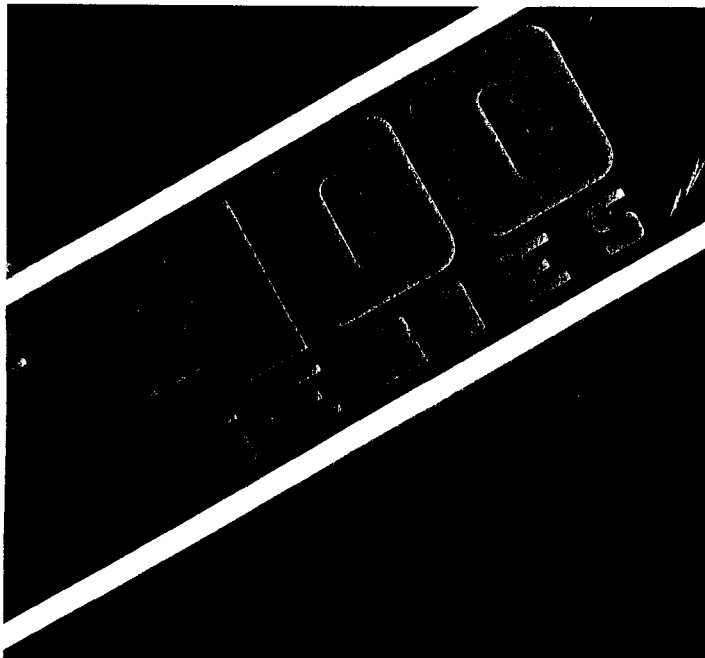

HS·TARM

Installation and Operation Manual

402 and 404
Wood- and Coal-Fired Boiler

SAVE THESE INSTRUCTIONS!

HS TARM

Dear Customer:

Thank you for buying an HS TARM boiler. Your boiler was manufactured in Denmark and conforms to traditionally high Danish standards for quality and reliability.

This manual contains complete installation and operation instructions for all models in the TARM 400 Series. For ease in reading, we have used "TARM 400" to represent all models in this series.

INSTALLATION MUST BE DONE IN ACCORDANCE WITH LOCAL ORDINANCES, WHICH MAY DIFFER FROM YOUR HS TARM 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 as successfully; the installing contractor is the best judge of a system's specific requirements as well as of local availability of different devices. However, no substitutions should be made for the standard safety equipment, such as the overheat control and relief valves, supplied with the boiler. The installation of these devices is absolutely necessary for safe operation of the boiler and protection of the heating system.

All threads and fittings on this boiler are American-sized and designed to be compatible with standard domestic controls and accessories.

We realize that it is not possible to answer all questions about the operation of the TARM 400 Series boilers in this manual. We urge you to contact your dealer, or us, if necessary, if you are in doubt about any aspect of your boiler's operation.

Sincerely,

HS TARM/TEKTON CORPORATION

TARM USA, INC
5 Main Street, Lyme, NH 03768
1-800-782-9927

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This boiler has a limited warranty, which appears on the inside back cover of this manual. To validate your warranty, detach the prepaid postcard, fill in the information requested and return the card to Tekton Corporation.

General Information

Please read the literature enclosed by the manufacturer with the various accessory devices. These devices are warranted by the manufacturer, NOT by Tekton Corporation. These accessory devices must be installed and used according to the recommendations of the manufacturer.

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 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 completed.

Please read carefully Section VIII, B., "Periodic Maintenance". Failure to protect your boiler from condensation during the warmer months MAY VOID YOUR WARRANTY!

Homeowners should read and familiarize themselves with BOILER OVERHEATING and PROCEDURE IN EVENT OF POWER FAILURE (see pages 32-34).

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

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: All coal fires produce carbon monoxide, a highly poisonous gas. Exposure to this gas produces drowsiness, sleep and, in some cases, brain damage or death. Please read and re-read carefully the sections in this manual devoted to chimneys and chimney cleaning and the instructions on coal firing before installing and using the TARM 400 boiler.

Installation Information

The boiler must be connected to a tile-lined masonry flue or other approved chimney. In some areas, codes require that no other appliance be connected to this flue. Consult your local building inspector for 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.

Boiler must be positioned to provide minimum clearances from combustibles or combustible surfaces as follows: LEFT SIDE - 24"; 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 zero inches.

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

When references are made to tapping numbers, please refer to page 4.

Do NOT use self-contained, non-electric zone valves in the zone controlled by the overheat control.

The boiler must not be installed or operated in a "cold-start" manner. Failure to observe this requirement will void the warranty.

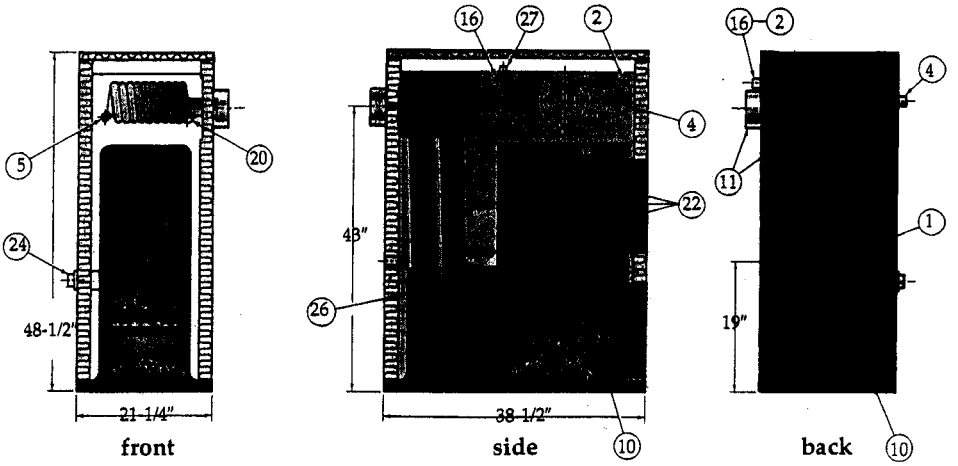
DO NOT USE with an automatic stoker.

Minimum required flue size:	*TARM 402*	*8" x 8" tile or 7" round*
	TARM 404	*8" x 12" tile or 8" round*

specifications

		TARM 402	TARM 404
Maximum Gross Output-Wood	Btu/hr	110,000	150,000
Burn Time	hr	5	6
Minimum Gross Output-Wood	Btu/hr	25,000	37,000
Burn Time	hr	14	16
Maximum Gross Output-Coal*	Btu/hr	120,000	168,000
Burn Time	hr	12	12
Minimum Gross Output-Coal*	Btu/hr	30,000	42,000
Burn Time	hr	24+	24+
Maximum Output with 6 Electrical Elements	Btu/hr	102,000	102,000
	KW	30	30
Boiler Body			
Width	in	21¼	24¼
Depth	in	38½	49¼
Height	in	48½	48¼
Firebox			
Length	in	18¾	27½
Width	in	13¼	16¼
Height	in	27½	27½
Volume	cu ft	4	7
Height to Center of Flue	in	43	43
Tapping(s) for:			
1 Return	in	1½	1½
2 Supply	in	1½	1½
3 Fusible Plug	in	¾	¾
4 Aquastats	in	¾	¾
5 Tridicator	in	½	½
10 Drain & Fill	in	1½	1½
11 Flue Outlet	in	6	8
14 Tankless Coil	in	¾	¾
15 Tankless Coil	in	¾	¾
16 Pressure Relief Valve	in	¾	¾
20 Draft Regulator	in	¾	¾
22 Electrical Elements	in	1	1
24 Preheated Secondary Air Control		–	–
26 Preheated Secondary Air Manifold		–	–
27 Air Vent	in	¾	¾
Water Volume	gal	41	62
Weight of Boiler Body	lbs	968	1,430
Weight of Jacket	lbs	88	99
Pressure Test	psi	60	60
Minimum Flue Size	in	8 x 8	8 x 12
Minimum Chimney Height	ft	20	20
Minimum Draft Required	in/WG	.05	.05

*** with optional coal baffle installed**



PACKING LIST: HS TARM 400 SERIES BOILERS

PLEASE UNPACK THE CONTENTS OF THE BOILER BODY AND THE THREE BOXES CAREFULLY, AND CHECK OFF THE ITEMS ON THE FOLLOWING LIST:

A complete 400 series boiler, as shipped from our warehouse, consists of four (4) pieces, as follows:

1. Boiler body

   A. In the firebox, you should find:

   -Complete set of grates
   -Cleaning tools (poker, scraper, brush, ash shovel)
   -Installation manual

   B. Under the smoke cover, you should find:

   -Flue outlet collar

2. Door box

   -Ash door
   -Loading door
   -Smoke flap
   -Secondary air dial
   -Package of door studs and nuts

3. Jacket box

   -Complete boiler jacket
   -Door gasket set
   -Loading door smoke shield

4. Safety control package

   -Primary draft regulator (Samson 5D)
   -Boiler pressure relief valve (WATTS 174A, 30 psi)
   -High temperature limit (Honeywell L4006B)
   -Coil pressure relief valve (WATTS 3L, 125 psi.) (boilers with tankless coil only)

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

I. BOILER SETUP

NOTE: Make all initial connections to boiler tappings (with the exception of domestic water connections) with iron fittings rather than copper. This insures that the fittings can be tightened enough to seal properly.

NOTE: All threaded fittings must be wrapped with 5 turns of TEFLON tape to seal properly.

NOTE: When assembling the boiler, please refer to the parts diagrams on pages 42-44.

A. Initial Assembly

1) Unpack the items in the boiler body, door box, controls box and jacket box and check off the items enclosed against the parts checklist, page 5. Be sure to inspect the chamber above the heat exchanger to assure that the baffle plate is in its proper position, and that the heat exchanger tubes are clear and unobstructed.

2) Place the boiler on a level concrete slab, as close to the chimney as possible. Leave enough room for installation of a barometric damper in the smoke pipe. Boiler location should permit as direct a chimney connection as is practical. THE BOILER SHOULD BE POSITIONED TO PROVIDE MINIMUM CLEARANCES BETWEEN BOILER SURFACES AND COMBUSTIBLE MATERIAL AS FOLLOWS: LEFT SIDE-24"; RIGHT SIDE-6"; REAR AND TOP-18"; AND FRONT-36". ANY FLAMMABLE DEBRIS, RAGS, PAPER, WOOD SCRAPS, ETC., SHOULD BE KEPT CLEAR OF BOILER, ESPECIALLY IN FRONT WHERE IGNITION OF SUCH DEBRIS IS MOST LIKELY TO OCCUR. THERE MUST BE A MINIMUM CLEARANCE OF 18" BETWEEN THE SMOKE PIPE AND ALL COMBUSTIBLE SURFACES.

3) Check the two (2) piece cast-iron separation baffle in the rear of the firebox (part #'s 165 & 166 on the parts list on page 42). The baffle plates may have slipped out of position during shipping. They will fall into place when in the proper position.

4) Insert the rectangular steel plate in the slots on the sides of the lower door opening.

5) Remove the plugs from tappings #5 and #20. Check to make sure that other factory-plugged tappings are secure. BE SURE THAT ANY UNUSED TAPPINGS HAVE BEEN PROPERLY PLUGGED BEFORE THE JACKET IS ASSEMBLED.

B. Jacket Assembly

The boiler comes equipped with a six-piece enameled jacket.

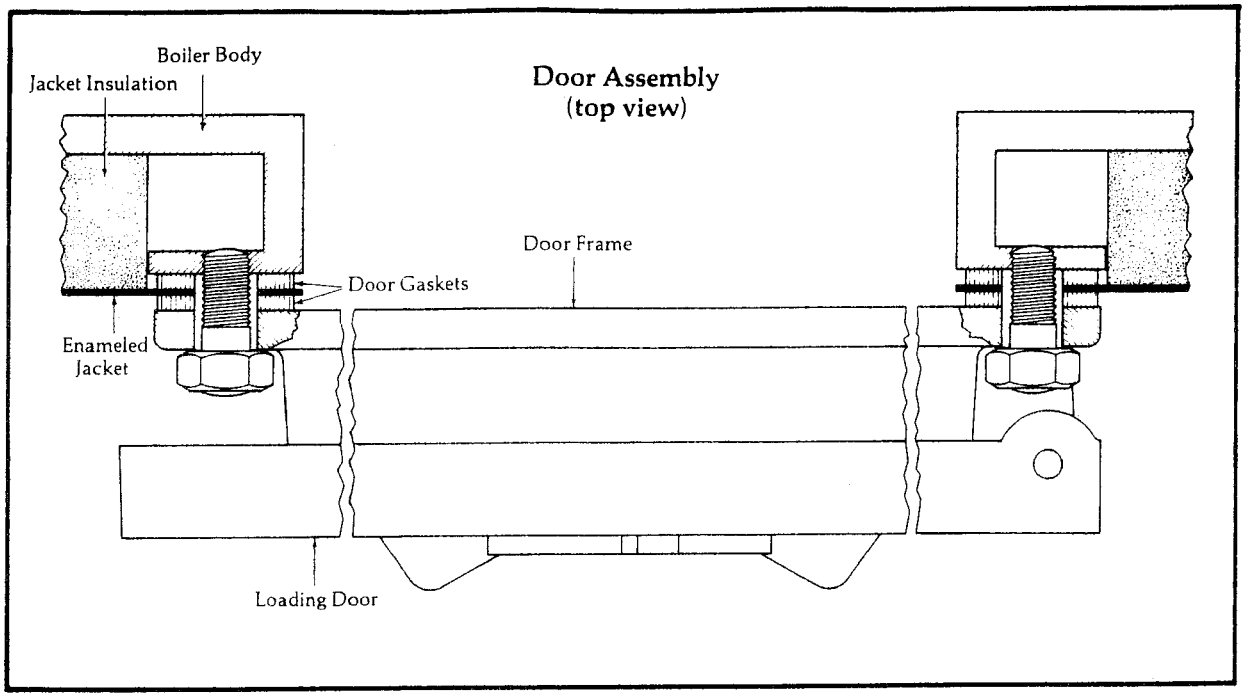
NOTE: The boiler body, front jacket panels and the door frames form a three (3) layer sandwich in final assembly. The openings must be fitted with gaskets between the boiler body and the jacket panel as well as between the jacket panel and the door frames to insure an airtight seal. Gaskets have been provided for this purpose (see diagram next page).

NOTE: The flue outlet collar (packed loose in the boiler)may be mounted on the rear or on the right side of the boiler. The boiler is supplied with the rear outlet covered with a blank plate, and the right side outlet ready for the flue collar. Any change in the location of the flue pipe outlet must be made before the jacket is placed on the boiler.

