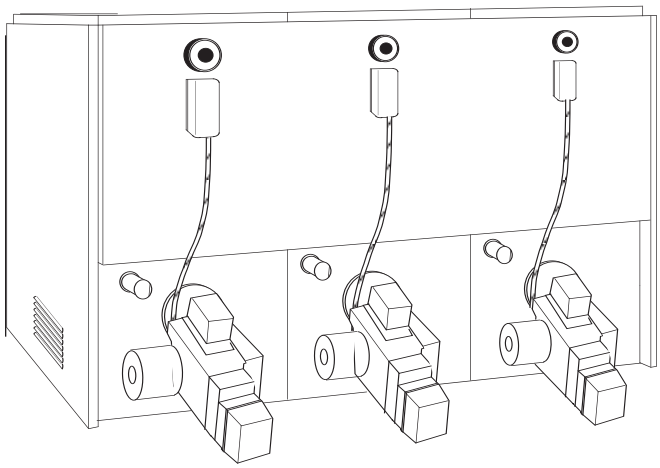
HydroTherm®

MG2-605
42-9158

MG SERIES INSTALLATION MANUAL AND REPLACEMENT PARTS LIST

Modular Power Gas Cast Iron Water Heating Plants 770,000 to 2,310,000 Btuh Input

Applicable For Larger Heating Plants Using Boiler Banks Of 6-Modules Or Less



NOTE: If shop drawings have not been provided, refer to the Appendices at the rear of this manual for sizing (breeching, chimney & gas piping) and control system data.

HydroTherm®

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SECTION 1: INTRODUCTION

HEATING PLANT DESIGN

Multi-Temp heating plants are comprised of individual cast iron modules that are piped to common headers to provide large hot water heating capacities. They are designed and intended for use for a central space heating system, for volume water heating, or for combination space heating/volume water heating. Each module is self-contained with its own set of controls and can operate independent of the other modules. Multi-Temp modules can be arranged to fit just about any available area. Products of combustion are vented through each module's vent connector, connected to a manifold (breeching) for joining individual connectors. Breeching is connected to a chimney which provides the necessary draft.

The objective of a Multi-Temp heating plant control system is to relate plant output to the actual heating load by automatic step-firing. This means that more or fewer modules are operated in response to an increase or decrease in actual heating load. Hydrotherm has developed three basic methods (levels) of control which meet most operating requirements encountered. Typical wiring diagrams for these basic methods are provided in the appendices at the rear of this manual. Special control system designs can be developed through the Hydrotherm applications engineering group.

CODE COMPLIANCE

Installations must conform to requirements of the authority having jurisdiction. Where required by the authority having jurisdiction, the installation must also conform to Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1.

All electrical wiring must be in accordance with the requirements of the authority having jurisdiction or, in absence of such requirements, with National Electrical Code NFPA-70-latest edition. If an external electrical source is utilized, installed module must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code NFPA-70-latest edition. UL listed power limited circuit cable is almost universally approved for safety controls on heating equipment, either internally or externally, without protection of conduits or raceway.

For Canada, installations must be in accordance with Standard C.S.A. C22.1 Canadian Electrical Code, Part 1 and Part 2, and/or local codes.

HEATING PLANT SHIPMENT

Heating plant packing list (attached to one of the packages) clearly lists the number of packages and their contents. Check this list against all material on the job site for completeness.

Heating Modules: Each module is shipped unjacketed in its own carton and weighs 623 lbs. (maximum for MG-385 module).

Draft Regulators: One for each module is shipped in carton with module.

Jackets: There are two jacket sizes- “A" jacket to en-close two heating modules and “B” jacket to enclose three heating modules. The correct combination of “A” and “B” jackets are furnished to form a complete enclosure for the entire heating plant.

Burners: When ordered, one Midco DS-45 power gas burner for each module is shipped in a separate carton.

Optional Header Sets: When ordered, each header set includes supply and return headers, pipe nipples, union and self-aligning couplings. There are two header set sizes -”A” headers for joining two heating modules and “B” headers for joining three heating modules. The cor-

The following terms are used throughout this manual to bring attention to the presence of potential hazards or to important information concerning the product:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

WARNING: Indicates a imminently hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

CAUTION: Indicates a imminently hazardous situation which, if not avoided, may result in minor injury or property damage.

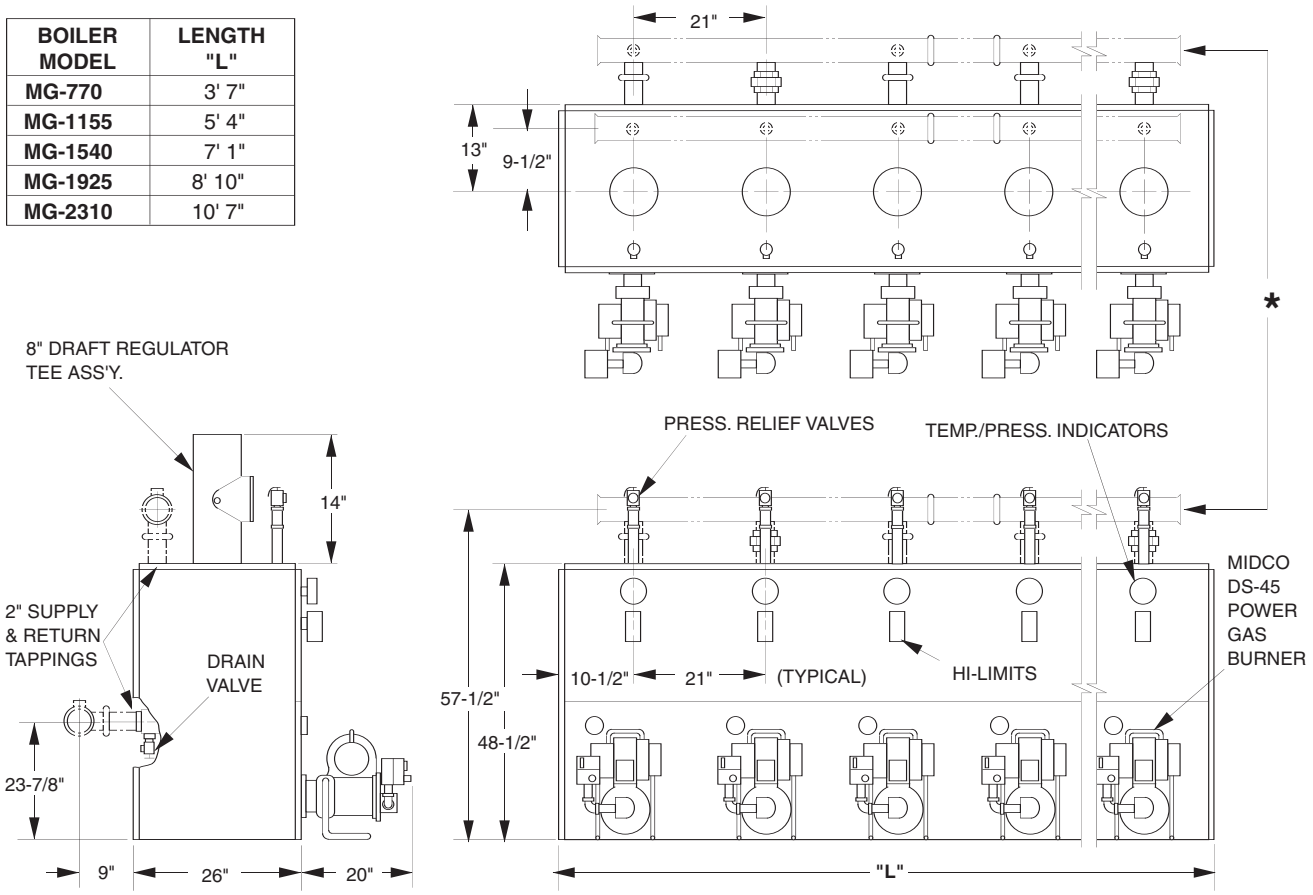
NOTE: Used to notify of special instructions on installation, operation or maintenance which are important to equipment but not related to personal injury hazards.

rect combination of “A” and “B” headers are furnished to manifold the complete heating plant.

Optional Heat Exchanger: When ordered, each heat exchanger is shipped with the pipe and fittings required for installation. There are two types of heat exchangers for volume water heating - “MC2” for two heating modules and “MC3” for three heating modules.

Control Equipment: When ordered, controls such as motorized valves, modulating aquastats, step controllers, thermostats, etc., are furnished in separate cartons.

BOILER MODEL	LENGTH "L"
MG-770	3' 7"
MG-1155	5' 4"
MG-1540	7' 1"
MG-1925	8' 10"
MG-2310	10' 7"



*** OPTIONAL: FACTORY-SUPPLIED SUPPLY & RETURN HEADERS**

MODEL MG HEATING PLANT DIMENSIONS

SECTION 2: INSTALLING MODULES

STEP 1: PLANNING AHEAD

IMPORTANT TO NOTE

1. Observe minimum clearances to combustibles.

2. Observe proper combustion air requirements.

3. Provide a firm, level and fireproof foundation (modules must be installed on non-combustible floor).

MINIMUM CLEARANCES TO COMBUSTIBLES: The following must be observed: 18” from jackets to front and rear; 6" each side; and 38” from jacket tops to ceilings. Local requirements may specify greater clearances and must be adhered to.

COMBUSTION AIR REQUIREMENTS: Provisions for combustion air must be in accordance with applicable local codes.

