOT adequate, and furnace is in GOOD condition, replace blower assembly or blower motor and outlays to yield proper flows. It NOT adequate and furnace is in POOR condition, replace the furnace with a new furnace of proper blower capacity. Or replace the furnace with a package fan-coil unit. It the furnace is adequate and in good condition, install the coil.
- **DO NOT INSTALL A COIL IN A SYSTEM THAT UTILIZES A HIGH EFFICIENCY OR CONDENSING FURNACE.**
- Call your local GARN® dealer or DECTRA CORPORATION if you do not have a source for coils.

High Limit Switch

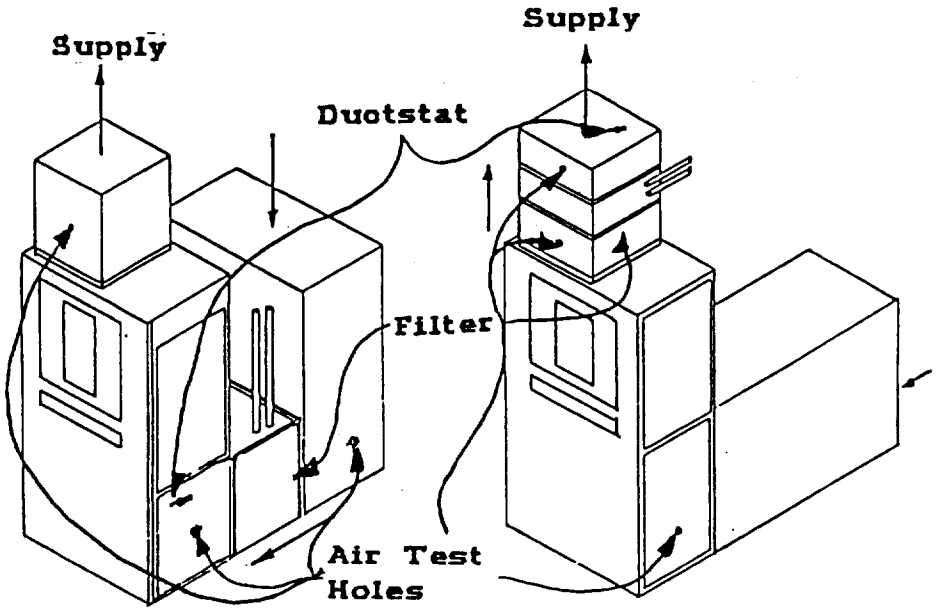
If the coil is placed on the return airside, a high limit switch, located on the downstream side of the coil, provides overheating protection for the blower motor. If the temperature of air discharged from the coil reaches l20F degrees, the switch stops the fluid flow through the coil. No additional heat will be available from the coil and the blower motor will not be subjected to excessive air temperature.

If the coil is placed on the supply airside, the high limit switch, located on the downstream side of the coil, provides overheating protection for the space being heated. If the temperature of air discharged from the coil reaches 140 degrees, the switch stops the fluid flow through the coil.

