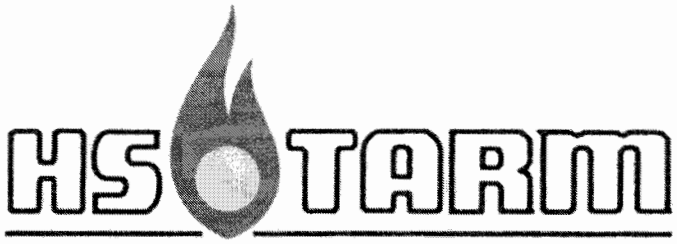
INSTALLATION AND OPERATING INSTRUCTIONS



MULTI-FUEL BOILER

TYPE OT 28, OT 35, OT 50, OT 70

WOOD, OIL, GAS or ELECTRIC FIRING

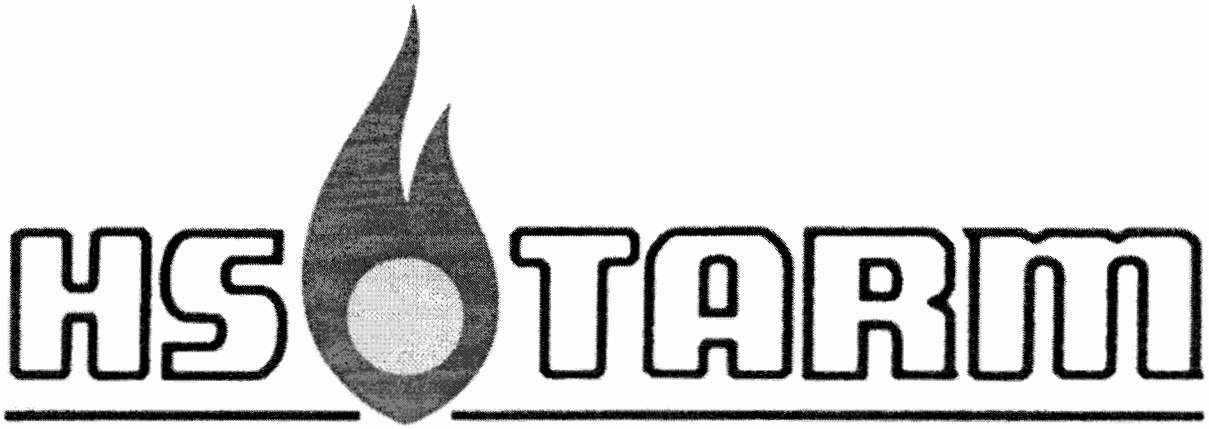
OWNER:For service and repairs to the heating syatem, please contact your Heating Contractor.The following information should be filled in by your installer, and used by you when seeking information concerning the boiler.

Boiler Serial No._____ Model No. _____

System Type: _____

Heating Contractor: _____ Phone Number: _____

Address: _____



TARM USA INC

HS TARM MULTI-FUEL SYSTEMS
FIVE MAIN STREET, PO BOX 285
LYME, NEW HAMPSHIRE 03768
1 (800) 782-9927

TARM USA INC

Box 285, 5 Main Street
Lyme, New Hampshire 03768
603-795-2214
www.woodboilers.com

Dear Customer;

Thank you for buying this HS Tarm boiler. These boilers are manufactured in Denmark, and conform to traditionally high Danish standards for quality and reliability. The recommendations in this manual are designed to give the owner maximum flexibility in using the fuel of their choice, while assuring safe and reliable operation on all fuels. All threads and fittings on this boiler are American sized, and designed to be compatible with standard domestic controls and accessories.

We at Tekton Corporation realize that it is not possible to answer all questions about the operation of the HS Tarm Type OT 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. Our main concern is that you be satisfied with your boiler and its performance.

IMPORTANT INFORMATION

The specific controls and accessories listed in this manual are intended to serve as guidelines rather than as specific recommendations. We realize that other equivalent makes and models of such devices exist and can be used as successfully as those we specify. The installing contractor is the best judge of a system's specific requirements and also of local availability of certain makes and models of controls and accessories. Certain systems may also require some deviation from the specific installation instructions in this manual. Again, a competent installing contractor is the best judge of when such a modification is appropriate. The preceding does not apply, however, to the equipment that comes with every boiler, such as relief valves and the overheat control. The installation of the specific devices we supply with every boiler is absolutely necessary for safe operation of the boiler and protection of the heating system!

Sincerely,

Tekton Corporation

TARM USA, Inc
5 Main St, PO Box 285
Lyme, NH 03768

800-782-9927

TABLE OF CONTENTS

IMPORTANT INFORMATION

PLEASE READ THIS PAGE CAREFULLY!

THIS BOILER HAS A LIMITED WARRANTY, A COPY OF WHICH IS PRINTED ON THE BACK PAGE OF THIS MANUAL.

THE BOILER MUST BE CONNECTED TO ITS OWN TILE-LINED MASONRY FLUE—NO OTHER APPLIANCES CAN BE VENTED TO THIS FLUE!

ALL BOILERS MUST BE INSTALLED IN ACCORDANCE WITH NATIONAL, STATE AND LOCAL PLUMBING, HEATING AND ELECTRICAL CODES AND THE REGULATIONS OF THE SERVING ELECTRICAL, 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.

THE ELECTRICAL COMPONENTS AND OIL OR GAS BURNER SHOULD BE INSTALLED ONLY BY LICENSED AND EXPERIENCED TECHNICIANS.

IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO SEE THAT ALL CONTROLS ARE INSTALLED CORRECTLY AND ARE OPERATING PROPERLY WHEN INSTALLATION IS COMPLETED.

USE TEFLON TAPE OR WICKING TO SEAL ALL THREADED CONNECTIONS.

DO NOT USE SELF-CONTAINED, NON-ELECTRIC ZONE VALVES IN THE ZONE CONTROLLED BY THE OVERHEAT CONTROL (See Section II, B #1).

BOILER SHOULD BE POSITIONED TO PROVIDE MINIMUM SIDE AND REAR CLEARANCES OF 36" AND A MINIMUM FRONT CLEARANCE OF 60" BETWEEN BOILER SURFACES AND ANY FLAMMABLE MATERIAL. A MINIMUM OF 24" CLEARANCE MUST BE MAINTAINED BETWEEN UNINSULATED SMOKE PIPE AND ALL FLAMMABLE MATERIALS.

ALL FLAMMABLE DEBRIS, RAGS, PAPER, WOOD SCRAPS, ETC., SHOULD BE KEPT CLEAR OF THE BOILER AT ALL TIMES. KEEP THE BOILER AREA CLEAN AND FREE OF FIRE HAZARDS.

WHEN REFERENCES ARE MADE TO TAPPING NUMBERS, PLEASE REFER TO SPECIFICATIONS SECTION IX.

PLEASE READ THE LITERATURE ENCLOSED BY THE MANUFACTURER WITH THE VARIOUS ACCESSORY DEVICES. THESE DEVICES ARE WARRANTED BY THE MANUFACTURER, *NOT* BY TEKTON CORPORATION. FURTHERMORE, THESE ACCESSORY DEVICES MUST BE INSTALLED AND USED ACCORDING TO THE RECOMMENDATIONS OF THE MANUFACTURER.

THE BOILER MUST BE CONNECTED TO ITS OWN TILE-LINED FLUE. A MINIMUM FLUE SIZE OF 8" × 12" IS NECESSARY FOR PROPER OPERATION.

UNDER NO CIRCUMSTANCES SHOULD A MANUAL FLUE DAMPER BE INSTALLED IN THE SMOKE PIPE BETWEEN BOILER AND CHIMNEY!

HOMEOWNERS SHOULD READ AND FAMILIARIZE THEMSELVES WITH SECTION VI, E, "PROCEDURE IN EVENT OF POWER FAILURE", AND SECTION VI, F, "BOILER OVERHEATING."

