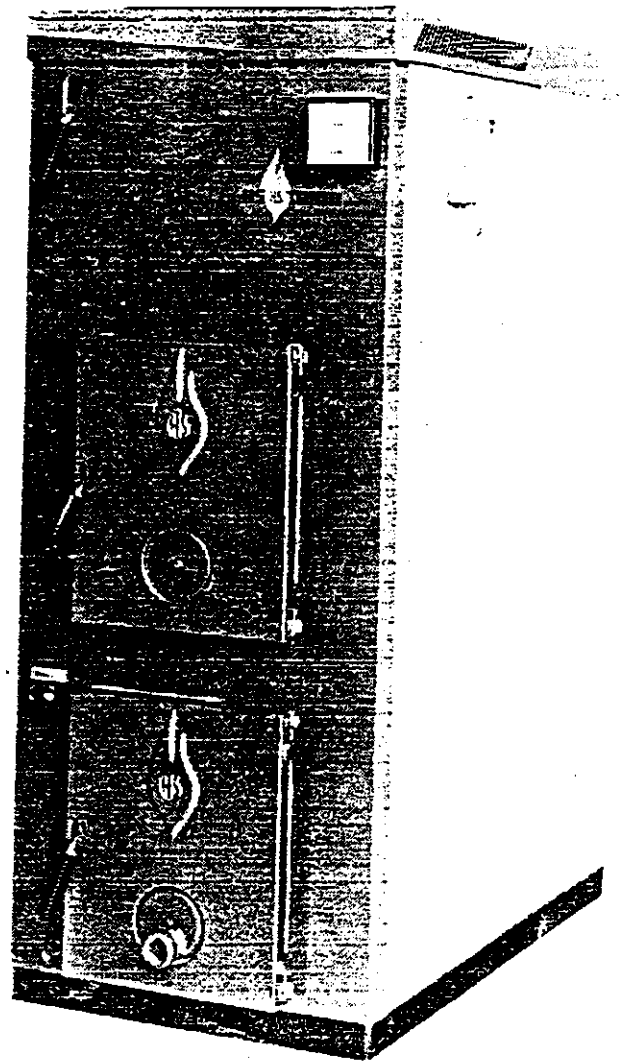


TARM 2000 S E R I E S

WOOD - FIRED GASIFICATION BOILERS

Installation and Operation Manual



SAVE THESE INSTRUCTIONS!

INTRODUCTION

Thank you for purchasing a H.S. Tarm Gasification boiler.

Your boiler was manufactured by H. S. Tarm, a world leader in hot water (hydronic) heating for over 70 years. The H. S. Tarm 2000 Series boiler conforms to traditional high standards for quality and reliability. It is truly state-of-the-art in high efficiency, clean-burning multi-fuel heating. When installed and operated properly, your boiler will operate at over 80% efficiency on wood fuel and 85% on oil or gas. If treated properly and operated according to the guidelines in this manual it will provide years of safe, dependable and economical heating.

Tarm boilers have been tested and listed by the Energy Testing Laboratory of Maine. The test standards used are ETLM 78-1, ANSI Z21.13 and UL726 for the United States and CSAB366.1-M1981 for Canada.

This manual contains installation, operation and maintenance guidelines for H. S. Tarm Series 2000 Gasification boilers. We strongly recommend that your heating system design and installation be done by a competent professional contractor.

NOTE: Installation must be done in accordance with local ordinances, which may differ in some ways from this owners manual.

Please note that the installation instructions refer to specific makes of controls and accessories. Equivalent makes and models of these devices may be used successfully. The installing contractor is the best judge of a system's specific requirements, as well as of local availability of different devices. However, be certain that no substitutions are made for the standard safety equipment, control panel and relief valves that we have supplied with the boiler. The installation of these devices is absolutely necessary for safe operation of the boiler and protection of the heating system.

Every effort was made during the writing of this manual to produce a guide which would be easy to understand and contain all pertinent information.

NOTE: 1. We urge you to thoroughly familiarize yourself with this manual before installing and operating the boiler.

2. Please keep this manual handy for future reference.

Included is information which will make operation of your new boiler an easier and more enjoyable experience. If questions arise during the installation, operation or maintenance, or if you are in doubt about any aspect of your boiler, please contact your installer, your dealer or TARM USA, Inc.

What is an H. S. Tarm Gasification boiler? It is a wood fired boiler designed and constructed for high efficiency combustion of firewood. Do not burn other fuels in the Tarm Gasification boiler.

WOOD COMBUSTION

Very important to the function and design detail is the wood fire combustion draft fan. The primary and secondary air are both fed through air ducts into the firebox with the precise velocity necessary for proper combustion.

The primary air is introduced into the top of the firebox. The secondary air is forced through the refractory, where it is heated and distributed through two channels and the many air nozzles on each side of the center slot in the refractory. The secondary air is injected with high velocity directly into the hot gases and flame to complete the wood combustion.

A very important design detail of Tarm Gasifiers is the refractory combustion tunnel in the heart of the boiler. These refractory blocks ensure that the wood combustion temperatures exceed 1800° F, several hundred degrees more than is needed to burn wood smoke and gas. This combustion is extremely efficient and virtually smoke and creosote free.

The optimal and environmentally desirable combustion of wood with the highest efficiency demands the correct proportional mixture of gas from the wood and combustion air from the fan.

The heat is transferred to the boiler water by means of heat exchange tubes located behind the firebox and refractory combustion tunnel.

RESPONSIBILITY

The user is responsible for the operation of the boiler and that the guidelines in this manual for firing are observed and followed. Not following the instructions can result in lower efficiency and environmental pollution because the desired clean flue gas is not obtained. Furthermore, misapplication will reduce the boiler's life. The correct operation and installation is the best guarantee of a proper operating boiler with a long lifetime and less pollution. It is a prerequisite that the user has the will and the right attitude towards firing with wood. In spite of everything, some work must be done to benefit from this environmentally desirable and economically profitable method of heating your home.

MAINTENANCE

It is also the responsibility of the user that the boiler be cleaned and maintained according to:

- normal practice,
- the instructions of this manual,
- instructions for the controls or equipment, and
- other circumstances described in the written warranty.

SAFETY

If an unsafe condition occurs it is to be repaired as soon as possible by a qualified serviceperson. Outlets, ventilating ducts, fresh air conduits and others must not be closed or clogged up.



PLEASE READ THIS PAGE CAREFULLY!

This boiler has a limited warranty which is included with your boiler as a separate enclosure. To validate your warranty, detach the postcard, fill in all information requested and return the card to TARM USA, INC. Please always raise questions or warranty claims with your installer/dealer who delivered the boiler to you. The installer/dealer then passes the claim on to TARM USA, INC., IF NEED BE. However, claims may also be raised directly with TARM USA, INC.

General Information

Please read the literature enclosed by the manufacturer regarding the various accessory devices. These devices are warranted by the manufacturer, NOT by TARM USA, INC. These accessory devices must be installed and used according to the recommendations of the manufacturer.

NOTE: All boilers must be installed in accordance with national, state and local plumbing, heating and electrical codes and the regulations of the serving electric, water and gas utilities.

All systems should be designed by competent contractors, and only persons knowledgeable in the layout and installation of heating systems should attempt the installation of any boiler.

It is the responsibility of the installing contractor to see that all controls are installed correctly and operating properly when installation is complete.

Please read carefully the section "OPERATION DURING SUMMER". Failure to protect your boiler from condensation during the warmer months MAY VOID YOUR WARRANTY! SEE PAGE 40.

Homeowners should read and familiarize themselves with "BOILER OVERHEATING" and "OPERATING IN THE EVENT OF POWER FAILURE". SEE PAGES 44 AND 45.

WARNING: Do not use gasoline, kerosene or other flammable liquids to start or maintain solid-fuel fires in your boiler. Serious burns and property damage may result.

WARNING: Do not store any combustibles, including fuel for the boiler, within the fire clearances specified below in "Installation Information". Keep fuel clear of the fuel-loading and ash-removal access areas.

WARNING: This boiler is designed to burn wood. Both hard and soft woods may be used, but under no circumstances should you burn coal or small pieces of wood or wood waste that can fall through the gap in the firebrick.

Installation Information

The boiler must be connected to a tile-lined masonry flue or other Type HT approved chimney. No other appliance should be connected to this flue. Consult your local building inspector for the chimney requirements, and install the boiler in accordance with all applicable codes.

The boiler requires adequate fresh air supply for efficient and safe operation. For more information refer to NFPA Standard #31.

The boiler must be positioned to provide minimum clearances from combustibles or combustible surfaces as follows: LEFT SIDE=6"; RIGHT SIDE=6"; TOP AND REAR=18"; FRONT=36".

There must be a minimum clearance of 18" between smoke pipe and all combustible surfaces. Clearance to hot water pipes is 1 inch.

Use 5 turns of TEFLON tape to seal all threaded connections to the boiler.

When references are made to tapping numbers, please refer to Page 7.

Do not use zone valves on the main heating zone as it is to be used as the overheat/dump zone.

**Installation must conform to ANSI / NFPA standard #211
MINIMUM REQUIRED FLUE SIZE -- 8" X 8" TILE OR 6" ROUND
MINIMUM DRAFT --- .05 IN/WG DURING NORMAL OPERATION**

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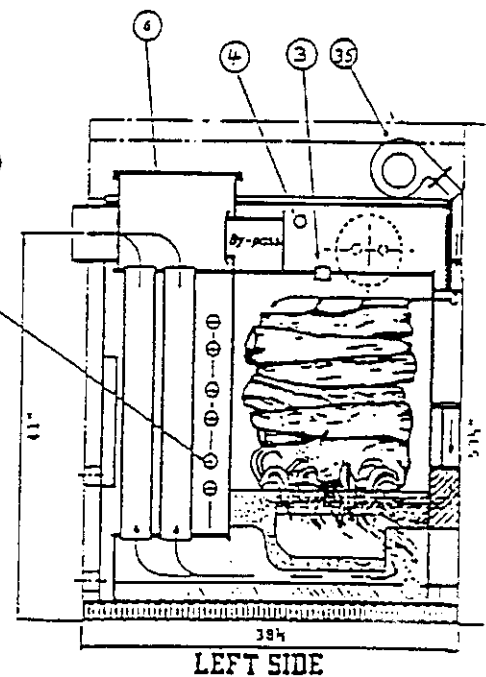
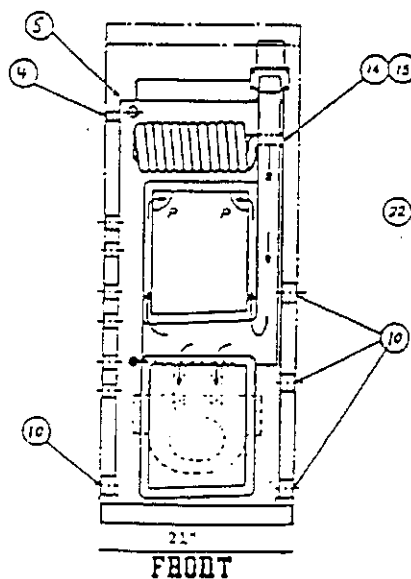
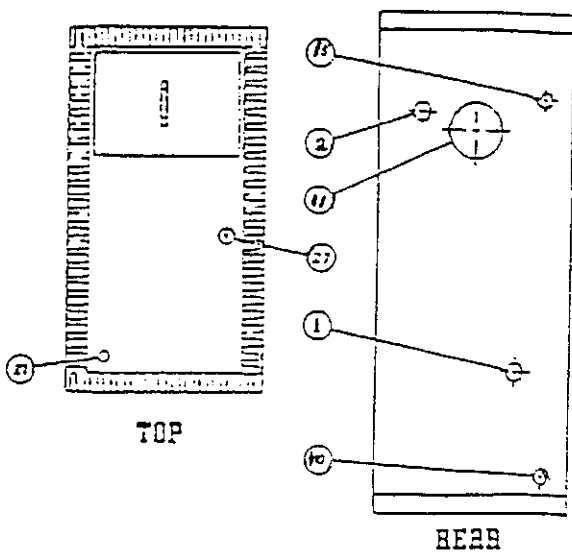
2004 2002

2004 2002

				Boiler Body		
Max. Gross Output-Hard Wood-	BTU/HR	140,000	102,500	Width	in.	25.4 21.0
Burn Time at above Output	Hrs	4.5	4.5	Depth	in.	38.5 38.5
Min. Gross Output-Hard Wood-	BTU/HR	17,000	17,000	Height	in.	53.4 53.4
Burn Time at above Output	Hrs	26.5	24.5			
Max. Output with Six Elements	BTU/HR	112,000	112,000			
Electric Elements (5.5 KW each)	KW	33	33	Firebox		
Domestic Hot Water Output	GPM	2.8	2.2	Length	in.	21.5 21.5
Water Volume	Gal.	53	41	Width	in.	18.5 14.0
Pressure test	PSI	60	60	Height	in.	23.0 23.0
Weight of boiler complete	LBS	1350	1250	Volume	Cu/Ft.	5.3 4.0
Minimum Flue Size	IN.	8x8	8x8			
Minimum Chimney Height	FT	15	15	Ctr of Flue	in.	41.2 41.2
				Flue Outlet	in.	6 6

TAPPINGS ,ETC.

1 Return	in.	1 1/4
2 Supply	in.	1 1/4
3 Fusible Plug	in.	3/4
4 Aquastat	in.	3/4
5 Pressure/Temperature	in.	1/4
6 Cleanout cover		
10 Washout and extra Tappings	in.	1 1/2
11 Flue Outlet	in.	6
14 Tankless Coil	in.	3/4
15 Tankless Coil	in.	3/4
16 Pressure Relief Valve	in.	1
21 Extra Tapping	in.	1/2
22 Electric Elements	in.	1
27 Extra Tapping (or air vent)	in.	3/4
35 Blower		



BEFORE YOU BEGIN

SAFETY NOTICE: READ THIS ENTIRE MANUAL BEFORE YOU INSTALL AND OPERATE YOUR NEW BOILER. FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE OR BODILY INJURY.

Contact local building or fire officials as the installation must be done in accordance with local ordinances, which may differ in some ways from this manual. Your local building official is the final authority for approving your installation as safe and determining that it meets local and state codes.

The metal listing label permanently attached to the jacket on the right side of your Tarm boiler (also shown on page 47 of this manual) indicates that the boiler has been tested to current UL and CSA standards and gives the name of the testing laboratory. Clearance information also is printed on this label. When the boiler is installed according to the information both on the label and in this manual, local authorities in most cases will accept the label as evidence that the installation meets codes and can be approved.