WARNING: The boiler must be supplied with combustion air in accordance with Section 5.3, Air for Combustion & Ventilation, of the latest revision of the National Fuel Gas Code, ANSI Z223.1 and all applicable local building codes. Failure to provide adequate combustion air for this appliance can result in excessive levels of carbon monoxide which can result in severe personal injury or death!

If the heating plant is installed in an unconfined space, adequate air will be available via normal infiltration.

If the heating plant is installed in a confined space (a space with a volume of less than 50 cubic feet per 1000 Btu/hr of input for all fuel burning equipment) or building construction is unusually tight, adequate air for combustion must be provided by two openings: one located about 6” below the ceiling, the other about 6” above the floor. **Each opening must have a minimum free area as follows:**

1. One square inch per 4000 Btu/hr of input when communicating directly with the outside or through a vertical duct.

2. One square inch per 2000 Btu/hr of input when communicating through horizontal ducts to outside.

3. One square inch per 1000 Btu/hr of input when ventilation air is provided by openings in doors, etc. to adjoining spaces having adequate infiltration.

NOTE: Modules employ atmospheric combustion. Combustion air must not be contaminated with halogenated hydrocarbon vapors, cleaning fluid vapors, aerosol propellants, freon or other corrosive chemicals. Otherwise, module heat exchangers will be subject to corrosion, reducing module life.

HEATING PLANT FOUNDATION: Concrete base pad is preferred. Loading is 195 lbs. per square foot; special reinforcements not required. If the floor is of combustible material and where permitted by local codes, fabricate a fireproof base as shown in Figure 2.1. Local codes may require different construction.

WARNING: Never install heating plant on combustible flooring without fireproof base or on carpeting as heat damage and/or fire may result.

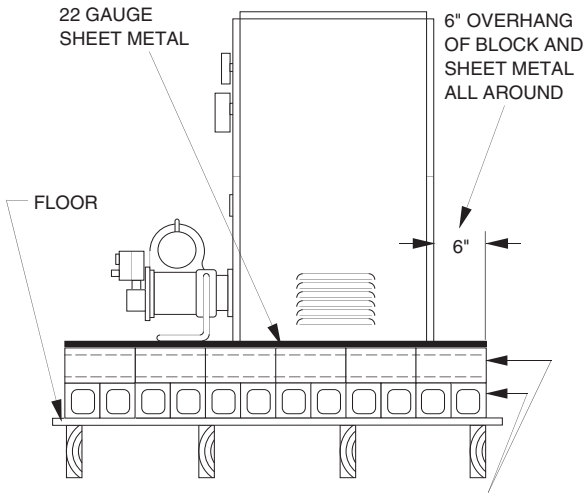


FIGURE 2.1

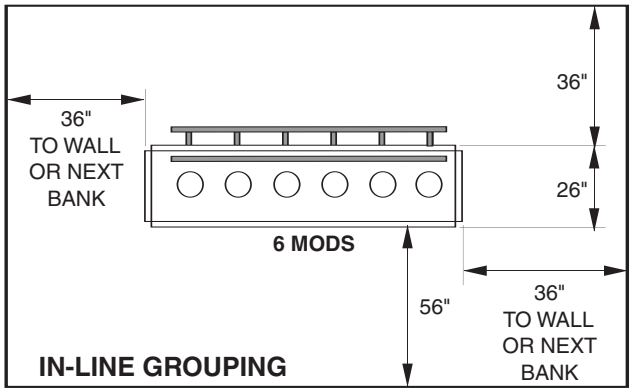
STEP 2: ARRANGING HEATING PLANT

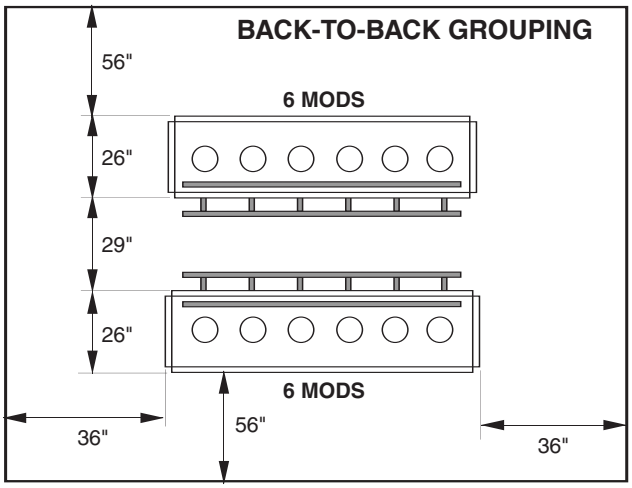
1. Locate heating plant as close to the chimney as possible so breeching length to chimney is kept to a minimum. Only 6" is required between the first module and the chimney.

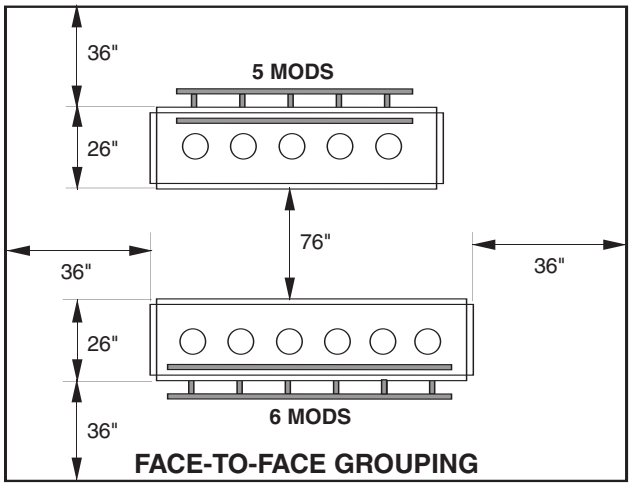
2. Modules employing MC heat exchangers (if any) must be located closest to the chimney to assure adequate draft for summertime operation.

3. Arrange heating plant in multiple banks of six modules or less (unless otherwise specified on factory-approved specially-designed venting systems). **NO MORE THAN SIX MODULES MAY BE CONNECTED DIRECTLY WITH FACTORY-SUPPLIED HEADERS.** Several examples of typical arrangements are shown here. Recommended clearances (which are more than clearances to combustibles) allow for servicing, system installation & connections.

4. Make sure that any connecting breeching runs will not oppose or face each other, but rather, mix together in the same general direction (specifically "Y" together rather than "tee" together).







STEP 3: SETTING & ALIGNING MODULES

1. Snap a chalk line on foundation where rear of modules will be located. Modules must be spaced 21" center to center.

2. Remove cartons from modules; move with skids to a position alongside final module location. Rock module off skid into proper location on foundation - rear of burner base on the chalk line and left of burner base at the interval mark.

3. Ensure that supply and return tappings on rear of each module are spaced at 21" intervals. If more than 1/8" of vertical discrepancy exists, shim under module base to bring the supply tappings in line.

4. Level each module front-to-rear and side-to-side by shimming under base as necessary.

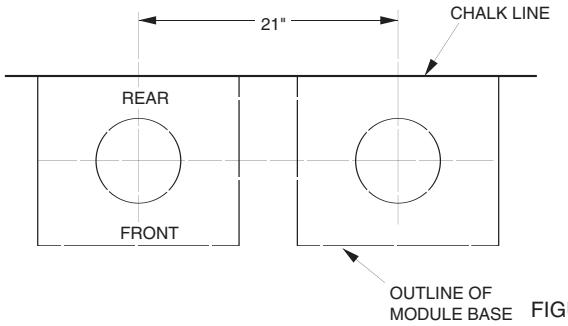


FIGURE 2.3

CAUTION: Do not loosen tie rods on module absorption unit. They accommodate thermal expansion. Loss of module's structural integrity & water leaks/damage may result.

SECTION 3: INSTALLING WATER PIPING

STEP 1: PLANNING AHEAD

IMPORTANT TO NOTE

1. Field-fabricated headers must have correct number of tappings to accept all water piping accessories; locations of tappings must be in accordance with guidelines provided in Step 4 in this section.

2. If system anti-freeze will be used, the system must be designed to accommodate the necessary changes in heat transfer, pump head, flow rate and expansion.

3. Water treatment is recommended in areas where water quality is a problem; it must be used in hard water areas and on very large volume heating systems.

FIELD-SUPPLIED COMPONENTS: Some of the following may not have been supplied by Hydrotherm, depending on how the heating plant was ordered, but are required for installation: air separator, air eliminator, expansion tank, low water cut-off, manual reset hi-limit, pressure reducing fill valve, pump(s), shut-off valves, and motorized valve (for combination space/ volume water heating). Optional: flow check valve, flow meter, strainer and backflow preventer.

FREEZE PROTECTION: Where it's absolutely necessary, system anti-freeze can be utilized, but it must be compatible with hydronic heating systems. For more information, consult The Hydronics Institute Technical Topics Number 2A publication.

NOTE: Never use an RV type anti-freeze protection solution nor an automotive type anti-freeze as damage to modules and other system components may result.

WATER TREATMENT: A local water treatment company should be consulted to determine the requirements for your particular system and locality through thorough chemical analysis of your system water.

CAUTION: Modules are not for use in systems where water is replenished. Minerals in the water can build up on heat transfer surfaces and cause overheating and subsequent failure of the cast iron sections. If piping exists where water leakage would not be visible, a water meter should be installed to record introduction of boiler feed water.

STEP 2: MC HEAT EXCHANGERS

For installation of factory-supplied MC/MCI heat exchangers, refer to Hydrotherm MC & MCI Installation Guide (MC2) packaged with the heat exchanger. All external piping must be supported by hangers, not by the boilers or their accessories.