YOU SHOULD RECEIVE THE FOLLOWING WITH YOUR BOILER: 1—JACKET BOX
1—DOOR BOX
1—SAFETY PACKAGE BOX

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

SAFETY PACKAGE BOX:

_____SAMSON automatic draft regulator

_____boiler pressure relief valve

_____water tank pressure and temperature relief valve(s) (for Type B only; OT 70 requires two)

_____tankless coil pressure relief valve (for Type S only)

_____high-limit hot water relay (overheat control)

BOILER BODY:

_____cast-iron grate sections (two whole sections for OT 28, three whole and one half section for OT 35 and OT 50, five whole sections for OT 70)

_____small rectangular plate (slides into slots in lower door opening)

_____long-handled flue brush

_____scraper for boiler walls

_____poker for wood fire

_____oil burner plate (large plate with round hole)

_____long brass hourglass coupling (two for OT 70; Type B boilers only)

_____ash scooping pan

_____bypass damper (installed in boiler)

JACKET BOX:

_____jacket panels (OT 28: 4 side, 1 top; OT 35, 50, 70: 6 side, 1 top)

_____pre-formed strips for joining jacket panels

_____door gaskets (two for each of the three doors and oil burner plate)

DOOR BOX:

_____firing door (large door with round dial)

_____draft door (large door with rectangular flap)

_____clean-out door (small door)

_____steel backup plate & 2 bolts for cleanout door (Type OT 50 & 70 only)

_____bag of nuts and studs for door mounting (4 each already are on boiler body)

_____instruction manual

Please contact your dealer immediately if any of the above items are not present.

I. **Boiler Set Up**

(NOTE: All threaded connections to the boiler must be wrapped with at least 5 turns of teflon tape to avoid leaks. All bushings or couplings going directly to the boiler (except for domestic water connections) should be iron, so that they may be tightened adequately.)

A. Unpack the items in the boiler body and the jacket carton, and check off the items enclosed against the *parts checklist,* page 4.

B. Place the boiler adjacent to the chimney and on a level concrete slab. THE BOILER SHOULD BE POSITIONED SO THAT THERE IS A MINIMUM 36" CLEARANCE BETWEEN SIDES AND REAR AND ANY FLAMMABLE MATERIAL. FRONT CLEARANCE IS A MINIMUM OF 60". ANY FLAMMABLE DEBRIS, RAGS, PAPER, WOOD SCRAPS, ETC., SHOULD BE KEPT CLEAR OF BOILER, *ESPECIALLY IN FRONT,* AS THIS IS WHERE IGNITION OF SUCH DEBRIS COULD OCCUR. THERE MUST BE A MINIMUM CLEARANCE OF 24" BETWEEN THE SMOKE PIPE AND ALL COMBUSTIBLE SURFACES.

C. Arrange the cast iron grate sections in the firebox (lower right). Insert the steel plate in slots at the front of the door and place the ash removal pan in proper position in the boiler under the grates.

D. Remove the plugs from tappings #4, #5, and #20. Insert and tighten plugs in tappings #21 and #10. Use sufficient teflon tape or wicking to seal threads. Refer to tapping location diagram in specification section at end of this manual.

E. The boiler comes equipped with either a 5-piece (OT 28) or 7-piece (OT 35, 50, 70) enameled jacket. The OT 28 has one back and one front panel; the other models have two back and two front panels.

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

The following order of assembly is suggested:

1) OT 28: join the back panel to the two side panels, then move this unit into position around the boiler.

   OT 35, 50, 70: join each half of the back panel to the appropriate side panel, move these two units into position around the boiler, then join them together in back.

2) Before installing the front jacket panel(s), screw studs into door mounting flange and place door gaskets over the studs on each of the three doors.

3) Check the straightness of the door frame mounting studs by placing each door frame over its studs. The door should go on easily. If this is not the case, 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 knock-outs in the front panel(s). Join the panels together and place in position on the front of the boiler. The remaining steel joiner strips are now used to join the front panel(s) to the rest of the outer jacket.

5) For OT 50 and 70 only: Assemble the steel backing plate to the cleanout door, using the two bolts provided. The lip on the plate should be at the bottom of the door.

6) The door openings are now fitted with gaskets again *over* the enameled jacket. The door assemblies can now be positioned on the studs and nuts used to tighten them down. (The lower right door is equipped with the flap damper; the upper door has the round secondary air opening.)

F. Chimney Connection

NOTE: THE BOILER MUST BE CONNECTED TO AN APPROVED CHIMNEY IN GOOD CONDITION. USE OF THE BOILER, ESPECIALLY WHEN FIRED WITH WOOD, CAN PRESENT A SERIOUS FIRE HAZARD IF THE BOILER IS CONNECTED TO A DIRTY OR INADEQUATE CHIMNEY. (Please refer to section VI, A, "Chimneys and Chimney Cleaning.") IT IS IMPERATIVE THAT THE BOILER BE CONNECTED TO ITS OWN SEPARATE FLUE. A MINIMUM FLUE SIZE OF 8" × 8" (OT 28, 35, and 50) or 8" × 12" (OT 70) IS NECESSARY FOR PROPER OPERATION OF ALL TYPE OT BOILERS. MANUAL FLUE DAMPERS MUST NOT BE INSTALLED BETWEEN BOILER AND CHIMNEY!

A MINIMUM CLEARANCE OF 24" MUST BE MAINTAINED BETWEEN UNINSULATED SMOKE PIPE AND ALL FLAMMABLE MATERIALS.

NOTE: A barometric damper is required by code in some areas. The damper if used must be set to maintain a minimum draft of .05 in./water. This amount of draft is required for proper wood firing. In cases of marginal draft, this damper may impair boiler operation, resulting in smoking when fueling the boiler, low heat output, and excessive creosote formation.

PROCEDURE:

Using as short a run of pipe as possible, connect the boiler to the chimney. The smoke pipe should be 26 gauge or thicker. The OT 28, 35 and OT 50 use 6" pipe; the OT 70 uses 8" pipe. The sections of pipe should be screwed together, and the smoke pipe should be fastened to the boiler by threading screws through the pipe into the large holes on the boiler flue outlet. Use 45° elbows instead of 90° elbows whenever possible, and install the smokepipe so that it is easily removed for cleaning.

G. Venting of Boiler Body

The boiler body is vented during filling and operation by a #700 Vent in Tapping #16 (above flue pipe on back of boiler)

1) Install a 1¼" (OT 35 and OT 50) or 1½" (OT 70) close nipple in tapping #16. Screw a 1¼" or 1½" elbow onto this nipple so the open end of the elbow points up.

2) Using the appropriate bushings, thread a #700 vent into the elbow.

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

II. Installation of Control Equipment

NOTE: Use teflon tape or wicking on all male pipe threads.

A. Install ¾" immersion wells in tappings #4 and #23.

B. Hot Water Overheat Control

1) Installation

The Hot Water Overheat Control, HONEYWELL #4008-B-1013, is fastened to the front of the boiler jacket. Use the control as a template to make two small holes for sheet metal screws. The top of the control is positioned 13 inches below the top edge of the jacket and its left side is 13 inches from the left front edge of the jacket. Drill two holes and mount the control, being careful not to kink the capillary tube (the wire-like tube connecting the probe and control). Again being extra careful not to kink the capillary tube, insert the sensing element through either hole in the jacket under tapping #4, up behind the jacket and across the top of the boiler to boiler tapping #23 (top view). The hole in the jacket should be lined with one of the rubber grommets packed with the jacket. Install the probe bulb in the well installed in tapping #23, using the clip furnished.

NOTE: On the OT 35, 50 and 70, temporary removal of the metal strip joining the two halves of the front panel may make it easier to get the sensing probe through the hole in the jacket. Re-join the halves after probe installation. The excess length of capillary tube on top of the boiler can be tidied -up by forming it into a spiral coil, using a short length of large-diameter pipe as a mandrel.

All interconnecting wiring must be completed as per the Wiring Diagram.
Recommended Setting of this control is 200°F.

C. Master Hot Water Control

1) Installation

The Master Hot Water Control, HONEYWELL #L8124C-1003 or equivalent, is installed in boiler body tapping #4 (front view) using the ¾" well already installed. All interconnecting wiring must be completed as per the Wiring Diagram, Section IX.

2) Recommended Settings

High Limit Setting	165°F.
Low Limit Setting	150°F.
Differential	20°F.

NOTE: If the boiler is to be operated exclusively on oil or gas for an extended period of time, it is desirable to reset the controls to:

High Limit	200°F.
Low Limit	180°F.
Differential	20°F.

D. Install TRIDICATOR #PTA-1088 or equivalent in tapping #5, using the ¾" x ½" bushing provided.

E. The SAMSON Automatic Draft Regulator is installed in the boiler body tapping #20 (front view), located above the wood loading door. The hexagonal-head screw must be at the top so that the red figures show. These red figures will be used in making adjustments. To install the regulator, apply teflon tape to the threads and screw the control into the tapping securely, but not too tightly as the threads may be damnaged if the control is turned too far.