IMPORTANT: Failure to follow these installation instructions and guidelines may result in a dangerous situation. Follow the instructions and do not allow makeshift compromises to endanger property or personal safety.

PLANNING THE INSTALLATION

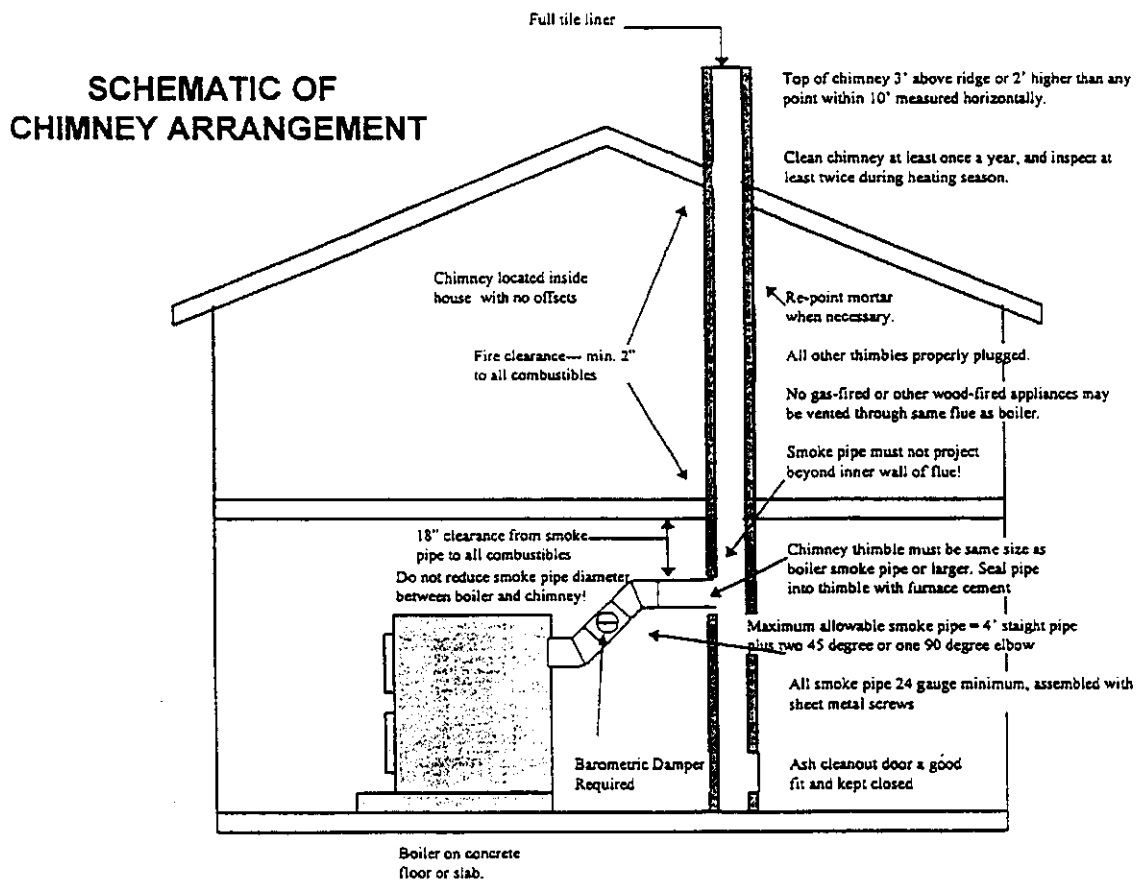
NOTE: We strongly recommend that your heating system design and installation should be done by a qualified local professional contractor.

Only persons knowledgeable in the layout and installation of heating systems should attempt the installation of any boiler. Proper planning and installation of your heating system and boiler will help greatly to assure many years of safe, dependable, comfortable and economical heating.

CHIMNEY REQUIREMENTS

The chimney is one of the most critical factors in the successful operation of any solid fuel heater, including your H. S. Tarm boiler. A good chimney will provide a continuous and dependable draft to pull the vented gases out of your house.

NOTE: The boiler must be connected to a lined masonry or a Factory-Built Type HT approved chimney and the chimney must be in good condition. If the boiler is connected to a dirty or inadequate chimney, it can present a serious fire hazard. All chimneys and connections must conform to *NFPA* standard #211. Please read the following before connecting the boiler to the chimney.



- In some areas, codes require that no other appliance be connected to the flue serving a wood-burning appliance; consult your local building inspector for chimney requirements and install the boiler in accordance with all applicable codes.

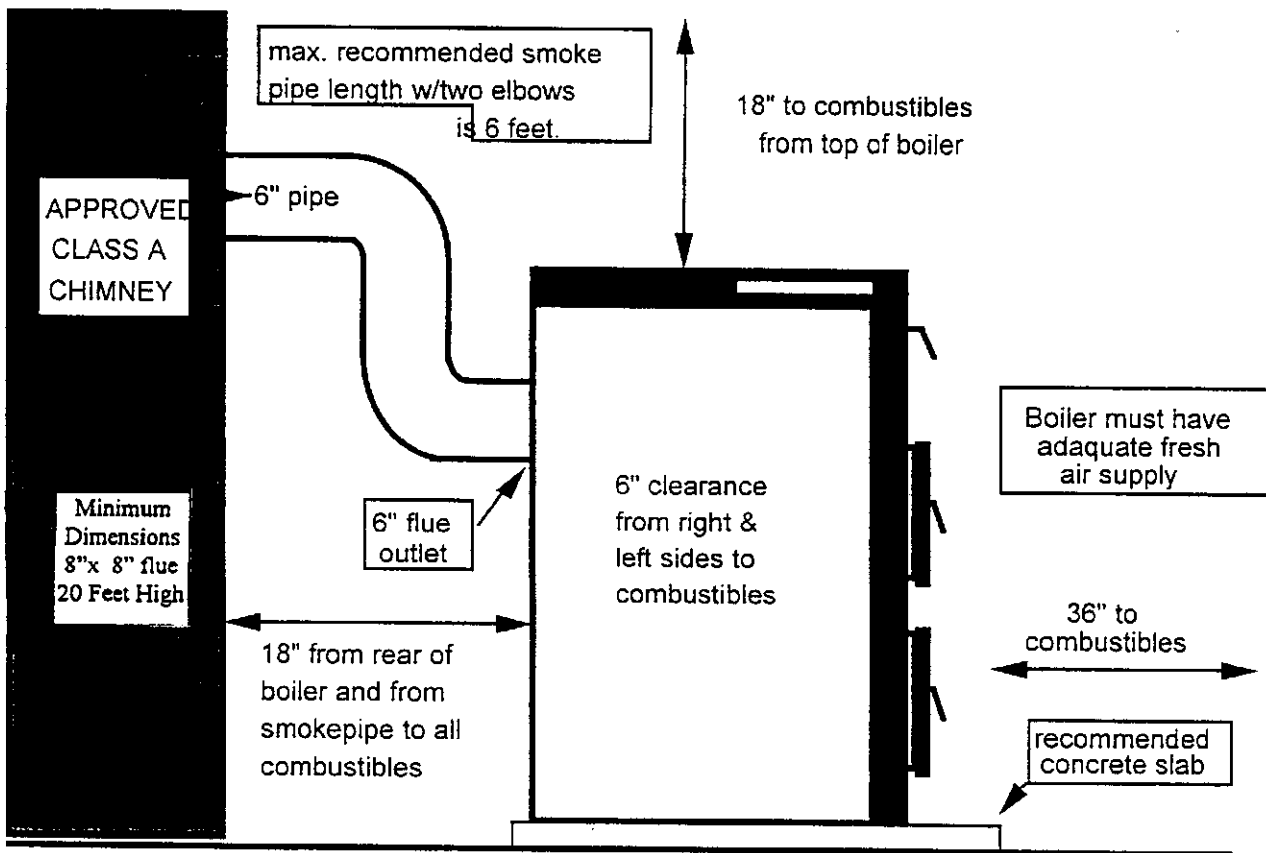
• Best draft will be provided by a chimney which has an 8" ID round flue or an 8" x 12" flue, is 20 ft. to 30 ft. in height and which is located inside the heated structure. A minimum flue size of 6" ID round or an 8" x 8" and a height of 20 ft. is necessary for proper operation of the Tarm Gasification boilers. The chimney must be capable of maintaining a breech draft of 0.05" H₂O during normal boiler operation.

CHIMNEY REQUIREMENTS (continued)

- Your Tarm Gasification boiler is designed to burn efficiently and nearly smoke-free, but under certain conditions creosote deposits can form in your chimney. Chimneys that are too large, are poorly insulated, or have bends in the flue passages are especially prone to problems with draft and/or creosote.
- If the chimney is too short and/or there is not enough draft, it may be necessary to add a draft inducing fan. However, we suggest that you determine first whether there are any problems before you invest in a draft inducer.
- **DRAFT REGULATORS:** Strong wind blowing across the top of a chimney or a chimney which has a particularly strong natural draft can cause the Tarm boiler to continue burning (heating) when the draft fan is off. This should not be allowed to happen because it can cause creosote formation and/or overheating of the boiler. The solution to this problem of excessively high or irregular draft is to use a barometric draft regulator in the smoke pipe, which we strongly recommend.
- Turbulators may be added to the heat exchange tubes increasing heat exchange efficiency and restricting draft. However, there is some risk that turbulators will cause the exhaust gases to cool too much which will lead to undesirable condensation in the chimney connector and/or flue.
- The smoke pipe connecting the Tarm boiler to the chimney flue must have a minimum thickness of 24 gauge and must rise a minimum of 1/4" per foot run toward the chimney. Smoke pipe sections must be attached to one another with a minimum of three sheet metal screws.
- **MASONRY CHIMNEYS:** Masonry chimneys must be lined, either with code-approved masonry or pre-cast refractory tiles, stainless steel pipe, or "poured-in-place" liner. Do not use an unlined chimney.
 - An existing chimney should be examined for cracks, loose mortar, other signs of deterioration, and blockage. Repair any defects or reline the chimney before use.
 - The chimney's clean-out door must seal tightly.
 - A newly-built masonry chimney must conform to local or national code.
- **FACTORY-BUILT CHIMNEYS:** Factory-Built chimneys must be tested and listed for use with solid-fuel burning appliances to the High-Temperature (H.T.) Standard (2100°F), UL 103, for the United States and High Temperature (650°C) Standard ULCS-629 for Canada. Factory-Built chimneys must be installed as per the manufacturers instructions.

BOILER PLACEMENT REQUIREMENTS

- The boiler must be placed on a non-combustible floor, such as, a level concrete slab. Many owners choose to raise the boiler 4" to 8" above the floor to make loading and cleaning more convenient. Four inch solid concrete blocks are often used for this purpose.
- Refer to the diagram below for the required minimum clearances between the boiler and combustibles or combustible surfaces. Smoke pipe clearances also are shown. Please keep in mind that these are minimum clearances for safety. For easy cleaning and maintenance of your boiler you may want 24" of clearance each side of the boiler and 48" in front.



PACKING LIST--- TARM 2000 SERIES BOILERS

PLEASE UNPACK THE CONTENTS OF THE BOILER BODY AND THE THREE (3) BOXES CAREFULLY, AND CHECK OFF THE FOLLOWING ITEMS ON THE LISTS BELOW:

The complete 2000 series boiler, as shipped from our warehouse, consists of four (4) pieces, as follows;

I. Boiler body

--- In or on the boiler body you should find;

- Refractory combustion chamber (installed)
- Ash removal pan.
- Ash removal/scrapper tool.
- Cleaning Brush
- By-pass damper lever (installed)
- Installation manual
- 24 volt draft fan (2002) or 110 volt fan (2004)

2. Jacket box

- One front panel
- Two side panel
- One rear panel
- Two top panels (front and rear)
- Door gasket set consisting of 2 pcs large flat gaskets

3. Door box

- Loading door
- Ash door
- By-pass lever bakelite knob (larger)
- Secondary air bakelite knob
- Stovex sealing compound
- Package of door bolts (8)

4. Safety control package

- Boiler pressure relief valve (Conbraco 10-407-05, 30 psi or Equiv.)
- Aquastat control (Honeywell L6081 A). (Prewired)
- Aquastat control (Honeywell L4008B) (Prewired)
- Immersion well, 1/2 inch
- Immersion well, 3/4 inch
- Pressure/Temperature Gauge
- Junction box (Standard 4" x 4")W/switch, timer, cover plate
- 24 Volt transformer on junction box (2002 only) (Prewired)
- NOTE: boilers equipped with tankless coil come with a 75# coil relief valve

Please contact your dealer immediately if any of the above items are missing! TARM USA Inc. reserves the right to substitute equivalent equipment for any of the controls and accessories specified above.

BOILER SET-UP

Initial Assembly

1. Unpack the items in the boiler body, door box and jacket box and check off the items enclosed against the packing list on page 12. Be sure to inspect all packages for damage from shipping. All shipping damage claims must be made with the carrier at the time of delivery.
2. Place the boiler in its planned location on a non-combustible floor and positioned for the proper chimney connection. The guidelines on pages 9, 10 and 11 of this manual should be observed!
3. Using the leveling bolts located on each corner of the base, level the boiler both front to rear and side to side.
4. Remove the sheet metal retainer plate from the lower door opening. Inspect the refractory chamber bricks for damage or cracks. There is no need to remove the large rectangular brick in the lower door, unless you believe there is damage to the refractory. If you remove the rectangular brick, be careful not to damage the donut gaskets on top.
5. Locate the secondary air adjustment lever at top left corner of lower door frame and fold it out so it will protrude through the jacket opening when the jacket is assembled.
6. It is not necessary to remove the wooden shipping braces on the boiler floor. They will burn up within a few hours of initial firing.
7. Install the Domestic Hot Water Coil if used. (optional)

Jacket and Door Assembly

NOTE: Prior to jacket installation, remove the appropriate jacket knockouts and plug any extra tappings (see tapping diagram on page 7).

NOTE: The boiler comes with an four-piece enameled jacket. The sides of the jacket are assembled by sliding the pre-formed steel strips down over the folded, vertical edges of the panels. For installations with low ceiling clearance, the jacket zip strips can be conveniently bent at the center point.

1. Place one each of the door mounting gaskets over the mounting flanges for the loading and ash doors. Use masking tape to hold them in place temporarily (be sure bolt holes are aligned).
2. Install the front jacket panel over the door mounting gaskets. Place the ash door and loading doors over their respective openings and thread the door mounting bolts into the tapped holes in the boiler mounting flange. Do not tighten the bolts yet!