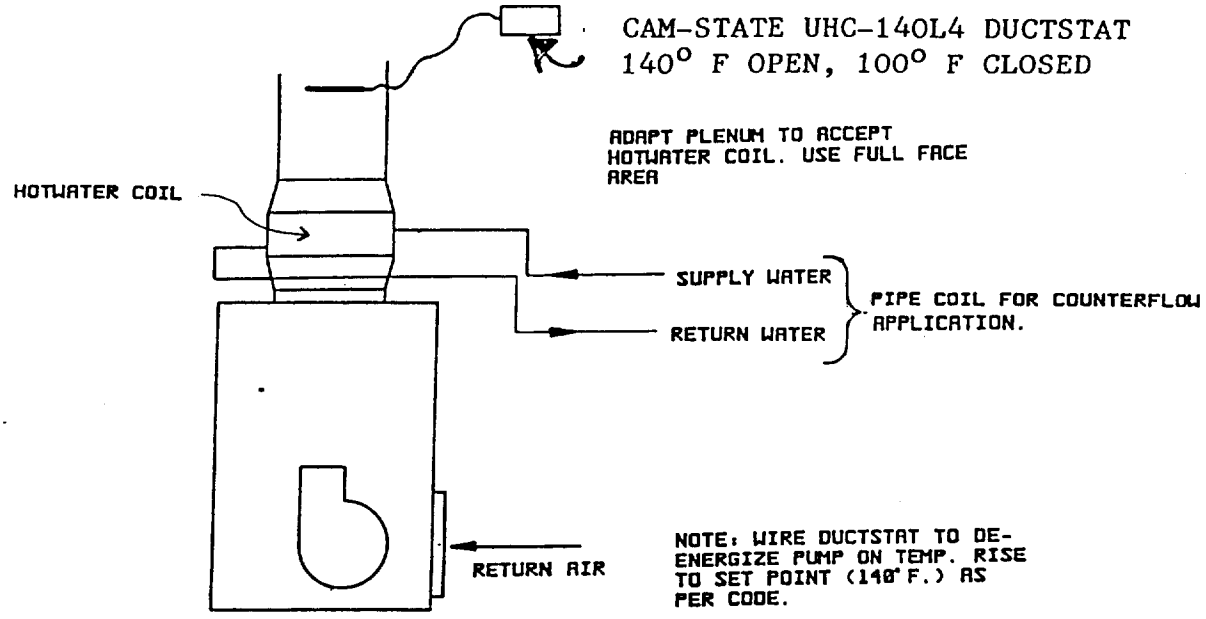
Blower Adjustment

It is very important that the proper air volume is supplied to the heated space, across the furnace's heat exchanger, and across the coil. These air volumes are to be determined by design specifications. A draft gauge reading of pressure drop across the furnace is taken before the coil is installed. This yields the initial system air volume. After the coil is installed, a pressure drop across the coil should be taken to indicate the new system air volume. This new system air volume must be adjusted to supply (1) the minimum air volume across the furnace's heat exchanger as specified in the manufacturer's engineering data, (2) the proper air volume across the coil to yield the required output, (3) the proper air volume to heat the space.

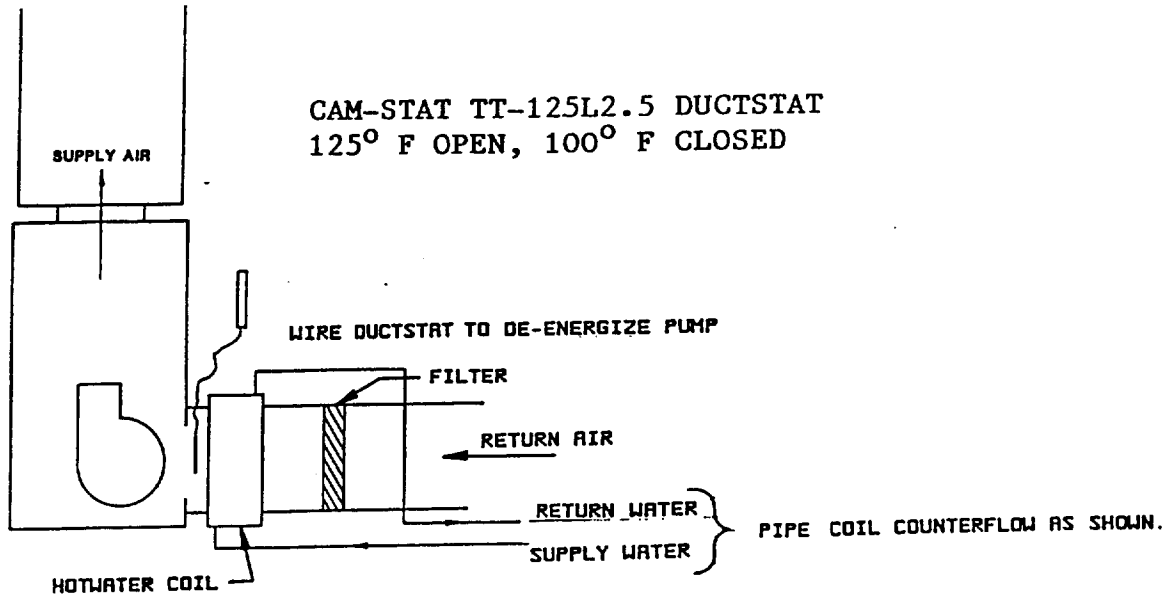
- A minimum of three 1/4" air test holes must be drilled. One in the ductwork on both sides of the furnace and one on both sides of the coil. Refer to following three (3) diagrams.
- Connect draft gauge. The zero end of the draft gauge scale connects to the air entering side. Insert the hoses so about. 1/4' extends inside the plenum. Seal around holes with permagum.
- Start furnace blower motor by placing thermostat fan switch in continuous position with no heating or cooling demand. Turn on power.
- Refer to the manufacturer's literature for the list of air volumes and equivalent draft gauge readings. Observe draft gauge reading, If reading is below required air volume, increase blower speed, if reading is above required air volume, decrease blower speed. Refer to furnace wiring diagram for changing direct drive blower speed.
- On belt drive blowers, check amperage draw on motor by connecting an ammeter to one leg of the motor supply line and comparing this reading with the full load amps listed on the motor nameplate. The motor pulley must be adjusted **not to exceed** the motor nameplate full load amps for motor installed.
- After required draft gauge readings are obtained, remove draft lines and insert snap hole plugs in air test holes.



Coil on return side of furnace **Coil on the discharge side of the furnace**



Forced air furnace – coil on discharge side of furnace



Forced air furnace – coil on return side of furnace

CONNECTION TO HOT WATER BASEBOARD SYSTEM

Hot water baseboard guidelines

Install good quality (even commercial grade) hot water baseboard. Sterling is a preferred brand. Cheaper grades produce few BTU'S per linear foot of baseboard; thus require significantly more footage for a given heat loss. Look for copper tube/aluminum finned elements, full back plates and die formed hangers with nylon or roller slides to eliminate noise. In addition:

- Size the baseboard for 140 F supply water temperature and a 20 F temperature drop.
- Circuit baseboards in a parallel configuration so that all elements receive the same 140 F supply water.
- Utilize either copper or **oxygen barriered,** cross linked, high density polyethylene for supply and return piping.
- **DO NOT** mount the baseboard closer than 4" above the floor.
- Size the pump to provide 1 to 1.5 gpm of flow at a maximum velocity of 4' per second through each baseboard.
- Individual room-by-room control is best. If this is not possible, try to zone the system so that rooms with similar heat loss characteristics are on the same circuit.
- Whenever a zone thermostat calls for heat, the pump serving that zone is to be activated.