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 loading 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. The end of the chain with the ring and the hook should be attached to the arm of the regulator. The other end of the chain attaches to the hole in the lower door air flap. After the ring is attached to the arm of the regulator, all adjustments to the regulator (see Section V, B) should be made with the 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.

F. Sequence of Controls Operation

The proper control sequence of operation is as follows:

The overheat control starts the circulator if the boiler water temperature reaches 200°F. If there are electric zone valves on the system, the zone with the greatest amount of radiation must be equipped with a zone valve with an end switch for the circulator; this valve must be wired to open when the boiler temperature reaches 200°F.

DO NOT USE SELF-CONTAINED, NON-ELECTRIC ZONE VALVES IN THE ZONE CONTROLLED BY THE OVERHEAT CONTROL. SUCH VALVES COULD PREVENT THE BOILER FROM BEING COOLED DOWN WHEN OVERHEATED BY BLOCKING CIRCULATION.

On a call for heat, the thermostat starts the circulator (and auxiliary system, i.e., electric elements, oil burner or gas burner if the boiler temperature is below 165°F.). If, during a call for heat, the boiler temperature is below the circulator setting of 140°F., the circulator will not run. When the boiler temperature recovers to 140°F., the circulator will operate. With auxiliary system or systems operative (oil burner, etc.), auxiliary heat is supplied to the boiler any time the boiler temperature is below the 165°F. high limit setting, and there is a call for heat on the system. The high limit setting of 165°F. is specified so that the auxiliary system or systems will operate only when the wood fire is unable to maintain boiler temperature above 165°F. Generally a wood fire will be set to keep the boiler at 180°F.

NOTE: If the house has a marginal amount of radiation, it may be necessary to operate the boiler at 200° to adequately heat the house during extremely cold weather. The SAMSON Draft Regulator should be set at 90, and the setting on the HONEYWELL L4008 should be increased to 210°F.

III. Domestic Hot Water System

A. Domestic hot water piping is led into the boiler through the slot in the top right rear of the boiler jacket. Pipe the cold water through WATTS Vacuum Relief Valve #36 or equivalent to tapping #24, and hot water from tapping #26. ¾" bronze street ells or 90° female/copper adaptors are recommended. It is also desirable to install unions external to the boiler in both the cold and hot water lines on Type OT boilers. The square plug in the center of the tank is the upper end of the replaceable tank anode. The short couplings should be removed from the nipples on the tank or coil and *should not be used as connections!* They are installed only to protect the threads on the nipples during transit.

NOTE: In certain areas, existing water supplies may contain a high amount of mineral content. This will lead to liming of the coil or tank over time, depending on the mineral content of the water and the amount of water passing through the coil or tank. In situations such as this, the coil or tank must be cleaned. Cleaning should always be done as soon as there is any indication that the hot water supply is being restricted. Coils are cleaned with hydrochloric acid—*it is a dangerous procedure that should only be attempted by a qualified and experienced person.* Tanks can often be cleared of a great deal of sediment by back-flushing with water. Consult your dealer or heating contractor for information on these cleaning procedures.

B. For storage tank water heater—models with suffix "B":

1) Install the brass hourglass coupling supplied on tapping #25 (OT35-B and OT50-B). Two couplings are supplied with OT 70 models. They should be installed on tappings #25 and #28.

2) The OT35-B and OT50-B must have one temperature and pressure relief valve. The OT70-B must have two, one for each tank (WATTS 40XL-8 in both cases, supplied with boiler). Remove knockout(s) in the top jacket panel to allow these valves to be inserted, and place this panel in position. If your top jacket panel does not have knockouts, use a high-speed 2" hole saw to make these hole(s). Mount the temperature and relief valve(s) in the coupling(s). The relief valve discharge line(s) must be piped to within 6" of the floor near a drain, and must be ¾" pipe *with no reduction.* It is desirable to use a union in the valve discharge line so that the top panel may be easily removed if necessary. IF THIS VALVE OPERATES, HOT WATER WILL BE DISCHARGED. IT SHOULD BE PIPED TO OR NEAR A DRAIN, SO THAT THIS WATER WILL NOT DAMAGE THE ROOM IN WHICH THE BOILER IS LOCATED.

3) With water piping in place, install tempering valve, WATTS #70A or equivalent. Follow the manufacturer's instructions for installation. IF THIS TEMPERING VALVE IS NOT INSTALLED, THERE IS DANGER OF SCALDING FROM EXCESSIVELY HOT DOMESTIC WATER.

C. For tankless water heater—models with suffix "S":

1) Install the pressure relief valve (WATTS #3L, 125 PSI) in a tee on either the cold water supply to the tankless coil(s) or the hot water line from the tankless coil(s). There must be no shut-off valve or check valve between the relief valve and the tankless coil(s). Pipe the drain line from the relief valve as suggested in (2) above. IF THIS VALVE OPERATES HOT WATER WILL BE DISCHARGED. IT SHOULD BE PIPED TO OR NEAR A DRAIN, SO THAT THIS WATER WILL NOT DAMAGE THE ROOM IN WHICH THE BOILER IS LOCATED.

IV. Connection to Radiation

NOTE: The wood fire in the Type OT boiler will always produce a certain amount of heat, even when there is no heating demand on the system. This fact makes the behavior ofsuch a system quite different from an oil- or gas-fired boiler, where heat is produced "on demand". The "baseline" heat output that is continuously generated by a 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 spring and fall (see Section VIII, "Seasonal Adjustments"), and is more likely to occur in certain of the systems described below than in others. Before choosing a particular system for your installation, the possibility of using a mixing valve arrangement to avoid such problems should be considered. Such an arrangement can be added to any heating system. *We recommend the use of a mixing valve with all boilers.* Please read part E of this section ("Mixing Valve Arrangements") for more information. Your dealer can help you decide whether such a system may be installed easily in your home.

A. Conventional Systems

NOTE: All hydronic heating systems require expansion or overhead air cushion tanks as well as proper venting for both the boiler and the heating system radiation and piping. It is especially important that the expansion or air cushion tank is properly sized for the system, as the Type OT boilers contain a large amount of water in themselves (please see Section IX, "Specifications"). For information on expansion and venting, please refer to IBR Bulletin #200, "Installation Guide for Residential Hydronic Heating Systems."

1) Return water should enter the boiler through tapping #1. The circulator should be installed in this line.

2) Supply water comes from tapping #2.

3) WATTS A.S.M.E. pressure relief valve #174A (supplied with boiler) must be installed directly on flange 1a.

NOTE: WATTS A.S.M.E. PRESSURE RELIEF VALVE MUST BE INSTALLED TO INSURE SAFE OPERATION OF THE BOILER AND FOR THE PROTECTION OF THE HEATING SYSTEM. Pipe the ¾" discharge line from this valve to within 6" of the floor *without reduction in pipe size.* IF THIS VALVE OPERATES HOT WATER WILL BE DISCHARGED. IT SHOULD BE PIPED TO OR NEAR A DRAIN, SO THAT THIS WATER WILL NOT DAMAGE THE ROOM IN WHICH THE BOILER IS LOCATED.

4) An AMERICAN #700 Vent must be installed in tapping #16 (located above the smoke pipe collar), using a bushing, close nipple, and elbow. This vent ensures that all air that accumulates at the top of the boiler is properly vented.

5) The cold water supply should be piped in through a WATTS #9D backflow preventer to a WATTS S1156F boiler fill valve. After leaving the fill valve, the water should enter the boiler through tapping #18. The boiler drain should also be installed at tapping #18.

NOTE: The electric power supply for the Circulator Pump Motor MUST be supplied through the "Master Hot Water Control." If multiple circulators are used for zoning, the heating system's largest radiation loop circulator must be controlled by the "Master Hot Water Control" and its related room thermostat.

When the HS TARM boiler is being fired with wood or coal, the possibility of boiler overheating does exist, particularly during relatively mild weather. The boiler is equipped with an Overheat Control to insure against this possibility. However, the Overheat Control operates only through the Master Hot Water Control and its controlled Circulator Pump. The activation of the Circulator Pump by the Boiler Overheat Control thus cools the boiler by releasing heat to the heating radiation system.