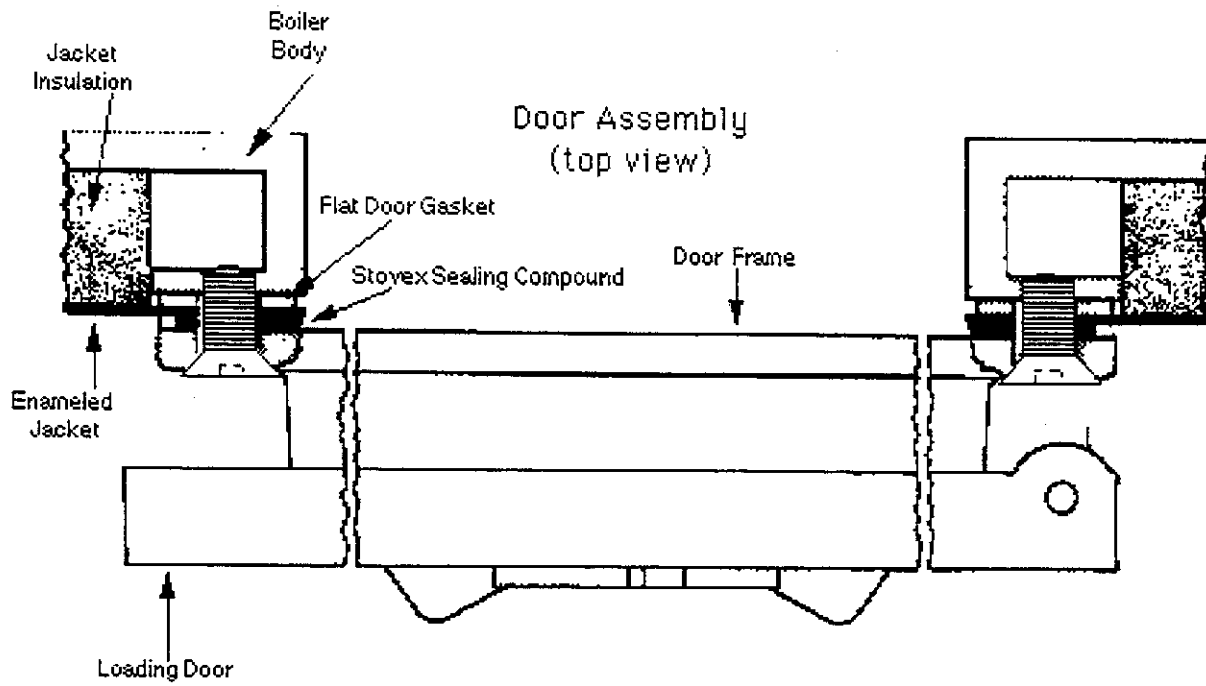
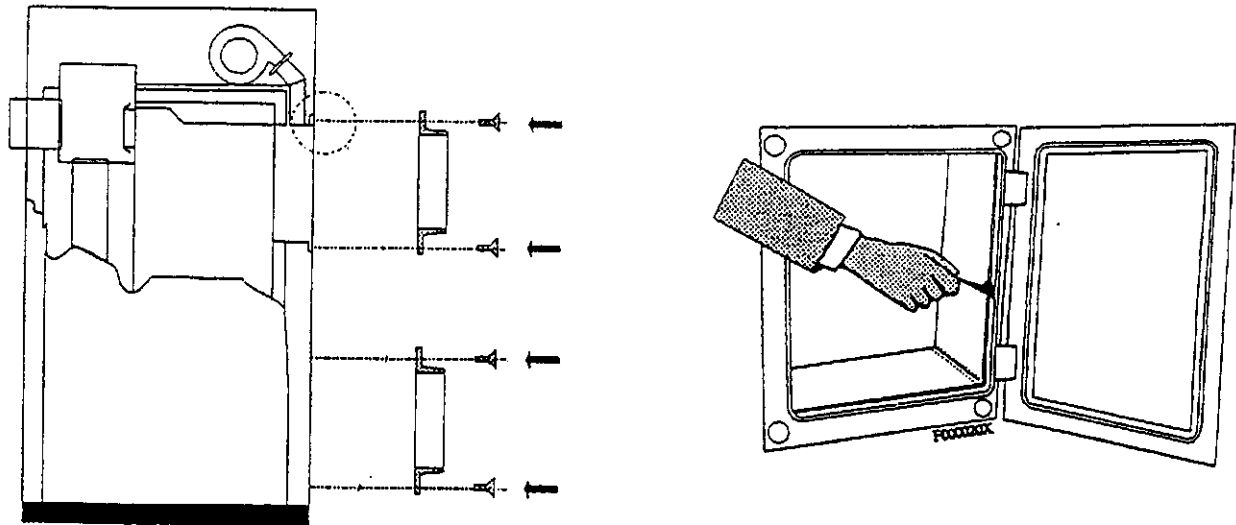
Jacket and Door Assembly (continued)

3. Install the 3/4 inch control well into the 3/4 inch tapping (#4) on the side of the boiler. Use teflon tape to seal the fittings correctly.
4. Install the left jacket panel into place. Attach to front panel using one (1) zip strip.
5. Install the left rear jacket panel.
6. Install right jacket panel into place. Remove the access panel for the optional Domestic Coil if it is to be installed.
7. Install rear jacket panel. Prior to placing this panel, remove the plug in tapping #10 if you are using it as your drain/feed.

HINT: Heating the plug prior to attempting to remove it will make the job much easier.

8. Install top front and rear panels by putting into place and pressing downward.
9. Check jacket for alignment.
10. Install doors. Doors hinge on right side. Door with observation port is lower door.
11. Seal front doors to face of boiler using the following procedure:
 - a. Back off door bolts until a 1/4" gap is between the door frame and the front jacket panel.
 - b. Using the enclosed applicator tool, press the STOVEX sealing compound into this 1/4 inch space. Be sure to fill all spaces.
 - c. Check for proper jacket alignment and tighten door mounting bolts.

Jacket and Door Assembly (continued)



Your jacket and doors are now fully assembled!

Installation of Fill-Valve; Drain, Pressure Gauges and Pressure Relief Valve

- 1) Install a 1/2" iron tee in tapping #10 (at the rear of the boiler), using the appropriate bushing. Install a boiler drain on this tee.
- 2) Pipe feed water to the boiler through a WATTS S11S6F Fill-Valve (not supplied) into the other end of the tee, Where required by law, a backflow preventer must be installed in the line to the fill-valve.

CAUTION : Use of any antifreeze with ethylene glycol or toxic heat transfer fluid instead of water is not recommended. Consult your code officials and heating expert for more information on this subject.

- 3) Install the pressure/Temperature Gauge in Tapping #5 on the front of the boiler.
- 4) Install the Conbraco 10-407-05 30 psi Pressure Relief Valve (supplied in safety package) in tapping # 16 using the appropriate bushing. **THIS VALVE MUST BE INSTALLED TO INSURE SAFE OPERATION OF THE BOILER AND FOR PROTECTION OF THE HEATING SYSTEM.** Pipe the 3/4" discharge line from this valve to within 6" of the floor with no reduction in pipe size.

Installation of Domestic Hot Water System

A tankless coil for heating domestic hot water is available as a factory installed option on the TARM 2000 boiler or it may easily be added after the boiler is already installed. For ready access to the coil, the cover plate on the jacket is removable.

Pipe the cold water to tapping #15 , and hot water from tapping # 14 (or vice versa) . It is desirable to install unions external to the boiler in both the cold and hot water lines.

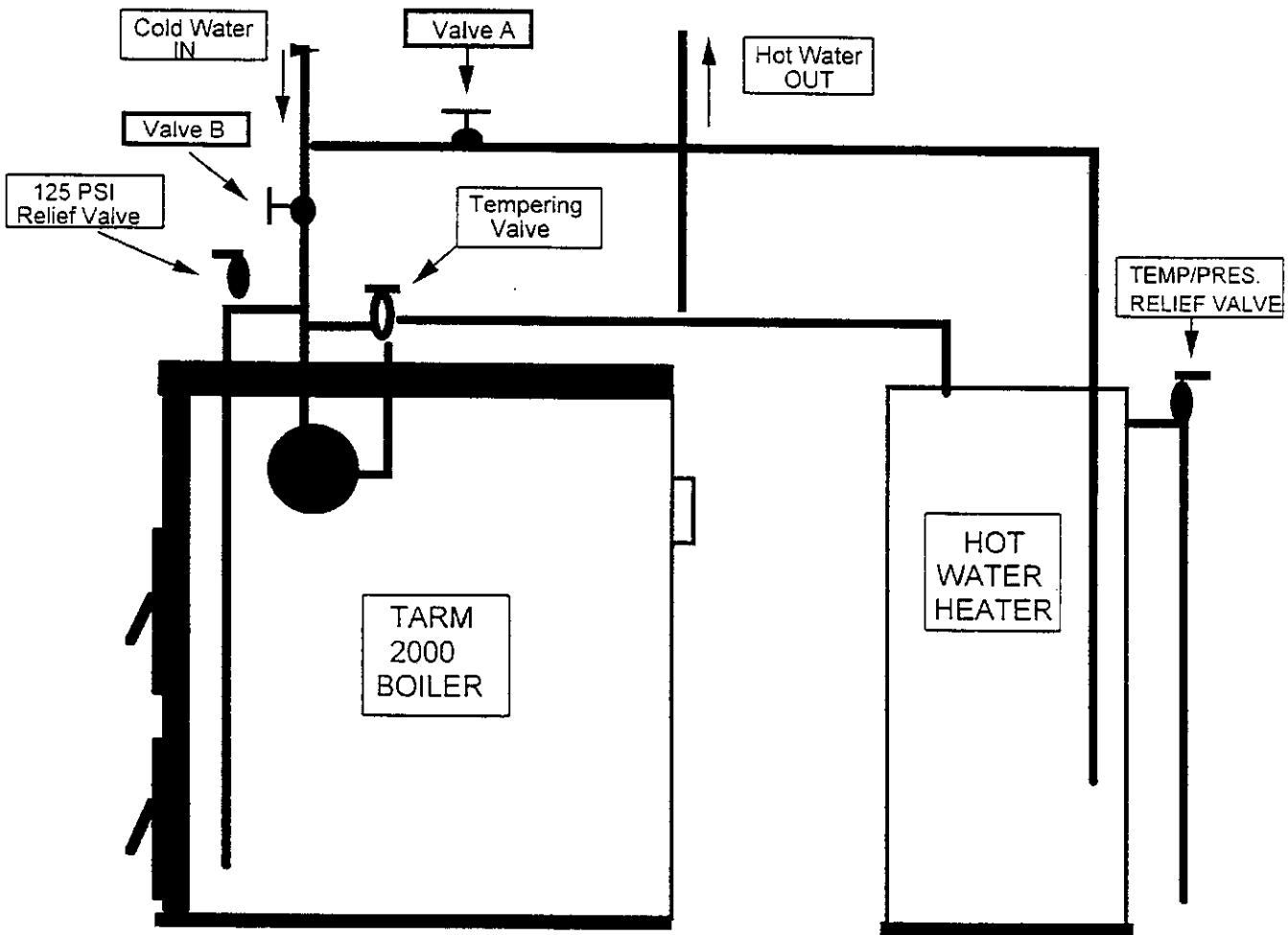
NOTE: If a separate hot water heater will be used to heat domestic water during the warmer months, please follow precautions for preventing corrosion described on Page 42 of this manual. Cold water must be piped separately to the separate Water heater, not through the coil in the TARM boiler. **Cold water must not flow through the TARM domestic coil if the TARM boiler is unheated! Condensation and corrosion of the boiler body can result if water flows through the unheated boiler.** Install the Pressure Relief Valve (Conbraco 17-402-01 75psi) in a tee on the cold water supply to the tankless coil, there must be no shut-off valve or check valve between the relief valve and the tankless coil. The Relief Valve discharge line must be piped to within 6" of the floor near a drain, and must be 3/4" pipe with no reduction. If this valve operates, hot water will be discharged. It should be piped to an open drain; so that this water will not damage the room in which the boiler is located.

NOTE: To prevent the possibility of a person sustaining serious burns from domestic hot water a tempering valve (Watts 70A or equiv.) must be installed to protect against dangerously high domestic water temperatures.

NOTE: In certain areas, existing water supplies may have a high mineral content. This will lead to liming of the coil over time, depending on the mineral content of the water and the amount of water passing through the coil. Coils should be cleaned as soon as there is any indication that the hot water supply is being restricted. Coils are cleaned with hydrochloric acid-- **CLEANING THE COIL IS A DANGEROUS PROCEDURE THAT SHOULD BE ATTEMPTED ONLY BY A QUALIFIED AND EXPERIENCED PERSON.**