1) To mount flue collar, remove blank plate on rear outlet. There should be two gaskets under the plate. Using one of the gaskets, mount the flue collar in the desired location. Be sure to tighten all bolts evenly. Using the remaining gasket, mount the blank plate on the remaining flue opening.

2) Before installing the jacket panels, screw studs into the door mounting flanges, and place door gaskets over the studs on each of these openings. You will notice that the bottom of the firing door opening is not at right angles to the sides of the frame. This is intentional and serves to relieve localized boiling that can occur under certain conditions.

3) Check the straightness of the door frame mounting studs by placing each door frame over its studs. The frame should go on easily. If it does not, thread a nut on the end of any misaligned stud and lightly tap with a hammer on the side of the nut to straighten the stud. Recheck the studs for straightness.



4) Remove the left- and right-hand knockouts in the front panel.

5) The left side panel has six knockouts for the electrical elements, as well as three knockouts for aquastats and a large hole for the preheated secondary air tube. Remove the two leftmost aquastat knockouts. If electrical elements are to be installed, remove the six knockouts for the elements.

6) The right side jacket panel has two large round plates with two knockouts in each plate. The left-hand plate is for the optional tankless coil, and the right-hand plate is for the flue outlet. If the boiler has a tankless coil, remove the two knockouts in this plate. If the position of the flue outlet has been changed, remove the other round plate and install it on the rear jacket panel.

7) Join the back jacket panel to the left side panel, and the front panel to the right side panel, using the steel strips.

8) Move these two right-angled units into position around the boiler and join them together, using the preformed steel strips.

9) The door openings are now fitted with the second set of gaskets over the enameled jacket. Install the sheet metal smoke shield on the two upper studs on the firing-door opening. The door assemblies can now be positioned on the studs and the nuts used to tighten them down. (The lower door is equipped with the flap damper; the upper door has the round secondary air opening. Hang the smoke flap (steel plate with rod welded across long edge) in the two brackets inside the upper portion of the firing-door opening.

10) The two top panels will be installed after the piping and wiring are completed. The thin edges of each top panel meet in the slots on the left and right side panels, and the thicker, seamed ends of the top panels go to the front and rear of the boiler.

11) Install the preheated secondary air control (the small cast-iron assembly packed with the doors) on the pipe that projects through the left jacket panel, and tighten the screw on the control against the pipe.

12) Where required by law, install an ASME fusible plug (available from your HS TARM distributor) in tapping #3 inside the firebox.

C. Chimney Connection

NOTE: THE BOILER MUST BE CONNECTED TO A TILE-LINED OR OTHER APPROVED CHIMNEY IN GOOD CONDITION. IF THE BOILER IS CONNECTED TO A DIRTY OR INADEQUATE CHIMNEY, IT CAN PRESENT A SERIOUS HEALTH HAZARD FROM CARBON MONOXIDE POISONING (WHEN FIRED ON COAL), OR, WHEN FIRED ON WOOD, 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:

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

2) A minimum flue size of 8" x 8" and height of 20' is necessary for proper operation of the TARM 402. A minimum flue size of 8" x 12" and height of 20' is necessary for proper operation of the TARM 404. Under certain conditions, larger flues and higher chimneys may be required for proper operation of the boiler.

3) The smoke pipe connecting the TARM 400 to the 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.

4) A barometric damper must be installed in the flue pipe between the boiler and chimney. IT IS UNSAFE TO ADJUST THE DRAFT HIGHER THAN .1 in/WG! IF THIS VALUE IS EXCEEDED, A POWER FAILURE COULD CAUSE A SOLID-FUEL FIRE TO BURN OUT OF CONTROL!

D. Venting of Boiler Body AMERICAN #690 or Eqiv Tapping # 27

The boiler body is vented during filling and operation by an AMERICAN #690 Vent in tapping #27 on the top of the boiler.

BE SURE TO LOOSEN THE VENT CAP 2-3 TURNS BEFORE FILLING THE BOILER WITH WATER.

E. Fill-Valve and Drain WATTS S1156F or Eqiv. Tapping # 10

1) Install a 1/2" tee in tapping #10, using the appropriate bushing. Install a boiler drain on this tee.

2) Install a WATTS S1156F Fill-Valve on the tee to provide makeup water for the boiler. Where required by law, a backflow preventer must be installed in the line to the fill-valve.

F. Install Tridicator AMETEK PTA-1088 or Eqiv. in Tapping # 5

G. SAMSON Draft Regulator SAMSON 5D Tapping # 20

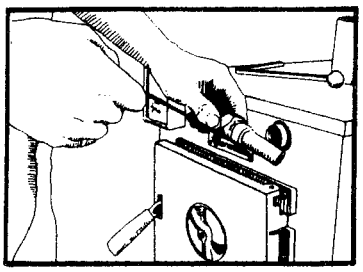
The SAMSON Automatic Draft Regulator is installed in the boiler body tapping #20 (front view). Please refer to the illustrations on the next page when installing the Regulator.

To install the regulator, apply five turns of TEFLON tape to the threads and screw the control into the tapping securely but not too tightly as the threads may be damaged if the control is turned too far. The hexagonal-head screw must be at the top so that the red figures show. The red figures will be used in making adjustments.

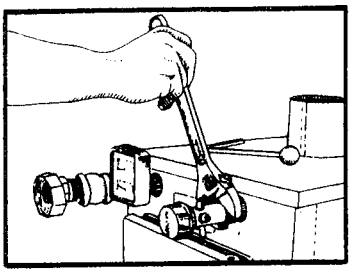
Carefully insert the arm into the hole from right to left, with the arm in the horizontal position, lifting and loosening the hexagonal-head screw if necessary.

Insert the arm about three inches, so that the chain, when attached, will not interfere with the opening of the firing door. Tighten the screw onto the arm, keeping the arm in a relatively horizontal position. The screw must bear on a flat segment of the arm, not on an edge. Attach the end of the chain with the ring to the arm of the regulator. Attach the other end of the chain to the hole in the air flap of the ash door.

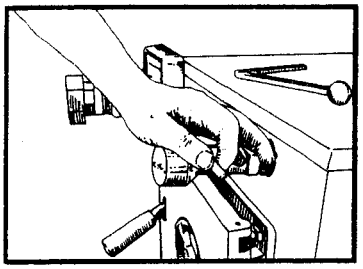
After the ring is attached to the arm of the regulator, all adjustments of the regulator should be made with the extra hook in this ring; in this way, the chain can be unhooked (thereby closing the draft flap) when fueling the boiler. It is undesirable to close the flap by turning the knob when fueling the boiler, as it causes unnecessary wear on the regulator. Instructions for setting and operating the Samson draft control are found on page 22.



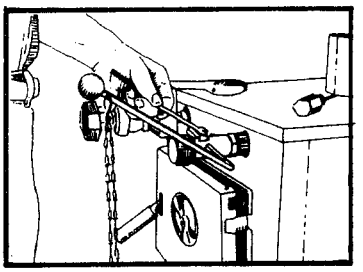
1. Wrap threads on regulator with at least 5 turns of teflon tape. Install regulator in tapping.



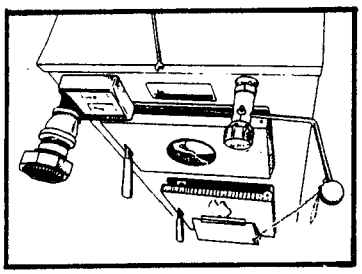
2. Tighten regulator with adjustable wrench - hex bolt should be vertical when complete. Do not over-tighten regulator!



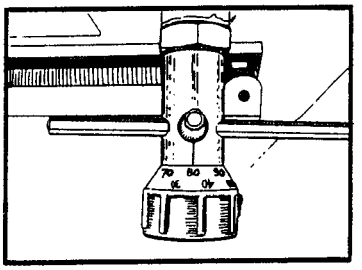
3. Loosen hexagonal bolt and remove wooden dowel from pivot joint. Note correct position of pivot joint when installed.



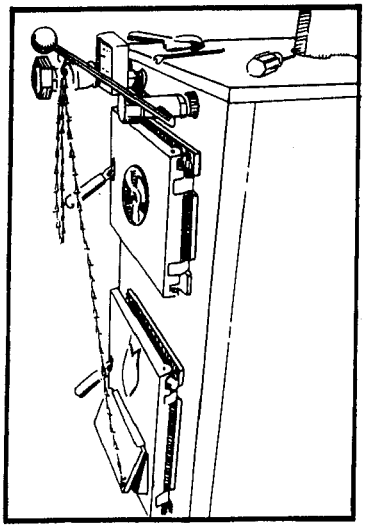
4. Install control arm and tighten hexagonal bolt, making sure it bears on a flat on the arm.



5. Top view of completed installation. Install chain as shown.



6. Regulator adjusted to 80 on dial.



7. Side view showing door position when boiler has reached set temperature.

II. DOMESTIC HOT WATER SYSTEM (optional)

A tankless coil for heating domestic hot water is available as a factory-installed option on the TARM 400 boiler, or it may be easily 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 in Section IX, B. of this manual, under "Summer". Cold water must be piped separately to the electric 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!!!

Install the Pressure Relief Valve (WATTS 3L, 125 psi) 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. Depending on the mineral content of the water and the amount of water passing through the coil, a coating of lime (calcium carbonate) will accumulate on the coil's inside surface. 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.

III. CONNECTION TO HEATING RADIATION AND/OR ANOTHER BOILER

NOTE: 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 deg. F. in the area heated by the loop, and a mean water temperature of 180 deg. F.

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

Choosing the Right System

The TARM 400 may be used alone as a wood/coal boiler (with optional automatic electric backup heat), or it may be used in conjunction with an existing oil-, gas- or electrically-fired boiler by connection in a series, parallel or Auto-Mix hookup. In the latter combinations, the TARM 400 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 the next page when reading the description of each system:

A. Only Boiler

The TARM 400 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, can be be provided by either the optional electrical elements or by a special double-swing door (both available from your HS TARM distributor), equipped with an oil or gas burner. To install the TARM 400 as the only boiler, see page 14.

B. Only Boiler with Electrical Backup

When equipped with the optional Electrical Element Package, the TARM 400 boiler can serve as an independent multi-fuel boiler, with up to 112,000 Btu/hr of electrical backup heat. The electrical elements switch on automatically when the wood or coal fire dies down or goes out.

NOTE: Installation information for the Electrical Element Package is contained in the manual supplied with the package. Piping instructions are found on page 15.

C. Series

A series hookup is the most direct and simplest form of connection between the TARM 400 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 400 cannot produce domestic hot water unless the circulator is running. Also, when the other boiler is heating the house, heating water will always flow through the TARM 400 as well. This will cause a small amount of standby loss through the unfired TARM 400. See page 15 for series hookup instructions.

D. Parallel

When the TARM 400 is connected in parallel with an existing oil-, gas- or electrically-fired boiler, domestic water can always be heated by a wood or coal fire, regardless of whether the coil is located in the TARM 400 or in the other boiler. Since the parallel connection also provides the TARM 400 with a larger effective reserve of water to be heated, the likelihood of boiler overheating is minimized and the system can respond more quickly to heating demand. For instructions on the parallel hookup, see page 16.

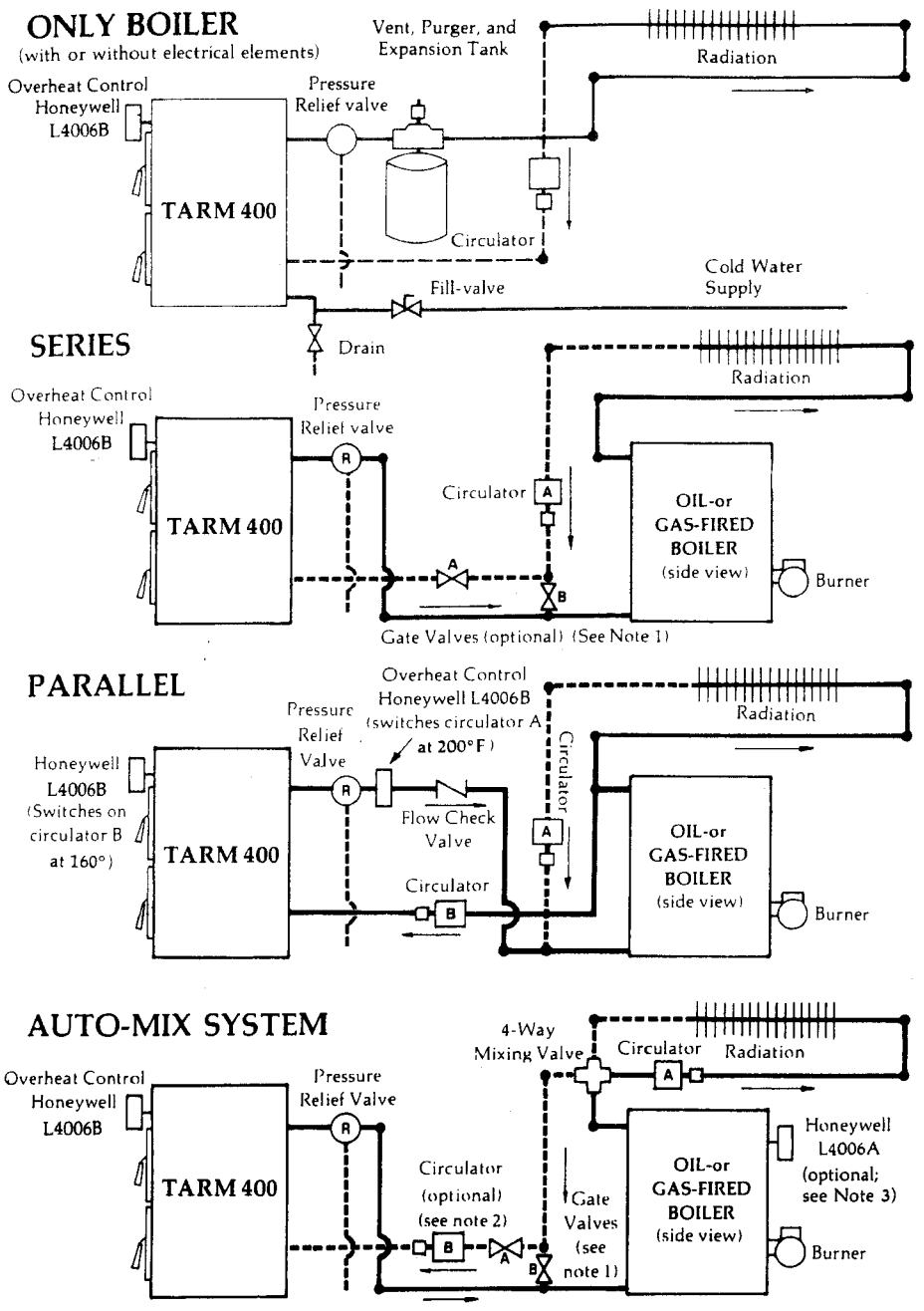
E. HS Auto-Mix

The HS Auto-Mix II system, piped as shown in schematics on the next page, provides the most convenient and fuel-efficient heating system possible with the TARM 400 boiler.