STEP 3: SUPPLY & RETURN HEADERS

1. Whether installing factory-supplied headers or field-fabricated headers, WATER PIPING MUST BE INSTALLED TO PROVIDE REVERSE RETURN FLOW (see Figure 3.1). This piping arrangement ensures adequate flow to every heating plant module.

2. For installation of factory-supplied supply and return headers, refer to Hydrotherm Supply & Return Header Installation Guide (H2) packaged with the header sets. All external piping must be supported by hangers, not by the boilers or their accessories. **NO MORE THAN SIX MODULES MAY BE DIRECTLY CONNECTED WITH FACTORY-SUPPLIED HEADERS.**

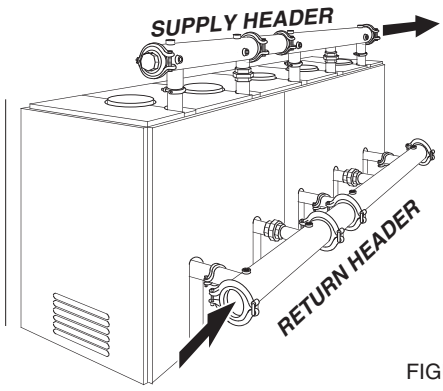
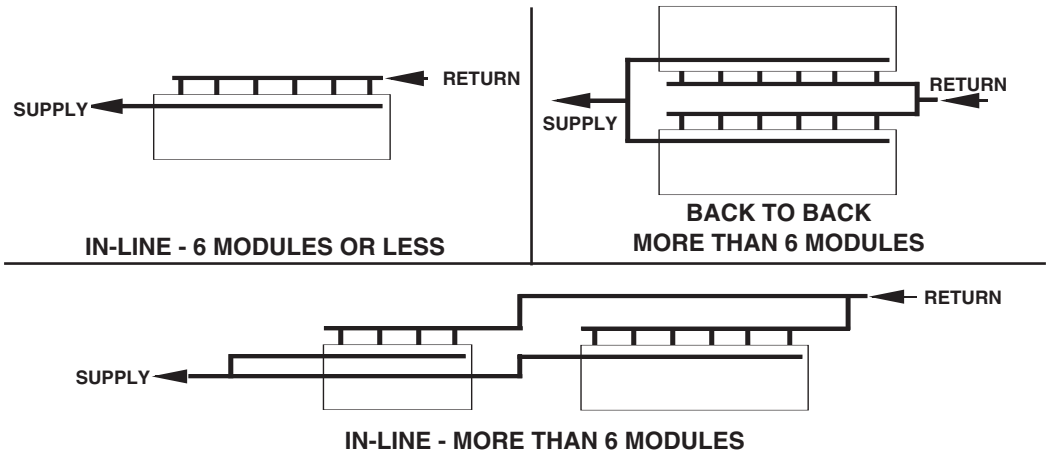


FIGURE 3.1

STEP 3: SUPPLY & RETURN HEADERS (CONTINUED)

EXAMPLES OF TYPICAL SUPPLY & RETURN WATER PIPING FOR HEADERS. NO MORE THAN SIX MODULES MAY BE DIRECTLY CONNECTED!



STEP 4: HYDRONIC COMPONENTS

The diagrams in Figures 3.4 through 3.7 show typical locations of various hydronic components required for Multi-Temp heating plants. In all cases, installation should be in accordance with component manufacturer's recommendations (literature, if applicable, is packaged with component). In addition, the following guidelines should be followed.

PRESSURE RELIEF VALVES: One supplied for each module. Install relief valves with spindle in the vertical position (i.e., valve discharge in horizontal) with coupling and nipple in 3/4" tapping at top of modules. Install field-supplied valve discharge piping (Figure 3.3).

WARNING: Never install any type of valve between the pressure relief valve and the heating plant modules! Failure to comply with this warning can result in a heating plant explosion causing extensive property damage, severe personal injury or death!

CAUTION: Piping must be installed from the relief valve discharge so there will be no danger of scalding personnel.

TEMPERATURE/PRESSURE INDICATORS: One temperature/pressure indicator supplied for each module. INSTALL AFTER ASSEMBLING JACKET.

DRAIN VALVES: One supplied for each module. Install below return connection.

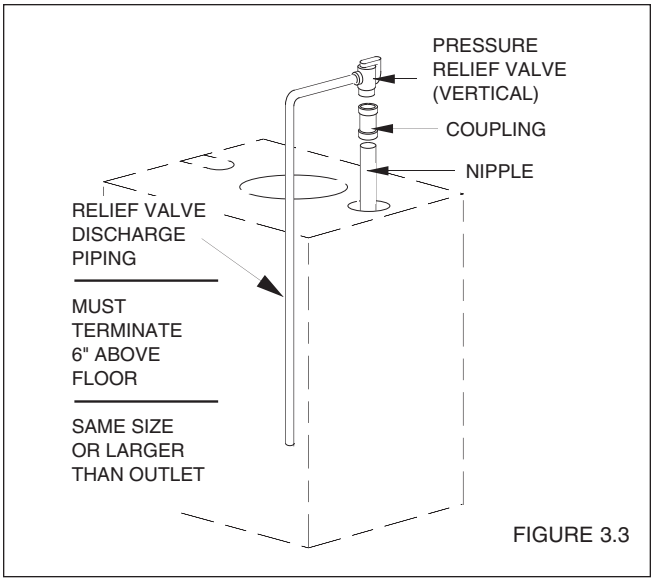


FIGURE 3.3

PRESSURE REDUCING (FILL) VALVE: Follow manufacturer's installation instructions.

AIR SEPARATOR(1): Locate in the supply line between boiler and system pump (where it will protect all modules under all operating conditions). Follow manufacturer's installation instructions.

AIR ELIMINATOR(1): Install on air separator (where it will protect all modules under all operating conditions).

(1) For heating plants providing volume water heating only (instantaneous recovery or with storage tank), see Figures 3.6 and 3.7 on page 10 for installation guidelines.

STEP 4: HYDRONIC COMPONENTS (CONTINUED)

Follow manufacturer's installation instructions.

EXPANSION TANK(1): Locate on suction side of pump (where it will protect all modules under all operating conditions). Follow manufacturer's instructions.

MANUAL RESET HI-LIMIT(1): Locate in supply piping downstream of connection of the last module.

LOW WATER CUTOFF(1): (Electronic type or float type) Locate in supply header. Follow manufacturer's installation instructions. If heating plant is to be installed above level of radiation, a low water cutoff must be installed to protect plant from dry fire.

CAUTION: To prevent accidental dry fire, do not install isolation valves between low water cutoff and the module.

CAUTION: Do not install any low water cutoff in a location where water will not freely drain away from the float or probe (i.e., in a pipe tree or loop) should a low water condition develop in the module.

For electronic probes, vertical installation (where all water can freely drain away from probe) is preferred over horizontal. Do not install in small diameter pipe nipples or bushings, as insufficient clearance to probe may result in corrosion and/or erroneous readings.

SYSTEM PUMP(1) Locate in the heating plant supply piping, downstream of the modules. Follow manufacturer's installation instructions.

NOTE: Heating plants must not be used without forced system circulation, as overheating/failure of cast iron sections may result.

MOTORIZED VALVE: Commonly used on combination space/volume water heating systems to ensure a priority for domestic hot water over space heating. (2" globe valve with motor for MC2 heat exchanger) (2-1/2" butterfly valve with motor and linkage for MC-3 heat exchangers) See Figure 3.5 for location. Follow manufacturer's instructions.

FLOW CHECK VALVE (Optional): Important to control direction of flow and prevent gravity circulation. Locate where it cannot cause isolation of any particular loop or zone from the main system. Follow manufacturer's installation instructions.

FLOW METER (Optional): Will help determine total system water volume for purposes of system water treatment, as well as aid in identification of a system leak. Follow manufacturer's installation instructions.

STRAINER (Optional): For retrofit or steam conversion systems, basket-type strainer will trap loose system scale. Locate in return water line. Follow manufacturer's installation instructions.

BACKFLOW PREVENTER (Optional): Used as a means of isolation (space heating system from main water supply) to safeguard against potential hazard of fill valve connection allowing migration of water treatment chemicals into potable water supply. Follow manufacturer's installation instructions.

OTHER COMPONENTS: Install all other waterside components such as shut-off valves, mixing valves, thermometers and supply water temperature sensors; install sensors or probes in a location that will sense supply water temperature from all modules. Follow manufacturer's installation instructions.