DOMESTIC HOT WATER PIPING WHEN A SEPARATE DHW HEATER IS USED IN THE SUMMER MONTHS

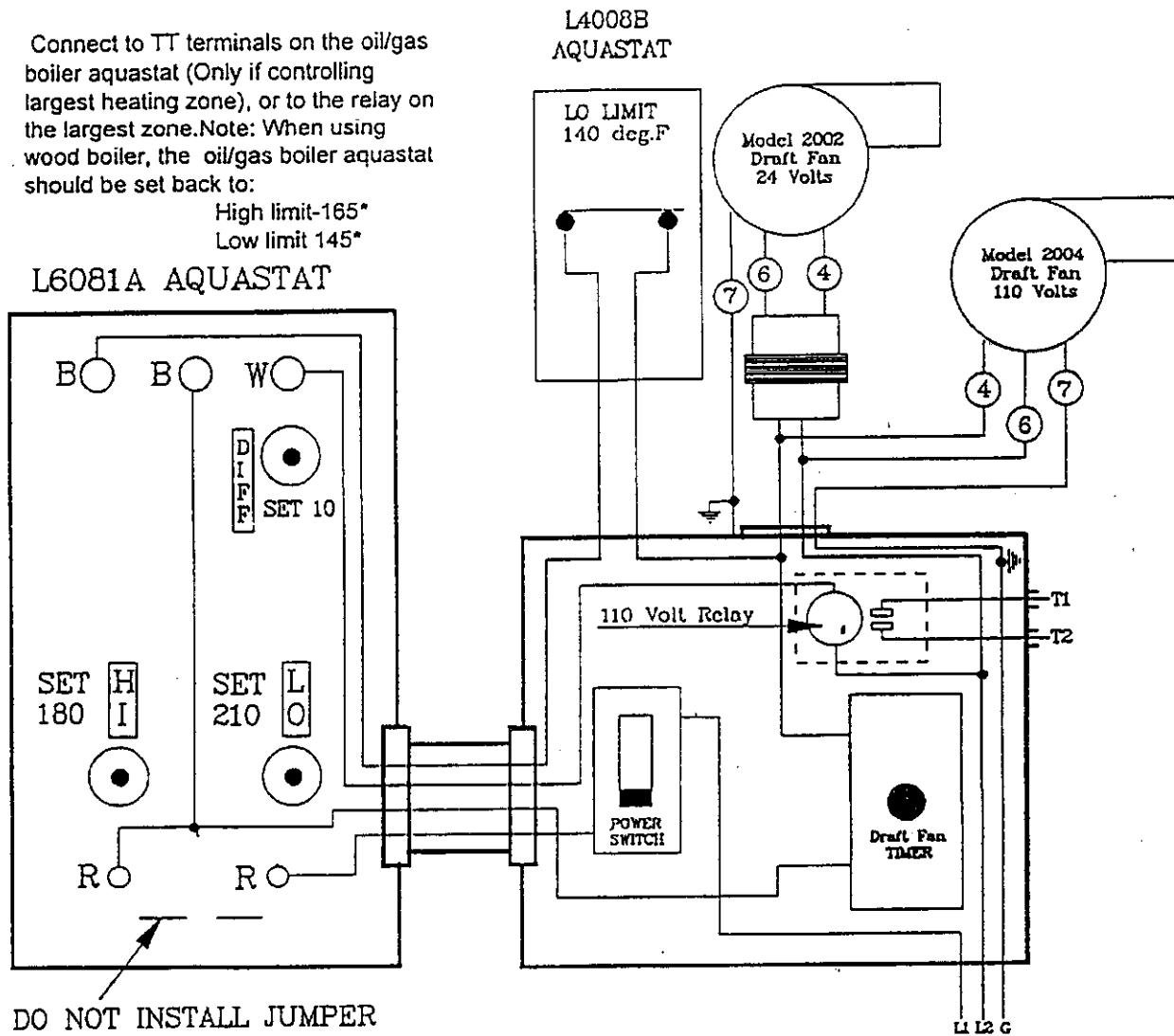
IN SUMMER: (or when TARM boiler is shut down) CLOSE Valve B and OPEN Valve A.
 IN WINTER: (when TARM boiler is in operation) OPEN Valve B and CLOSE Valve A.



2000 WIRING DIAGRAM

Connect to TT terminals on the oil/gas boiler aquastat (Only if controlling largest heating zone), or to the relay on the largest zone. Note: When using wood boiler, the oil/gas boiler aquastat should be set back to:

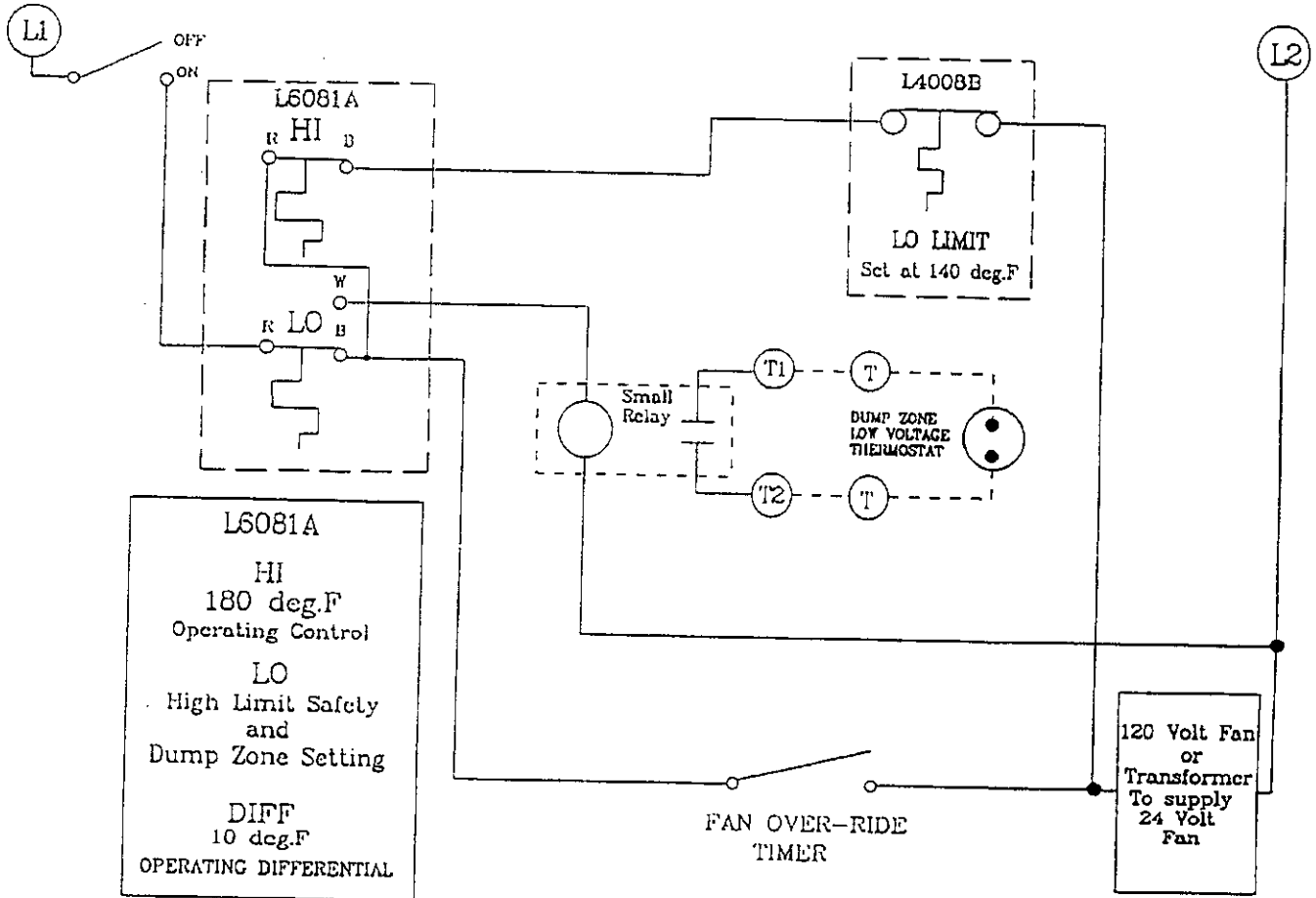
High limit-165°
Low limit 145°



CONTROL LOGIC

1. Starting with a cold boiler, the only way to start the fan and boiler is to turn on the timer. The timer will activate the fan till the water temperature is over the setting of 140° on L4008B Aquastat. After this minimum operating temperature of 140° is reached, the operating aquastat "HI" KNOB on the L6081A, will now maintain the boiler temperature at 180°. If the boiler should overheat for some reason and reach the setting of the high limit aquastat "LO" KNOB on the L6081A aquastat, the fan will be shut off, if a mal-fuction should be causing it to run. The T, -T2 terminals will also be energized to activate the circulator of the dump zone, which should be the zone with the most radiation. This will cool the boiler by lowering the boiler temperature below 210°.
2. If the wood burns out or can't keep up with the heat load when the boiler temperature drops below 140°, the L4008B aquastat will shut off the fan so that it will not continue to run when there is no wood in the boiler. As stated earlier, the only way to restart the boiler is to activate the timer once the boiler temperature drops below 140°.

2000 WIRING DIAGRAM



Connection to Heating Radiation and/or Another Boiler

OVERHEAT LOOP: The piping and controls must be connected to the boiler in such a way that in the event of a power failure there is one loop of radiation available for gravity circulation. This loop must not be obstructed by any valves or other accessories which would prevent gravity circulation during a power failure. The loop must be large enough to dissipate at least 10% of the boiler's maximum rated output on solid fuel, assuming an ambient temperature of 65° F. in the area heated by the loop, and a mean water temperature of 180° F.

NOTE: The overheat loop is connected by wiring from the terminal block, on the outside of the control junction box, to the relay controlling the dump zone circulator. This 24 volt wire is in parallel with the thermostat wire.

The minimum pipe size for this loop is 3/4", and, if possible, the loop should be located and pitched to maximize natural thermal convection of the water. The design of the loop must be such that it can be made inoperative only by deliberate manual action. If large enough, an existing heating radiation zone may be used for the over heat loop, if it is equipped with zone valves which will open automatically during a power failure. (We recommend the use of AUTOMAG automatic zone valves for this application. TARM USA, INC. can supply these valves.)

If large enough, a heating zone under circulator control may also provide enough overheat capacity.

Choosing the Right System

The TARM 2000 may be used either as the sole boiler or in conjunction with an existing oil-, gas- or electrically-fired boiler by a series, parallel or AutoMix hookup. In the latter combinations, the TARM 2000 serves as the primary boiler and the existing unit as the backup system. The type of installation chosen will depend upon the requirements of a given heating system. Please refer to the piping schematics on page 23 when reading the description of each system.

Only Boiler

The TARM 2000 can be used as the sole heating source for a hot water system. This installation is relatively simple and inexpensive; however, back-up heat, if required, would have to be provided by the optional Electrical Elements Package (available from your TARM USA, INC. distributor). To install the TARM 2000 as the only boiler, see pg 22-25 .

Series

A series hookup is the most direct and simplest form of connection between the TARM 2000 and an oil-, gas- or electrically fired boiler. A disadvantage of the series hookup is that if the domestic hot water coil is located in the other boiler, the TARM 2000 cannot produce domestic hot water unless the circulator is running. Also, when the other boiler is heating the house, there will be a small amount of standby loss through the Tarm 2000. See pg 24 for series hookup instructions.

Parallel Note: This is the preferred method when using the 2000 as an add-on boiler

When the TARM 2000 is connected in parallel with an existing oil, gas, or electrically-fired boiler, domestic water can always be heated by a wood fire regardless of whether the coil is located in the TARM 2000 or in the other boiler. For instructions on the parallel hookup; see page 25.

HS Auto-Mix

The HS AutoMix, when piped as shown in the diagram, provides the most convenient and economical heating system possible using the TARM 2000 boiler.

The HS AutoMix system is a method of controlling house temperature that is different from and more sophisticated than conventional systems. In the conventional hydronic system, the temperature in the house or zone is controlled by circulating or not circulating water of a fairly high and relatively constant temperature to radiation. The thermostat used in such a system is a simple temperature-actuated switch that turns a circulator on and off. In the HS Auto-Mix system, the circulator in the radiation loop runs continuously, and the temperature of the water flowing to the house is controlled by the mixing valve, which adds varying amounts of heated boiler water to the continuously circulating water in the radiation loop. The valve is controlled automatically by a thermostat.

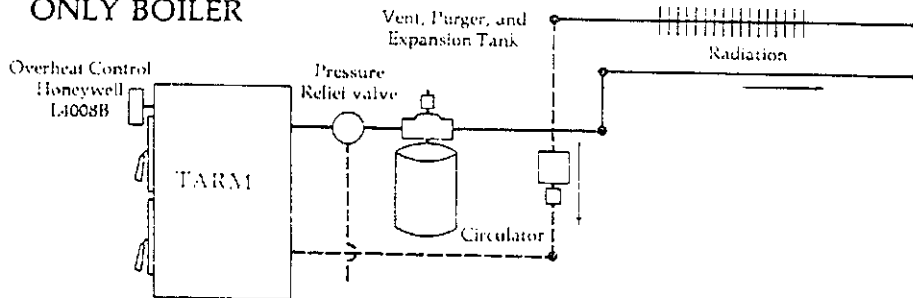
In an Auto-Mix system, the circulator runs constantly. Heat is always being drawn from the boiler, thus minimizing the likelihood of boiler overheating and creosote and soot formation.

The HS Auto-Mix promotes safer, cleaner and more efficient burning of any solid fuel. The AutoMix is especially important in installations with cast-iron radiation. The large volume of returning cold water from cast-iron radiation causes boiler temperature to drop suddenly and often results in poor boiler performance on solid fuel unless a mixing valve is used to keep radiation warm at all times in proportion to heating demand.

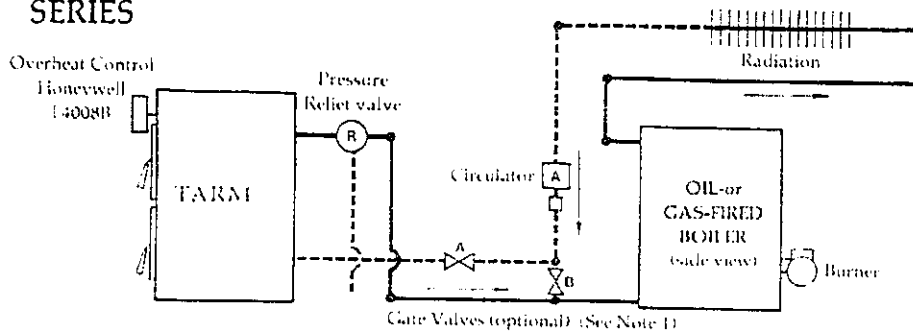
See page 26 for instructions on installing the HS AutoMix. For more information on the HS Auto-mix System contact your local HS TARM distributor.

PIPING SCHEMATICS

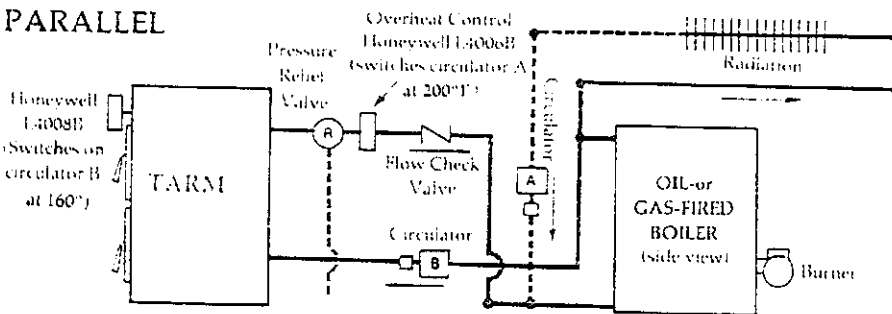
ONLY BOILER



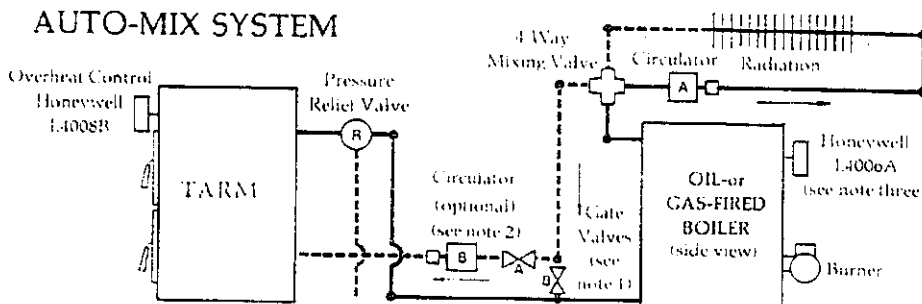
SERIES



PARALLEL



AUTO-MIX SYSTEM



Note 1:

Optional valves A and B can be used to bypass the MB-Solo boiler when the oil or gas boiler is fired for extended periods of time.