New construction

Determine the lineal footage of wall that is available for the placement of the hot water. Divide the BTU/HR heat loss of the building by the available footage. Select the baseboard units that can supply the BTU's per foot required to meet the building's heat loss. Select the baseboard based on a supply water temperature of 140 F. Adding more baseboard, selecting a more efficient baseboard, or selecting a larger GARN unit maybe required it the available liner wall footage is not sufficient.

Converting an existing baseboard system

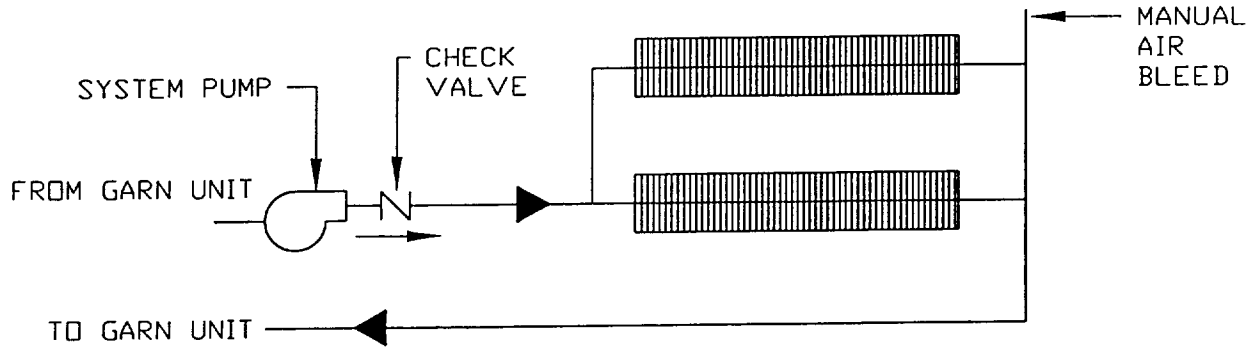
Most installers select a GARN system that will supply 140 degree water to a baseboard system. If the existing system was supplying water at a higher temperature, say 180 degrees, an analysis must be done to determine whether a lower supply temperature water will meet the needs of the building. The following table can be used for this purpose.

Water Temperature Correction Factors, based on an entering air temperature of 65 F

	Average supply water temperature in degrees F.												
	100	110	120	130	140	150	160	170	180	190	200	210	215
Correction factor	.13	.19	.25	.31	.38	.45	.53	.61	.69	.78	.86	.95	1.0

The above table can be used to determine the difference between the BTU/HR delivered by the existing system vs. the BTU/HR that can be delivered by the GARN system at a lower supply water temperature. A standard of 215 degrees is used in the industry as the basis for rating. If a baseboard is rated at 1000 BTU's/linear foot at 215 degrees (contact manufacturer for output ratings), the table indicates that at 180 degrees the existing baseboard can deliver 69% of the rated BTU's or 690 BTU's/linear ft. A GARN system sized to use 140 degree water will yield 38% of the rated BTU's or 380 BTU's/linear ft. If the old system was sized twice as large as the actual heat loss (a common occurrence), then the sizing of the GARN system for 140-degree water is correct. If more heat is required, a larger storage system or more baseboard footage will be required.

The **drawing below** shows a simple, multiple zone hot water baseboard system.



CONNECTION TO HYDRONIC RADIANT FLOOR SYSTEM

Radiant floor guidelines

Use only **oxygen barriered,** cross linked, high density polyethylene for radiant floor installation. HeatLink, Wirsbo, Kitec and Roth are the preferred brands. Any radiant floor system shall be installed in strict compliance with manufacturers specific instructions. In addition:

- **DO NOT USE** steel, copper, rubber based hose (such as Heatway tubing), low density polyethylene, polybutylene or PVC plastic pipe as radiant floor tubing. All of these involve significant and complex corrosion and durability issues for the tubing, pumps and controls, as well as GARN equipment.