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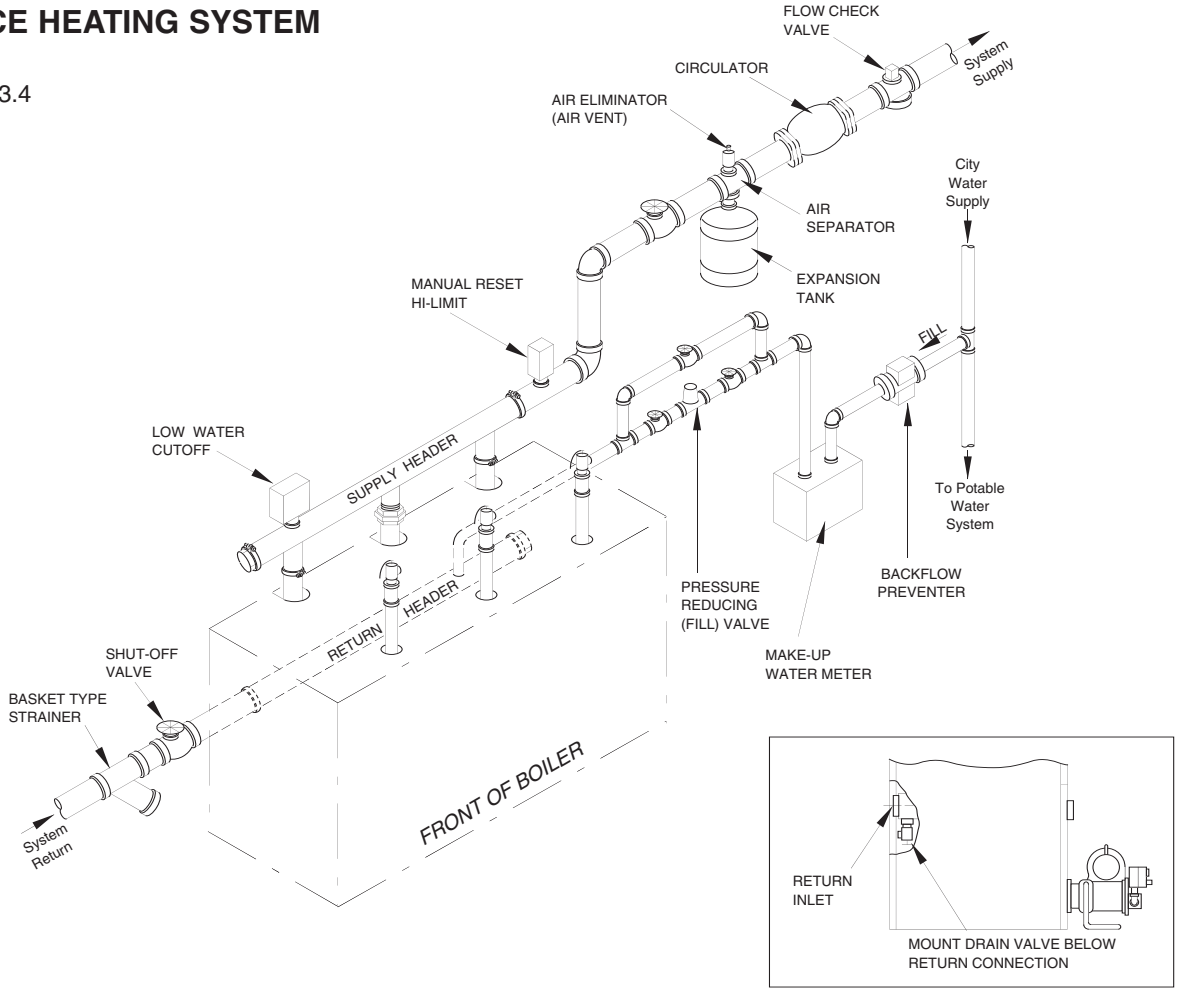
(1) For heating plants providing volume water heating only (instantaneous recovery or with storage tank), see Figures 3.6 and 3.7 on page 10 for installation guidelines.

STEP 5: HYDROTESTING THE SYSTEM

It is recommended that hydrotesting of the entire heating system be performed before installing jackets and controls or wiring the system. Fill the entire system with water and pressurize. All fittings and components should then be inspected for visible signs of leakage. If no pressure drop is detected for a two-hour period under pressure, the heating system may be considered water tight.

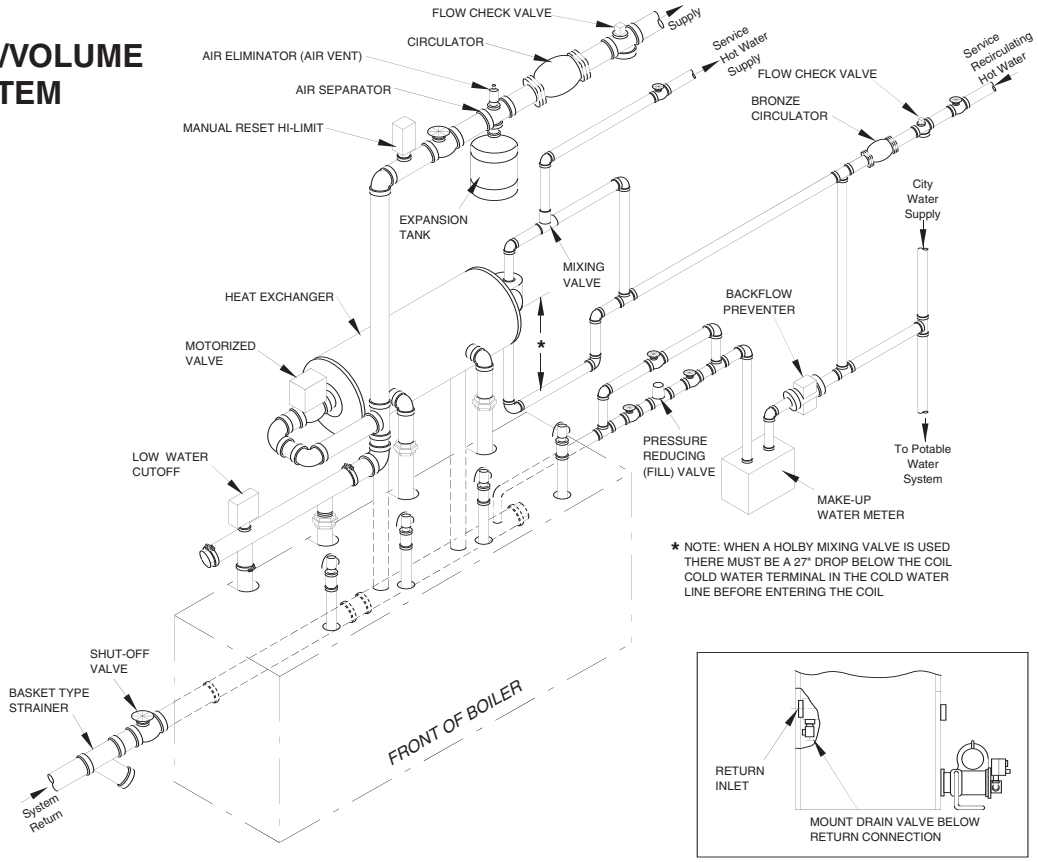
TYPICAL PIPING FOR SPACE HEATING SYSTEM

Figure 3.4



TYPICAL PIPING FOR COMBINATION SPACE/VOLUME WATER HEATING SYSTEM

Figure 3.5



TYPICAL PIPING FOR VOLUME WATER HEATING ONLY (INSTANTANEOUS RECOVERY)

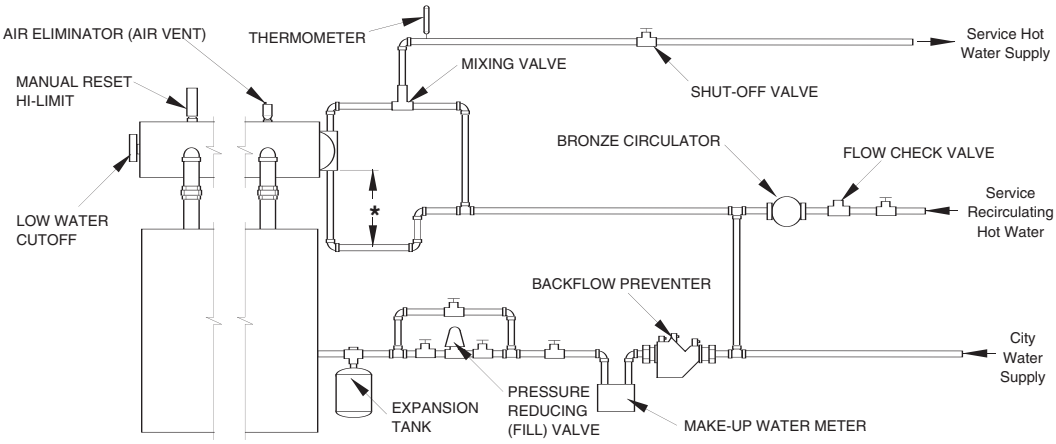


FIGURE 3.6

* NOTE: WHEN A HOLBY MIXING VALVE IS USED THERE MUST BE A 27" DROP BELOW THE COIL COLD WATER TERMINAL IN THE COLD WATER LINE BEFORE ENTERING THE COIL

TYPICAL PIPING FOR VOLUME WATER HEATING ONLY (WITH STORAGE TANK)

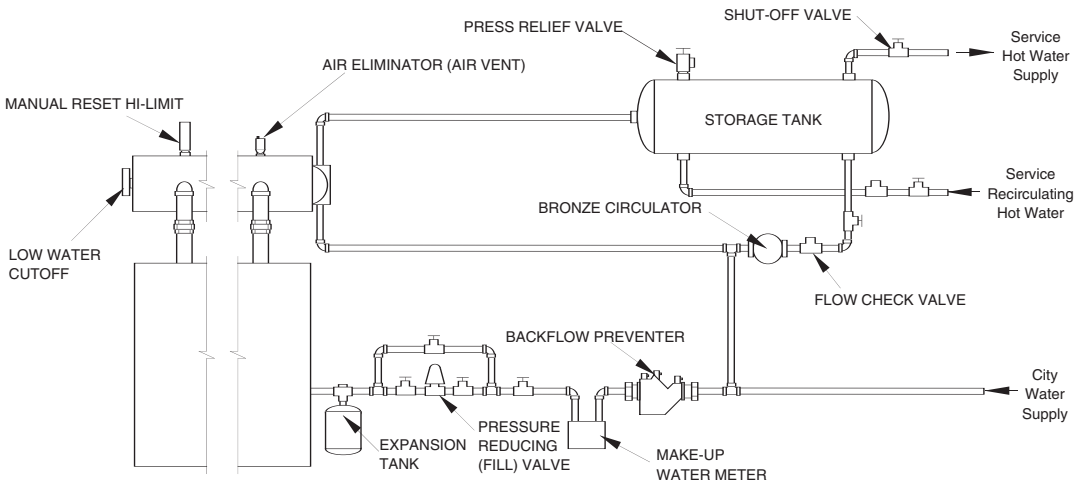


FIGURE 3.7

INSTALL MANUAL RESET HI-LIMIT, LOW WATER CUTOFF, AIR ELIMINATOR (ONE OR MORE), EXPANSION TANK AND BRONZE CIRCULATOR IN LOCATIONS SHOWN. AIR SEPARATOR NOT REQUIRED.