The HS Auto-Mix II 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 II 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 II promotes safer, cleaner and more efficient burning of any solid fuel.

The HS Auto-Mix II 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. For single-zone piping instructions for the Auto-Mix system, see page 17. For multizone schematics using the HS Automix II, see the HS Automix II instruction manual.

PIPING SCHEMATICS



Note 1:

Optional valves A and B can be used to bypass the TARM 400 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. To control this circulator, a Honeywell L4006A aquastat must be installed on the oil- or gas-fired boiler.

Note 3:

Set Honeywell L4006A to turn on circulator B at least 20° above the burner low limit setting. (Suggested settings: L4006A at 180°F, burner low limit at 160°F.

PIPING INSTRUCTIONS

A. TARM 400 As Only Boiler Without Electrical Back-Up

NOTE: All interconnecting wiring must be completed as per Section IV, "Wiring", page 19.

1) Thread a 1-1/2" pipe nipple into tapping 2, right side of boiler. Thread an AMTROL 445 (1-1/2") air purger using the inlet tapping "U", onto this nipple. DO NOT REDUCE THE PIPE SIZE UNTIL AFTER THE 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) Thread an AMERICAN 700 vent into tapping "V" on top of purger. Unscrew cap on top of vent two turns.

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

5) Connect WATTS 174A Pressure Relief Valve (supplied with boiler) to tapping 16 on the right side of the boiler. 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! When this valve operates, hot water or steam 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.

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

7) The circulator may be controlled by a Circulator Relay (HONEYWELL RA89A or equivalent). This relay should be wired to both the room thermostat and the Hot Water Overheat Control.

NOTE: In a case where the thermostat is calling for heat and the boiler fire is out or otherwise unable to meet the heating demands 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. As an alternative to draining the system, a mixture of non-toxic heating system antifreeze and water can be used in place of normal water in the system. Such a mixture should be added only after the system is thoroughly checked for leaks. Consult your dealer for further information.

8) Install a 3/4" x 1/2" bushing in the tapping 4, left side of boiler.

9) The Hot Water Overheat Control, HONEYWELL L4006B, comes with a 1/2" immersion well. Install the well in tapping 4. Then install the control onto the well. Set the control at 210 deg., and set the differential at 15 deg.

THE CONTROL SHOULD BE WIRED TO START THE CIRCULATOR WHEN THE BOILER WATER REACHES THE TEMPERATURE SET ON THE CONTROL DIAL. DO NOT USE SELF-CONTAINED, NON-ELECTRIC ZONE VALVES IN THE ZONE CONTROLLED BY THE OVERHEAT CONTROL. SUCH VALVES WOULD PREVENT THE OVERHEAT CONTROL SYSTEM FROM COOLING THE BOILER WHEN NECESSARY.

NOTE: When the TARM 400 is being fired, the possibility of boiler overheating does exist, especially during relatively mild weather. Should this happen, the Hot Water Overheat Control will turn on the circulator, which will dissipate the heat through the heating radiation system. IF MORE THAN ONE ZONE EXISTS, THE OVERHEAT CONTROL MUST BE CONNECTED TO THE CIRCULATOR OR ZONE VALVE THAT CONTROLS THE LARGEST AMOUNT OF HEATING RADITION.

B. TARM 400 As Only Boiler, With Electrical Back-Up

NOTE: All interconnecting wiring must be completed as per Section IV, "Wiring", page 19.

NOTE: Information for installing the Electrical Element package is found in the installation manual that comes with the Package. The following information applies only to the installation of the boiler itself.

1) Pipe out from tapping #2 of the TARM 400 boiler to a 1-1/2" Tee.

2) Install the WATTS #174A 30 psi Pressure Relief Valve into one arm of the tee using a 1-1/2" by 3/4" bushing. THIS VALVE MUST BE INSTALLED TO ENSURE 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. When 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.

3) Thread an AMTROL 445 (1-1/2") air purger and 1-1/2" nipple into the remaining arm of the 1-1/2" Tee. Use the inlet tapping "U" of the air purger for this connection.

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

5) Thread an AMERICAN #690 or #700 air vent into tapping "V" on top of the air purger. Unscrew the cap on top of the vent two turns.

6) The remaining tapping "U" on the air purger is used for connection to heating radiation.

7) Auto-Mix system installations should be piped out from tapping #1 to the unmarked tapping on the 4-way Mixing Valve.

   If a conventional heat distribution system is used, a circulator should be installed in the return line from radiation. Pipe the return line into Tapping #1 at the rear of the boiler. See diagrams on page 13.

8) Install the Honeywell L4006B Overheat Control, as described in #8 and #9 on page 14, with the exception that the Control should be installed in tapping 16, not tapping 4.

9) Install Honeywell L8124M Master Hot Water Control in tapping #4.

   For the remainder of the installation, please refer to the installation manual for the Electric Element Package.

C. Series Hookup

NOTE: All interconnecting wiring must be completed as per Section IV, "Wiring", page 19.

1) Connect the radiation return line to tapping 1 of the TARM 400.

2) Using 1-1/2" pipe, connect tapping 2 to the return tapping of the other boiler. Be sure to provide means for venting air from the TARM 400 boiler and the piping connecting it to the system.

3) Install WATTS 174A Pressure Relief Valve (supplied with boiler) in tapping 16. 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 floor with no reduction in pipe size. When 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.

4) If the addition of the TARM 400 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.

5) Install the HONEYWELL L4006B Hot Water Overheat Control as described in steps #8 and #9, page 14.

NOTE: In cases where the TARM 400 boiler is not being fired for extended periods of time, standby loss up the flue can be reduced by unhooking the chain on the SAMSON Automatic Draft Regulator so that the air flap on the lower door is closed. The upper door air disc and secondary air control should also be closed.

NOTE: If the TARM 400 boiler is being fired on wood or coal a good deal of the time, it is desirable to reduce the settings on the aquastat of the existing oil- or gas-fired boiler. 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 400 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.

D. Parallel Hookup

NOTE: All interconnecting wiring must be completed as per Section IV, "Wiring", page 19.

NOTE: All pipe connecting the two boilers must be 1-1/2".

1) Remove existing radiation supply and return lines from oil- or gas-fired boiler. Install nipples and pipe tees in supply and return lines of existing boiler, or on the boiler itself. Reinstall supply and return lines.

2) Pipe out from tapping 2 of the TARM 400 boiler to a 1-1/2" tee. Do not reduce pipe size!

3) Install a HONEYWELL L4006B or equivalent into one arm of the tee, using the 1/2" immersion well supplied and a 1-1//2" by 1/2" bushing.

4) Pipe from the tee installed on tapping 2 to the tee previously installed on the existing boiler's return tapping.

5) Install a WATTS 174A Pressure Relief Valve (supplied with boiler) in tapping 16. 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. When 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.

6) Using a 3/4" x 1/2" bushing and a 1/2" immersion well, install a second HONEYWELL L4006B in the tapping 4 on left side of boiler.

7) If the addition of the TARM 400 has increased the water capacity of the heating system beyond the rating of the existing expansion tank, additional capacity should be added to the system. If in doubt about the requirements of the heating system.consult your distributor.

8) Install piping, a flow check valve, and a circulator between TARM 400 tapping 1 and the tee previously installed on the existing boiler's supply tapping or piping. Refer to the piping schematics (page 14) for the correct direction of flow.

NOTE: Both HONEYWELL controls installed above are "close-on-rise" type in operation. The control in tapping 4 on the TARM 400 boiler is set at 160 deg. F. and is connected to the circulator installed between the TARM 400 boiler and the existing boiler. When the TARM 400 is being fired and reaches operating temperature, this circulator will start and circulate water through both boilers. This allows the TARM 400 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 the circulator between the two boilers from forcing water past the flowcheck in the supply line(s) to radiation in the building.

The HONEYWELL control on the "tee" (step 3 above) is set at 210 deg. F., with a differential setting of 15 deg., and should be wired to the circulator supplying water to the largest heating zone. This "overheat" control acts as a safety device in case the TARM 400 should overheat, and dissipates heat from the TARM 400 to radiation.

DO NOT USE SELF-CONTAINED, NON-ELECTRIC ZONE VALVES IN THE ZONE CONTROLLED BY THE OVERHEAT CONTROL! SUCH VALVES WOULD PREVENT THE OVERHEAT CONTROL FROM COOLING THE BOILER WHEN NECESSARY.

When the TARM 400 is inactive, the flow-check valve installed between the TARM 400 return and the oil- or gas-fired boiler supply prevents gravity circulation between the two boilers, and consequent standby loss from the TARM 400. 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 400 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 400 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.

E. Auto-Mix System

NOTE: All interconnecting wiring must be completed as per Section IV, "Wiring", page 19.

NOTE: The four-way mixing valve should be oriented so that the tapping labeled "UP" actually faces to the left when viewed from the front of the boiler. If the "UP" tapping must be oriented up, please consult the Auto-Mix II Installation Manual for the proper assembly procedure.

1) Using 1-1/2" pipe, pipe out from tapping 2 of the TARM 400 boiler to the return tapping on the oil-, gas- or electrically-fired boiler. We recommend installing optional gate valves A and B (see piping schematics).

2) Install WATTS 174A Pressure Relief Valve (supplied with boiler) in tapping 16. 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. When 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.

3) Pipe the supply from the oil-, gas- or electrically-fired boiler to tapping 1 on the four-way mixing valve.

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

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

6) Pipe the unmarked tapping opposite the "UP" tapping on the mixing valve to tapping 1 on the TARM 400 boiler. We recommend installing optional circulator B in this return line if the tankless coil for domestic water is located in the oil-, gas- or electrically-fired boiler. We also recommend installing the optional gate valves (see piping schematics) so that the TARM 400 can be isolated from the system when desired.

7) If the addition of the TARM 400 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. If in doubt about the requirements of your heating system, consult your dealer.

8) Install the Honeywell L4006B Overheat Control, as described in #8 and #9 on page 14.

NOTE: When the TARM 400 is being fired, the possibility of boiler overheating does exist, especially during relatively mild weather. Should this happen, the Hot Water Overheat Control will open the mixing valve and dissipate heat through the heating radiation system.

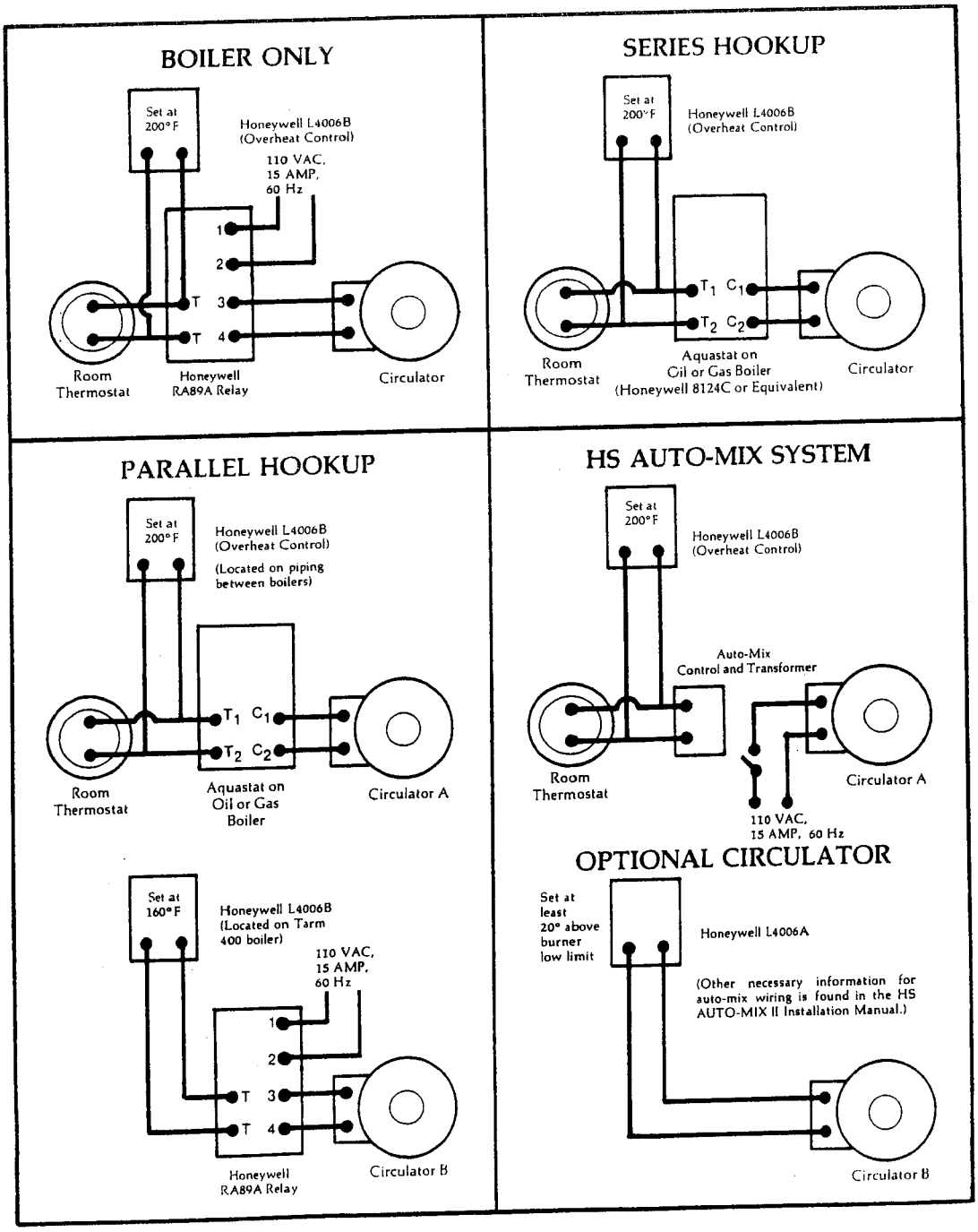
THE CONTROL SHOULD BE WIRED TO OPEN THE MIXING VALVE WHEN THE BOILER WATER REACHES THE TEMPERATURE SET ON THE CONTROL DIAL.

IV. ELECTRICAL WIRING (Refer to diagrams on this page.)

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 500 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 Electrical Code, ANSI/NFPA #70-1978.