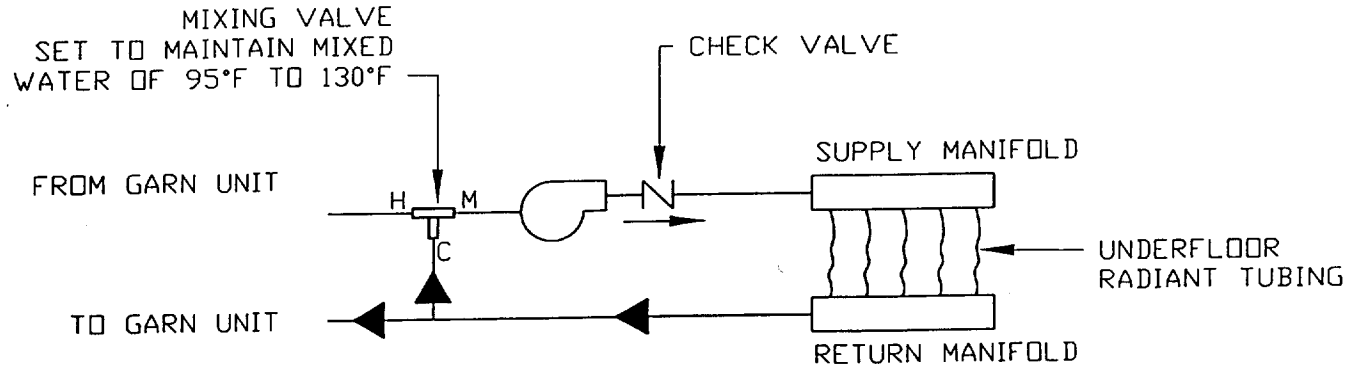
- The installation of rubber based hose (such as Heatway tubing), low density polyethylene, polybutylene or PVC plastic pipe in a radiant floor system connected to a GARN unit **will void the GARN warrantee.**

- In new construction, install 2" of blue, yellow, green or pink foam board (**extruded** polystyrene foam – minimum of 1.6 PCF density, per ASTM C 578-95 specification) under the **entire** slab that is to be radiantly heated. The foam should be placed immediately below the bottom of the slab, upon 6" of well compacted granular fill. This construction provides a proper structural bed (compacted gravel) yet minimizes downward heat loss.

- When radiant heating is utilized with above grade floors, the underside of the floor **MUST** be insulated to prevent significant downward heat loss and overheating of the rooms below. A minimum insulation valve of R =13 is recommended.

- The radiant floor manifolds supplied by the manufacturers listed, provide for room-by-room control while using a single pump and mixing valve. Therefore, multiple pumps/valves are generally not required.

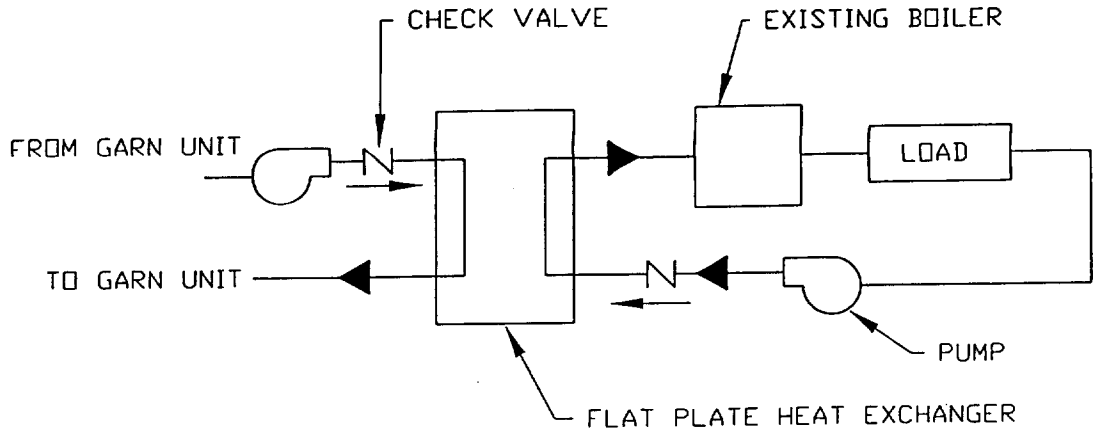
- Install a 3 way mixing valve to bend cooler radiant floor return water with hot supply water from the GARN unit in order to maintain the moderate supply water temperatures (between 95 F and 130 F) required for radiant floor heating. Preferred mixing valve brands are Paxton ESBE, Honeywell Sparco and Watts. Install the mixing valve between the GARN unit and pump so that the pump draws through the valve from the GARN. Note the position of the pump in the **drawing below:**



CONNECTION TO AN EXISTING PRESSURIZED SYSTEM

In some instances, the backup system will be an existing pressurized boiler. Retrofitting a **GARN WHS** unit to an existing pressurized heating system will require the installation of a pressure rated flat plate heat exchanger. Contact your local **GARN** dealer or **DECTRA CORPORATION** for sizing, availability and pricing of FlatPlate heat exchangers. Note the following and review the drawing below:

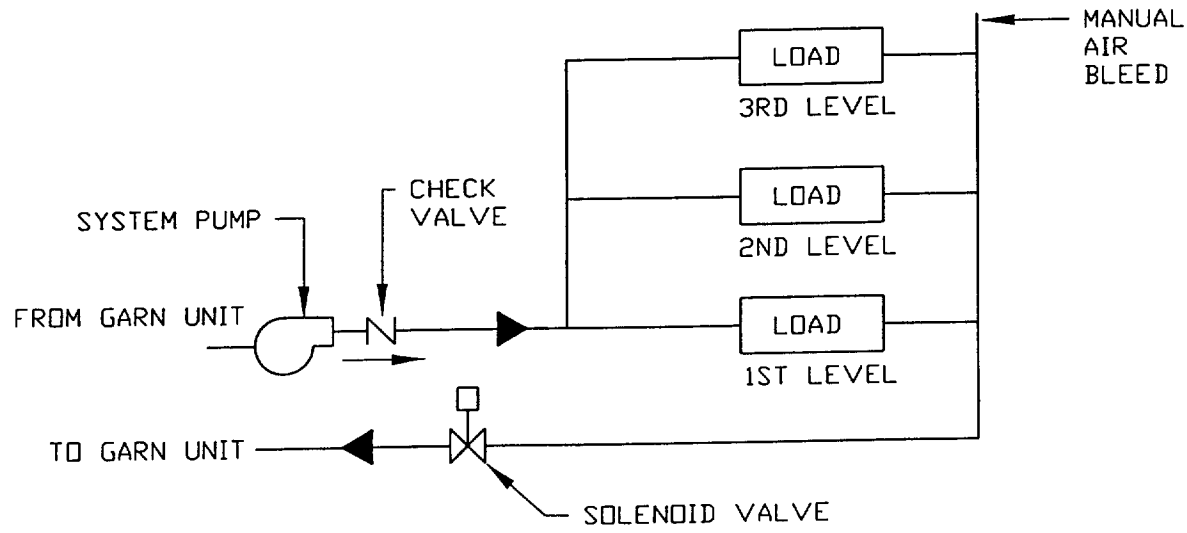
- **DO NOT** connect any GARN unit to a steam boiler or steam heating system.
- The water-to-water heat exchanger must have a pressure rating that is equal to or greater than the pressure rating of the existing boiler.
- The heat exchanger shall be positioned on the return side of the existing boiler.
- The **GARN WHS** unit and the heat exchanger shall **NOT** be installed so as to interfere with the normal delivery of heated water from the existing boiler.
- The **GARN WHS** unit and the heat exchanger **SHALL BE** installed without changing the function of the controls or rewiring the existing boiler. A control wiring connection is permitted only if required to obtain proper operation. For instance, when a thermostat calls for heat, both the GARN pump and the existing pump are to be powered.
- The electrical system of the existing boiler and GARN unit shall be powered from a single branch circuit, without exception.
- The **drawing on the next page** is a schematic representation of connection to an existing pressurized system.



CONNECTION TO AN ELEVATED SYSTEM

Even though the **GARN WHS** unit is non-pressurized, it is adaptable to heating systems that are elevated up to 24' above the level of the slab on which the GARN unit sets. If the vertical distance is greater than this, a flat plate water-to-water heat exchanger must be installed (refer to "Connection to an Existing Pressure System). Note the following and **review the drawing below:**

- This type of system is found mostly in warehouses with high ceilings and in multiple floor residences or small commercial facilities.
- All piping and flanges **MUST** be air-tight or this type of installation will not function properly. Air leaks will constantly bleed air into the system (negatively affecting both system performance and corrosion).
- **DO NOT** use automatic air bleeds in the heat delivery system. Install only manual air bleeds.
- Select pump to overcome total head, i.e., pipe friction and vertical elevation. Pump sizing is very critical in this application.
- Install a solenoid valve that is energized to open when the pump is powered. This valve is to close whenever the pump is not powered. The valve locks the water in vertical loop when the pump is not operating.
- Install a reliable full port spring check valve down stream of the pump.



DOMESTIC HOT WATER CONNECTION

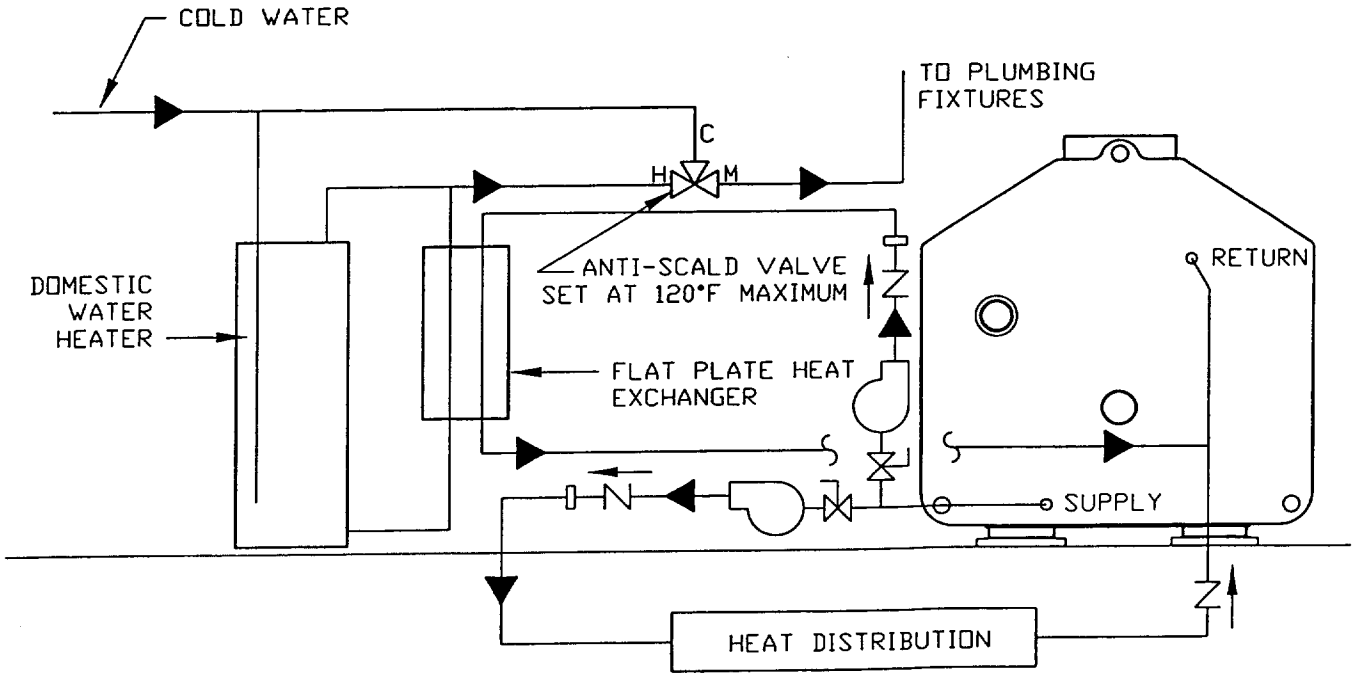
The preheating or heating of domestic water is easily accomplished with GARN equipment. However, in-tank copper water heating coils are **NOT** provided within the GARN tank for several reasons:

- A copper coil within any steel boiler induces electrolytic corrosion, leading to early tank failures.
- With a coil inside a remote boiler, two additional below grade insulated domestic water lines are required (a supply and return line that connects the coil to the water heater). This adds significant cost to the project.
- Because on non-turbulent flow conditions, the tank mount heat exchanger is significantly larger (more expensive) that a heat exchanger mounted close to the water heater.

The two methods of preheating domestic water include: an external "saddle mounted" heat exchanger; and a stand alone "indirect fired" tank heat exchanger. The FlatPlate brand of stainless steel water-to-water heat exchangers is recommended for use as a "saddle type" heat exchanger. This heat exchanger is to be mounted external of, close to and slightly below the level of the top of the existing water heater. Saddle heat exchanger can be installed to thermo-siphon or use a pump on the domestic water side.

Indirect fired tank heat exchangers generally include a stainless steel internal coil within an insulated stainless steel tank. This unit is then connected in series upstream of the existing water heater. Contact your local **GARN** dealer or **DECTRA CORPORATION** for sizing, availability and pricing of either preheat unit. Please carefully review the following as it applies to **ANY** domestic water heating system.:

- All domestic water piping, valves, fittings, pumps, controls and the overall installation must meet all national and state plumbing, sanitation and health codes.
- After installation is complete, the entire domestic waterside of the system must be pressure tested, flushed, then sanitized according to local health department requirements.
- In all cases, a NSF or Board Certified **anti-scald mixing valve** is required by national and state codes when preheating or heating domestic water with equipment other than a conventional water heater. The valve shall be set to deliver hot water at a temperature of 120 F maximum.
- Install an aquastat or differential thermostat to control the small (1/25 hp) system pumps. The domestic water within the water heater should be heated to 145 F in order to kill water borne Legionelle bacteria.



SOLAR INTERFACE

All **GARN WHS** equipment is factory ready to connect to solar collectors. The collector with the simplest interface is the drain-back solar collector. Water is pumped from the GARN unit to the collector, is circulated through the collector, then drained back into GARN unit via gravity. An NPT flanged fitting on the left side of the manway collar is the drain back fitting where the return line from the collectors is to be connected.

Some solar collector designs utilize a collector non-water based medium in lieu of water. Such collectors require a heat exchanger to interface with the GARN unit.

Refer to manufacturers manuals and data provided with the solar collectors regarding proper installation.

BACKUP HEATING

If the GARN unit is being added to an existing building, the existing heating system will normally be used as a backup system. However, off peak electric heating is available to serve as a backup to the wood heating. Some utility companies offer discounted electric rates to installations using electric heat with heat storage equipment. Contact your local utility about various programs. Then contact your GARN dealer or **DECTRA CORPORATION** for electric backup heating options.

L. CHECK OUT AND START UP PROCEDURES

REVIEW

Before filling the **GARN** unit with water and chemicals, review the following check list:

- Has the unit been assembled in strict compliance with the **Unpacking & Assembly** section of this manual?
- Has the unit been installed in strict compliance with the **Installation** section of this manual as well as state and local codes?
- Is all piping connected correctly? Are shut off valves in place, in correct open/closed position and operable?
- Have all wiring and controls been installed by a Licensed Electrician and inspected by local code authorities?
- Has the unit been properly grounded electrically?
- Are all unused electric element holes plugged inside of the element box?
- Have you thoroughly reviewed the **Water Treatment Chemical** and **Suggested Water Treatment Procedures** sections?

As stated in the **Insulation** section, the unit and related piping does **not** have to be insulated prior to check out and start up. It is much easier to located and correct pipe leaks, etc without insulation in place. If everything checks OK, then fill the unit with clean water according to the **Suggested Water Treatment Procedures** section.

Any combustion process produces water, in the form of water vapor. One-year-old dry firewood stabilizes at approximate 20% moisture content. When such wood is burned, 1 to 3 gallons of water will condense (within the unit) as the temperature of the water in the **GARN** unit increases from approximately 50 F to 90 F. The bulk of this water vapor is blown out the flue with the other products of combustion; however, some can puddle in the flue tubes and blower housing. Although not dangerous, it can be messy.