COMBINATION HEATING & COOLING INSTALLATIONS

If hot water module is installed in connection with water chiller, chilled water must be piped in parallel with module, using appropriate valves to prevent chilled medium from entering module. When modules are connected to heating coils in air handling units, where they may be exposed to refrigerated air circulation, module piping system shall be equipped with flow-control valves or other automatic means to prevent gravity circulation of module water during cooling

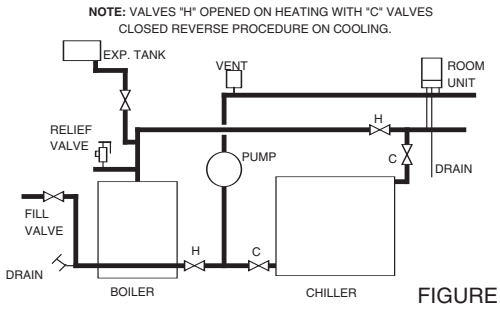


FIGURE 3.8

SECTION 4: VENTING THE HEATING PLANT

STEP 1: PLANNING AHEAD

IMPORTANT TO NOTE

1. Breaching runs must be as short as possible.

2. No more than six modules may be served by one breaching run to assure adequate draft (unless otherwise specified on factory-approved specially-designed venting systems).

3. Observe breaching construction requirements.

4. Observe proper chimney requirements.

5. Flues from other gas-burning appliances must not be connected into heating plant breaching; otherwise, inadequate draft may result.

6. Natural draft equipment (heating plants without mechanical draft components) must not be connected into any portion of a mechanical draft or power vent system operating under positive pressure, including the chimney.

7. If shop drawings with approved breaching and chimney sizes are not available, you can use the sizing guidelines recommended in Appendix A at the rear of this manual.

MULTI-TEMP HEATING PLANT VENTING SYSTEM: Consists of draft regulators (factory-supplied), vent connectors, breaching and chimney or vent pipe (see Figure 4.1). Draft regulators are installed between the modules's flue outlet and vent connector. Breaching is the horizontal manifold for connecting each module's vent connector to the chimney. Venting system components must be installed in accordance with requirements of the local authority having jurisdiction.

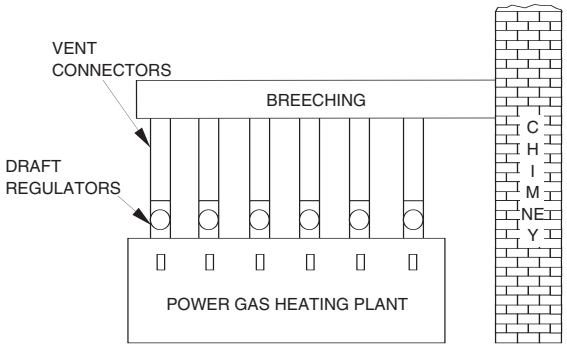


FIGURE 4.1

BREACHING CONSTRUCTION REQUIREMENTS: Round breaching is preferred to maximize flue gas flow. Rectangular breaching is the only acceptable alternative; **the larger dimension of the rectangle must be in the vertical.** Breaching should be constructed of sheet metal with smooth interior surfaces. Figure 4.2 provides minimum sheet metal gauges (adhere to local requirements for sheet metal thickness). All joints must be tight to prevent leakage, by sufficient joint overlap, rolled joints or welding.

CHIMNEY REQUIREMENTS: Lined masonry chimneys

MINIMUM SHEET METAL GAUGE FOR ROUND AND RECTANGULAR BREECHING		
ROUND	RECTANGULAR	
DIAMETER IN INCHES	GREATER DIMENSION IN INCHES	SHEET METAL GAUGE
6 TO 10	10 TO 13	24
10 TO 12	14 TO 18	22
14 TO 16	19 TO 20	20
OVER 16	OVER 20	16

FIGURE 4.2

or Type B metal vent systems, constructed in accordance with national codes, are suitable. Chimney construction materials must be compatible with the fuel being used. Chimney condition is of paramount importance for a safe and efficient installation. For existing chimneys, all installations must include a chimney inspection by a qualified individual or agency. Particular attention should be paid on oil-to-gas conversions. Soot may have accumulated in the chimney and/or degraded the chimney liner. Most utilities require the installation of a new liner, safety spill switches or other chimney upgrades. Check with the local utility for the required safety precautions.

DANGER: A chimney which does not meet modern safety standards will result in a fire or deadly carbon monoxide poising of the building residents.

MECHANICAL DRAFT REQUIREMENTS: When proper venting of the Multi-Temp heating plant cannot be accomplished by natural means, mechanical draft inducers or power venters may be used, properly sized and properly installed, following the recommendations of their manufacturers. A fan prove switch must be used in the control system and wired such that the heating plant will not fire (prevent flow of gas) until inducer or power venter fan operation is proved.

STEP 2: DRAFT REGULATORS, VENT CONNECTORS & SLIP JOINTS

DANGER: Flue outlet and draft regulator as supplied must not be altered as proper module operation would be jeopardized. Fire or carbon monoxide poisoning will result.

1. Mount each module's factory-supplied draft regulator over module flue outlet opening, with barometric draft control facing to the front.

2. Install a vent connector between each module's draft regulator and the breaching. Vent connector diameter should be the same as draft regulator; **IT MUST NEVER BE SMALLER**.

3. Where possible, vent connector height should use all available head room. Minimum vertical height of vent connector is 1-foot.

4. Vent connector should connect to breaching with a straight 90^0 connection. For improved flue gas flow, connectors may be installed with 45^0 rounded type elbow; angled toward chimney (see right diagram).

5. For ease of servicing, install a slip joint or a draw band between the draft regulator and vent connector.

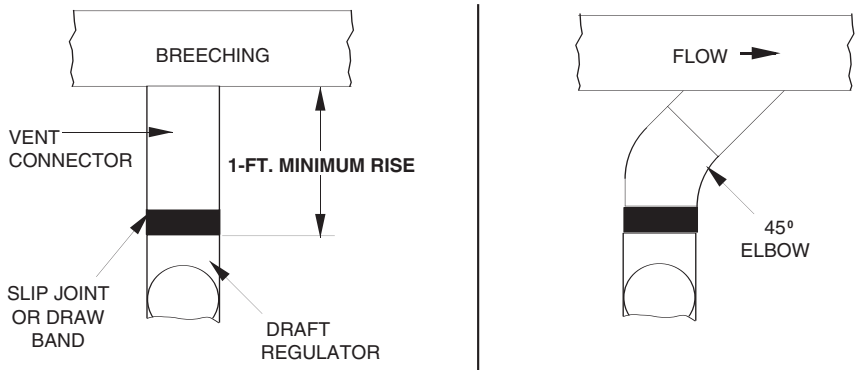
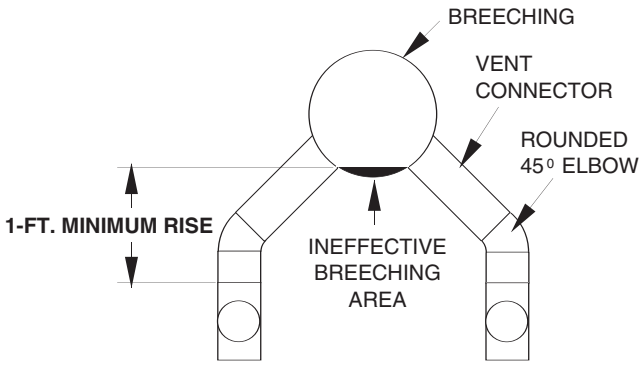


FIGURE 4.3

6. Where it may be necessary to vent two banks of boilers into a common breaching, the vent connectors must be angled at 45^{0}s and they must enter the breaching at the lowest point possible to minimize the ineffective area of the breaching. The 45^0 elbows must be the rounded type, and the 1-foot minimum height must be maintained.