Wiring Diagrams



HOW TO BURN WOOD IN YOUR HS TARM BOILER

The following information is intended to help both the beginning and advanced woodburner learn how to fire the TARM 400 boiler. Boiler operation is different from woodstove operation, and only experience will produce the best results.

Much of the information in this section is applicable to coal firing. In order to start a coal fire, for example, you must first build a wood fire. Therefore, you are urged to read not only the section on coal burning but also this section on wood burning before attempting to burn coal in your boiler.

VI. WOOD-FIRING INSTRUCTIONS

A. Chimneys

The chimney is one of the most critical factors in the successful operation of any heating system. A good chimney should provide a continuous and dependable draft. (For draft requirements of the TARM 400 boiler, see page 8.)

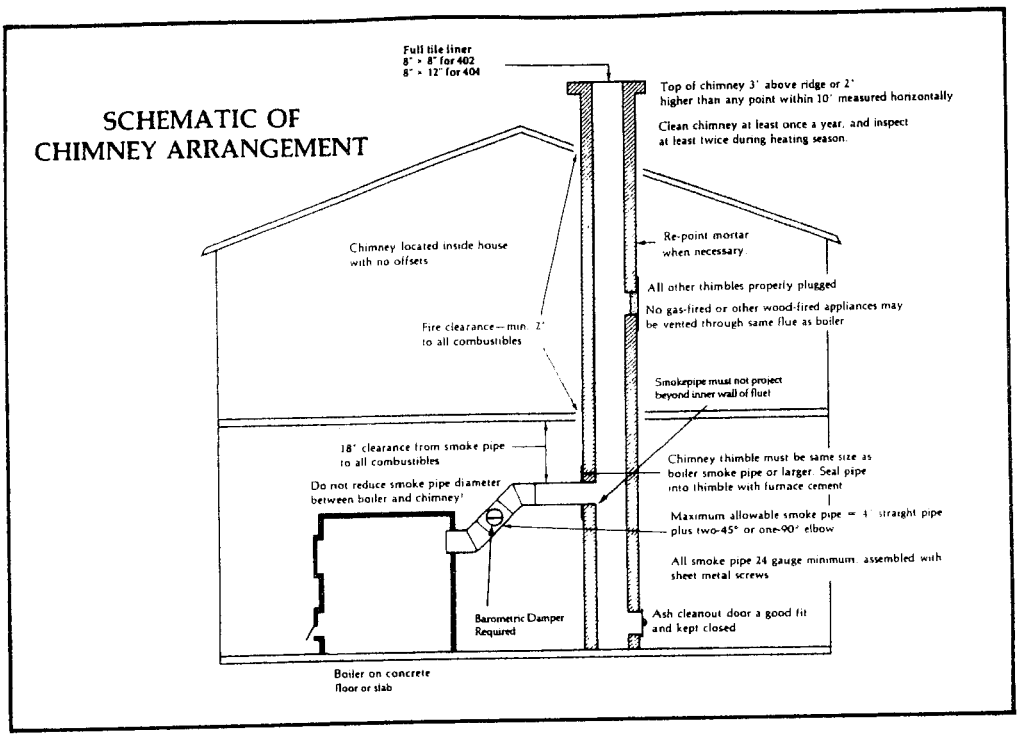
The top of the chimney should be at least three feet above the point it passes through the roof and two feet above any point on the roof that is within 10 feet measured horizontally. If an adjoining roof section is higher than the section where the chimney is located, the chimney should be at least as high or higher than that tallest section. If these two conditions are not satisfied, a down-draft may result. Down-drafts may also be caused by other nearby buildings or trees that are taller than the chimney.

Tile-lined masonry chimneys are generally used since they are strong and unlikely to crack from high temperatures. Fire insurance underwriters favor and sometimes require masonry construction for chimneys.

Natural draft in a chimney depends on two variables. Some draft is created by the aspirating effect of air currents blowing across the top of the chimney. Of greater importance is the natural draft which will develop when the temperature of the flue gases is higher than the temperature of the atmosphere around the chimney. Therefore, insulating the chimney flue liner will increase the draft as well as make it more consistent. Insulation also will reduce soot and creosote deposits by reducing the amount of moisture condensation from the flue gases.

The following notes and the accompanying diagram briefly summarize some of the most important points about chimney construction.

1) Proper height is required for adequate draft to occur. The minimum height required for the TARM 400 is 20 feet. (Higher chimneys may be required in certain installations.)
2) The interior surface of the flue should be as smooth as possible to avoid friction and to help decrease the possibility of creosote, soot, and fly ash buildup.
3) The connecting smoke pipe should be the same diameter or larger where it enters the chimney as where it enters the heating unit. In other words, it should never become smaller in diameter going from the heating unit to the chimney.
4) Chimney cleanout doors must be airtight or they will admit cold air, both lowering stack temperatures and spoiling the draft. Such doors should be located at least one block section from the base of the chimney so that any condensation that may drip down inside the chimney does not run out the door if it accumulates.
5) Air leakage in cracks where mortar has fallen out will mean a cold chimney.
6) A chimney must be warm (above 250 deg. F.) for proper draft to occur.
7) The smallest cross-sectional area should be considered the effective area of the chimney. For example, an 8" x 8" chimney that is restricted to 8" x 6" at some point should be considered only as effective as an 8" x 6" chimney.



8) Connecting smoke pipe must be kept a safe distance from combustible materials. This distance is specified in local codes, which should be referred to by the installer. In no case should non-insulated smoke pipe be closer than 18" to a combustible surface. Insulated pipe should be installed according to manufacturer's instructions.

9) The area where the connecting pipe enters the chimney should be sealed with refractory cement so that the connection is airtight.

B. Chimney Cleaning

Check your chimney and smoke pipe at least twice a year to see if they require cleaning. Check it more frequently if you are new to coal or wood burning or have reason to believe that fly ash, soot or creosote is building up.

It is not unusual to have a little smoke come into the room as you open the door slightly for a moment before opening it completely. But if your boiler begins to smoke increasingly as you open the door to add wood, you may have a chimney blockage. To find out what is wrong, look into the chimney from above or below. If either is inconvenient, use a mirror and a flashlight. The cleanout door is a handy place to use a mirror to look up the flue.

Various cleaning methods may be used: There are a large number of wire "flue brushes" on the market that are manufactured in sizes to match most smoke pipes and tile liners in common use. When equipped with handles and extensions, these brushes are the fastest and most effective method of cleaning chimneys and smoke pipes. WARNING: Use of steel-wire cleaning brushes to clean coal firing systems may produce sparks, possibly causing a dust explosion. Special plastic and non-ferrous brushes and accessories are available to eliminate this hazard. Remove as much soot as possible before any hard scraping of the sides of the chimney flue.

Chemical chimney cleaners such as "Chimney Sweep" are also available. These are generally thrown into the hot fire, supposedly causing creosote and soot to crumble and disintegrate. We cannot testify as to what the long-range effect on the chimney or boiler may be. However, we have been advised that any chemical salt added to the fire may cause serious corrosion in insulated metal chimneys or plain smoke pipe or boilers, and we therefore do not recommend their use. We have found that periodic burning of anthracite pea coal will reduce creosote buildup. A thin layer added to a filled firebox once a week should be adequate.

C. Starting a Fire

NOTE: Read and understand this entire manual, and be certain that the heating system is fully installed and that all electrical and auxiliary systems have been checked out by the installer BEFORE STARTING A FIRE. The system must be filled with water and vented to remove air. It is recommended to bring the boiler up to 140 deg F by oil/gas or electricity before starting a fire.

There are three controls important to starting a proper fire in your TARM 400 boiler. These are the primary air inlet on the ash door, the air inlet on the firing door, and the secondary air inlet on the left side of the boiler.

The primary air inlet is controlled during normal operation by the SAMSON draft regulator.

The regulation of the firing door air inlet and the secondary air inlet is extremely important for the efficiency of boiler operation. As wood is heated in any fire it emits gases which, when burned, yield heat. When they are not burned completely, they can represent a significant loss of efficiency and, in some cases, form creosote. Creosote is formed when flue gases condense in the boiler or chimney. The admission of additional air through the secondary air inlet or the air inlet on the firing door allows these gases to be burned rather than having them proceed wastefully up the chimney.

To start your first fire, turn the SAMSON draft regulator control so that the flap on the ash door is wide open. Open the air inlet in the firing door far enough to admit two fingers. The secondary air inlet on the left side of the boiler should remain closed at this time and should always be closed when starting a new fire or when adding a great deal of wood to a fire that is nearly out.

Start the fire in the conventional manner, using paper, kindling and two or three small logs. Pile all these on the grates. Once the logs are burning well, add more, larger logs. The largest wood may be added when the fire is burning well with some coals forming; logs should be one or two inches shorter than your firebox and be of such diameter as not to "bridge" or jam in the firebox. The burning wood should be able to settle easily as it is consumed. For this reason, it is important that the logs be stacked horizontally.

CAUTION: Firing and ash doors must remain closed except when loading fuel or removing ash. Door gasket seals must be maintained in good condition, and replaced as necessary to maintain an airtight seal. Replacement seals are available from your HS TARM dealer.

NOTE: Do not be alarmed if you smell an unusual odor the first few times you fire your boiler. This is the result of oil and other residue burning off the steel plates, and will not occur again.

D. Adjusting the SAMSON Draft Regulator and Secondary Air Dial

The SAMSON draft regulator and secondary air dial should now be adjusted as follows:

Turn the black knob on the regulator to set the red number 80 at the red line. Allow the wood fire to slowly bring the boiler temperature up to about 200 deg. F. on the Tridicator. When this temperature is reached, adjust the chain and then the knob so that the small primary air inlet flap is just closed but is still maintaining tension in the chain. The control will open and close the air inlet flap automatically to allow the proper amount of combustion air to enter the firebox to maintain the selected boiler temperature.

It may take several trials working with the control setting and chain positioning to maintain a proper boiler temperature, during wood firing, of approximately 180-190 deg. F. The final control setting may be more or less than 80 on the dial.

Many people find that their boilers run better and cleaner when operated at 200 deg. F. In addition, the radiation in many houses is designed to provide adequate heat at a boiler water temperature of 200 deg. F. If your boiler can maintain a temperature of 180 deg. F., but your house is not getting enough heat when the outside temperature is low, it may help to operate your boiler at 200 deg. F. All that need be done to raise your boiler temperature is to set the SAMSON Draft Regulator to a higher number. However, NEVER adjust the regulator higher than 100 on the dial or so that the boiler operates at over 210 deg. F. Be sure to adjust the HONEYWELL L4006 B Overheat control to a setting 20 deg.F. higher than the selected boiler operating temperature.

The setting of the secondary air inlet and the firing door air inlet will vary according to chimney draft, type of wood, dryness of wood and other factors. If shut too tightly, not enough air will be admitted to burn all the flammable gases, and creosote and soot will form more readily. If open too far, too much air will be admitted and the primary draft control will have little effect on the rate of combustion. The primary air inlet must be able to shut the fire down or open it up, according to the heating demands of the house. The firing door air inlet should never be left completely closed as some air over the fire is required for proper combustion. Accurate setting of these inlets will develop quickly with practice if the above instructions are kept in mind.

E. Long-Term Firing

In long-term maintenance of wood fires, frequent stoking with small amounts of wood is more desirable than infrequent stoking with large amounts. When the firebox is full, you are using heat energy to drive ordinarily burnable gases in the unburned wood up the chimney, wasting energy and increasing creosote formation. When you are going to bed, or plan to be away from home for more than a few hours, however, it will be necessary to load up the firebox. Normal use, and especially large loads of wood, will often leave you with quite a few coals when you next stoke the fire; these coals should be pulled forward in the firebox (your cleaning tool is handy for this) where they can get sufficient air to burn and set fire to the next load of wood.

When refueling the boiler, before opening the firing door close the air flap on the ash door by removing the hook from the ring at the top of the chain. The firing door should be opened gradually, so as to build up the draft through this door. These procedures will minimize smoke escaping from the firing door when it is open.

Ashes should be emptied before they build up to a level where they are touching the grates. Grates are normally kept somewhat cooler than the fire by air flowing over them. Ash buildup can prevent this cooling, causing grates to wear out prematurely.

After removing ashes from the boiler, place them in a metal container with a tight-fitting lid. Place the closed container on a non-combustible floor or on the ground, well away from combustible materials, pending final disposal. Make certain that ashes are cooled thoroughly before burying them in soil or disposing of them by other appropriate means.

F. Creosote and Soot

One of the most critical aspects of operating a wood-burning central heating system is the control of creosote and soot. This is especially important when there is a low demand for heat, such as in the fall or spring. A good understanding of the causes and cures for excess creosote or soot formation is essential to the operation of the TARM 400 boiler.

Your boiler and, for that matter, all types and makes of wood-burning equipment can make excessive creosote under certain conditions. You should be aware of these conditions and avoid them.

When wood burns slowly, it produces acetic and other pyroligneous acids which combine with expelled moisture to form creosote. Highly combustible in its solid and semi-solid states, creosote is present in the gases given off by burning wood. A SERIOUS FIRE MAY RESULT IF A SUFFICIENT CREOSOTE BUILDUP IS PERMITTED. Creosote may build to a considerable thickness on the interior of the chimney, and the draft will be subsequently reduced.

NOTE: Accumulations of creosote on the boiler jacket can be removed with a mixture of electric dishwasher soap and water, using a scrub brush or sponge. This mixture should NOT be used to clean the inside of the boiler, smoke pipe and chimney.

Creosote condenses from the flue gases more quickly when the temperature in the chimney is low. The actual amount of creosote deposited depends on: (1) the amount of moisture in the flue gases; (2) the temperature of the stack; (3) the rate at which the wood burns; (4) the amount of draft in the stack; and (5) how completely the combustible elements in the flue gases have been burned in the combustion chamber. Most problems with creosote are due to insufficiently dry wood, poor chimneys with low draft and cold boiler walls, and/or to a low rate of burning when little heat is required during the spring and fall months.

Moisture in the flue gases may be controlled by:

- using properly seasoned firewood.
- mixing small pieces (preferably slab wood) with every full load.
- never using only large wood (usually less dry) during mild weather when combustion is relatively slow.

The temperature in the stack may be controlled by:

- using as short a length of smoke pipe as possible between the boiler and the chimney.
- using an insulated smoke pipe to connect the boiler to the chimney.

The amount of draft in the stack may be controlled by:

- having as few bends as possible.
- insuring adequate chimney height and preventing air leaks.
- eliminating obstructions in the chimney outlet.
- having only one appliance per flue.