Therefore, if the unit is filled with cold well water or water that is less than 80 F, it may be best to warm the **GARN** water to 80 F before executing an initial fire. This can be accomplished by the following methods:

- If the average daily outdoor temperature is **above 70 F**, simply let the unit sit for a few days and the air will warm the water. This warming will be accelerated by activating the induced draft blower (**without** a fire).
- If the unit is outfitted with optional electric heating elements, simple set the electric controls to bring the water up to 80 F.

If neither of the above water warming techniques is workable, start up will have to be accomplished with a wood fire. Do this in compliance with the procedures set forth in the next sections; however, use **only one year old dry cord wood, 3" to 10" in diameter** and build a full size fire. Do **not** down size the fire in hopes of preventing condensation, as a small fire will produce significant hazardous **creosote,** as well as condensation.

LEAK CHECK

1. Start at the unit and check for any obvious signs of water leakage – particularly at the elements and sensor locations.

2. Check supply and return pipes. Make sure all threaded steel joints are doped and tight.

3. Check dielectric fittings where steel pipe joins copper pipe; check valves, pumps, gate and ball valves, etc.

4. Energize pumps, circulate water, and bleed air from all lines.

5. Check water level after line bleed.

GARN UNIT CHECK

If no leakage is evident and all items are installed and piped correctly, make the following inspections before start-up operations.

1. Check door gasket and door latch adjustment. Latch should be snug fitting. If you need to force handle to get door closed, adjust the door by rotating the inner disc until the latch closes snugly without excessive force.

2. Is the ceramic reaction chamber with its end gasket in proper position? Carefully slide it into the metal tube at the back of the combustion chamber. Small chips in the liner are normal and will not affect the performance of the unit.

3. Do not insulate unit until after start-up procedure.

START UP OPERATION

READ THE ENTIRE OPERATOR'S MANUAL BEFORE STARTING THE FIRST FIRE!

Confirm that the water temperature is above 80 F before proceeding with the following steps.

1. Open the fuel-loading door.

2. Place small kindling or a small amount of newspaper near front of combustion chamber. Securely tuck the newspaper and/or kindling under the first few log. Paper can be sucked into the flues when the door is closed if not anchored down.

   This step is eliminated when reloading the unit. In some cases a few remaining coals and the hot bricks provide sufficient heat to ignite a fire even after sitting idle overnight.

3. Place 50 to 85 lbs of **one-year dry cordwood, 24" to 32" long and 3" to 10" in diameter, into the combustion chamber. Wood 10" in diameter and larger should be split once or twice.** Place the fuel toward the rear of the combustion chamber. **Load all wood carefully** or damage to the reaction chamber may occur.

4. **DO NOT OVERLOAD THE FIREBOX. The wood fuel should not extend above the half way line of the loading opening.** Sufficient heat release volume must be maintained **above the wood fuel** for proper combustion.

5. Turn **WHS Timer** on to confirm that the draft inducer is operative. Shut Timer off.

6. Light the paper and watch it for a few seconds to a minute to confirm that the paper has ignited.

7. Turn the **WHS TIMER** past the 3-hour setting to activate the draft inducer.

8. Close door.

9. After 15 minutes, open door, check fire, add more wood if necessary, close door.

10. Note the water temperature. What is the rise in temperature from the start in (1) above? It should be in the range described in the Operator's Manual.

11. If you have experienced any problems up to this point, turn the power off, **LEAVE THE DOOR CLOSED** and call your dealer. Discuss the problem before proceeding further.

12. If there are no problems, allow the unit to burn for an hour or more.

13. The water should be approximately 120 F at this point. If no problems have developed, add additional fuel wood and shut the door. Again do not load past the 1/2 full mark in order to allow for sufficient "heat release volume" above the woodpile.

14. Ten minutes after loading open the door and observe if combustion is proceeding.

15. During this first burn, check for leaks and pump operation. When the thermostat calls for heat, the pump should operate.

16. Check supply/return water pipes at various locations to verify heating conditions.

17. If air vents are installed and there is not heat being delivered, bleed air from system.

18. Note water temperature after completed second burn. Did you get a similar (but slightly less) rise in water temperature?

19. It all is well, continue to burn until the water temperature is 190 to 200 degrees. At this condition, water level in manhole should be slightly below the overflow pipe. If too much water was put in initially, heat will cause it to expand and drain out the overflow.

CAUTION: Take care when checking the water level at this temperature as the water vapor could cause burns.

20. Check water level again after tank has cooled down to 100 degrees. It should be a couple of inches below the overflow pipe.

During the first week or two, the owner should check the water level at high and low water temperature levels. Instruct the owner on this procedure. It would be preferable for the dealer to make these checks.