Note 2:

Optional circulator B may be necessary to maintain proper temperature of domestic hot water supply from the tankless coil in oil- or gas-fired boiler when the mixing valve is closed.

Note 3:

Set Honeywell L4006A to turn on circulator B at least 20° above the temperature at which the burner will come on. (Suggested settings: L4006A at 180°F, burner control at 160°F.)

TARM 2000 As Only Boiler With or Without Electrical Back-Up

NOTE: All interconnection wiring must be completed as per the wiring diagram, see pg. 28.

1) Thread a 1-1/4" pipe nipple into tapping 2, rear of boiler. Thread an AMTROL #444 (1 1/4") air purger using the inlet tapping "U", on to this nipple. **DO NOT REDUCE THE PIPE SIZE UNTIL AFTER THE AIR PURGER**

2) Connect AMTROL #60 expansion tank to tapping "Z" on bottom of the purger (This tank is sufficient for systems up to 86 gal.capacity. For systems with greater capacity, consult your distributor.)

3) The other tapping "U" is used for connection to heating radiation.

4) Install the circulator in the return line from the heating radiation. Pipe the return into tapping 1, rear of boiler.

5) The circulator may be controlled by a Circulator Relay, Honeywell RA89A or equivalent. This relay should be controlled by both the room thermostat and the Hot Water Overheat Control (L6081A, Low limit side).

NOTE: In a case where the thermostat is calling for heat and the boiler fire is out or otherwise unable to meet the heating demand of the house, the circulator will continue to run. This has the advantage of helping prevent the water in the system from freezing if the house temperature drops below 32 deg F. If subfreezing interior temperatures are anticipated, the system must be drained.

If you want to install the optional electric backup package, contact TARM USA, INC. for additional specific installation, wiring, and control logic information.

NOTE: ALL WIRING MUST BE COMPLETED IN ACCORDANCE WITH LOCAL, STATE AND NATIONAL ELECTRIC CODES.

A 240 VOLT service capable of handling the 150 amps drawn by the electrical elements and equipped with a 150 amp circuit breaker, is required to supply power to the sequencer control box with the electric backup package.

Series Hookup

NOTE: All interconnecting wiring must be completed as per the wiring diagram, page 28.

1) Connect the radiation return line to tapping 1 of the TARM 2000.

2) Using 1-1/4" pipe, connect tapping 2 of the TARM 2000 to the return tapping of the other boiler.

3) If the addition of the TARM 2000 has increased the capacity of the heating system beyond the rating of the existing expansion tank, an additional tank should be added to the system. Consult your dealer if in doubt about the requirements of your heating system.

NOTE: It is desirable to reduce the settings on the aquastat of the existing boiler if the TARM 2000 boiler is being operated much of the time. The recommended settings are:

High Limit 165 deg. F.

Low Limit 145 deg. F.

The "High Limit" setting of 165 deg. F. prevents the oil or gas burner from starting on a call for heat unless the TARM 2000 is unable to maintain this temperature. The "Low Limit" setting is the temperature at which the burner turns off when there is no call for heat. For further information on adjusting the oil- or gas-fired boiler's aquastat, consult your distributor.

Parallel Hookup

NOTE: All interconnecting wiring must be completed as per the wiring diagram, page 28.

NOTE: All pipe connecting the two boilers must be 1-1/4".

- 1) Install tees in the supply and return manifolds of the oil or gas boiler.
- 2) Pipe out from the supply (tapping 2) of the TARM 2000 boiler to a 1-1/4" tee using an iron pipe nipple. Do not reduce pipe size! The tee should be as close to the TARM boiler as possible, preferably not more than 8" away. This will ensure accurate operation of the L4006B aquastat to be installed there.
- 3) Install a HONEYWELL L4006B or equivalent Aquastat into one arm of the tee, using a 1/2" immersion well and a 1-1/4" by 1/2" bushing. This Aquastat is used to control the circulator between the boilers. Another method would be to use a continuous circulator that would be turned on while burning wood. See wiring instructions for more information.
- 4) Pipe from the tee installed on TARM 2000 supply to a flow check valve and then to the tee previously installed on the existing boiler's return manifold.
- 5) If the addition of the TARM 2000 has increased the water capacity of the heating system beyond the rating of the existing expansion system, an additional expansion tank should be added to the system. Consult your distributor if in doubt about the requirements of the heating system.

6) Install piping and a circulator between the TARM 2000 return (tapping I) and the tee previously installed on the existing boiler's supply tapping. Refer to the piping schematics (page 23) for the correct direction of flow. It is a good idea to install isolation valves on either side of the circulator.

NOTE: The HONEYWELL L4006B aquastat mentioned above is a "close-on-rise" type of control. This control is set at 160 deg. F. and is connected to the circulator installed between the TARM 2000 boiler and the existing boiler. When the TARM 2000 is being fired and reaches operating temperature, this circulator will start and circulate water through both boilers. This allows the TARM 2000 to handle the domestic hot water and heating load on the other boiler. When the circulator in the piping to radiation is inactive, its resistance, plus that of the flow-check valve, will prevent circulation through radiation by the circulator between two boilers.

When the TARM 2000 is inactive, the flow-check valve installed between the TARM 2000 return and the oil- or gas-fired boiler prevents thermal siphoning and consequent standby loss from the TARM 2000. The aquastat on the existing boiler should be set as follows:

High Limit 165 deg. F.
Low Limit 145 deg. F.

The high limit setting of 165 deg. F. prevents the oil or gas burner from starting on a call for heat unless the TARM 2000 is unable to maintain this temperature. The low limit setting is the temperature at which the burner turns off when there is no call for heat. These settings can be raised if the TARM 2000 is not to be fired for an extended period of time. For further information on adjusting the aquastat of your oil- or gas-fired boiler, consult your distributor.

Auto-mix Hookup

NOTE: All interconnecting wiring must be completed as per the wiring diagram, Page 28.

NOTE: REFER TO THE SEPERATE AUTO-MIX II INSTRUCTION MANUAL

1) Using 1-1/4" pipe, pipe out from tapping 2 (supply) of the TARM 2000 boiler to the return tapping on the oil-, gas- or electrically-fired boiler. Consider installing optional gate valves A and B (see piping schematics).

2) Pipe the supply from the oil-, gas- or electrically-fired boiler to tapping I (return) on the four-way mixing valve.

3) Connect the supply side of heating radiation to the "UP" tapping on the mixing valve.

4) Bring the return side of heating radiation through circulator "A" to tapping 2 on the mixing valve.

5) Pipe the unmarked tapping (it may be labeled #3) (opposite the "UP" tapping on the mixing valve) to tapping I (return) on the TARM 2000 boiler. Consider including optional circulator B in this return line in the installation if the tankless coil for domestic water is located in the oil-, gas- or electrically-fired boiler. Also consider installing the optional gates valves (see piping schematics) so that the TARM 2000 can be valved out of the system when desired.

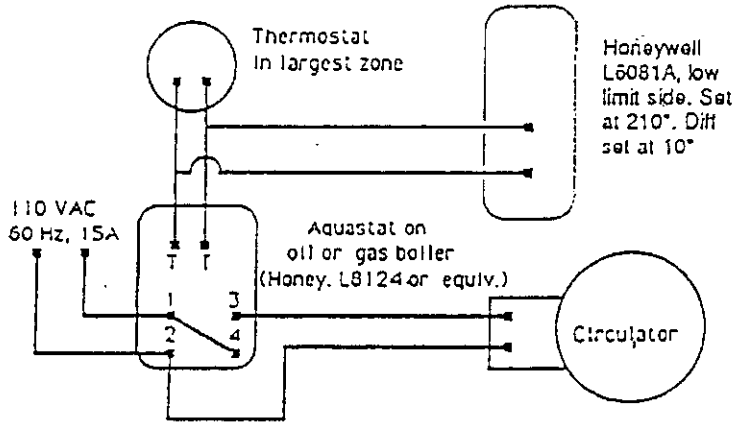
6) If the addition of the TARM 2000 has increased the capacity of the heating system beyond the rating of the existing expansion tank, an additional tank should be added to the system. Consult your TARM distributor if in doubt about the requirements of your heating system.

ELECTRICAL WIRING

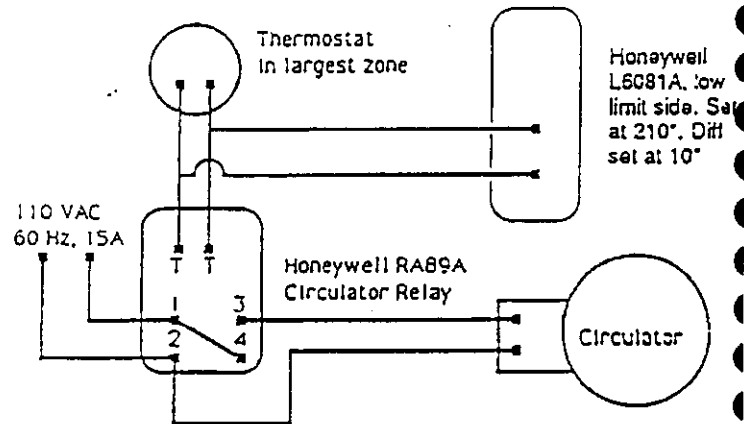
NOTE: All wiring must be completed as per the wiring diagram on this page. ALL WIRING MUST BE INSTALLED IN ACCORDANCE WITH NFPA STANDARD #70 AND THE NATIONAL ELECTRICAL CODE.

NOTE: The electrical system of the boiler shall be supplied from a single branch circuit except when the electrical sequencer kit has been installed in the TARM 2000 boiler. The boiler itself must be grounded in accordance with the requirements of the authority with jurisdiction, or, in absence of such authority, in accordance with the National Code, ANSI/NFPA #70-1978.

SERIES HOOKUP

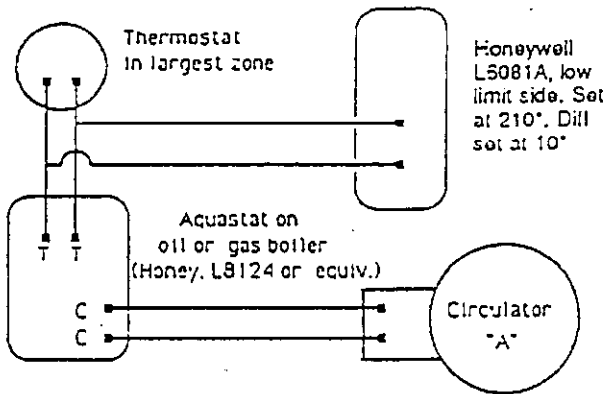


ONLY BOILER

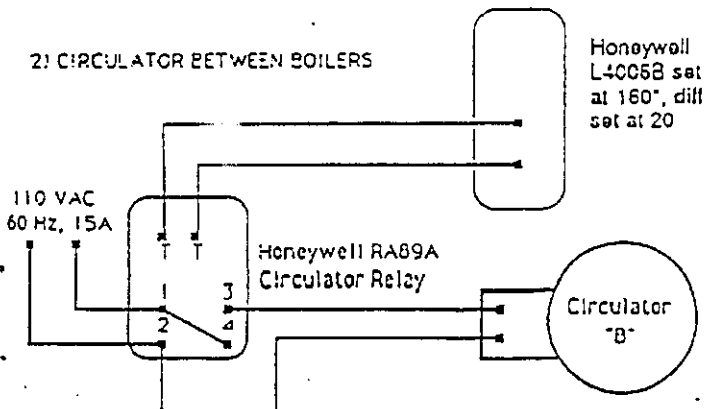


PARALLEL HOOKUP

1) OVERHEAT CONTROL

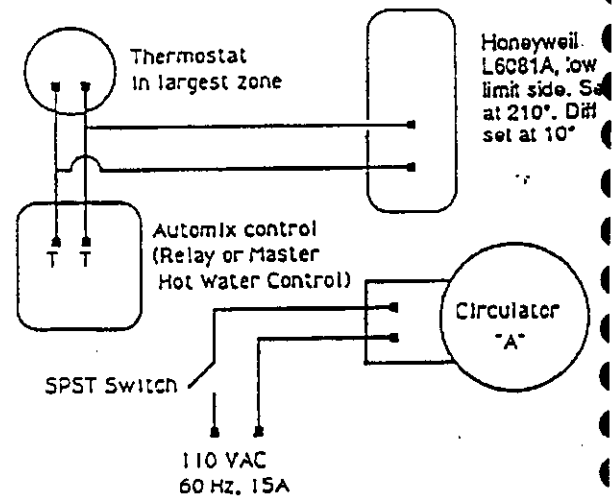


2) CIRCULATOR BETWEEN BOILERS

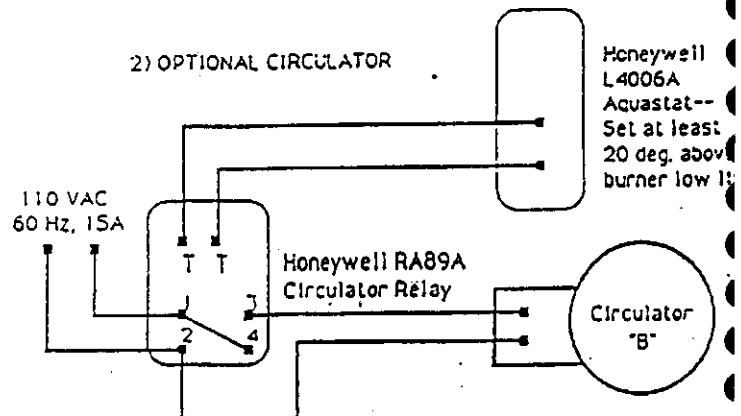


AUTO-MIX SYSTEM

1) OVERHEAT CONTROL



2) OPTIONAL CIRCULATOR



RADIANT FLOOR HEATING

An increasing number of H. S. Tarm boilers are being installed with radiant floor heating systems. Your heating system installer and/or your radiant floor equipment supplier will supply needed design and installation details.

HOT AIR HEATING

Boilers can be used in a number of ways to provide hot air heating. This can be done with existing forced hot air heating systems and in new construction. Again, your system installer and/or your equipment supplier should supply the needed design and installation details.