G. Chimney Fires

Chimney fires are caused when an excessive buildup of creosote in the smoke pipe or chimney is ignited by a racing fire, or when a burning piece of material is swept out of the firebox into the chimney.

If you have a chimney fire, you will hear a roaring sound in your chimney. In addition, sparks may be seen flying from the chimney outside the house.

Chimney fires can set fire to the interior of your house or your roof. They are potentially very dangerous. If you think you have a chimney fire:

(1) Call the fire department
(2) Shut all doors and close all air inlets on your boiler and smoke pipe.
(3) Evacuate your house
(4) If possible, use a garden hose to wet your entire roof.

Chimney fires can be avoided by following the recommendations in this manual for minimizing creosote formation, by maintaining your chimney in good condition, and by cleaning your chimney regularly.

H. Firewood

Burn dry and well-seasoned hardwood with a moisture content of 20% or less. Season wood an absolute minimum of a year, preferably eighteen months. Woodburners who ignore this advice are almost certain to have dirty chimneys and inadequate performance from their boilers.

Theoretically, there are about 8600 Btu's available as heat from each pound of oven-dry wood. It takes about 1000 Btu's to evaporate each pound of moisture from a log. The wetter the wood, the more energy it takes to get the moisture out of your firewood and the less energy is available to heat your home.

Seasoned wood will produce less creosote. Seasoned wood also produces more usable heat, 20-25% more in the case of some hardwoods.

A cord of wood measures four by four by eight feet. A cord of four-foot logs thus stacked occupies 128 cubic feet and contains about eighty cubic feet of solid wood, the rest being air space between logs.

If you buy a cord of wood, cut it to length, then split it, you will find it does not occupy 128 cubic feet when stacked. You have not necessarily been cheated. A cord cut to length and split packs more tightly and occcupies less space.

If you want your wood to dry as quickly as possible, cut it to length and split it. Stack it where the air can move through the pile and shelter it from the weather. A woodshed with air vents in the side walls is effective. Covering your wood supply with plastic sheeting will prevent the wood from drying.

If you store firewood near your TARM boiler, be sure it doesn't fall within the fire clearances specified on the listing label on the boiler jacket. Also, don't leave wood in the fuel-loading and ash-removal access areas.

If you cut your trees in the spring or summer, let them lie a while. Until the leaves wither, they will draw moisture from the wood, drying it more quickly than if you limbed the tree immediately.

A good time to cut your own wood is in the late winter or early spring, as soon as the woods are free from snow. Then hold the wood for use in eighteen months. This is often the best time to buy wood, too. Green wood can sometimes be had at rock bottom prices in spring or early summer.

The moral is: Don't burn green wood. If you buy green wood, season it before using. With some experience you can spot green wood easily. It is heavier, it looks different. Seasoned wood will often show cracks radiating outward like wheel spokes from the heartwood toward the bark. Green wood will not show this pattern of cracks.

Use the longest piece that will conveniently fit into the firebox. The wood will tend to burn (especially with the draft turned low) from front to back in the firebox. The longer the stick, the longer the fire will hold.

You get roughly the same amount of heat from a pound of wood, no matter what species of tree it comes from. But wood is not sold by the pound; it is sold by the volume -- by the cord. Therefore, the dense, heavy woods are the best ones to buy because they will give you more pounds per cord.

The following figures compiled by the United States Forest Products Laboratory indicate the amount of heat available per cord of wood from a few representative tree species:

AVAILABLE HEAT PER CORD, MILLIONS OF BTU

Species	Green Wood	Air Dry	Percent More Heat for Air-Dry Wood
Ash	16.5	20.0	21
Aspen (popple poplar)	10.3	12.5	25
Beech, American	17.3	21.8	26
Birch, yellow	17.3	21.3	23
Douglas Fir, heartwood	13.0	18.0	38
Elm, American	14.3	17.2	20
Hickory, shagbark	20.7	24.8	19
Maple, red	15.0	18.8	24
Maple, sugar	18.4	21.3	16
Oak, red	17.9	21.3	19
Oak, white	19.2	22.7	18
Pine, eastern white	13.1	13.3	10
Pine, southern yellow	14.2	20.5	44

HOW TO BURN COAL IN YOUR HS TARM BOILER

Coal is fast becoming a popular home heating fuel in many areas of this country. Formerly the most widely used home heating fuel, coal declined markedly in use with the introduction of oil-burning equipment in the 1940's. But with abundant domestic supplies still available, the price of coal has remained stable for many years. Today, coal is cheaper than fuel oil in many areas.

Your TARM 400 boiler is designed to burn coal efficiently and reliably. But as with firewood, specific knowledge and experience are essential if coal is to be burned safely and effectively.

So that you are better able to decide whether or not to burn coal, please consider carefully the advantages and disadvantages of using this fuel. Following, you will find a chart that compares coal with wood burning and a formula for calculating the cost of coal relative to other fuels.

NOTE: In order to start a coal fire, you must first build a wood fire. Before attempting to burn coal in your TARM 400 boiler, please read carefully the preceding section on wood firing, particularly the parts on chimneys and chimney cleaning.

COAL VS. WOOD BURNING

Advantages

- Coal burns for a longer time than wood; burn times of 14 hours or more are common.
- Anthracite coal produces no creosote and very little soot; even well-seasoned wood contains moisture and will produce creosote.
- Coal produces very even heat, whereas wood produces a varying heat output. Once established, a coal fire, if properly regulated, burns more smoothly than a wood fire.
- Coal may be loaded easily by shovel. There are no problems with logs being an inch too long or with packing irregularly-shaped logs into the firebox!
- Coal is uniformly cheaper than fuel oil in most places and, in some places, cheaper than good firewood.
- In a given boiler, coal produces up to 20% higher maximum heat output than wood, which means that the boiler will heat a larger space when burning coal than when burning wood; thus, a single firebox load of coal will burn longer than one of wood.

Disadvantages

- Coal can cause a boiler to overheat more severely than wood if the air flow to the firebox is not regulated properly (e.g., the ash door is left ajar by mistake), due to the fact that a firebox full of coal contains more heat than an equivalent amount of wood.
- Coal has a high ash content, and ashes must be emptied once a day. (The best coal will produce 250 lbs. of ash per ton, whereas an equivalent amount of hardwood will produce only 40 lbs.) Coal ashes, unlike wood ashes, are not suitable for use on gardens.
- Coal is a non-renewable resource; firewood is essentially "stored solar energy" and therefore a renewable resource. The mining of coal contributes to erosion and scarring of land and carries occupational health and safety hazards as well.
- Coal cannot be obtained for free whereas firewood often can be obtained at little or no cost.
- Coal produces more carbon monoxide gas than wood (see page 28). Also, a coal fire produces sulfur oxides, which cause the "acid rains" that now threaten plant and animal life in many parts of the world.
- Coal must be ignited by first building a wood fire; wood fires are easier to start and they get the boiler to temperature more quickly.

RELATIVE FUEL COSTS

To compare the price of coal in your area with the price of other fuels, first determine the unit price of the fuels:

FUEL	UNIT PRICE (in dollars)
Coal	price per ton (delivered)
Cord Wood (dry hardwood	price per cord (cut, split, delivered)
Fuel Oil	price per gallon
Natural Gas	price per 100 cubic ft. (1 therm)
LP Gas	price per gallon
Electricity	price per kilowatt

Then, to determine the unit price of each fuel for an equivalent amount of Btu's, multiply each price by the factor listed:

UNIT PRICE	x	FACTOR	=	COST/million Btu
Coal		.069		
Cord Wood		.088		
Fuel Oil		11.11		(Example: Coal at $105/ton
Natural Gas		15.4		x .069 = $7.24/million Btu)
LP Gas		15.4		
Electricity		294.0		

The costs you have calculated take into account the actual burning efficiency of each fuel. For example, it would be inaccurate to compare the total available heat contained in $10 worth of firewood with that in $10 worth of fuel oil since oil burns more efficiently than wood. Burning efficiencies must be taken into account for a realistic comparison.

Once you know the cost of one million Btu's of any fuel, it is easy to compare costs. For example, let's say you want to know how much you could save by burning coal instead of fuel oil. Your coal would cost $7.24 per million Btu's, and your oil would cost $11.11 per million Btu's. Divide the price of coal by the price of oil:

$$\$7.24/\$11.11 = .65$$

The cost of burning coal would be 65% of the cost of burning oil -- or 35% cheaper.

VII. COAL-FIRING INSTRUCTIONS

A. A Warning About Carbon Monoxide Poisoning from Burning Coal.

All coal fires produce carbon monoxide (CO), a highly poisonous gas. Exposure to this gas produces drowsiness, sleep and, in some cases, brain damage or death. Since carbon monoxide is odorless and colorless, the victim is rarely aware that he or she is being overcome until it is too late.

Your HS TARM boiler is designed to burn coal safely. BUT IF THE OPERATOR FAILS TO MAINTAIN THE COMBUSTION SYSTEM PROPERLY, UNBURNT CARBON MONOXIDE COULD ESCAPE FROM THE COMBUSTION CHAMBER, SMOKE PIPE, FLUE OR CHIMNEY, AND ENTER THE HOUSE. This could occur if any of the following conditions exist:

- A blocked chimney;
- A closed smoke pipe damper;
- A poor chimney draft;
- An internal blockage in the heating appliance that can be caused by a buildup of ashes or creosote.

WARNING:

The flue outlet in the bottom rear of the firebox must be periodically cleared of ash. As this opening is directly above the grates (which slope towards the back), DO NOT ALLOW ASH TO BUILD UP IN THE BACK OF THE FIREBOX AND RESTRICT THE FLUE OPENING! Rake the coal bed towards the front of the firebox and clean out ashes from this area at least once every 2 days.

Your HS TARM boiler is designed to provide years of safe, efficient operation. HOWEVER, THE DANGERS OF COAL BURNING ARE REAL. Make certain that your boiler, accessories and related equipment are maintained properly to avoid these dangers.

If you have any questions about coal burning, please consult your dealer or call our service department, (413) 369-4367.

B. Choosing the Right Coal

Coal varies in type, size and grade. Just as there is good and bad firewood, there is good and low quality coal.

We recommend anthracite (hard) coal of the "nut" size; you may find, however, that different sizes (such as pea coal) or layers of two or more sizes may produce the best results in your particular boiler/heating system/chimney combination. For example, pea coal may produce less output and a longer burn than nut coal. Stove coal is too large for most HS TARM installations.

There are many grades of anthracite coal; we recommend one with a low ash and low sulphur content. (Less ash means less cleaning, and less sulphur means less pollution.) Coal is rated also for its slate content. The more slate, the more solid the residue -- and the harder it will be to shake ashes through the grates.

We DO NOT recommend bituminous coal. Bituminous coal is gererally not of uniform size, is messy to handle and produces large amounts of pollutants. It also burns hot enough to damage the grates, and produces large clinkers (fused ash), which can jam the grates.

Before ordering any type of coal in large quantities, buy a bag or two of the coal you intend to use and try it first in your boiler. As you experiment, bear in mind the following points:

- The larger the size of the coal used, the deeper the coal bed must be to maintain a good fire.
- Coal sizes may be mixed but should be applied in separate layers for best results.
- Smaller sizes of coal can be used to "bank" a fire on top of the bed for longer burns.
- If the draft is sluggish, consider installing a draft inducer.
- If the coal doesn't burn completely, leaving a "heart" of unburned coal surrounded by residual ash, the coal bed is too shallow, or the draft is too weak.

C. Coal Grates

Because all coal fires produce large quantities of ash and solid residue, most coal-burning appliances are equipped with special, moveable grates. These grates stir, shake, grind or otherwise get ash, slate and clinkers (residue fused together by high temperatures) through the grates and into the ash pan below. Your TARM 400 boiler comes with shaker grates designed especially for burning anthracite coal.

D. Starting the Fire

NOTE: Read and understand this entire manual, and be certain that the heating system is fully installed and that all electrical and auxiliary systems have been checked out by your installer BEFORE STARTING A FIRE. The system must be filled with water and vented to remove air.

First set the boiler controls in the proper position:

- secondary air dial on firing door closed initially.
- secondary air control on side of boiler closed (may be opened partially during colder weather once fire is established).

These settings are intended as a starting point for your initial fire. You may find that variations from these settings are appropriate for a particular installation. For example, the greater the draft, the lower the secondary air setting(s) may be. Whatever the installation, however, the primary air inlet flap should be kept wide open until the coal fire is burning well; coal fires need a lot of air to get started.

NEVER USE GASOLINE, KEROSENE, LIGHTER FLUID OR ANY OTHER CHEMICAL TO START YOUR FIRE NOR USE THESE CHEMICALS ONCE YOUR FIRE IS ESTABLISHED.

To start a coal fire, first build a small wood fire, using lots of dry, softwood kindling and small pieces of dry hardwood (see wood-firing instructions, preceding section). Concentrate the greatest amount of wood in the front of the firebox. Be sure that the bed of wood is burning well before you add any coal.

Add coal in a thin layer, leaving a small region in the front of the firebox uncovered. After about ten minutes, add another layer, making sure that the wood in the front of the firebox is burning well. (Whenever adding coal in layers, wait until the last layer of coal produces blue flames before adding the next layer). Coal may be added to the rear of the combustion chamber, and after a few minutes raked forward in a uniform layer. This will preheat the coal before it covers the burning kindling.

By the third layer of coal, the kindling in the front of the firebox should be covered with coal. Add coal in thicker layers over shorter intervals until the the firebox is filled to within two to three inches of the bottom of the firing door. If you cannot avoid overheating the boiler when maintaining this large a fire, you can assume that it is too warm outside to be burning solid fuel. (Switching from nut to pea coal will enable you to burn coal during warmer months without overheating the boiler.)

The SAMSON draft regulator should now be adjusted. The procedure for adjusting this regulator is the same for burning coal as for burning wood (see page 22 for instructions). Once the fire is established, open the upper door air inlet approximately 1/2.

If the fire starts to die down as layers of coal are added, use a poker, rake or shovel to dig a channel through the coal to the glowing embers.

Whenever adding a thick layer of coal, be sure to make a depression in the new layer so that the glowing coals in the bed below are visible; this opening will ensure that gases produced by the burning coal can surface and then be burned or vented up the chimney. It is not wise to add more than a few inches of coal at a time when loading the firebox. Large amounts of coal may produce excessive amounts of cumbustible gases. If these gases ignite, a small gas explosion may result. A ten minute wait between layers is adequate. If you should experience gas explosions in the boiler or chimney, you either have a poor draft, or your secondary air dial on the loading door is not open enough, or you are adding too much coal at one time when fueling the boiler.