DO NOT USE SELF-CONTAINED, NON-ELECTRIC ZONE VALVES WITH THIS BOILER. SUCH VALVES WOULD PREVENT THE OVERHEAT CONTROL SYSTEM FROM COOLING THE BOILER WHEN NECESSARY.

B. Mixing Valve Arrangements

A mixing valve arrangement is a method of controlling house temperature that is different from and more sophisticated than more conventional systems. In the average hydronic system in this country,

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 a mixing valve-controlled system, the circulator runs continuously, and the temperature of the water flowing to the house is controlled by the mixing valve, which adds more or less cooler return water to the water being pumped to radiation. The valve is controlled manually by the homeowner (a very common system in Europe), or it is controlled automatically by a special proportional thermostat.

A system controlled by a mixing valve has several advantages over more conventional systems. These are:

—longer boiler life due to the elimination of thermal shock to the boiler caused by surges of cold return water at circulator start-up.

—longer circulator life, as most wear in circulators occurs during motor start-up.

—a quieter house during the heating season, as the noises caused by sudden changes in water temperature in the radiation are eliminated.

—a more comfortable house because the heat is more even. Rather than having the heat turn completely on and completely off in response to heating demands causing fluctuation in house temperature, the heat is always "on", with the temperature of the radiation adjusting gradually to respond to the house's heating needs.

In addition, a mixing valve arrangement has important advantages for wood-burning hot-water systems. Because there is constant circulation, there is always some heat being drawn from the boiler. As a wood fire is always generating a certain amount of heat, such a system will dispose of this heat efficiently. In a conventional system, there is a greater possibility of boiler overheating (when there is no circulation) and creosote formation (caused by the fire burning too slowly). A mixing valve system minimizes the possibility of either of these problems occurring, thus increasing both the safety and efficiency of the wood-burning system. Mixing valve arrangements can be added to any of the systems described in this section, or, in fact, to any conventional heating system as well. *We recommend the use of a mixing valve arrangement with all Type OT* installations. More information on mixing valve arrangements is available from your dealer or directly from Tekton Corporation.

V. Installation of Auxiliary Heating Devices

NOTE: Your dealer can advise you on the best equipment for your area. For example, in areas where a natural gas pipeline is available, a gas burner might be more desirable than an oil burner. In areas where inexpensive "off-peak" electricity is available, the addition of electric heating capability may allow you to heat your boiler more economically during off-peak periods than if you were using gas or oil at these times.

THE ELECTRICAL COMPONENTS AND OIL OR GAS BURNER SHOULD BE INSTALLED ONLY BY LICENSED AND EXPERIENCED TECHNICIANS, AND ACCORDING TO ALL APPLICABLE NATIONAL, STATE AND LOCAL CODES.

A. Oil Burner

The oil burner should be connected to the master hot water control as specified in the "Electrical Wiring Diagrams," Section IX. Please refer to the literature provided by the burner manufacturer for other information concerning the burner and related equipment.

B. Gas Burner

The gas burner (available from your dealer) should be connected to the master hot water control according to the instructions supplied by the burner manufacturer. Please refer to this literature for other information concerning the burner and related equipment.

C. Electric Heating Elements

Electric heating elements and controls (available from your dealer) should be installed according to the recommendations of the manufacturer.

V. **Wood Firing Instructions**

PLEASE READ THIS SECTION BEFORE BUILDING YOUR FIRST WOOD FIRE!

Part of the following is reprinted from *The Lange Stove Catalogue and Wood Heat Guide,* copyright 1976, by David Lyle.

A. Chimneys and Chimney Cleaning

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 of not less than .05 in./wtr. and preferably around .06 in./wtr.

The top of the chimney should be at least three feet above the point it passes through the roof and two feet above the high point of the roof. 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 not likely to crack from high temperatures. Fire insurance underwriters favor and sometimes require masonry construction for chimneys. In several states, it is now illegal to use anything but a tile-lined masonry chimney with wood-fired, central heating systems.

Natural draft in a chimney depends on two variables. First, draft is created by the aspirating effect of air currents blowing across the top of the chimney. When the temperature of the flue gases is higher than the temperature of the atmosphere around the chimney, natural draft also will result. Because of this, insulating the chimney flue liner will increase the draft as well as make it more consistent. Insulation also will reduce creosote deposits by reducing the amount of moisture condensation from the flue gases. Therefore, many users prefer UL-approved insulated metal chimneys. Only water-repellent mason's vermiculite insulation should be used in masonry chimneys.

The following notes 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 wood-burning boilers is 20 feet.
2) The interior surface of the flue should be as smooth as possible to avoid friction, which also helps to decrease the possibility of creosote buildup.
3) Only one appliance should be hooked into each flue.
4) 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 get smaller in diameter going from the heating unit to the chimney.
5) 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.
6) Air leakage in cracks where mortar has fallen out will mean a cold, and possibly dangerous, chimney.
7) A chimney must be kept warm (above 250° F.) for proper draft to occur.
8) 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 creosote that may drip down inside the chimney does not run out the door if it accumulates.
9) Connecting stove pipe must be kept a safe distance from combustible materials. This distance is specified in local codes which should be referred to by installer. In no case should non-insulated stove pipe be closer than 18" to a combustible surface. Insulated pipe should be installed according to manufacturer's instructions.
10) The area where the connecting pipe enters the chimney should be sealed with refractory cement so that the connection is airtight.

Chimney cleaning—check your chimney and flue pipe at least twice a year to see if they require cleaning. Check more frequently if you are new to wood burning or have reason to believe that you are building up soot or creosote.

It is not unusual to have a little smoke come into the room as you open the door to add more wood. You can generally avoid this by opening the upper door slightly for a moment before you open 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.

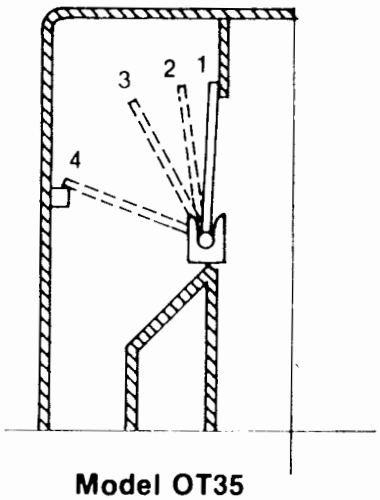
Various cleaning methods may be used. Some people favor a bunch of tire chains raised and lowered on a rope inside the chimney. A burlap sack filled with straw or a ball of chicken wire can be used in the same way. Drop a rope down the chimney to a helper, then pull the sack or ball or wire up and down inside the chimney. Some people substitute a small spruce tree for the burlap sack. If your chimney is not too tall, tie a burlap sack to the end of a long pole and use it as a giant swab.

Chemical chimney cleaners such as "chimney sweep" are on the market. These are generally thrown into the hot fire and cause creosote to crumble and disintegrate. We cannot testify to what the long range effect on the chimney or boiler may be, but we have been advised that adding *any* chemical salt to the fire may cause serious corrosion in insulated metal chimneys or plain stovepipe or boilers.

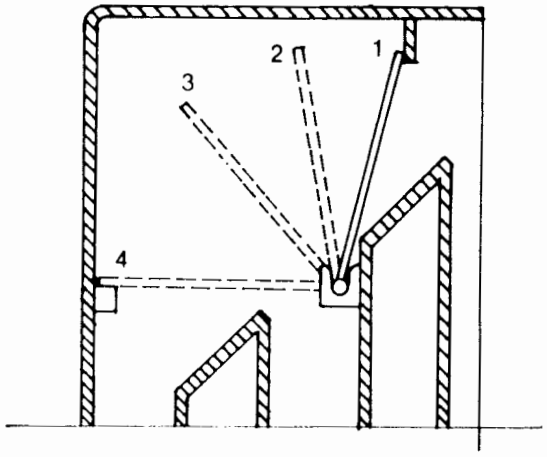
B. Starting and Maintaining a Fire

NOTE: Small gas explosions may occur when refueling any wood-burning device. ALWAYS OPEN THE FIRING DOOR WITH YOUR LEFT HAND AND KEEP YOUR FACE AWAY FROM THE DOOR UNTIL IT IS COMPLETELY OPEN!

There are three controls important to starting a proper fire in your OT boiler. These are two draft controls (secondary, in the upper door, and primary, controlled by the SAMSON Draft Regulator) and a flap damper. The flap damper is adjusted through the cleanout door on the OT 35, 50, and 70, and through the firing door on the OT 28. It controls the relative amounts of smoke leaving the top and bottom of the firebox (see figures below).