FILLING YOUR BOILER

Fill your Tarm EXCEL boiler and heating system in the conventional manner.

NOTE: The boiler may be protected with antifreeze. It should be propylene glycol and should be checked annually for proper freeze protection and P.H. level. HOWEVER, please remember that the domestic hot water coil, if you have one, is not protected by the antifreeze.

BEFORE YOU BEGIN

SAFETY NOTICE: READ THIS ENTIRE MANUAL BEFORE YOU INSTALL AND OPERATE YOUR NEW BOILER. FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE OR BODILY INJURY.

To operate your boiler in disregard of the information provided in this section can cause permanent damage to your boiler and void your warranty.

WARNING: NEVER USE GASOLINE, KEROSENE OR OTHER FLAMMABLE LIQUIDS TO START OR MAINTAIN SOLID-FUEL FIRES IN YOUR BOILER -- SERIOUS BURNS OR PROPERTY DAMAGE MAY RESULT!

NOTE: Do not be alarmed if you smell an unusual odor the first few times you fire the boiler. This smell is due to burning of oil residues in the paint on the boiler and the smoke pipe. Ventilate the boiler room well for the first few hours during the first fire.

STARTING YOUR TARM GASIFICATION BOILER

Before starting your boiler for the first time the installer must check that it is properly filled with water and vented of air. It is also important to vent the boiler again after the boiler is up to the 180° F. operating temperature. It is important also that the installer check all the control functions and settings before leaving the boiler unattended. Check the operating, low temp. cut out, overheat functions.

AQUASTAT CONTROL SETTINGS

Before you start your boiler make certain the aquastats are set as follows:

Honeywell L6081A

Scale	Setting	Function
LO	210° F	Back up High Temperature Limit. Dump Zone Activated
HI	180° F	Boiler Operating Temperature
DIFF	10° F	Cut In Differential Below High Limit

Honeywell L4008B

Setting	Function
140° F	Low Temperature Cut Off For Fan. (You will need to use the timer to cause fan to run to bring boiler above this temperature.)

USE OF THE BY-PASS DAMPER

The by-pass damper must always be opened before opening the loading door. This will minimize smoking and puff-backs. The by-pass should always be locked tightly in the closed position when the boiler is in operation.

A WORD ABOUT WOOD FUEL

Your Tarm Gasification boiler is designed to burn natural cord wood with high efficiency and low emissions. With properly dried and prepared wood you will fully realize the best operating, heating and clean-burning potential of your boiler. If you use poor wood, your boiler will be much less efficient and produce less heat. Dry wood gives big returns!

- Log length should be approximately 18" to 20".
- Pieces over 5" to 6" in diameter should be split.
- Moisture content of 15% to 20% is best.

To promote faster drying of firewood, it should be cut to length, split and stacked loosely off the ground with a maximum exposure to the sun and the wind so that air can circulate through the stack. Cover the top of the stack (at an angle to allow moisture to run off) to keep out rain and snow. Some varieties of wood may take 1 1/2 years to dry adequately.

Scrap wood may also be used but pieces should not be too small or they will burn too quickly and inefficiently.

WARNING: DO NOT BURN PAINTED, CREOSOTED OR PRESSURE TREATED WOOD.

Natural wood is an environmentally desirable fuel as it is CO₂ neutral.

Briquettes of wood or straw may also be used, but must exceed 2 1/2" in diameter and 3-4" in length. Lignite briquettes may also be used. Very small pieces of wood or wood pellets are not suitable fuels.

WARNING: COAL CANNOT BE USED IN YOUR TARM GASIFICATION BOILER.
Coal will damage the refractory in the firebox.

Lighting The Boiler For The First Time

Starting Your Tarm Gasification boiler for the first time, or, if the fire is out.

NOTE: THE WOODEN SHIPPING BOARDS HOLDING THE REFRACTORY IN PLACE WILL BURN UP. DO NOT TRY TO REMOVE THEM!

1. Set the by-pass damper lever in the open position by pulling the knob up and fully forward.
2. Open the loading door and line the bottom of the firebox with several pieces of crumpled newspaper. Place several pieces of kindling and small pieces of wood on top of the paper.
3. Place 6 or 8 more crumpled sheets of paper on top of kindling. Light the paper and close the door.
4. Immediately turn the power switch "ON" to start the wood combustion draft fan. If the boiler temperature is below the 140° F set point of the L4008B Aquastat you will have to use the timer to start the fan.

NOTE: To cause the fan to run to operate the boiler below the 140° F cut off temperature, it is necessary to use the 60 minute timer.

5. Partially close the by-pass damper leaving it slightly open and unlatched.
6. After 3-4 minutes, open the by-pass and turn "OFF" the power switch. Immediately open the upper door slowly and carefully to see that the fire is established. If it is, add several more small pieces of firewood. Close the upper door.
7. Immediately turn "ON" the power switch to start the draft fan. Close and latch the by-pass by pushing in and down to lock it shut.
8. Wait approximately 5 more minutes, then look through the sight glass in the ash door. You should see a full active flame filling the combustion tunnel. If not, give the fire a few more minutes before loading with larger fuel. When loading wood it should be placed close together and uniformly front to back and not crosswise.

Depending on the dryness and size of your firewood you may be able to skip step #8 and fully load the boiler in step 6.

WARNING: If there is a fire in the firebox, do not leave the boiler with the power switch "OFF". This must be "ON" so the overheat circuit can function, if necessary.

CAUTION: The Firing and Ash doors must remain closed except when loading fuel or removing ash. Door gasket seals are very important to the operation of your boiler. They must be maintained in good condition and replaced if necessary in order to maintain an air tight seal.

Lighting The Boiler For The First Time (continued)

Primary Air Adjustment

The primary air is pre-set at the factory to be fully open. However, if the flame is too large and cannot be adjusted properly by the secondary air, you can decrease the primary air by adjusting the stop in front of the draft fan under the top front jacket panel. Loosen the locking nut and turn the bolt in for less primary air and out for more - tighten the locking nut when adjusted properly.

Secondary Air Adjustment

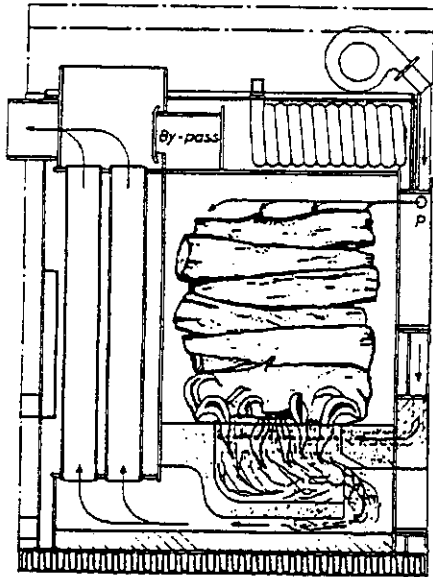
Correct secondary air adjustment is essential for optimum combustion and efficiency. Adjustment is by means of the bakelite knob on the front of the boiler next to the top left corner of the ash door. To adjust, pull the knob down and slide left (more air) or right (less air). The drier the wood is the more secondary air required.

The primary air coming through the holes behind the loading door and the total quantity of air should normally not have to be changed if the boiler is kept clean. This means that adjustment of the air quantity should only take place by moving the secondary air knob.

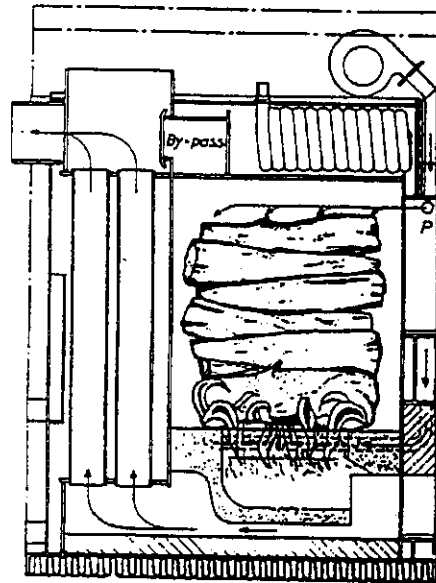
After approximately 45 minutes of operation with a load of wood, the boiler and refractory should be heated. Observe the flame through the observation port or open the lower door carefully while the fan is still running. Adjust the secondary air as needed. Once the proper adjustment has been set it should only be necessary to re-adjust when changing the type or quality of fuel. Use diagrams on page 34 to help guide you in setting the secondary air.

Until you know your boiler well, you can use the basic rule of "dry wood/more secondary air---greener wood/less secondary air."

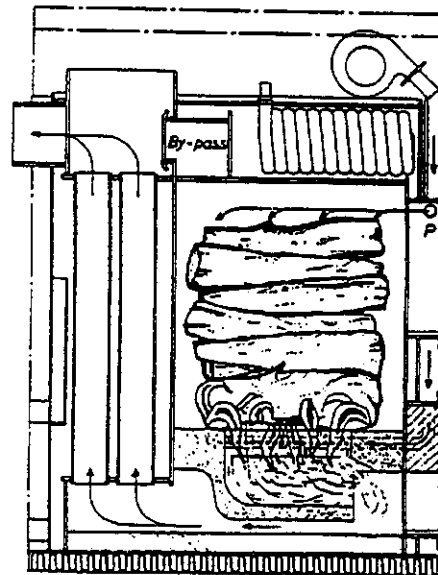
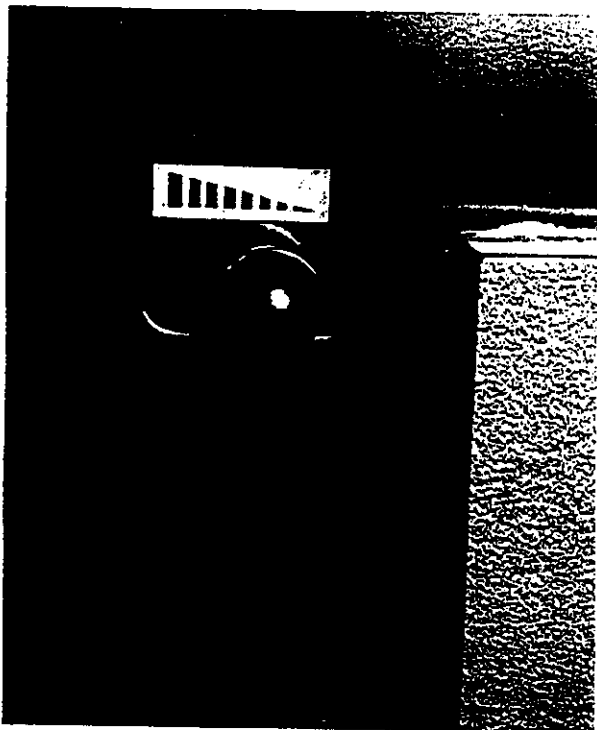
Secondary Air Adjustment (continued)



Insufficient secondary air - the flame is too long. Move the slider damper to the left.



Too much secondary air. Move the slider damper to the right.



Correct amount of secondary air - the flame is adequate and does not smoke.

When you have found the ideal setting, it should not be necessary to alter the secondary air adjustment, unless you change over to another type or source of fuel. If the secondary air setting is at its lowest, and the flame still spills forward out of the combustion tunnel, the primary air flow must be reduced (see section 'E').

REGULAR STOKING OF THE BOILER

HINT: It is advantageous to have the wood that you are going to load ready and next to the boiler before opening the by-pass damper. This will mean less smoke spillage into the boiler room and less smoke up the chimney.

When restoking the boiler proceed as follows:

If The Draft Fan is OFF: BOILER AT OPERATING TEMPERATURE

CAUTION: RISK OF WOOD GAS EXPLOSION as explosive gases may be present.

1. OPEN THE BY-PASS DAMPER.
2. NEXT, TURN THE TIMER on the control panel fully clockwise. This will activate the draft fan, overriding the operation control to help prevent the risk of gas explosion when the door is opened. Let the fan run for 2-3 minutes to vent the hot gases.

NOTE: WHEN YOU ARE BURNING WOOD IN A TARM GASIFICATION BOILER, the aquastat turns off the draft fan when the boiler gets up to temperature. This cuts the supply of oxygen to the fire and the flame goes out. There remains, however, a lot of hot coals and a red hot refractory which will continue to bake the wood creating a build up of hot gas in the firebox. Any person dealing with a Tarm Gasification boiler needs to keep in mind that hot explosive gases may always be present. These gases are hot enough to burn but without oxygen they can't. If the draft fan is off for 15-20 minutes these gases will start to condense as creosote on the inner surfaces of the firebox. However, if you open the load door when the gases are hot and explosive, you provide enough oxygen for a sudden back flash or puffing (WOOD-GAS EXPLOSION) to occur. This explains why you should **never open the load door unless the fan is running** to vent hot explosive gases from the firebox first.

3. Turn the draft fan off by switching the power switch to "OFF" on the control panel.
4. Without delay, open the loading door 3/4" with your left hand.
5. Wait approximately 20 seconds.
6. Open the loading door slowly, fully, and cautiously!
7. Load the firebox with wood, placing the wood uniformly front to back and tight together, not crosswise.
8. Close the loading door.
9. Turn the draft fan back on by switching the power switch to "ON" on the control panel.
10. Close the by-pass damper.

If The Draft Fan is OFF: BOILER TEMPERATURE BELOW 140° F

1. OPEN THE BY-PASS DAMPER.
2. NEXT, TURN THE TIMER on to activate the draft fan.

NOTE: When the boiler temperature is below 140° F the assumption is that the fire has burned out and that hot gases are not present. However, never open the door unless you have tried to vent hot gases from the firebox first.

3. Proceed as in steps 3-10 above.

REMEMBER: You will have to put enough time on the timer to cause the fan to run long enough to raise the boiler temperature above 150° F. The time needed will depend upon your wood and any heating demand on the boiler. Once the boiler is above 150° F, the fan will be controlled by the HI setting of the L6081A Aquastat.

REGULAR STOKING OF THE BOILER (continued)

If The Draft Fan Is ON:

1. Open the by-pass damper.
2. WAIT, 2-3 minutes with the draft fan running.
3. Turn off the draft fan by using the power switch on the control panel.
4. Without delay, open the loading door 3/4" with your left hand.
5. Wait approximately 20 seconds.
6. Open the loading door slowly, fully, and cautiously!
7. Load the firebox with wood, placing the wood uniformly front to back and tight together, not crosswise.
8. Close the loading door.
9. Turn the draft fan back on by switching the power switch "ON" on the control panel.
10. Close the by-pass damper.