E. Maintaining the Fire

Once the coal is burning well, the SAMSON draft regulator will maintain a very constant heat output and control the boiler water temperature precisely.

If the fire goes out when the firebox is full of coal, clear a small area at the front of the firebox and start a small wood fire with kindling. When the fire is burning well, rake coal up over the burning wood.

After starting a coal fire, allow a longer than normal period of time before shaking the grates. From 12 to 18 hours should be adequate.

F. Reloading the Firebox

Normally, reloading is necessary only at eight-hour intervals. To reload the firebox, add several layers of coal on top of the bed. Wait 10 minutes. Then shake the grates until the ash pit is glowing uniformly. DO NOT OVERSHAKE - leave 1 - 2 inches of ash between the coal bed and grates.

Shaking the Grates:

It is important to avoid jamming the shaker grates with pieces of unburned coal. Jamming will make shaking difficult, and, in the worst cases, the firebox will have to be emptied completely before the grates can be un-jammed. To clear small amounts of ash, it is necessary only to "vibrate" the grates rather than swing them as far as they can move in either direction.

When clearing large accumulations of ash (which must be done at least once a day), shake the grates more vigorously, using short, choppy motions, to grind up the residue on the grates. Shake or rock the grates only until the ash falling through the grates turns red; if you shake the grates too long and whole pieces of coal become pinched between the grate sections, the grates may jam.

When clearing unusually large amounts of ash and residue, it may be necessary to break up the residue first with a straight poker, so that it may be shaken more easily through the grates. To break up the residue, open the ash door and slide the poker through the small vertical swinging grate and over the top of the grates, plunging the poker repeatedly back and forth. Cover as much area as possible by plunging the poker in different directions. Then shake down the ash as described above.

After shaking the grates, be sure that a small amount of ash is left on the grates to protect them from the direct heat of the burning coal.

After removing ashes from the boiler, place them in a metal container with a tight-fitting lid. Place the closed container on a non-combustible floor or on the ground, well away from combustible materials, pending final disposal. Make certain that ashes are cooled thoroughly before burying them in soil or disposing of them by other appropriate means.

As fires normally burn front to back, it is important to have good hot coals in the front of the firebox.

Let the coal fire heat up for about 15 minutes before completely filling the firebox with new coal. Watch for any cold spots that may develop. Never fill the firebox in one load. This may cause gases to accumulate which could result in a small explosion. It is far better to add coal in layers no more than 3" in depth.

When reloading the firebox with pea or other small-sized coal, it is advisable to leave a glowing "crater" of already burning coal exposed at the center or sides of the firebox.

Once the coal fire is burning evenly it is best to continue adding coal until the firebox is filled level with the bottom of the loading door.

Coal burns best at a uniform rate. Hard firing followed by slow firing often produces clinkers and may cause premature failure of the grates.

Installation of the HS Auto-Mix will promote more uniform burning.

G. Overnight Firing

First bring the boiler to operating temperature with the coal fire. When the fire is burning well, shake the grates. Then load the firebox with new coal. Spread a layer of ash or a layer of small-sized coal over the top of the bed to insulate the coal for a long burn.

H. Reviving a Nearly Dead Fire

Do not poke the fire or shake the grates. Spread a thin layer of good, dry coal on the fire and open the draft fully. When this new coal has ignited and is burning well, shake the grates and reload the firebox as usual.

I. Special Coal-Burning Problems

The two most common difficulties encountered by coal burners are inadequate output and having the fire go out. Both problems are usually caused by trying to maintain too small a fire.

Many people avoid building a large coal fire because they believe that a large bed of glowing coal will overheat the boiler. The truth, however, is that despite coal's high energy density, a large bed of burning coal is easier to control than a large wood fire. A coal bed has more resistance to air movement, and it burns more uniformly than firewood; hence, it can be regulated well over a wide range of heat outputs by the SAMSON draft regulator.

A small coal fire can die out easily and can be put out easily by additions of even modest amounts of coal. Remember, a coal fire requires a minimum "critical mass" of burning coal to maintain itself.

You can add new coal to a large, established fire without danger of putting out the fire. This feature is particularly advantageous at night, when you must provide enough fuel for a long burn and also insulate the burning mass below the new fuel so that the fire will burn evenly when the demand for heat is low.

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 400 boiler.

It is not possible within the scope of this manual to cover all possible service aspects of hydronic heating systems. Your HS TARM dealer is your best source of information on all aspects of your heating system.

VIII. TROUBLESHOOTING

A. Boiler Overheating

NOTE: The wood or coal fire in the TARM 400 will always produce a certain amount of heat, even when there is no heating demand on the system. This fact makes the behavior of such a system quite different from an oil- or gas-fired boiler, which produces heat "on demand." The "baseline" heat output that is continuously generated by a coal or wood fire must be absorbed by the boiler itself when there is no circulation of water through the system. If the boiler temperature rises excessively in order to absorb this heat, the overheat control will cause circulation of heated water to the house, even with no call for heat. Such potentially wasteful overheating is most likely to occur during the spring and fall. Before choosing a particular system for your installation, the possibility of using a mixing valve system to 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. We recommend the use of a mixing valve with all TARM 400 boilers. Please see page 11 for more information. Your dealer can help you decide whether such a system is desirable for your installation.

HS TARM makes a four-way mixing valve designed especially for use with your TARM 400 boiler. The system is available in both automatic and manual versions.

Overheating in the TARM 400 is an occurrence that all homeowners must be familiar with so that it can be corrected when it occurs.

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

The most common causes of this overheating are:

- Overfiring the boiler (i.e., putting in too much wood or coal for the heating needs of the house at a given time). For proper firing with wood see pages 20 - 25; for coal firing, see pages 26 - 31.
- Improper adjustment of the SAMSON draft regulator. See page 22.
- Electrical power failure. See page 34.

Following the recommendations in this manual will minimize the possibility of overheating, but even the most experienced person will occasionally overheat his boiler. To cope with this problem, the boiler is equipped with two safety devices -- the Overheat Control and the Pressure Relief Valve.

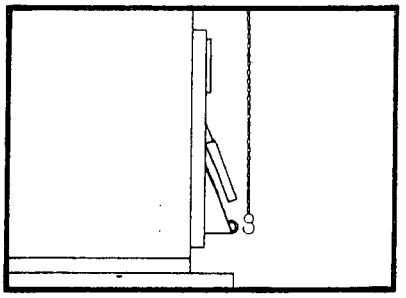
The Overheat Control is wired to circulate excess boiler heat to the house when the boiler reaches a preset temperature of 210 deg. F. The control turns on the circulator and opens either the mixing valve or any zone valves in the largest heating zone. Generally, the overheated boiler can be cooled within 10 minutes.

If the overheating condition is more severe, the temperature will continue to rise. At about 250 deg. 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 400 boilers are pressure-tested to 60 psi at the factory.

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.

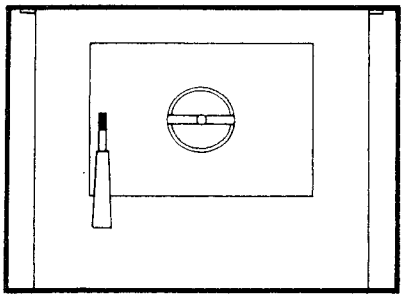
The reason that steam rather than water is discharged is due to the fact that water under pressure can reach temperatures above 212 deg. F. without boiling (as in a boiler), but, when released to the atmosphere by the relief valve, water turns immediately to steam if it is over 212 deg. F.

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

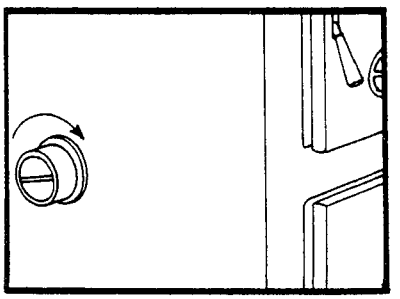


1. Make sure the lower door air flap and all secondary air inlets are closed.

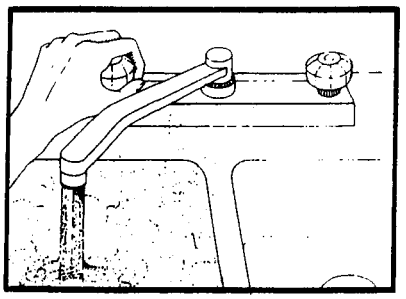
a. (view of flap on door)



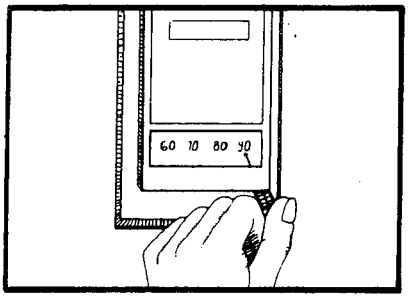
b. (closed secondary air inlet on door)



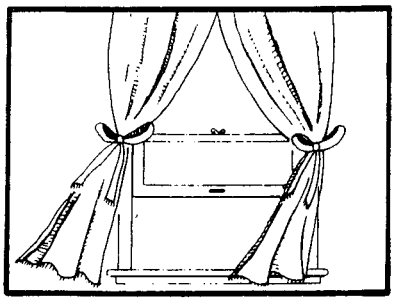
c. (closed secondary air inlet on side of boiler)



2. Open all hot water faucets in the house if the boiler has a domestic hot water coil.



3. Turn all thermostats up to their highest setting.



4. Open windows as necessary to keep the house cool.

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

B. Procedure in 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 have a mixing valve, open it to the highest setting, then lock it into position.

2) The SAMSON Automatic Draft Regulator will continue to control the coal or wood fire in the absence of electric power. It is important to remember that the heating system cannot safely use the heat from a great deal of coal or wood without the circulators running. Under such conditions, extreme caution must be used to avoid overfiring. DO NOT LOAD LARGE AMOUNTS OF WOOD OR COAL INTO THE BOILER! Fire the boiler cautiously until you are able to determine how quickly the boiler can consume fuel without overheating.

3) When the power has returned, reset all flow-check and zone valves and resume normal operation of the system.

NOTE: This does not apply to gravity systems, as they have no flow-check valves and will continue to operate normally without electricity.

C. Low Heat Output

There are many possible reasons for low heat output during spells of cold weather. The table on the following page is intended to help you and your heating contractor diagnose and correct this problem.

D. TROUBLE SHOOTING GUIDE

To diagnose operational problems with your HS TARM boiler, it is first necessary to establish that the boiler is operating with the proper draft and maximum flue gas temperature (Stack Temperature). Please follow the proceedure outlined on pages 37 - 38 of this manual.

SYMPTOM: LOW HEAT OUTPUT, BOILER DOES NOT MAINTAIN WATER TEMPERATURE:

STACK TEMPERATURE	CAUSE	SOLUTION
Maximum stack temperature below 600 deg.F.	Weak Draft.	Clean chimney and all flue passages.
		Seal all leaks in chimney and smoke pipe. Cover barometric damper.
		Remove other appliances from chimney and plug these openings.
		Shorten smoke pipe to boiler. Eliminate 90 els in pipe, if possible, or replace with 45 els.
		Insulate chimney if possible.
		Increase height of chimney.
		Install draft inducer.
	Improperly seasoned wood.	Use well-seasoned wood. Wood should be cut at least 18 months ahead, then split and stored under cover in a dry place with good air circulation as soon as possible after cutting.
Maximum stack temperature above 800 deg.F.	Excessive draft.	Install barometric damper and adjust stack temperature.
Maximum stack temperature in the normal range: (600 - 750 deg.F.)	Boiler too small for home.	Add insulation to house. Weatherstrip doors and windows.
		Insulate all boiler piping located in unheated spaces.
		Burn coal, which can increase output by 25%.
		Use your oil or gas burner to supplement wood heat output.

GENERAL PROBLEMS:

SYMPTOM	CAUSE	SOLUTION
Boiler functions well with good burn times but inadequate on coldest days.	Boiler temperature set too low.	Increase boiler water temperature by adjusting the Samson draft regulator for 200 deg.F. boiler temperature.
Boiler maintains water temperature. House is not warm.	Not enough radiation.	Add radiation where appropriate, if possible.
Excessive heat dumped in overheat zone.	Overheat control set too low.	Set HONEYWELL L4006B at 210 to 230 deg. F.
	Too much fuel in the firebox for weather conditions.	Load less fuel, and use larger pieces of wood. If burning coal, use smaller size coal, or reduce the draft setting.
Auto-Mix system: 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.
Auto-Mix system: House temperature is above thermostat setting	Locking quadrant set too far to the right.	Reset locking quadrant on the mixing valve further to the left.
Creosote formation in the flue and firebox.	Improperly seasoned wood.	Wood should be cut at least 18 months ahead, split and stored in a dry place with good air circulation.
	Boiler water temperature too low.	Boiler water temperature should be above 180 deg.F. If creosote forms at this temperature, adjust Sampson to regulate boiler temp. to 200 deg. F.
Excessive overheating accompanied by creosote formation in boiler.	Boiler oversized for installation.	Use less fuel, cut wood into smaller pieces. For coal burning, use smaller size of coal and reduce draft.
		Cover 2 or 3 of the heat exchanger fire-tubes with metal plate, or refractory millboard.
Samson Draft Regulator no longer responds to boiler temperature.	Worn Samson internal element.	Replace internal element (see instructions enclosed with Samson).

E. BOILER TUNE-UP PROCEDURE

(TEST FIRING AND MAXIMUM STACK TEMPERATURE ADJUSTMENT)

One of the most important factors in the efficient operation of a solid fuel boiler is the strength of the draft which is produced by the chimney. Too much draft will cause very high combustion temperatures and loss of heat up the chimney. The boiler may be unable to maintain water temperature while at the same time, large quantities of fuel will be consumed. If the draft is too weak, not enough air will be supplied to the fire to generate the actual heat output for which the boiler is designed. Water temperature will be low and much fuel will be consumed through inefficient combustion.

A simple means to establish the proper draft is to measure the temperature of the gases which are leaving the boiler (stack gas temperature). This measurement requires the use of a stainless steel, stem type, insert thermometer, with a range of 200 - 1000 deg.F. Magnetic surface-type thermometers are not recommended, as they are not accurate enough for this measurement.

The system should first be filled with water and vented of air. Bring the entire system up to an operating boiler water temperature of 180 - 190 deg.F.

If a solid fuel fire is started at water temperatures below 140 deg.F, there will be a great deal of water condensation and creosote formed. Using the oil or gas burner to bring the boiler water temperature up to 140 deg. F. will speed up the process.

In order to set the proper maximum stack temperature, the boiler must be fired with fuel of the type to be used for heating. Draft settings for wood operation will not be appropriate for coal firing. As a consequence, whenever the operator changes from one fuel type to another,(wood to coal; coal to wood) the maximum stack temperature adjustment must be made to give best results with the new fuel.