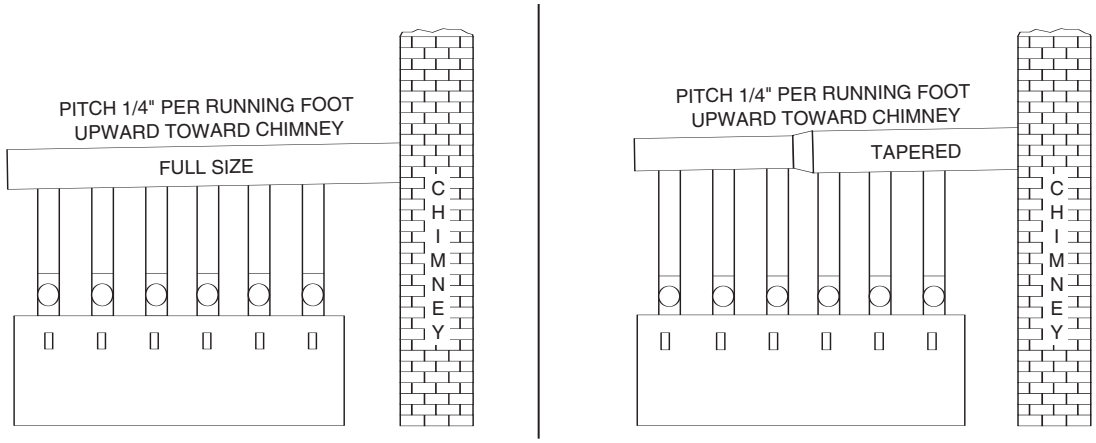
This arrangement applies for a maximum of three boilers per bank (unless otherwise specified on factory-approved specially-designed venting systems). For larger banks of boilers, use individual breaching for each bank.

FIGURE 4.4



STEP 3: BREACHING RUNS

FIGURE 4.5



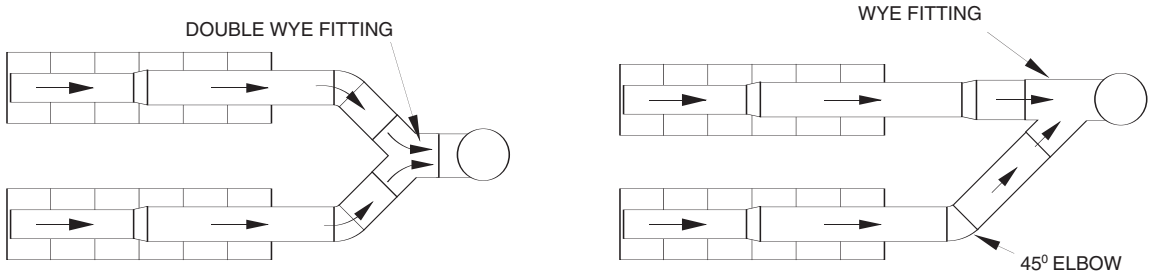
1. Breaching can be full size for an entire bank of boilers (Figure 4.5 left) or may be tapered (Figure 4.5 right), using one tapered division within a bank of six modules.

2. For tapered breaching, the smallest sized breaching division is always the furthest from the chimney with transition to the larger division leading toward the chimney (see Figure 4.5 right). All increaser fittings must be tapered to assure proper flue gas flow.

3. Remember, for rectangular breaching, the larger dimension of the rectangle must be in the vertical.

4. ALL BREACHING RUNS MUST BE PITCHED 1/4" PER FOOT OF LENGTH UPWARDS TOWARD THE CHIMNEY.

5. Where breaching runs connect into another breaching run, they must be connected so the flow-streams from each breaching run do not face or oppose each other, but rather, mix together in the same general direction (see Figure 4.6). Construction involves using Wye-fittings and rounded 45^0 elbows angled towards the chimney to assure proper flue gas flow.



PREFERRED **ACCEPTABLE**

FIGURE 4.6

6. Where two or more breaching runs connect into the same chimney, make sure the openings into the chimney do not face or oppose each other.

7. At the breaching-chimney connection, breaching must be flush with the inside of the chimney liner and sealed.

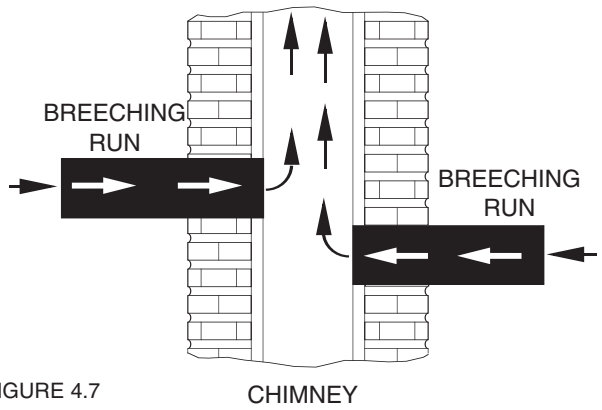


FIGURE 4.7

SECTION 5: INSTALLING JACKETS

NOTE: Remember, "A" jacket sets are for enclosing two modules and "B" jacket sets are for enclosing three modules.

1. Join upper and lower rear panels with screws provided.

2. Place front and rear panels along heating plant, and attach side panel on the right with screws provided.

3. Any number of "A" or "B" jackets may be joined together in one continuous line; just omit one side panel (left panel) in between jacket sets. Fasten front and rear panels to remaining side panel(s) with screws provided; when assembling, overlap bends as shown.

4. Install top panels starting with left top panel. Lock each panel into the preceding panel and secure with the screws provided.

5. Attach rating plate, lighting instructions label and literature pak where indicated by stencils.

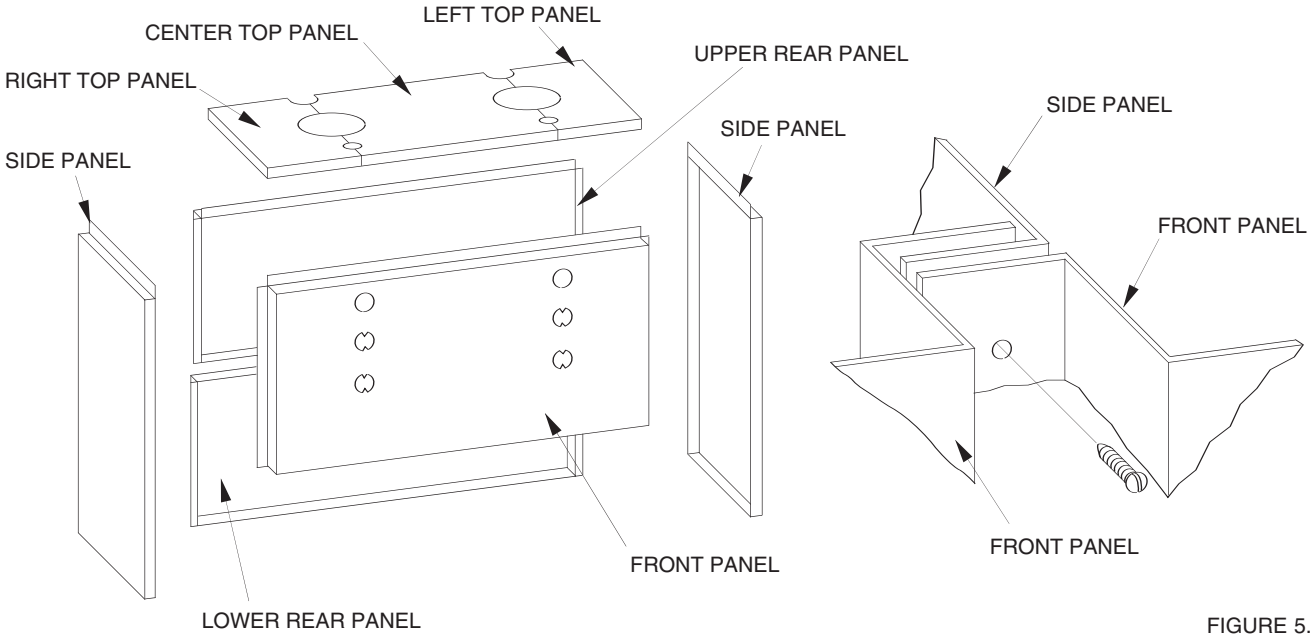


FIGURE 5.1

6. **Temperature/Pressure Indicators:** Install in top holes in front panels; one per module.

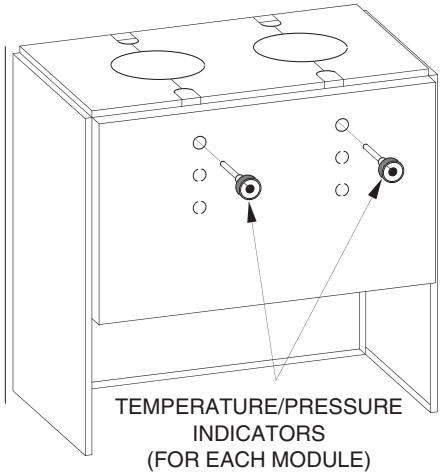


FIGURE 5.2

7. **Hi-Limits:** Install through knockouts in front panels; one per module. (Well is factory installed.)