HEAT DEMAND ON THE BOILER

In order to achieve the best combustion efficiency and the longest boiler life with the least amount of creosote in the combustion chamber, it is necessary that there be a reasonable demand for heat from the boiler.

OPERATIONAL PROCEDURES

The following operational procedures should be followed, especially when the boiler has excess capacity, (as it will have during milder weather):

1. **Load the boiler with wood at least 3 times a day.**
2. Only load the boiler with the amount of wood needed for the demand caused by the weather and the heat loss of the house. The wood should be totally burned and reduced to low coals before you reload. The ability to judge the correct amount of wood for each load can only come from experience. There are many factors to consider and each installation is somewhat unique.
3. If steps 1 & 2 above are followed, the heating surfaces of the wood firebox will have a chance to dry out at the end of the burning of each load of wood.
4. If steps 1 & 2 above are followed, you will have no problems with smoke spilling out of the loading door because only coals will be present when reloading. The next batch of wood will ignite easily and quickly because of the presence of the coals remaining from the previous load.
5. If steps 1 & 2 above are followed, the by-pass damper will open easily and won't be stuck shut with creosote.
6. Maintain a high boiler temperature of at least 180°.

OPERATIONAL PROCEDURES (continued)

7. Clean the boiler frequently as per the instructions elsewhere in this manual (see pages 41 and 42). Routine cleaning will help maintain boiler efficiency. Accumulated ash and soot act as an insulator and reduce boiler heat exchange efficiency.
8. Due to greatly reduced heat demand, it is complicated to fire with wood in the summer. **Therefore, we do not recommend burning wood in the summertime.** Save your wood fuel for colder weather, or equip your boiler with a storage tank system. Contact TARM USA, INC. for more information on storage tank systems.

NOTE: The refractory tunnel must be kept free of ashes and charcoal so that there is enough room for the gasification flame. Use the ash rake to pull the ashes and coals out of the tunnel. Leave the coals on the floor and they will burn up when the boiler fires next.

NOTE: Keep in mind that the refractory bricks are hardest when they are new. They get softer with age. When loading wood and using tools around the refractory areas keep this in mind. Don't break the refractory by 1) throwing wood directly onto the refractory (place the first few pieces into the boiler gently) and/or 2) digging or prying at the refractory in the areas of the slot or tunnel.

COMBUSTION PROCESS

The Tarm Gasification boilers have excellent combustion efficiency. Pollution of the boiler (except the firebox), chimney and environment is kept to an absolute minimum.

NOTE: Your firebox will form creosote on the walls. However, this normally has no effect on the boiler and does not need to be removed. During combustion, when the draft fan is running, gases and smoke are created which make up the main part of the wood's heat value. Formic and acetic acids and other gases are mixed with the right quantity of combustion air at very high temperatures producing combustion efficiency around 80%. This highly efficient combustion process produces virtually no smoke or creosote.

When the boiler gets up to temperature, the draft fan shuts down and stops the supply of combustion air to the firebox. The fire shuts down due to the lack of oxygen and does not continue smoldering to cause smoke, creosote or overheating. When the boiler temperature drops, the fan will turn on re-igniting the coals which have been resting on the refractory. During the off cycle, the coals stay hot enough to burn but they will be dormant because of the lack of oxygen. The combustion process of the Tarm allows you to burn wood as efficiently, as clean and as controlled as many fossil fuel heating systems.

HEAT OUTPUT

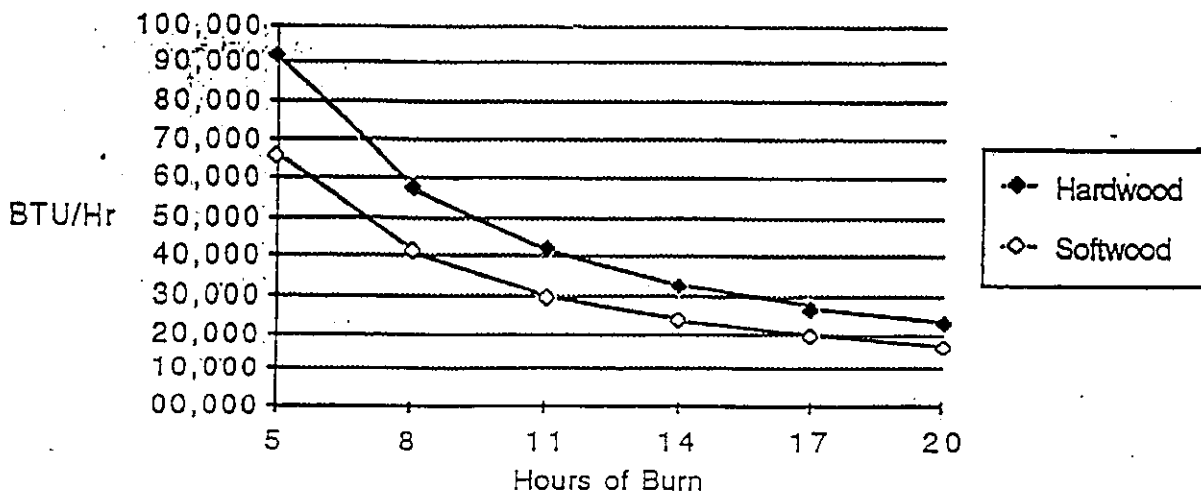
The Tarm Gasification boiler is designed to operate in an output range from as low as 17,000 BTU's per hour to a maximum of 102,500 BTU's per hour (140,000 on the 2004). At maximum output, the fan will operate continuously. At lower outputs, the fan and the fire will cycle on and off just as an oil or gas burner does to meet the heating demand. However, trying to operate the Tarm Gasification boilers on wood fuel during periods of lower heat demand can be problematic due to lower chimney draft.

NOTE: The chimney draft must always be strong enough to prevent reversed flow in the boiler's primary and secondary air supply ducts. Otherwise, smoke may be forced backwards through the boiler and emitted out of the fan when it is off. This reversed flow will maintain a smoldering fire in the boiler and can lead to partial or complete blockage of the air supply ducts, causing inefficient and problematic operation. It may also result in an objectionable smell of creosote or smoke in your home. These problems are eliminated entirely when you operate the boiler with enough demand on it and have a chimney which maintains proper draft.

BURN TIME

Burn time is dependent of the type of fuel and heat load on the boiler as well as how full you fill the firebox. The following graph will give you a rough estimate of burn times. Our experience has shown that this graph is very conservative.

NOTE: This graph is for illustration purposes only! As noted earlier in this manual, you should load you Tarm boiler at least 3 times a day and let the previous charge of wood burn down to low coals before loading wood again.



OPERATION DURING SUMMER

- **We recommend that you not fire your Tarm Gasification boiler in the summer.**
- The Tarm Gasification boilers will operate at highest efficiency burning wood during the cooler months, but, because of the characteristics of the gasification combustion system, you can operate the boiler through the fall and spring whenever the outside night temperatures require central heating. Your chimney draft and gasket seals are more critical to operation during the warmer months. If you have too high a chimney draft or air leaks around the fan or doors, the boiler may tend to overheat. If your chimney draft is too low, the fire will tend to either go out or smoke will back-up through the fan into your basement. The key to operating the boiler in the warmer months and even through the summer (if you have a high domestic hot water demand) is to stoke only small amounts of fuel at a time.

NOTE: You will have greater creosote formation in the firebox during operation at lower output. This creosote, if excessive, can lead to shortened boiler life.

SHUTDOWN PROCEDURES

If you are not firing the Tarm Gasifier for any extended time periods (such as the summertime), you must maintain the boiler temperature at 140° F. in order to prevent condensation and corrosion. If you cannot maintain boiler temperature, then you must protect the boiler by taking the following steps:

1. Clean the inside of the boiler using the scraper and wire brush.
2. Remove all ash deposits from the boiler completely with a vacuum cleaner.
3. Remove and clean the smoke pipe connecting the boiler to the chimney.
4. Do not replace the smoke pipe.
5. Stuff insulation into the flue outlet of the boiler to block off air passing through the boiler.
6. Keep all doors and air dampers closed.

If you still notice condensation forming inside the boiler firebox, hang a 15-25 watt light bulb inside the firebox.

CAUTION: IF YOUR TARM BOILER IS EQUIPPED WITH A DOMESTIC HOT WATER COIL, BE SURE THAT COLD WATER DOES NOT PASS THROUGH THE COIL WHEN THE BOILER IS SHUT DOWN! This can cause excessive condensation on the boiler body and will void your warranty.

Your Tarm boiler requires periodic maintenance and cleaning to work correctly and efficiently. Most of the routine maintenance procedures are usually quick and easy to perform.

WARNING: Failure to properly maintain and inspect your boiler will reduce the performance and life of the boiler, void your warranty and may create hazardous conditions.

ASH REMOVAL

With routine firing, before you add new firewood, work the ashes on the sides of the firebox towards the slot. You do not want a deep build up on the surface of the refractory. If you are not firing the boiler correctly, you may find a buildup of creosote will creep onto the surface of the refractory at the corners. If this buildup occurs, it must be removed.

Most of the ashes will be worked down through the secondary combustion slot during routine firing, as above. Twice a week, or as needed, remove ash that has accumulated in the combustion tunnel and on the refractory floor through the ash door. Place your ash pan on the floor in front of the ash door and pull the ash in this area into the pan using the ash removal tool. Be sure to remove ash buildup under the heat exchange tubes behind the combustion tunnel. Remember to be careful when working around the refractory.

SMOKE BOX AND HEAT EXCHANGE TUBE CLEANING

The smoke box, the flue outlet and the heat exchange tube areas should be cleaned twice a month with the boiler brush. Let the boiler cool and shut off the power switch. Remove the cover plate under the rear top jacket panel. Push the cleaning brush to the bottom and pull back up several times in each heat exchange tube. Remove fly-ash from the smoke box area above the heat exchange tubes.

It is important that the by-pass damper close and seal tightly for optimum boiler efficiency. If you are operating your boiler properly you should not have a problem with the by-pass damper sticking closed. Clean the by-pass and flap each time you clean the smoke box and heat exchange tubes.

DRAFT FAN AND AIR DAMPER CLEANING

Clean the draft fan blades at least once a year. Dust buildup in the fan blades can significantly reduce fan performance. Remove the screen and clean the blades with a bristle brush and a vacuum cleaner. If there is creosote on the fan you have a chimney draft reversal problem that needs to be fixed.

DRAFT FAN AND AIR DAMPER CLEANING (continued)

The primary air damper (flapper) in front of the draft fan **MUST** move (swing) open and closed freely and easily. The draft fan should open the primary air damper and the counterbalance should close the damper when the fan turns off. If the damper sticks in either position, operation will be adversely affected. Lubricate the damper with a light graphite oil. Check the damper once or twice a month!

LOADING DOOR

The primary air inlets are located at the top corners of the loading door. Any creosote buildup in these openings must be removed. The door frame and opening should be cleaned frequently to remove any creosote buildup.

Check the loading door and ash door gaskets regularly to insure that they are sealing well and that there is no smoke spillage into the house or unwanted air leakage into the boiler.

CLEANING THE PRIMARY AIR DUCTS

The primary air ducts on each side of the loading door can very rarely get clogged with creosote due to a reversed chimney draft or improper firing. Although this should not happen, if it does, the boiler will start to perform poorly and it will be necessary to clean the primary air ducts. To clean the air ducts, the load and ash doors, along with the front jacket panel, will need to be removed. Then remove the panel cover between the upper and lower door openings. You now have access to clean the primary air ducts. Make sure you don't let debris block the secondary air ducts. Reposition the secondary air damper and access panel. Apply silicone to reseal the access panel. Re-install the jacket panel and doors as done during the original installation.

SMOKE PIPE CLEANING AND INSPECTION

Annually disassemble the stove pipe. Clean and inspect for corrosion. If any pipe is seriously corroded (for example, if a screwdriver can easily be poked through the metal), this section must be replaced.

CHECK FOR CREOSOTE BUILDUP

Check for creosote buildup in the heat exchange tubes, the smoke pipe and the chimney once a month. If you see a buildup of creosote, something is wrong.

NOTE: Creosote buildup, other than in the primary combustion chamber, is generally a sign that there is air leakage into the boiler during the off cycle which is resulting in a low grade fire. Check your door gaskets and the primary air damper near the draft fan.

TROUBLESHOOTING

This section is designed to assist the homeowner and the installing contractor in the care of the heating system as well as in the correction of some of the more common problems encountered in the operation of the Tarm Gasification boiler. It is not possible within the scope of this manual to cover all possible service aspects of hydronic heating systems. Your installing contractor or designer are the best source for information to answer questions regarding your heat distribution system. Your H.S. TARM dealer or TARM USA, INC. are available for further support as to heating system questions and any and all questions regarding H.S. TARM boilers and how they are integrated into your distribution system.

BOILER OVERHEATING

IN NORMAL OPERATION, Tarm Gasification boilers cycle on and off to meet the heating demand. The heat output from these boilers is very controlled and very seldom is there a problem with overheating. However, the wood fire will always produce a certain amount of heat. When there is no demand for heat on the system, boiler temperature may rise. Usually this extra heat is absorbed in the water of the boiler without causing an over-heat condition. The on-off cycling of the boiler is like that of an oil or gas boiler.

Should the water temperature rise excessively, in order to absorb heat, the overheat control will cause circulation of heated water to the house, even though the thermostat is not calling for heat. This potentially wasteful overheating is most likely to occur during the spring or fall. Before choosing your heating system design, the possibility of using a mixing valve system to help avoid such problems should be considered. Such an arrangement (one of the most sophisticated methods of heating system regulation available) can be added to any heating system.

NOTE: Overheating of the boiler is an occurrence that all homeowners must be familiar with so that it can be corrected, if it occurs.

When the boiler temperature rises above a preset limit (usually 200-210° F.), causing the overheat control to operate and, perhaps eventually, the pressure relief valve to open, the boiler is overheated.

CAUTION: NEVER ADD WATER TO AN OVERHEATED BOILER. Wait until the boiler has cooled down before adding water.

The most common causes of overheating are;

- Overfiring the boiler (i.e., putting in too much wood for the heating needs of the house at a given time,
- Improper setting on temperature controls,
- Electrical power failure,
- Air leaks into the boiler (worn door gaskets, worn door latch, primary air damper stuck open), and
- Excessive chimney draft.

BOILER OVERHEATING (continued)

Following the recommendations in this manual will minimize the possibility of overheating. However, even the most experienced person may occasionally overheat his boiler. To cope with this problem, the boiler is equipped with two safety devices-- the Overheat Circuit and the Pressure Relief Valve. The Overheat Circuit is wired to circulate excess boiler heat to the house when the boiler reaches a preset temperature of 210° F. This control turns on the circulator or opens the mixing valve for the largest heating zone. Generally, the overheated boiler can be cooled within 10 minutes.