Model OT35



Models OT50 and OT70

With the damper in a vertical or near vertical position (Figure H, position 1 or 2), much of the smoke will be drawn out at the base of the fire box. This position is suitable for normal wood-burning operation. Poor chimney draft conditions (warm day, high humidity) and some fuels require use of an intermediate position (position 2 or 3). An oil or gas burner works well in positions 1-3, unless it is being used exclusively, as in the summer, in which case the damper should be in a horizontal position (position 4). This increases efficiency by allowing the flue gases to give up more of their heat as they take a longer path through the solid fuel firing section.

The regulation of the secondary air inlet is extremely important for the efficiency of boiler operation. As wood is heated in any fire it emits gases that, when burned, yield heat. When they are not burned completely they can represent a significant loss of efficiency and in some cases form a tar-like flammable deposit called creosote. Creosote is formed when flue gases condense in the boiler or chimney. The Type OT's base-burning principle encourages burning of these gases. Much of the smoke leaves the firebox at its base where flammable gases are drawn over the fire's hot coals. The admission of additional oxygen from above through the secondary air inlet (upper door) allows these gases to be burned as they go over the coals, rather than having them proceed wastefully and dangerously (see Creosote and Soot, Section C) up the chimney.

The primary air inlet is controlled during normal operation by the SAMSON Automatic Draft Regulator.

To start your first fire, set the flap damper in position 4, and hook the SAMSON Automatic Draft Regulator control so that the flap on the lower door is wide open. Open the secondary inlet in the upper door far enough to admit two fingers. Start the fire in the conventional manner, using paper, kindling and two or three small logs. Pile all these in the correct order *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 1 or 2 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.

Once the fire is well started, the flap damper should be set to position 1 (2 or 3 if necessary for poor draft conditions). This damper need not be changed until summer use of oil or gas only, as described previously.

The SAMSON Draft Regulator should be adjusted as follows. Turn the black knob to set the red number 80 at the red line. Allow the wood fire to slowly bring the boiler temperature up to about 200°F on the Tridicator. When this temperature is reached, adjust the chain and then the knob so that the small air inlet flap is barely closed but is still maintaining tension in the chain. The control will automatically open and close the air inlet flap to allow the proper 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 170-180° F. The final control setting may be more or less than 80 on the dial.

The setting of the secondary air inlet in the upper door will vary according to chimney draft, type of wood, dryness of wood and other factors. If shut too tightly, insufficient 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 slowing 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. Accurate setting of the secondary air inlet will develop quickly with practice, if the above instructions are kept in mind.

When fueling the boiler, the lower air flap should be closed by removing the hook from the ring at the top of the chain. The upper door should be opened gradually, so as to build up the draft. These procedures will minimize smoke escaping from the upper door when it is open.

In long-term maintenance of the boiler fire, 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 for more than a few hours, it will be necessary, however, to load up. Normal use, and especially large loads of wood, will often leave you with quite a few coals when you next stoke the fire. Such accumulations of coals should be pulled forward in the firebox (your boiler cleaning tool is handy for this) where they can get sufficient air to burn and set fire to the next load of wood.

When loading the boiler in the morning, it is a good idea to occasionally let the boiler run at a high rate for a few minutes after new fuel is added. This will tend to safely burn off any creosote that may have formed during the night. The easiest way to get the boiler running fast is to prop the primary air flap open to temporarily shorten the chain by wrapping it around the arm of the Draft Regulator. BE SURE TO RESTORE THE DRAFT FLAP TO ITS NORMAL POSITION AFTER A FEW MINUTES OF FAST OPERATION. *NEVER* USE THIS PROCEDURE IF YOU SUSPECT YOUR CHIMNEY IS PARTIALLY BLOCKED WITH CREOSOTE, AS YOU MAY IGNITE A CHIMNEY FIRE.

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.

C. 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 OT boiler.

Your boiler and for that matter, all types and makes of wood-burning equipment will give trouble with creosote deposits under certain conditions. You should be aware of these conditions and avoid them.

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

NOTE: Surface accumulations of creosote on the boiler jacket can be removed with a mixture of automatic dishwasher soap and water, using a scrub brush or sponge.

Creosote condenses from the flue gases more quickly when the temperature of those gases 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 is burned, (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 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 (usually less dry) wood during mild weather when combustion is relatively slow

The temperature in the stack may be controlled by:
- —using as short a length of stovepipe as possible between the boiler and the chimney
- —using an insulated flue 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 external obstructions in the chimney outlet
- —having only one appliance per flue

D. Firewood

Burn dry and well-seasoned hardwood, with a moisture content of 20% or less. Season wood *at least* six months, preferably a year to eighteen months. Woodburners who ignore this advice are likely to have dirty chimneys and inadequate performance from their boilers.

Theoretically, there are about 8600 Btu's available as heat from each pound of 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.

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 and 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 the firebox. The OT 35 and OT 50 can take wood up to 20" long. The OT 70 can handle wood up to 30" long. 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 the species of tree it comes from. But wood is not sold by the pound; it is sold by volume—by the cord. Therefore, the dense heavy woods, giving you more pounds per cord, are the ones to buy.

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 in millions of Btu		**Percent More Heat for Air-Dry Wood**
Species	**Green wood**	**Air-dry**	
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

Other good to moderately good firewoods include apple, walnut, pecan, dogwood, cypress, sycamore and gum. The latter two, however, are hard to split, as is elm.

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 occupies 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, like a tobacco drying barn, is effective.

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.

E. 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. These procedures apply to the wood-fired boiler, as the gas- or oil-fired boiler, if any, will be completely inoperative.

1. Locate any "flow-check" valves in the system, and unscrew completely the knob on the top of all these valves. (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.)

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

2. The SAMSON Automatic Draft Regulator will continue to control the wood fire in the absence of electric power. It is important to remember that the heating system cannot dispose of a great deal of firewood without the circulators running. Under such conditions, extreme caution must be used to avoid overfiring. DO NOT LOAD LARGE AMOUNTS OF WOOD INTO THE BOILER! Fire the boiler cautiously until you are able to determine how quickly the boiler is consuming wood.
3. When the power has returned, reset all controls and flow-check valves for normal operation.

F. Boiler Overheating

Overheating in the OT boiler is an occurrence that all homeowners must be familiar with, so that it can be both corrected, and in general, avoided altogether.

When the boiler temperature rises above a preset limit (usually 200°-210°F.), causing the Overheat Control 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 for heating needs of the house at a given time). For proper firing, see section VI, "Seasonal Adjustments."

—Improper adjustment of the SAMSON Draft Regulator (See Section IV, B, "Starting and Maintaining a Fire.")

Following the recommendations in the manual will minimize overheating. 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 (200°F.). It does this by turning on a circulator and opening any zone valves in the largest heating zone, even if there is no call for heat from the thermostat. This will generally cool an overheated boiler within 15 minutes.

If the overheat condition is more severe, the temperature will continue to rise. At about 250°F., the pressure in the boiler will have reached 30 psi, and the Pressure Relief Valve will open, discharging steam. The valve prevents the boiler from reaching a dangerous pressure. For your information, all OT boilers are pressure tested to 60 psi at the factory.

If the discharge tube from the relief valve is piped to a point 6" from the floor, or to a drain (as it always should be), the release of steam is harmless. The reason that steam, rather than water, is discharged is due to the fact that water under pressure can reach temperatures above 212°F. without boiling (as in a boiler), but, when released to the atmosphere by the relief valve, it turns immediately to steam if it is over 212°F.

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

1. Make sure the lower door air flap and all secondary air inlets are closed.
2. Open all hot water faucets in the house.
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.

G. Coal Burning

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 and, in many areas, even firewood.

Your HS TARM 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 table of the cost of coal relative to other fuels.

COAL VS. WOOD BURNING

Advantages	Disadvantages
Coal burns for a longer time than wood; 14 hour burns with a good heat output are not uncommon.	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 produces no creosote and very little soot; even well-seasoned wood contains moisture and will produce creosote.	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 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 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 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 cannot be obtained for free whereas firewood often can be obtained at little or no cost.
Coal is uniformly cheaper than fuel oil in most places and, in some places, good firewood.	Coal produces more carbon monoxide gas than wood (see Section II). 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 produces up to 20% more heat output than wood, and, per firebox load, two to three times the output.	Coal must be lit by first building a wood fire; wood fires are easier to start and they get the boiler to temperature more quickly.