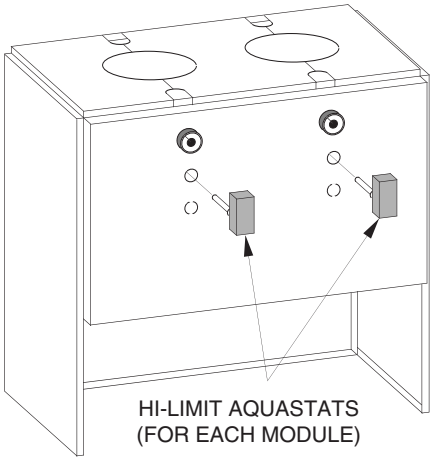


FIGURE 5.3

SECTION 6: INSTALLING BURNER

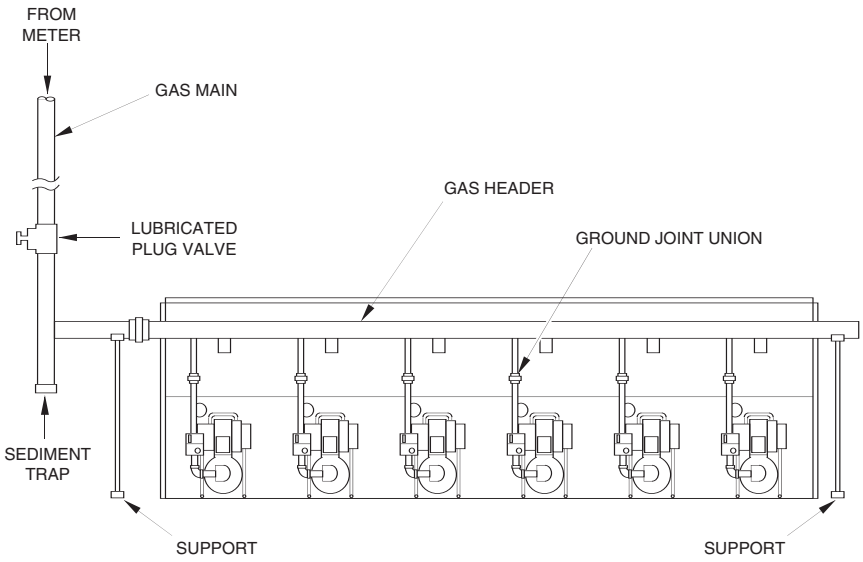
Install each module's burner, following manufacturer's installation instructions packaged with the burner.

SECTION 7: INSTALLING GAS PIPING

STEP 1: GAS MAIN & GAS HEADERS

1. Gas main and gas headers must be sized to provide a total maximum pressure drop of 0.3" W.C. (natural gas) or 0.5" W.C. (propane) between gas meter and each module's power gas burner. If shop drawings with approved pipe sizes are not available, use sizing guidelines recommended in Appendix B at the rear of this manual.

2. Gas main from meter to gas headers must have a non-restrictive lubricated plug valve close to the modules as well as a full-sized sediment trap at the low point in the gas main. Use a vertical rise sediment trap that is a minimum of three times the gas main pipe diameter.



3. The gas header is the manifold to which each module's burner is connected; the connection at each burner inlet requires a ground joint union. If total equivalent pipe length, straight pipe plus fittings, from burner inlet to header is 5-ft or less, use a pipe diameter that matches burner inlet; over 5-ft, calculate diameter.

4. All piping must be supported with floor supports or by hangers, not by boilers or accessories. Always follow good piping practices. Pipe joint compound must be compatible with gas being used. Check local codes and utilities for any special requirements.

STEP 2: TEST GAS PIPING

DANGER: Before placing gas piping into service, carefully test it to assure every joint is gas tight. Bubble test all joints with a soap solution. NEVER TEST WITH AN OPEN FLAME AS FIRE OR EXPLOSION WILL RESULT.

For any pressure testing in excess of 1/2 psi, the module and its individual shutoff valve must be isolated from the piping system by disconnecting them and capping the outlet(s). For any pressure testing equal to or less than 1/2 psi, module must be isolated from the piping system by closing its manual shutoff valve.

Minimum pressure required at the gas burner inlet is 5" W.C. (natural gas) and 11" W.C. (propane). Maximum pressure allowable at the burner inlet is 14" W.C. If the gas pressure is above these limits, a pressure regulator must be installed. If the gas pressure is below these limits, contact the local utility.

WHEN TESTING IS COMPLETED, CLOSE MAIN GAS SHUT-OFF VALVE & SET POWER GAS BURNERS IN "OFF" POSITION

SECTION 8: WIRING THE HEATING PLANT

DANGER: Turn off electrical power supply before servicing. Contact with live electric components can cause shock or death.

CAUTION: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

If shop drawings with approved control selection and wiring diagrams are not available, you can use the control and wiring guidelines recommended in Appendix C at the rear of this manual.

All electrical wiring must be in accordance with requirements of the authority having jurisdiction or, in absence of such requirements, with National Electrical Code NFPA-70-latest edition. If an external electrical source is utilized, module must be electrically grounded in accordance with requirements of the authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code NFPA-70-latest edition. UL listed power limited circuit cable is almost universally approved for safety controls on heating equipment, either internally or externally, without protection of conduits or raceway.

For Canada, installations must be in accordance with Standard C.S.A. C22.1 Canadian Electrical Code, Part 1 and Part 2, and/or local codes.

Safety devices (such as low water cut-offs and manual reset high limits) must be wired so they shut down all modules protected by those devices. Switch ratings on safety or control devices must not be exceeded; this may require the use of relays for larger heating plants.

Air and water temperature sensor wiring must not be run in the same conduit as power wiring; use shielded wiring in runs over 25 feet long.

NOTE: If any of the original wire supplied with module must be replaced, use similar wire of 105 C rating. Otherwise, insulation may melt or degrade, exposing bare wire.

NOTE: Module transformers must not be used to power external accessories (i.e. zone valves, relays, etc.). Otherwise, transformers will be overloaded and burn out.

POWER REQUIREMENTS PER MODULE
3 amps, 115v/60Hz

SECTION 9: HEATING PLANT START-UP

STEP 1: PLANNING AHEAD

1. Check flow direction arrows imprinted on water system components are pointing in the proper direction.

2. If system was not previously hydrotested, fill system. Check all temperature/pressure indicators to assure there is at least the desired cold fill pressure in the system.

3. Check all fittings and components for visible signs of leakage, including each module's (and header's) supply and return water connections.

4. Check that system pump(s) are interlocked with the heating plant's operating controls so modules cannot fire without pump(s) running.

STEP 2: START-UP & ADJUSTMENTS

DANGER: To avoid fire or explosion hazards: Do not store anything against modules or allow dirt or debris to accumulate in area immediately surrounding modules. Keep heating plant area clear and free from combustible materials, gasoline and other flammable vapors and liquids. Lint, paper or rags must not be allowed to accumulate near burners. Do not place clothing on module casings to dry.

NOTE:Do not draw water from heating system for cleaning. Minerals in the water can build up on heat transfer surface and cause overheating and subsequent failure of the cast iron sections.

1. Thoroughly purge system following standard purging practices. Remember, every loop in the system must be properly purged.

2. Check air elimination equipment for proper operation to be certain there is no air in the water system.

3. With main gas valve OFF, turn on power to modules. Open all zones individually; let system pump(s) run until all air is purged from each zone (sound of air bubbles flowing in piping has been eliminated).

4. Then operate system pump(s) with all zones open; continue for the minimum time required to pass entire system volume through separation point until sound of air bubbles flowing in piping has been eliminated.

5. Open main gas valve, allowing gas to flow through gas piping system. Open each burner's gas inlet.

6. Set operating control(s) to call for heat and follow start-up instructions packaged with burners.

7. Allow system water temperature to rise slowly to about 30° F above fill temperature; shut down modules but allow system pump(s) to run continuously. When all sounds of air bubbles are eliminated, increase system temperature another 30° F. Repeat procedure until maximum system design temperature is reached.

8. Start and stop burners several times by raising and lowering the controls settings.

9. Check all safety and operating controls to be sure they are operating in accordance with manufacturer's recommendations.

a. Hi-Limit Aquastat: Mounted on each module, it cuts off gas supply to the module when module wa-ter temperature exceeds setting. Check high limit is set at 220° F. To verify aquastat operation, with a small screwdriver, reduce high limit setting to 100° F. Fire module until water temperature reaches or exceeds 100° F, at which time the burner should shut off. If for any reason burner does not shut off, or allows the water temperature to exceed 120° F, replace aquastat. If no replacement is necessary, return setting to 220° F.

b. Manual Reset High Limit: Mounted in supply header, it shuts off all module burners if system operating water temperature exceeds setting. Check that setting is 250° F. To verify operation, with a small screwdriver, reduce setting while heating plant is firing. All module burners should shut off, as operating water temperature exceeds the reduced setting. If module burners do not shut off, check high limit electrical wiring. If O.K., replace high limit.

c. Check that low water cutoff(s) actually shut down heating plant as intended.

10. Before leaving the job, make sure heating plant installation has been inspected and approved by local authorities having jurisdiction over the installation.

APPENDIX A: BREECHING/CHIMNEY SIZING

DRAFT REQUIREMENT: For MG heating plants, the chimney-breeching system should produce -06" to -08" W.C. (as measured with draft gauge) in vent connector and -01" to -03" W.C. in combustion chamber.

BREECHING LENGTH

Maximum breeching length (from the furthest module to the chimney) for each bank of boilers is limited by the chimney height. As a general rule, maximum breeching length should not exceed 75% of chimney height; this can be superseded by specially engineered venting systems. For power gas heating plants, chimney height is measured from base on which the module sits. Therefore, it is important to locate the heating plant as close to the chimney as possible. To minimize breeching length and corresponding chimney height requirement only 6" required between chimney and first module.

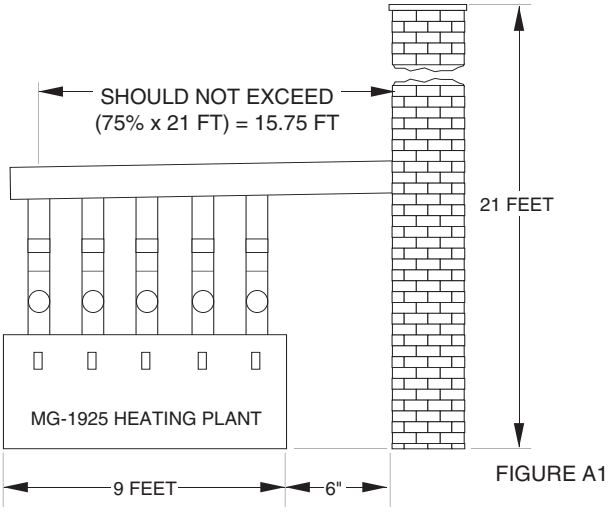


FIGURE A1

Example: Let's assume a MG-1925A heating plant has been specified and the chimney height is limited to 21-feet due to building constraints (see Figure A1). The breeching length for the heating plant should not exceed 15.75 feet. Using the chart in Figure A2, an MG-1925A heating plant requires approximately 9-feet in length plus a 6" minimum clearance between the first module and the chimney; thus, breeching length is compatible with the allowable chimney height.