THE DRAFT MUST BE STRONG ENOUGH TO PRODUCE MAXIMUM STACK GAS TEMPERATURES IN THE RANGE OF 600 - 750 deg.F. A barometric damper of the Field R/C type in the smoke pipe will allow adjustment of the draft if the maximum stack temperature is not in the required range.

Set-Up:

The thermometer should be inserted through a drilled hole in the smoke pipe as close to the boiler as possible. If possible install the thermometer so that it is visible from the front of the boiler. If there is a barometric damper in the smoke pipe, the thermometer must be installed between the damper and the boiler.

The boiler should be fired to its normal operating water temperature. This is usually between 180- 200 deg.F. The firebox should be more than half full and no kindling or fresh fuel should be added during the testing and adjusting period. Secondary air controls should be in the normal firing position.

NOTE: If the boiler has difficulty achieving operational temperatures of 180 deg.F., it may be necessary to turn off the circulator(s). Be sure to turn the circulator(s) on again when you are finished, or if the water temperature should exceed 210 deg.F.

Test:

Allow 15 minutes to elapse from the time you last added fuel, then lift the primary air flap on the lower door to its maximum opening. Secure the air flap in this position and allow the stack temperature as shown on the stack thermometer to climb until it reaches a steady maximum value. This should take from 2 - 10 minutes, depending on the type and quality of the fuel.

NOTE: If the stack temperature exceeds 900 deg.F., close the air flap. Stack temperatures above 1000 deg.F. may cause a chimney fire. A barometric damper must be installed before proceeding. If a barometric damper is already in place, set the barometric damper to a lower draft value, and repeat the test.

As soon as the stack temperature has stabilized, the draft may be adjusted as follows:

Temperature above 700 deg.F:

If no barometric damper is present, it will be necessary to install one. Reduce the draft by adjusting the weight on the barometric damper to a lower value of draft such that the stack temperature is reduced to about 650 deg.F.. Changes in the stack temperature will occur quickly as the draft is changed. If it is not possible to reduce the stack temperature to within the desired range, it may be necessary to install a second barometric damper in the smoke pipe.

Temperature below 600 deg.F:

The draft must be increased by resetting the weight on the barometric damper to a higher position. If the stack temperature cannot be raised to 600 deg.F, there is not enough draft in the system to operate the boiler at its maximum rated Btu output. The draft must be increased. The simplest means to achieve this is by the installation of a draft inducer. The Tjernlund Auto-draft is a reliable example of this type of appliance. The draft inducer should be installed and operated according to the manufacturer's recommendations. The stack temperature should then be adjusted in the way described above. The draft inducer should be located close to the chimney. A barometric damper placed between the boiler and the draft inducer will be useful for setting the proper maximum stack temperature.

NOTE: Whenever changing from one fuel type to another, (coal to wood, or wood to coal) it will be necessary to re-adjust the draft in order to achieve the proper temperature for the fuel to be used.

General Information:

When testing the boiler, do not expect the stack temperature to be absolutely stable. There will normally be fluctuations of 20 to 50 degrees (this is particularly true with wood). The average temperature should be used.

During normal operation, the stack temperature will be between 200 and 400 deg.F.

The stack thermometer may be used to moniter the boilers performance and the quality of fuel. The maximum stack temperature should be checked periodically to assure that no changes have occurred in the draft. If the stack temperature shows a progressive decline over time, this usually is an indication of an accumulation of ash or creosote in the heat exchanger or the flue. Check all passages and flues and clean as necessary.

Any time the boiler does not seem to perform as expected, check the maximum stack temperature. This will provide a starting point for solving problems. Wet wood, inferior coal, changes in the draft, will all effect the boilers performance and change the maximum stack temperature.

The stack thermometer is particularly useful when burning coal:

Both the operating stack temperature and the tested maximum stack temperatures will be lowered when ash has accumulated on the grates to the extent that it is necessary to shake them.

It is possible to use stack temperature to evaluate a particular supply of coal before purchasing large quantities. Buy a sample of 50 - 100 pounds and build a fire with this coal. Perform the stack temperature test. If the quality of the coal is lower then that of the coal which you have been burning, the stack temperature will be noticably lower.

IX. PERIODIC MAINTENANCE

A. Cleaning

The efficiency of the TARM 400 boiler is affected by the amount of creosote and soot coating the inside of the boiler. Layers of these materials act as an insulator, preventing the coal or wood fire from heating the water, and allowing valuable heat to escape up the flue.

The inside of the boiler should be cleaned periodically during the heating season. At least once every two months (and more often if burning partially green wood or if firing during periods of low heating demand)

a) Allow the fire to die out.

b) Using the burner service switch or heating system emergency switch, deactivate the oil or gas burner.

BE CERTAIN THAT THE BOILER AND ANY ASHES HAVE COOLED THOROUGHLY BEFORE PROCEEDING FURTHER.

c) Remove all ash and unburned coal or wood.

d) Using a long-handled steel bristle brush (or a wire wheel connected to an electric drill by a flexible shaft) and your boiler scraping tool, clean all accumulated fly ash, soot and creosote from the inside of the boiler.

e) Next, disassemble the smoke pipe connecting the boiler and chimney. Clean and inspect for corrosion; if any section of the pipe is seriously corroded (for example, if a screwdriver can easily be poked through the metal), this section must be replaced.

f) Replace the smoke pipe.

g) Remove the top rear jacket panel and loosen the four wing nuts on the cleanout cover.

h) Being careful not to damage the gasket, remove the cleanout cover.

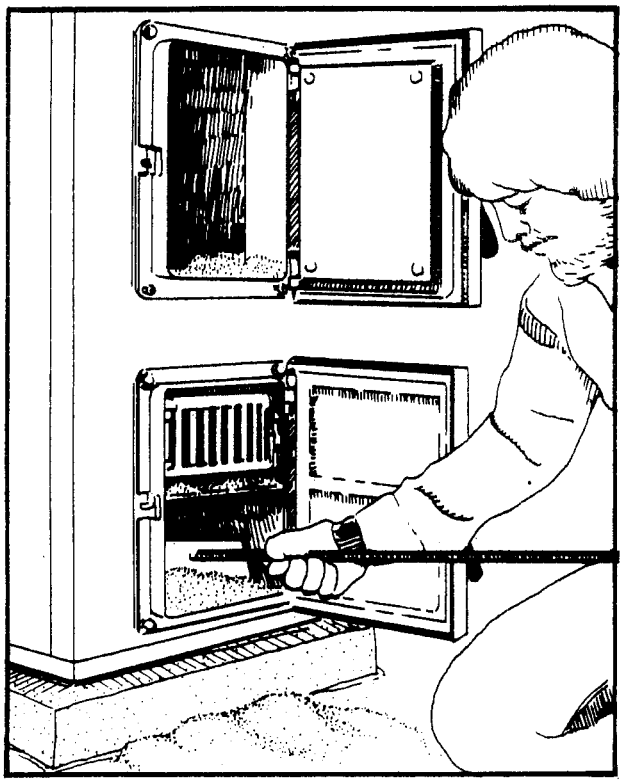
i) Clean the heat exchanger tubes with the round flue brush.

NOTE: To extend the life of your cleanout cover gasket, make sure the edge of the boiler that contacts the gasket is clean and smooth.

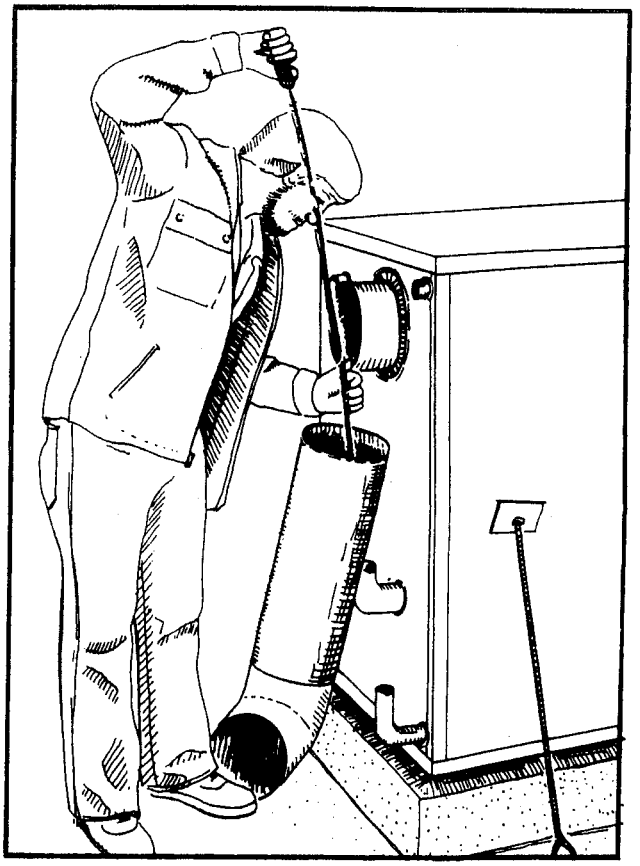
j) Replace the cleanout cover and top jacket panel. Tighten the wing nuts by hand only, as too much pressure will crush the gasket.

k) Thoroughly remove (preferably vacuum) all remaining ash and scrapings from the grates and ash pit.

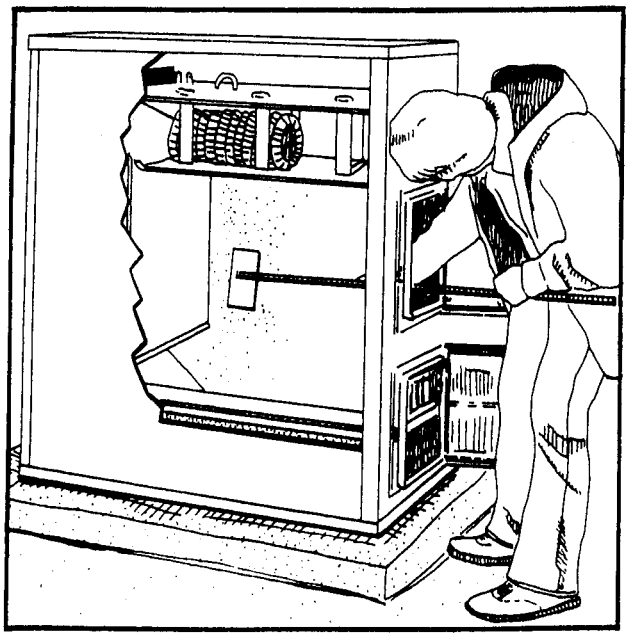
l) When cleaning is completed, turn back on any switches you have turned off.



Scrape all ash from firebox.



Clean smoke pipe with flue brush.



Scrape creosote from sides and top of firebox.

B. Seasonal Adjustments

1) Fall and Spring

One of the more critical aspects of operating the TARM 400 boiler is regulation when the heating season is starting or tapering off. For example, if you build a coal or wood fire on a day when the outside temperature rises to 60 deg. F., you will be faced with a lot of heat being generated and nothing very useful to do with it. (In this case, the overheat control would cause heated water to circulate throughout the house, no matter what the inside temperature was.) It is recommended that the TARM 400 be fired on oil or gas during warmer weather.

The TARM 400 boilers can be modified to burn wood or coal more efficiently during warmer periods such as late fall or early spring, or during the summer if you have high domestic hot water demand. To make this modification, remove the cleanout cover under the rear top jacket panel. Cover 2 or 3 of the firetubes with either a flat steel plate or fireproof refractory insulation material. With this modification the boiler will burn more efficient during such periods of intermittent or low heating demand. For proper replacement of the cleanout cover, see page 39.

2) Summer

Coal and wood burning invariably produce sulphur deposits in the smoke pipe and boiler firebox. When combined with moisture, these deposits produce sulphuric acid and other corrosive substances, which will corrode and drastically shorten the life of the boiler and stack. Since summertime humidity will promote condensation, the following steps must be taken to minimize the formation of these corrosive acids.

At the end of the heating season, remove any soot and ash by thoroughly cleaning the boiler firebox and smoke pipe.

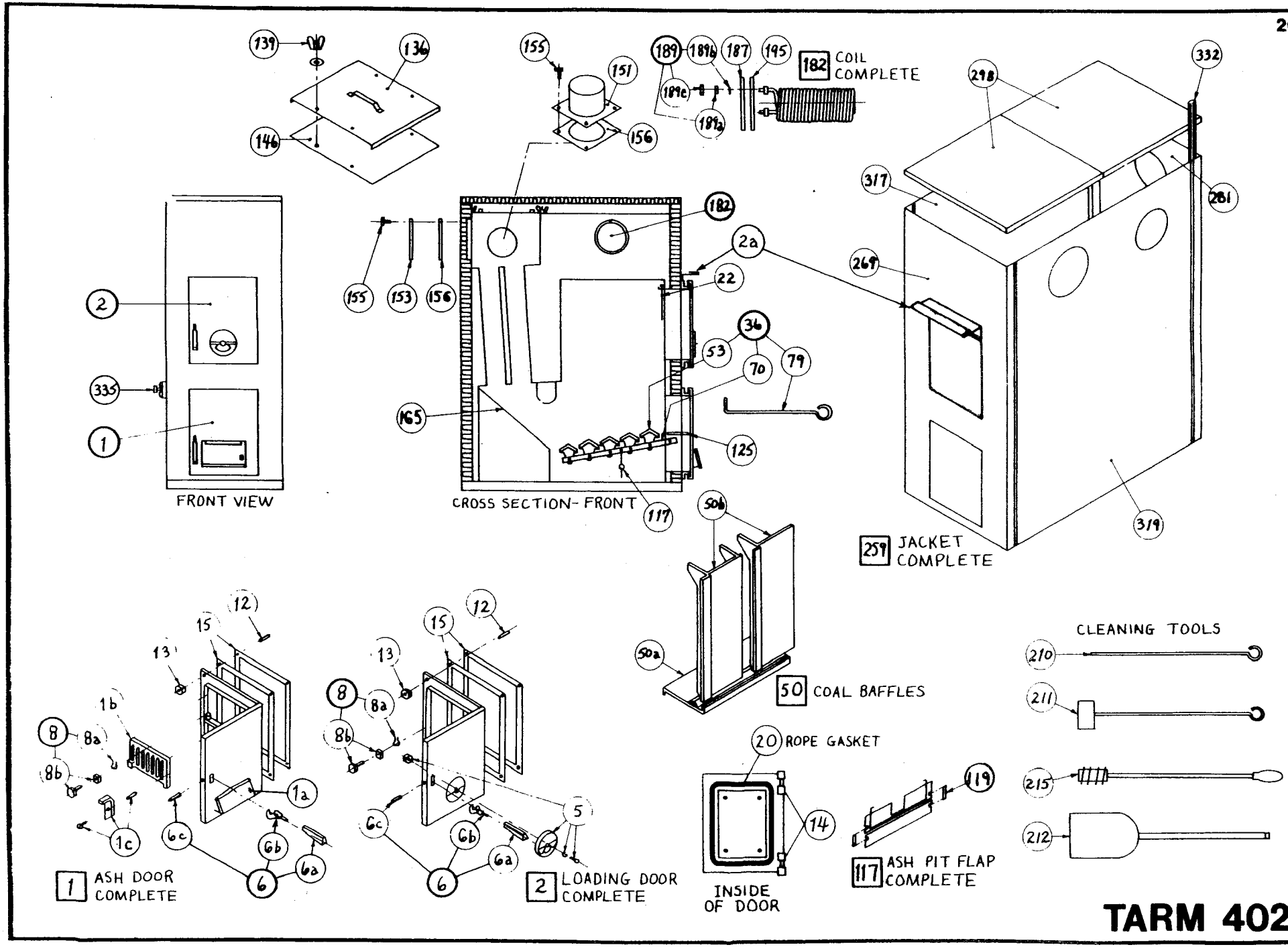
During the summer, the TARM 400 must be maintained at a temperature of 140 deg. F. to prevent condensation in the firebox and the smoke pipe.