PRICE OF COAL, WOOD AND FUEL OIL FEBRUARY 1980, NEW ENGLAND

	Price/unit	Btu/unit	Price per million Btu	*Average* Burning Efficiency	*Price per* million Btu Actually Obtained
Coal	$90/ton	24,000,000	$3.75	60%	$6.25
# 2 Fuel Oil	.94/gallon	138,000	6.81	70%	9.72
Firewood (hardwood w/20% moisture content)	$90/cord	22,000,000	4.09	50%	8.18

1. **WARNING ABOUT CARBON MONOXIDE POISONING FROM BURNING COAL**

   All coal fires produce large quantities of 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 EXCAPE 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, poor position of the fuel, or the use of too much fuel.

Please make sure that the internal bypass damper is kept in position 2 or 3 (see page 12 in this manual) at all times. In these positions, the boiler operates partially as an updraft burner, and there is no risk of blocking the boiler's internal flue passages. Make sure that the area around the bypass damper is clear of creosote at all times!

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, collect.

2. 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 generally recommend anthracite (hard) coal of the "nut" size; you may find, however, that other sizes (such as pea or stove coal) or different layers of two or more sizes may produce the best results in your particular boiler/heating system/chimney combination. For example, stove coal produces more heat output but a shorter burn time than nut coal, while pea coal may produce less output and a longer burn.

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 (soft) coal. Bituminous coal has a high ash and sulphur content and produces byproducts that can corrode the boiler firebox.

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 coal used, the deeper the coal bed must be to maintain a good fire.
—Coal sizes should not be mixed but 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 your boiler has too great a draft, causing the fire to burn too quickly or too hot, use a smaller size of coal.
—If the draft is sluggish, use a larger size of coal.
—If the coal doesn't burn completely, leaving a "heart" of unburned coal surrounded by residue, use a smaller size of coal.

3. 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.

HS TARM shaker grates are designed specifically for coal burning and are essential for best results. Coal may be burned on the standard HS TARM wood grates, but reloading the firebox and cleaning the grates and ash pan are more time-consuming and difficult tasks.

4. Starting the fire

First check to see that the boiler controls are set in these positions:
—bypass damper in #2 or #3 position (see diagram on page 12 of this manual)
—secondary air dial open halfway

The settings are intended as a starting point for your initial fire. You may find that variations from these settings are appropriate for your 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 needs a lot of air to get started.

NEVER USE GASOLINE, KEROSENE, LIGHTER FLUID OR ANY OTHER CHEMICAL TO START YOUR FIRE OR 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. 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 still burning well. (When adding coal in layers, wait until the last layer of coal produces blue flames before adding the next layer.)

Add thicker layers of coal over shorter intervals until the firebox is filled to within two to three inches of the bottom of the firing door. In the OT boiler, the coal should slope up to the left of the firebox as the draft is strongest there. If you cannot avoid overheating when maintaining this large a fire, you can assume that it is too warm outside to be burning solid fuel.

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. Stir the embers or, if necessary, move them into areas that are not burning.

Whenever adding a thick layer of coal, be sure to make a hole in the new layer so that 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.

5. Maintaining a fire

Once the coal is burning well, a very constant heat output can be maintained. The SAMSON Draft Regulator will control the boiler water temperature as precisely as it does when wood is used.

Cold spots may develop in areas with insufficient air for combustion. Should this occur, use a poker, rake or shovel to dig into the bed (to the level of the grates) and stir or agitate the embers to increase air flow to the spot. If the cold spot gets larger or if the fire goes out, first shake the grates (see Section 6). Then clear a small area at the front of the firebox, and start a small wood fire with kindling. When the wood fire is burning well, rake coals up over the burning coal.

6. 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. Then shake the grates until the ash pit is glowing uniformly.

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 larger 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.

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.

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.

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

7. Overnight Firing

   First bring the boiler to operating temperature with the coal fire. When the fire is burning well, poke the bed with a poker and shake the grates. Then load the firebox with new coal. Spread a layer of ash or a layer of small size coal over the top of the bed to insulate the coal for a long burn. If the boiler has a flue damper, be sure to close it.

8. 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 drafts fully. When this new coal has ignited and is burning well, shake the grates and reload the firebox as usual (see Section 6).

9. Problems

   The two most common difficulties encountered by coal burners are inadequate output and having the fire go out. Both problems are 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.

   If you leave the ash door open by mistake, however, a coal fire will overheat the boiler more severely than will a wood fire of the same size!

   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.

VII. Periodic Maintenance

The maintenance needs of the OT series boilers vary from season to season. They require somewhat more attention than an ordinary boiler, but this is because they are actually doing more, and because a wood-burning device of any kind requires some routine maintenance.

One critical aspect of maintenance is chimney cleaning. This should be done a minimum of once a year and more often if required. This subject is covered under Section VI, no. 1.

Cleaning of the boiler itself is a procedure that should be done at least every two months during the heating season. A buildup of creosote and soot on the walls of the firebox and flue passages can reduce the thermal efficiency of the boiler a great deal, as it insulates the water in the boiler from the heat of the wood fire, as well as some of the heat from the oil or gas flue gases after they have left the burner firebox. *Frequent cleaning of these surfaces will give you more heat from your wood and oil or gas.* A long-handled scraper and flexible-handled bristle brush are supplied with the boiler. The scraper should be used to clean the flat surfaces accessible through the wood loading door and the clean-out door; the flexible brush can be used to get down between the baffles visible through the clean-out door.

VIII. Seasonal Adjustments

A. Winter

Information for winter firing will be found under Section VI, no. 2, "Starting and Maintaining a Fire." Control settings for multi-fuel or gas/oil firing only will be found in Section II-B, no. 2, "Master Hot Water Control—Recommended Settings."

B. Fall and Spring

One of the more critical aspects of operating the OT series boiler is regulation during the period when the heating season is coming or going. For example, if you build a wood fire on a day when the outside temperature rises to 60°, you will be faced with a lot of heat being generated and nothing very useful to do with it. (In a case such as this, the overheat control would come on and circulate heated water through your house, no matter what the inside temperature was.)

Low heat demand will mean unusually slow burning creosote-producing fires. See Section VI, particularly Part C, regarding creosote.

If you are committed to using wood during such times, the best thing you can do is monitor the quantity or quality of the wood you burn. By intermittently building small fires or by using wood with a low caloric value (poplar, for example), you may be able to avoid overheating and creosote buildup.

It is recommended that you fire with oil, gas, or electricity during the transition seasons.

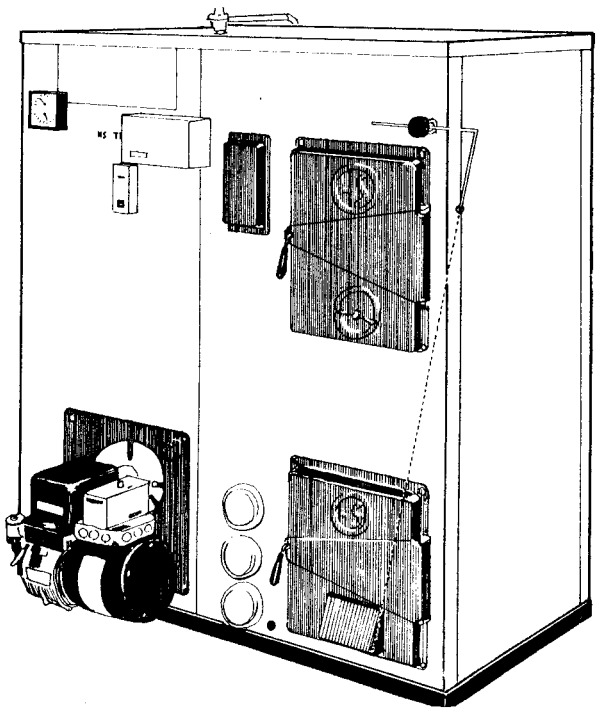
C. Summer

During the summer you should continue to heat your domestic hot water with the oil, gas or electric backup systems. These systems will heat your tap water as cheaply as a separate hot water heater using the same heat source. Having the boiler remain above 140° all year 'round is necessary as it reduces the possibility of condensation forming in the boiler flue passages. Condensation in the fireboxes or flues can combine with combustion products such as creosote, causing severe corrosion of the steel plate. So use your boiler all year.