If the overheating condition is more severe, the temperature will continue to rise. At about 250° F., the pressure in the boiler will have reached 30 psi; and the pressure relief valve will open, discharging steam. For your information, all Tarm boilers are pressure tested to 60 psi at the factory.

NOTE: TO PREVENT THE POSSIBILITY OF SERIOUS BURNS OR PROPERTY DAMAGE FROM THIS STEAM, THE DISCHARGE TUBE MUST BE PIPED TO A POINT 6" FROM THE FLOOR OR TO A DRAIN!

The reason that steam rather than water is discharged is due to the fact that water under pressure can reach temperatures above 212° F. without boiling (as in a boiler), but, when released to the atmosphere by the relief valve, water turns immediately to steam if it is over 212° F.

TO COOL A SEVERELY OVERHEATED BOILER (relief valve discharging, or temperature rising over 230° F.) follow these steps:

1. Be sure the loading door and ash door are tightly closed.
2. Be sure the by-pass is in the closed position.
3. Open all hot water faucets in the house if the boiler has a domestic hot water coil.
4. Turn all thermostats up to their highest setting.
5. Open windows as necessary to keep the house cool.

When the boiler has cooled to normal operating temperature, resume normal operation.

OPERATING IN THE EVENT OF POWER FAILURE

Should your electricity go off during the heating season, there are several procedures that should be followed in order that you may continue to safely operate your heating system.

1. Locate any "Flow-check" valves in the system, and unscrew completely the knob on top of each valve. (This will allow a certain amount of heated water to circulate by convection throughout the house, preventing the pipes from freezing and keeping the house partially heated.) If you installed Auto Mag automatic zone valves instead of Flow-check valves, they will open automatically with any power failure, giving you maximum protection even when you are not at home. If you have a mixing valve, open it to the highest setting, then lock it into position.

OPERATING IN THE EVENT OF POWER FAILURE (continued)

2. Open the by-pass damper and remove the sight glass cover and the sight glass. It is important to remember that the heating system cannot safely use the heat from a great deal of wood without the circulators running. Under such conditions, extreme caution must be used to avoid over firing. **DO NOT ADD LARGE AMOUNTS OF WOOD INTO THE BOILER!** Fire the boiler cautiously until you are able to determine how quickly the boiler can consume fuel without overheating. Re-install the sight glass to slow the fire.
3. When the power has returned, reset all flow-check and zone valves and resume normal operation of the system.

NOTE: The above procedures do not apply to gravity systems, as they have no flow-check valve and will continue to operate normally without electricity.

TROUBLESHOOTING (continued)

This section of the manual is designed to help you to isolate and correct problems that may occur during the operation of your TARM ~~EXCEL~~ ²⁰⁰⁰ BOILER.

SYMPTOM:**POSSIBLE CAUSE:****REMEDY:**

SYMPTOM:	POSSIBLE CAUSE:	REMEDY:
<u>NO HEAT IN HOUSE</u>		
Boiler Temperature is below 150° F. while burning wood	No Fuel in Boiler Low Fan Output	Restart or relight fire Fan wheel dirty--CLEAN Air Ducts Plugged -- CLEAN
	Fan does not operate	Turn on Timer. Check transformer, switches, etc., with voltage meter
	By-pass damper is open	Close by-pass damper
	Combustion chamber is obstructed	Clear ash and other obstructions through lower door
	Wood is unsplit or unseasoned	Split wood and season
	Fan operates slowly	Bad transformer or motor capacitor - replace
Boiler Temperature is below 140° F., wood fan doesn't shut off	Wrong setting on L4008B	Set L4008B at 140° F
Boiler Temperature above 150° F.	Air in piping	Call Serviceman
	Circulator not operating	Call Serviceman
	Not enough radiation in house	Add radiation as needed
Boiler functions well with good burn times but inadequate on coldest days	Boiler temperature is set too low	Increase boiler water temperature by adjusting the "HI" setting on the L6081A control to 190° F.
Excessive heat dumped into over heat zone	Overheat control set too low	Increase "low" setting on L6081A to 210°
Short burn times	Wood not seasoned	Season wood for at least 8 months under cover
	Firebox not filled adequately	Cut wood to full length of firebox
	Poor quality wood	Choose Oak, Hickory, or other dense hardwoods for longest burn
Wood fire goes out before being burned completely	Inadequate Draft	Increase chimney draft
	No demand on boiler for an extended period of time	Burn backup fuels or turn house thermostat up so the boiler fan will operate more often
Excessive smoke out of load door when loading	Too much wood left in firebox from last stoking	Load less wood
	Weak chimney draft	Make chimney higher or warmer Use a stove pipe or chimney draft inducer Check with TARM USA
AUTO-MIX SYSTEMS		
Does not maintain house at set temp.	Locking quadrant set too low for weather conditions	Reset locking quadrant on the mixing valve further to the right
House temp. is above thermostat setting	Locking quadrant set too far to the right	Reset locking quadrant on the mixing valve further to the left

A copy of the ETLM listing label for the H. S. Tarm Gasification Boiler, Series 2000, also known as the Solo Plus series, is shown below:

H. S. KEDLER TARM

TARM, DENMARK

WOOD-FIRED GASIFICATION BOILER

SERIES 2000

MINIMUM CLEARANCE TO COMBUSTIBLES: FRONT 36"

RIGHT SIDE 6" LEFT SIDE 6" REAR 18" TOP 18"

CHIMNEY CONNECTOR 18"

RATING:	MODEL	FUEL	BTUH OUTPUT	ELECTRICAL RATING	MAX. OVERLOAD PROTECTION
	2002	WOOD	102,500	120V., 60HZ., 1.5A.	15 AMP.
	2004	WOOD	140,000	120V., 60HZ., 1.5A.	15 AMP.

CENTRAL & SUPPLEMENTAL HEATING HOT WATER

INSTALL AND USE ONLY IN ACCORDANCE WITH THE MFGR'S. INSTALLATION AND OPERATING INSTRUCTIONS.

INSPECT AND CLEAN CHIMNEY FREQUENTLY.

UNDER CERTAIN CONDITIONS OF USE, CREOSOTE BUILDUP MAY OCCUR RAPIDLY.

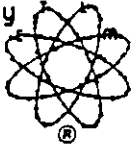
TEST DATE SEPT. 1986 LABEL SER. NO.

TEST STANDARDS USED ETLM 78-1 & CSAB366.1-MT981

INSTALL ONLY ON
NON-COMBUSTIBLE FLOOR.

Energy Testing Laboratory
of Maine

Southern Maine Vocational Technical Institute
Fort Road, South Portland, Maine 04106



LISTED 86-09-05

MASS. LAB. CHTL003

WARRANTY - FOR USE IN U.S.A.

HS Kedler Tarm (Manufacturer) warrants the residential steel boiler identified below and the hot water tank or coil, and the cast iron doors and grates, against defects in material and workmanship under normal home use and service, TO THE ORIGINAL PURCHASER AT THE ORIGINAL INSTALLATION SITE in the United States and Canada, under the following terms.

BOILER BODY
LIMITED 20 YEAR WARRANTY

Subject to all the limitations stated below, Manufacturer warrants the steel boiler body (but not including cast-iron doors, coil or other components) against defects in materials and workmanship resulting in breaks or leaks causing significant impairment of performance.

MANUFACTURER'S OBLIGATION: The Manufacturer's sole obligation under this limited warranty is to provide payment of the below listed percentage of the cost of the repair of the warranted item. The Manufacturer may at its option decide to use this sum as a partial allowance to replace the warranted items. Manufacturer will pay all required labor and the cost of all materials for the repair of the boiler defects arising during the first five years of the warranty period. In years six through twenty, Manufacturer will pay for a percentage of labor and materials for the repair of the boiler body up to a maximum of the same percentage of the Manufacturer's retail price for the HS Tarm model during the year in which the boiler was originally purchased. Shipping charges in connection with replacement or repair shall be paid by the owner.

Warranty Year	
1-5	100%
6	60%
7	50%
8	40%
9	30%
10-20	20%

Example #1: Repair costing \$250 in year 7. Manufacturer will pay \$125.00 (50%) of this repair.

Example #2: Boiler (original cost \$4000) needs major repairs in year 9. Manufacturer will pay \$1200 (30% of \$4000) toward replacement with similar HS TARM boiler or up to 20% of the repair cost (\$1200 maximum).

OTHER COMPONENTS
LIMITED THREE YEAR WARRANTY

YEARS ONE THROUGH THREE: Subject to all the limitations stated in the following table, Manufacturer warrants the cast iron doors, hot water tank or coil, refractory and combustion chambers, cast-iron separation baffles and plates against defects in materials and workmanship resulting in breaks or leaks causing significant impairment of performance.

Warranty Year	
1	100% of parts & labor
2	100% parts only
3	50% of parts only

CONDITIONS OF WARRANTY

- This limited warranty covers only repairs or replacements resulting from defects in materials and workmanship.
- This warranty shall be void if the boiler is installed by someone other than a qualified contractor whose principal occupation is the sale or installation of plumbing and heating equipment.
- This warranty shall be void if the owner fails to have the boiler serviced or inspected at least once every two years by an experienced and qualified service person.

EXCLUSIONS: Expressly excluded from coverage by this limited warranty are the following:

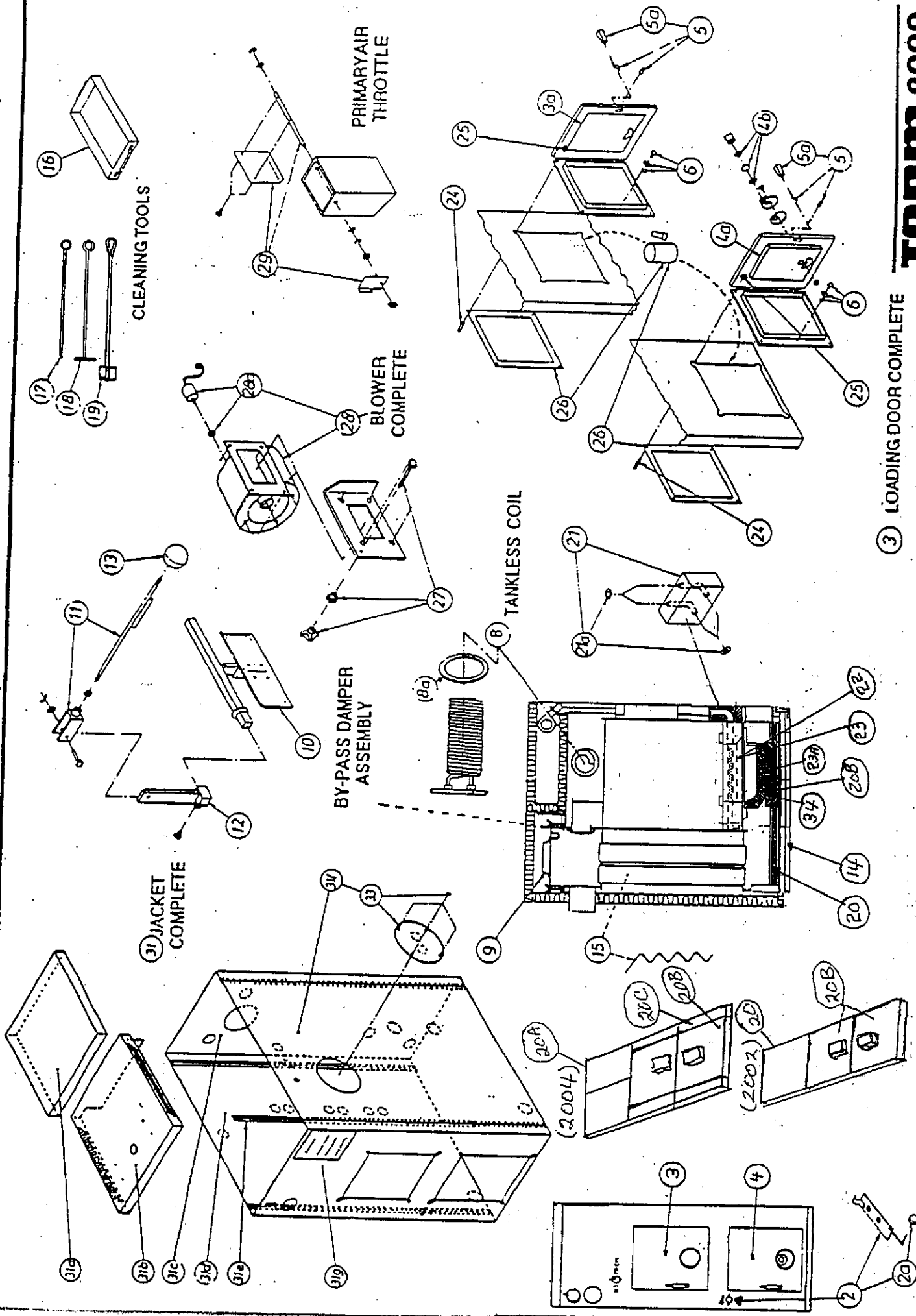
- Ordinary wear and tear, repairs or replacements necessitated by normal home use as described in the Installation and Operation Manual.
- Repairs or replacements arising from the effects of corrosive water supply or corrosive fuel.
- Repairs or replacements arising from the use of the boiler in a "cold start" system.
- Repairs or replacements of fittings, motors, fuel units, oil and gas burners, any and all other controls, relief or regulating valves, transformers, and accessories.
- Repairs or replacements to repair damage caused by operation with inadequate draft, or too hot operation from a cold start or any other use in violation of the instructions or cautions set forth in the Installation and Operation Instruction Manual.
- The repair or replacement of any component furnished by any other manufacturer, or damage caused by the functioning or malfunctioning of any such component.

PURCHASER'S LEGAL RIGHTS: This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state. This warranty shall not be construed as inconsistent with any federal, state or municipal law or any regulations promulgated in connection herewith.

Questions regarding this warranty may be referred to TARM USA INC., 5 Main St., Lyme, NH 03768 Phone: 1-800-STAY-WARM

HOW AND WHERE TO GET SERVICE Repairs or replacements under this limited warranty must be performed by your dealer or someone authorized by him. You may be required to present this limited warranty to the dealer before any work is performed. You must pay for any work performed which is not covered by this limited warranty or which is not authorized by the dealer.

TARM 2000



③ LOADING DOOR COMPLETE

④ ASH DOOR COMPLETE