If it is not possible to maintain this temperature first remove the smoke pipe. Clean the pipe thoroughly and block it with newspaper; do not reconnect the smoke pipe to the TARM 400 until the heating season begins in the fall. Then, to keep condensation from forming in the firebox, either suspend a 40W bulb inside the firebox OR have the boiler drained for the summer. Boilers should be drained and refilled ONLY by a qualified plumber or heating contractor.

Since there are several potential sources of leakage under the top jacket panel of most HS TARM boilers, the top jacket panel should be removed periodically and the boiler body top inspected carefully (especially around plugs and fittings) for leaks and corrosion.

Leaks could develop from defective or worn-out air vents, pipe joints, coil gaskets etc. If they remain undetected, leaks can corrode the boiler body, top, and/or sides. We therefore recommend that the homeowner or contractor make this service check a routine part of their maintenance program, but in no event should it be done less than once a year.

FAILURE TO FOLLOW THESE RECOMMENDATIONS MAY VOID YOUR WARRANTY!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182 COIL COMPLETE
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FRONT VIEW
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182
2a
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125
117
CROSS SECTION- FRONT
50b
50a
50 COAL BAFFLES
259 JACKET COMPLETE
319
CLEANING TOOLS
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212
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15
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1b
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8a
8b
1c
1a
6c
6b
6a
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1 ASH DOOR COMPLETE
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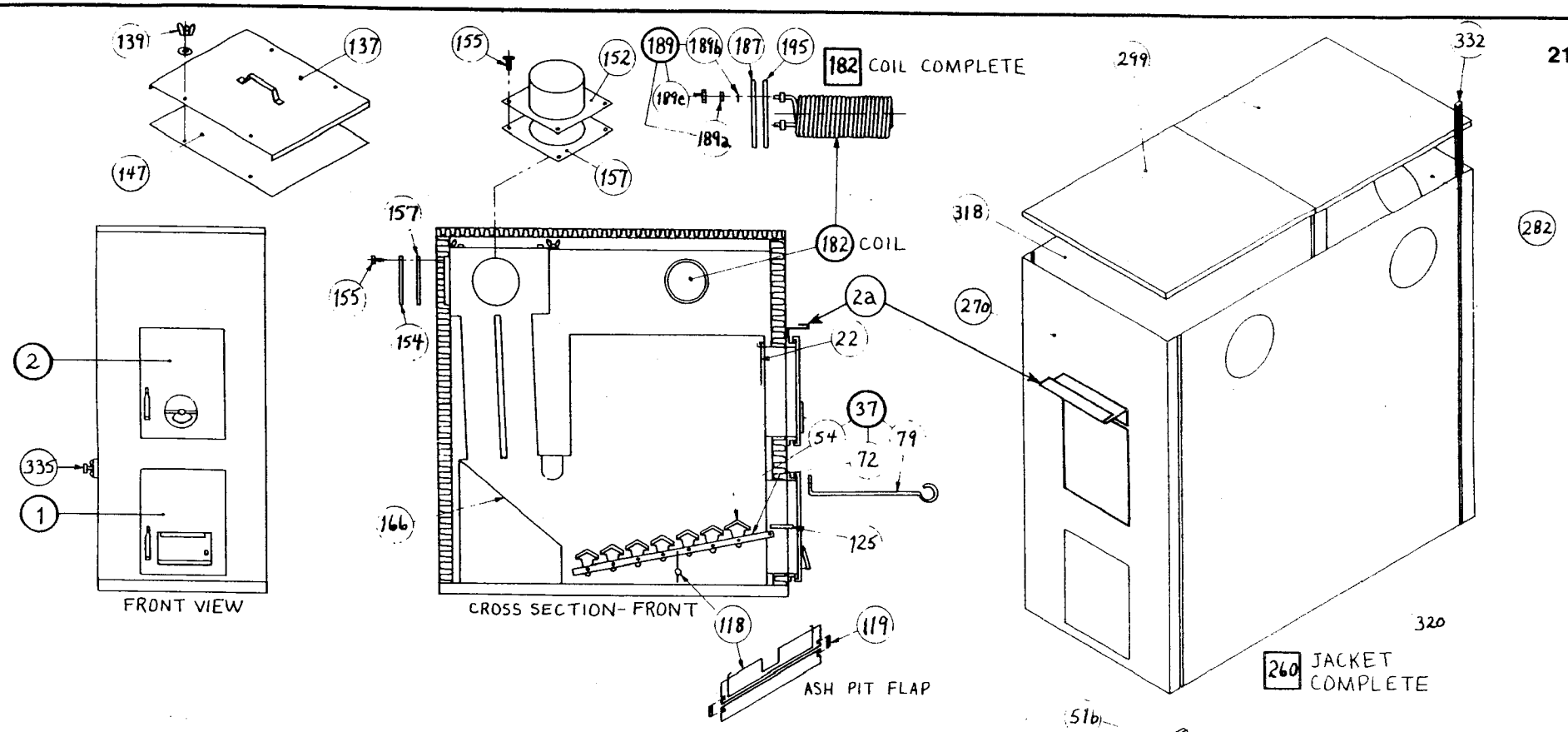
6c
2 LOADING DOOR COMPLETE
20 ROPE GASKET
14
INSIDE OF DOOR
119
117 ASH PIT FLAP COMPLETE

TARM 402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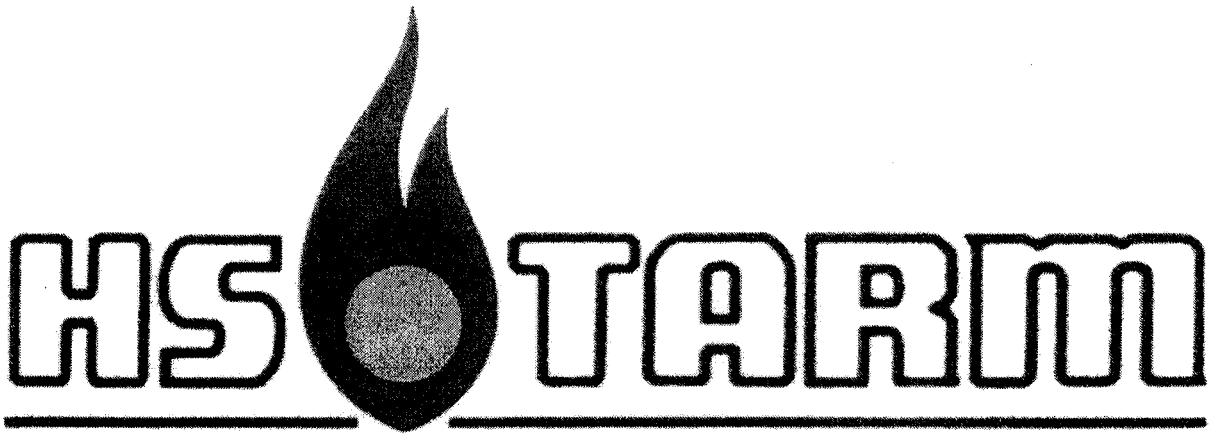
2 LOADING DOOR COMPLETE
20 ROPE GASKET
14
INSIDE OF DOOR
51b
51a
51 COAL BAFFLES
CLEANING TOOLS
210
211
218
212

TARM 404

DIAG. REF.#	PART/ ORDER#	DESCRIPTION	T402	T404
1	21.8503	ASH DOOR COMPLETE D=12x15	1	1
1a	06.0023	DAMPER FOR ASH DOOR D=4x8.25	1	1
1b	06.0024	FRONT SWING GRATE D=5.5x9.5	1	1
1c	21.9035	LATCH FOR SWING GRATE	1	1
1d	06.0025	ASH DOOR INSULATION BLANKET	1	1
2	21.8502	LOADING DOOR COMP (400) D=12x15	1	1
2a	03.0140	LOADING DOOR SMOKE SHEILD L=13	1	1
5	06.0016	AIR DIAL F/LOADING DOOR OD= 4	1	1
6	04.0028	DOOR HANDLE ASMBLY COMP. P=3	2	2
6a	04.0027	BAKELITE GRIP FOR DOOR HANDLE	2	2
6b	04.0028.4	DOOR LATCH HOOK (CASTING)	2	2
6c	04.0085	PIVOT PIN FOR DOOR HANDLE	2	2
8	21.9036	DOOR CATCH ASSEMBLY (400) P=3	1	1
8a	04.0051	SPRING F/DOOR CATCH ASMBLY (400)	1	1
8b	21.9037	SCREW/WASHER F/DOOR CATCH (400)	1	1
12	05.3030	DOOR STUD M10x30	8	8
13	05.6005	DOOR NUT M10	8	8
14	04.0028.6	HINGE PIN FOR DOORS L=2.75	4	4
15	07.0075	DOOR GASKET SET COMPLETE (400)	1	1
20	07.0000	ROPE PACKING FOR DOORS (Q=ft)	8	8
22	21.9018	SMOKE FLAP (400) D=6x10.5	1	1
36	21.8909	SHAKER GRATE SET COMP (402) P=8	1	
37	21.8910	SHAKER GRATE SET COMP (404) P=10		1
50	21.9059	COAL CONVERSION BAFFLE (402) P=3 *	1	
50a	21.9060	BASE PLATE F/BAFFLE (402) D=4x12 *	1	
50b	06.0114	BAFFLE UPRIGHT SECTION C=9-254 *	2	
51	21.9063	COAL CONVERSION BAFFLE (404) P=3 *		1
51a	21.9066	BASE PLATE F/BAFFLE (404) D=8x15 *		1
51b	06.0115	BAFFLE UPRIGHT SECTION C=9-253 *		2
53	06.0063	SHAKER GRATE SECTION (402) L=10.5	5	
54	06.0073	SHAKER GRATE SECTION (404) L=14		7
70	27.2013	CONNECTING BAR (402) L=22.5	2	
72	27.2015	CONNECTING BAR (404) L=28.5		2
79	28.1808	SHAKER GRATE HOOK L=19	1	1
81	05.1025	SHAKER GRT SET SCREW M12x35	5	7
117	21.9061	ASH PIT FLAP ASSEMBLY COMP. (402)	1	
118	21.9067	ASH PIT FLAP ASSEMBLY COMP. (404)		1
119	22.0009	RING FOR ASH PIT FLAP ASMBLY	2	2
125	21.3015	GRATE RETAINER (400) D=4x9.5	1	1
136	21.9069	CLEANOUT COVER (402) D=13.5x17	1	
137	21.9070	CLEANOUT COVER (404) D=16x20		1
139	05.6025	WING NUT M10	4	4
146	07.0110	CLEANOUT GASKET (402) D=13.5x16	1	
147	07.0112	CLEANOUT GASKET (404) D=16x19.5		1
151	21.9058	FLUE OUTLET (402) 6-INCH	1	
152	21.9065	FLUE OUTLET (404) 8-INCH		1
153	15.0393	FLUE OUTLET COVER (402) D=7x7	1	
154	15.0397	FLUE OUTLET COVER (404) D=9x9		1
155	05.1011	FLUE OUTLET SET SCREW M8x16	8	8
156	07.0111	FLUE OUTLET GASKET (402) D=7x7	2	
157	07.0113	FLUE OUTLET GASKET (404) D=9x9		2
165	06.0096	SEPARATION BAFFLE (402) C=9-249	2	
166	06.0097	SEPARATION BAFFLE (404) C=9A-249		2
182	21.9609	COIL COMPLETE (400)-optional *	1	1
187	18.0086	BLANK COIL COVER PLATE OD=9.5	1	1
189	21.9604	COIL FITTING ASMBLY COMP. P=3 *	2	2
189a	04.0097	BEVELED WASHER F/COILS ID=1 *	2	2
189b	04.0098	O-RING F/COIL ASMBLY ID=1 *	2	2
189c	04.0096	BRASS NUT 3/4" F/COIL *	2	2
195	07.0025	COIL PLATE GASKET (400) OD=7.5	1	1
197	05.6007	NUT M12	8	8
210	28.1900	POKER L=29.5	1	1
211	21.9008	SCRAPER L=33	1	1
212	21.3057	ASH SHOVEL (400) L=35"	1	1
215	21.0208	CLEANING BRUSH (402) 3" ROUND	1	
218	21.0209	CLEANING BRUSH (404) 6" ROUND		1
259	21.3686	JACKET COMPLETE (402) P=7	1	
260	21.3689	JACKET COMPLETE (404) P=7		1
269	21.3670	FRONT PANEL (402) D=20x49	1	
270	21.3681	FRONT PANEL (404) D=23.5x49		1
281	21.3669	REAR PANEL (402) D=20x49	1	
282	21.3680	REAR PANEL (404) D=23.5x49		1
298	21.3673	TOP PANEL (402) D=21x19.5	2	
299	21.3684	TOP PANEL (404) D=24x25		2
317	21.3688	LEFT SIDE PANEL (402)	1	
318	21.3691	LEFT SIDE PANEL (404)		1
319	21.3687	RIGHT SIDE PANEL (402)	1	
320	21.3690	RIGHT SIDE PANEL (404)		1
332	03.0141	JACKET ZIP-STRIP L=49	6	6
335	21.8514	SECONDARY AIR DIAL (400) OD=3.3	1	1

* = Optional Accessory



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