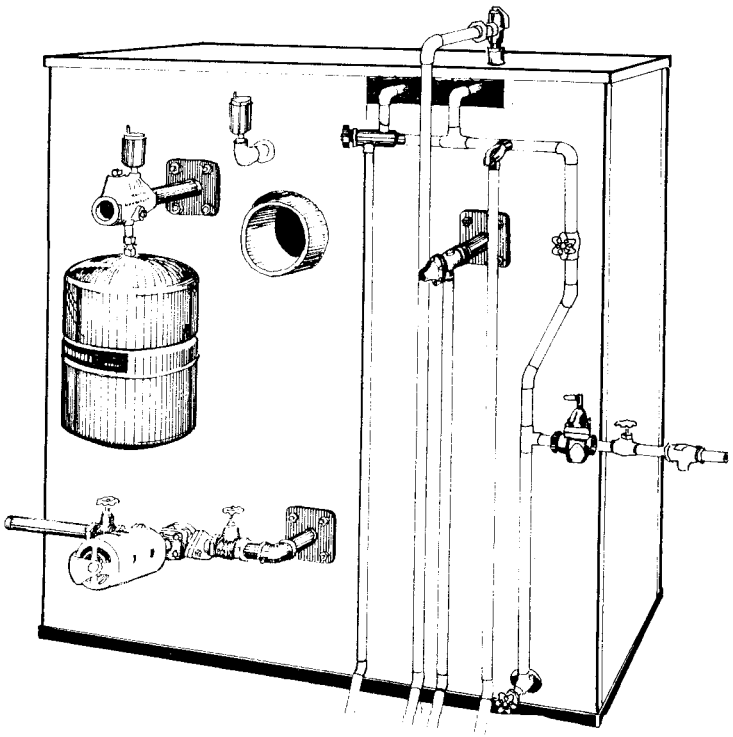
IX. Specifications

PERSPECTIVE VIEWS

FRONT



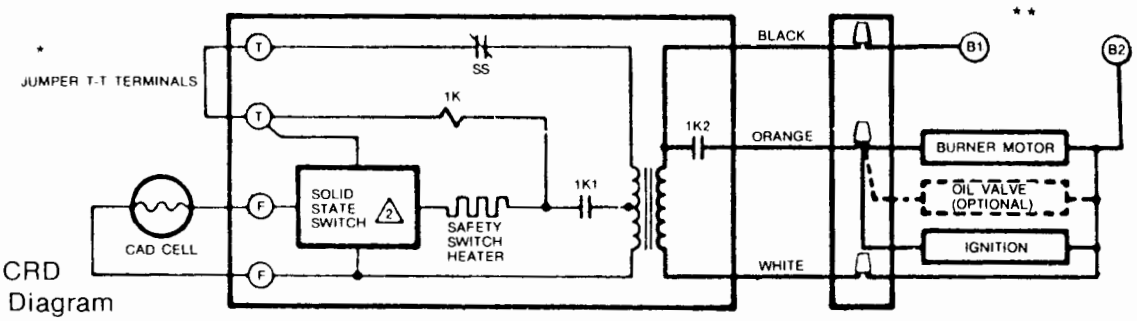
REAR



OIL BURNER-WIRING DIAGRAM

CARLIN

Model 100CRD & 101CRD
Oil Burner — Wiring Diagram

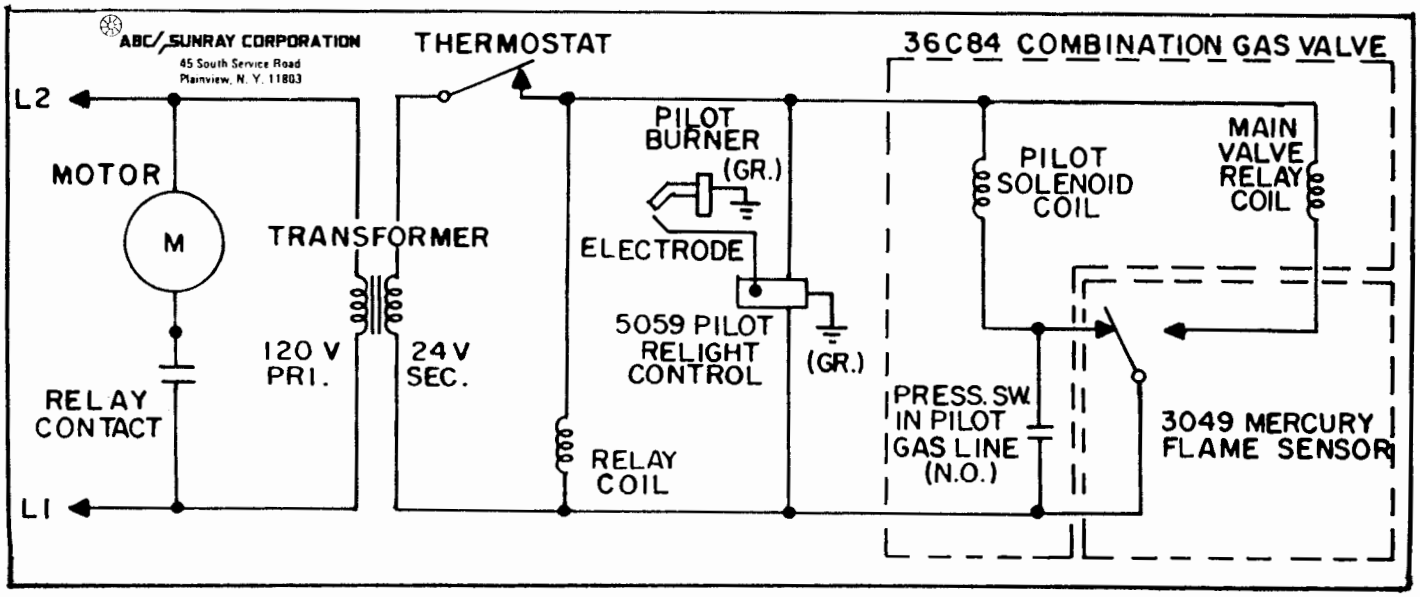


Internal Schematic R8184G

NOTE: *Wire jumper across terminals T-T at time of installation.

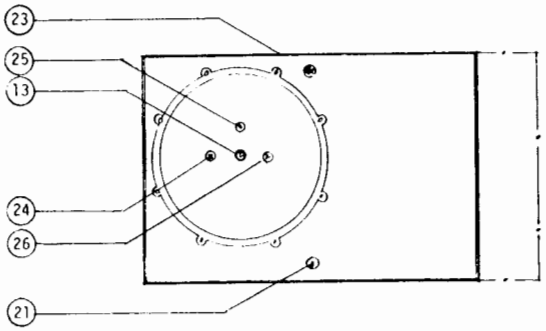
**Wire connections B1 and B2 refer to the wire connections numbers at the terminals of the Honeywell #L8124C Triple Aquastat Relay Control.

GAS BURNER-WIRING DIAGRAM

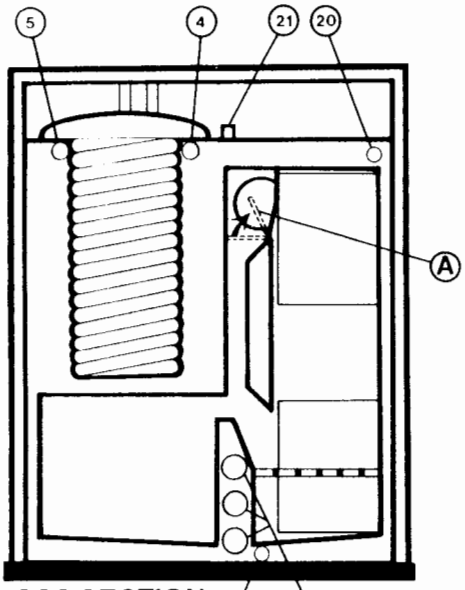


NOTE: Wire jumper across thermostate terminals at time of installation.