GARN® WHS MODEL 1450, 1500, 2000, 2100 and 3200
NON-PRESSURIZED WOOD FIRED BOILER
TESTED TO CSA B366.1 – M91 and ETLM-78-1
REPORT No. 632-600901 - April 17, 1986

Electrical rating: 115 Vac; 11 Amps; 60 Hertz; 1 phase

INSTALLATION - Use only a solid fuel chimney. **DO NOT** connect to a chimney serving another appliance. Place only on a non-combustible, slab on grade floor. Maintain the following clearance to combustibles:

Sides, top and rear = 2 in. Front = 60 in. Class A flue = 2"

This equipment may only be installed by qualified personnel. This appliance may be connected to an existing boiler system by utilizing a pressure rated water-to-water heat exchanger.

RQUIRED CONTROLS - Use only with GARN Sensor Stems and either the GARN WHS Component Timer package or GARN WHS/ETS Controller.

OPTIONAL CONTROLS - If electric backup heating is desired, use only GARN components and controls or UL listed components and controls. Refer to the GARN ETS Manual for sizing, installation, operation, etc.

OPERATION - Refer to the Operator's Manual supplied with this appliance. Burn only wood, densified wood briquettes or corn-on-the-cob. Load fuel carefully or damage may result. **DO NOT OPEN THE DOOR** in the event of a power failure.

DANGER - Risk of Fire or Explosion – DO NOT USE chemicals to start a fire. **DO NOT BURN** garbage, gasoline, naptha, engine oil, or other inappropriate materials. **DO NOT STORE** fuel or other combustibles within the above listed clearances. **DO NOT OPERATE** this unit with the fuel loading door open or any of the clean-out covers removed. **DO NOT LOAD** fuel above the mid-point of the fuel loading door. **DO NOT OPERATE** this unit during an electrical power failure.

CAUTION - Hot surfaces. Keep children away. Do not touch during operation. Inspect and clean the heat exchanger and flue on a regular basis. Remove any accumulated creosote and ash to minimize corrosion potential. This is especially important before extended periods of non-use. This appliance and the chimney must be maintained in good condition.

Adhere WH label with indexed number here

DECTRA CORPORATION @ 3425 33rd Avenue Northeast, Saint Anthony, Minnesota 55418. Phone 612-781-3585. Fax: 612-781-4236. Web Site: www.garn.com.

WARRANTY

WARRANTY ON GARN® PRODUCTS: GARN® products are warranted by the manufacturer to be free of defects in material and workmanship as follows, with the below-enumerated exclusions:

- With respect to the blower motor, controls and miscellaneous parts furnished as part of the basic unit, a one-year warranty shall apply.
- With respect to the storage tank, combustion chamber, flue tube heat exchanger, outer door, middle door and blower housing, a five-year warranty shall apply with regard to materials and workmanship.
- With respect to wear items such as gaskets, firebrick, reaction chambers, door latch and latch pin, door hinge and hinge pin, etc., a one-year warranty shall apply regarding materials and workmanship excluding normal wear and tear. Proper use and periodic maintenance will extend the life of these items. No warranty with regard to either anode rods or chemicals.
- **NO WARRANTY SHALL APPLY WITH REGARD TO EPOXY COATINGS, PAINT, CORROSION OR CORROSION INDUCED FAILURES OF ANY COMPONENT OF THE UNIT OR COMPONENTS ATTACHED TO THE UNIT.** It is the sole responsibility of the owner to install, maintain and test water treatment chemicals in order to minimize corrosion potential and damage. Testing of the GARN water is required once every year with a copy of results forwarded to DECTRA CORPORATION.
- DECTRA shall not be liable for injury, loss, damage or any expense directly or indirectly arising from the use of the products it offers for sale or from any other cause.
- This warranty does not cover any parts replacement due to shortage or damage in shipment, exposure to weather, improper installation, operating the unit under abnormal conditions, or other claims not agreed to in writing by DECTRA. Replacement parts purchased from DECTRA are warranted for ninety (90) days from the date of installation.
- No warranty is given in connection with second-hand products and equipment, or products and equipment altered or rebuilt without DECTRA's knowledge or written approval.
- No warranty is given regarding the predicted or actual performance of any product manufactured or supplied by DECTRA.
- **THIS WARRANTY IS EXPRESSLY MADE IN LIEU OF ANY & ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PURPOSE SHALL APPLY. NO WARRANTY OF LOCAL CODE ACCEPTANCE OR OF INSURANCE CARRIER ACCEPTANCE SHALL APPLY. NO WARRANTY FOR INSTALLATION OR FOR HEATING SYSTEM PARTS OR PERFORMANCE SHALL APPLY.**

The foregoing warranty periods shall each commence on the date of shipment to user of the products or parts and the obligation of DECTRA with respect to such products or parts shall be limited to replacement or repair FOB point of origin, and in no event shall DECTRA be liable for consequential or special damages, or for transportation, installation, adjustment, or other expenses which may arise in connection with such products or parts. Determination of what is a defective part, assembly or product is the sole responsibility of DECTRA CORPORATION personnel. The obligation of DECTRA hereunder with respect to any products or parts shall be to replace, or at its option, to repair parts determined to be defective in materials or workmanship. Correction of any such defects by repair or replacement shall constitute fulfillment of all obligations of DECTRA to the Purchaser hereunder.

DECTRA assumes no liability for labor or any other expenses incurred by anyone without DECTRA's express written consent.

No person, agent or representative is authorized to give any additional warranty on behalf of DECTRA or assume for DECTRA any other liability in connection with any GARN® products.