*Wire L1 and L2 to B1 and B2 on Honeywell L8124C Triple Aquastat



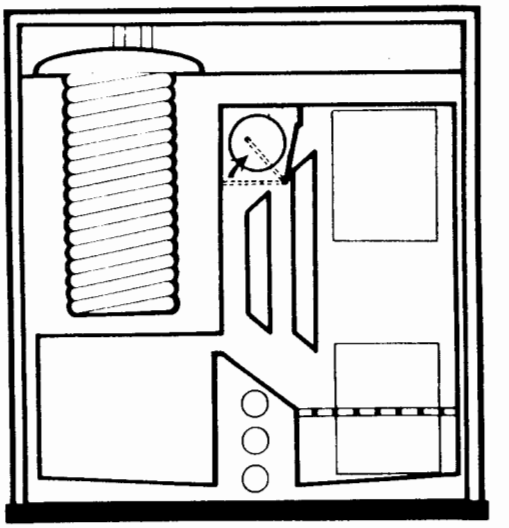
OT 35 & 50



CROSS SECTION
TYPE OT-35S

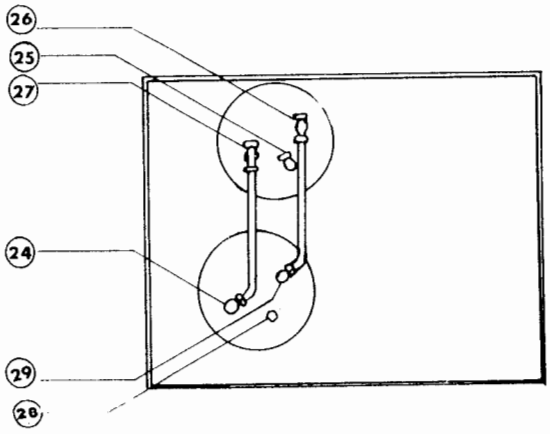
SPECIFICATIONS

TYPE		OT-28S	OT-35S	OT-50S	OT-70S
Gross Output—Oil	Btu/hr	112,000	140,000	200,000	280,000
Gross Output—Wood	Btu/hr	72,000	112,000	140,000	196,000
Max. Hot Water Output	GPM	2.3	2.8	4.0	5.7
Output with 3 Elect. Heater	KW	15	21	21	27
Width (B)	in	35 3/4	39 1/2	46 3/4	46 3/4
Depth	in	24 3/4	30	30	39 1/2
Length of Wood Chamber	in	15 1/2	21 1/2	21 1/2	31
Width of Wood Chamber	in	7 3/4	10 1/2	13 1/4	13 1/4
Wood Loading Door	in	7X10	10x12	10x12	10x12
Height up to Middle of Flue Outlet (H)	in	38 1/2	38	37 1/2	37 1/2
Distance (C)	in	24	24 1/2	25	25
1 Return	in	1 1/4	1 1/4	1 1/4	1 1/2
2 Flow	in	1 1/4	1 1/4	1 1/4	1 1/2
4. Tapping Triple Hot Water Control	in	3/4	3/4	3/4	3/4
5 Tapping for Tridicator	in	3/4	3/4	3/4	3/4
10 Extra Tapping	in	1/2	1/2	1/2	1/2
11 Flue Outlet (Outer Diam.) (D)	in	6	6	6	8
14 Hot Domestic Water	in	3/4	3/4	3/4	3/4
15 Cold Domestic Water Supply	in	3/4	3/4	3/4	3/4
16 Extra Tapping	in	1 1/4	1 1/4	1 1/4	1 1/2
18 Boiler Drain Tapping	in	1	1	1	1
20 Tapping for Draft Regulator	in	3/4	3/4	3/4	3/4
21 Vent Tapping	in	1/2	1/2	1/2	1/2
22 Electric Element Tapping	in	2	2	2	2
Water Capacity—Boiler w/Coil	Gal	73 1/2	76	91	130
Weight Boiler with Jacket	lb	946	1089	1444	1800
Pressure Test—Boiler	psi	72	72	72	72
Pressure Test—Hot Water Coil	psi	250	250	250	250
Minimum Flue Size	in	8X8	8x8	8x8	8x12
Minimum Chimney Height	ft	20	20	20	20

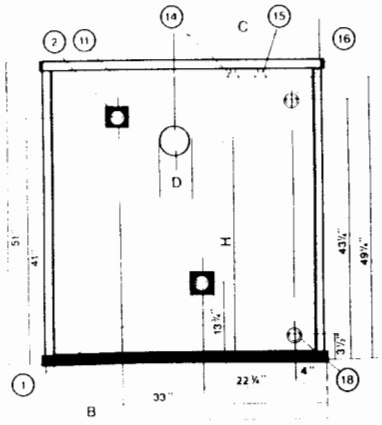


CROSS SECTION TYPE OT-50S, OT-70S

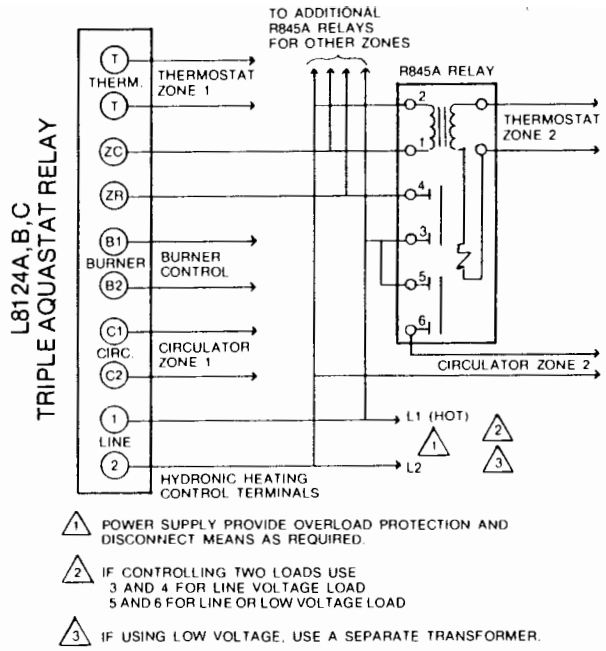
All specifications are subject to change without notice.



OT 70



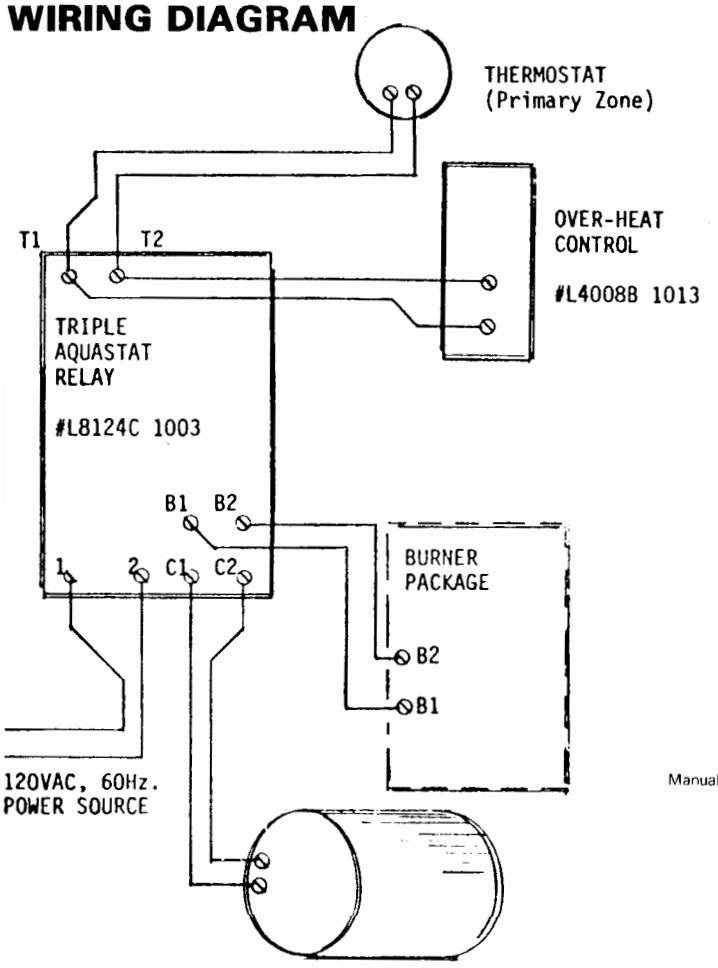
REAR VIEW



MULTIZONE-WIRING DIAGRAM

SCHEMATIC DIAGRAM SHOWING R845A IN A MULTIZONE, FORCED HYDRONIC HEATING SYSTEM. THIS ARRANGEMENT IS SUITABLE FOR ANY NUMBER OF ADDITIONAL ZONES.

CONTROLS PACKAGE-WIRING DIAGRAM



PIPING SCHEMATIC

Top View