Breeching Length Formula: For your installation.

1. _____ ft. x 75% = _____ft.
   (Chimney Ht.) (Max. Breech Lg.)

2. _____ft. + _____ft. = _____ft.
   (Plant Lg.) (From 1st Mod To Chimney) (Req. Breech Lg.)

3. If required length is equal to or less than maximum length, application is O.K. If required length exceeds maximum length, then you would have to consider appropriately dividing the heating plant or bank of boilers.

Boiler Model	No. of Modules	Length	Breeching Sizing (Minimum) Circular Dia. In. I.D.	Rectangular Sq. In. I.D.
MG-770	2	3' 7"	10	86
MG-1155	3	5' 4"	12	124
MG-1540	4	7' 1"	13	146
MG-1925	5	8' 10"	14	169
MG-2310	6	10' 7"	15	194

FIGURE A2

BREECHING DIAMETER

1. Determine if one full size breeching, which is preferred, or a tapered transition to a smaller diameter will be used in the breeching run to serve the particular heating plant or bank of boilers.

2. Determine the number of vent connectors being accommodated by each section of the breeching (one vent connector per module).

3. Treating each section separately, determine the correct breeching size from sizing table in Figure A2. (Size is based on heating plant operating at sea level; first module 6" from chimney; breeching full size and insulated from top of draft regulator to chimney entrance; and 1-ft minimum vent connector height. The recommendations in Figure A3 are not to be used for any other configuration; for non-standard configurations, consult Hydrotherm factory directly.)

Example: Let's assume a MG-2310A heating plant.

1. Breeching will be circular with a tapered transition, identified as Section A and Section B (see Figure A3).

2. The number of vent connectors feeding into Section A is 6 (all of the vent connectors in the heating plant). The number of vent connectors feeding into Section B is 3.

3. For Section A size, under the heading "No. of Modules" in Figure A2, go down to 6 and read across to the column, "Breeching Sizing," where you'll find that Section A

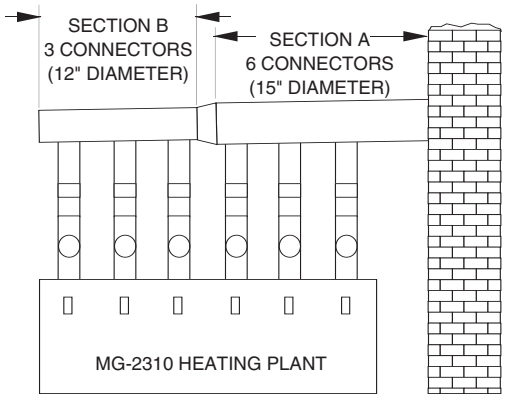


FIGURE A3

must be 15" in diameter. For Section B size, go down to 3 modules, where you'll find that Section B must be 12" in diameter. Where the two breeching sections are connected, a 12" to 15" tapered increaser must be used.

Rectangular Breeching: Where necessary to use rectangular instead of circular breeching, the larger dimension of the rectangle must be in the vertical, as shown in Figure A4, MG-2310A heating plant example. For the breeching division sizes from Figure A2, Section A is 194 square inches and Section B is 124 square inches. Size of the rectangles will be about 15" high by 13" wide for Section A and 12" high by 11" wide for Section B.

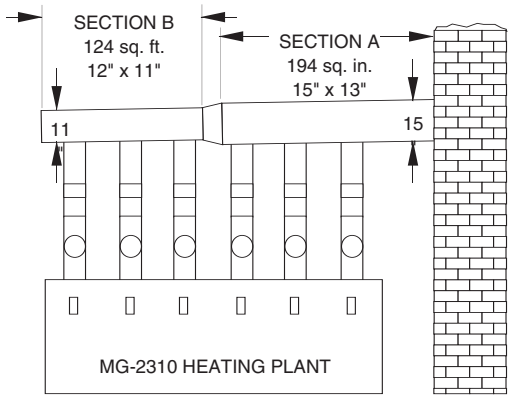


FIGURE A4

CHIMNEY SIZING

As a reminder, if the existing chimney will be used for the new heating plant, it cannot be assumed that chimney size is adequate. Chimney size must be based on the chimney's capacity, which involves several factors, the first of which is the chimney's capability to handle the heating plant Btuh input capacity that is to be vented into it. For example, a six-module MG-2310A heating plant has a Btuh input of 2,382,000; therefore, the chimney must be sized to handle a minimum of 2,382,000 Btuh. However, if the installation has two MG-2310A heating plants vented into the same chimney, then the chimney capacity must be 4,764,000 Btuh input.

Chimney capacity is directly related to what's connected to it - the chimney does not function on its own, but operates in conjunction with the breeching and equipment

CHIMNEY SIZING (MINIMUM)		
Boiler Model	Circular Dia. x Ht. (In. x Ft.)	Rectangular Linear x Ht. (In. x In. x Ft.)
MG-770	14 x 22	13 x 18 x 22
MG-1155	16 x 23	18 x 18 x 23
MG-1540	18 x 25	20 x 20 x 25
MG-1925	20 x 25	20 x 24 x 25
MG-2310	22 x 25	24 x 24 x 25

FIGURE A5

connected to it. Another important factor is draft loss; equipment and breeching must be located as close as possible to chimney to minimize draft loss. Equipment located further away from the chimney will have greater draft loss, necessitating a chimney with a greater capacity to accommodate the greater draft loss.

Chimney capacity also varies with its height and inside diameter. The higher the chimney, the greater its capacity; the larger the inside diameter, the greater its capacity. Any two different size chimneys can have equal ca-pacity; that is, a short chimney with a larger inside diameter can have the same capacity as a higher chimney with a smaller inside diameter.

Chimney height determines the total draft which can be developed and is generally governed by the building height/design and boiler room location. Chimney inside diameter determines the restriction to flow with the larger diameter having less restriction. Generally, the inside diameter should never be smaller than the diameter of the breeching connecting into it.

Figure A5 shows minimum chimney sizes for Multi-Temp power gas heating plants. (Sizes based on first module located 6" from chimney and proper breeching size, as determined from Appendix A. If first module is located more than 6" from chimney or breeching is non-standard configuration, then proper chimney height and diameter, for a specific heating plant Btuh input capacity & breeching, can be determined from ASHRAE guidelines.)

APPENDIX B: GAS PIPE SIZING

For accurate gas pipe sizing, be sure to use total equivalent pipe length: Add the equivalent foot-length of all fittings, such as elbows, tees and valves, used in the gas pipe run to the straight length of pipe. This can be determined from National Fuel Gas Code tables. For the initial determination only, add 20% for the fittings to the straight length of piping to get a total equivalent length. However, once a diameter has been selected, total equivalent length must be verified.

You need to know:

1. Total Btuh input of all modules in the heating plant.

2. Heating value, Btu per cubic foot, of the natural gas which can be obtained from the local gas utility.

3. Total equivalent lengths of the gas main and the gas headers which must be sized separately.

Tables B1 and B2 are pipe sizing tables for natural gas and propane gas piping. They apply for sizing black iron pipe only and are based on total equivalent pipe length and maximum capacity of the pipe, in cubic feet of gas per hour for natural gas or in thousands of Btu per hour for propane. Natural gas sizing table assumes a 1000 Btu/cu.ft. heating value for natural gas.

Gas Headers (Natural Gas)
1. Determine cubic feet of gas per hour for each bank of modules, using the following formula:

$$\frac{\text{Module Bank Btuh Input}}{\text{NG Heating Value}} = \text{Cubic Feet Per Hour}$$

2. Determine length of the header, which is typically dependent on length of the bank of modules which it serves. Use the “Length” column in Figure A2. In most cases, the header is straight pipe only.

3. In Table B1, find appropriate pipe length in upper portion of table under "Length of Pipe, Feet" heading.

4. Move down the column; match the cubic feet per hour from Step 1. Higher capacity selection is acceptable.

5. Move across to the left-hand column "Nominal Iron Pipe Size, Inches" and read required pipe size.

Gas Main (Natural Gas)
1. Determine the cubic feet of gas per hour for the total heating plant, using the following formula:

$$\frac{\text{Heating Plant Btuh Input}}{\text{NG Heating Value}} = \text{Cubic Feet Per Hour}$$

2. Determine total equivalent length of gas main. Remember, if exact number/type of fittings are not known, for initial determination only, add 20% for fittings to the straight length of piping to get a total equivalent length.

3. In Table B1, find appropriate pipe length in upper portion of table under "Length of Pipe, Feet" heading.

4. Move down the column; match the cubic feet per hour from Step 1. Higher capacity selection is acceptable.

5. Move across to the left-hand column "Nominal Iron Pipe Size, Inches" and read required pipe size.

6. Once a diameter has been selected, verify the total equivalent length.

TABLE B1

Maximum Capacity of Pipe in Cubic Feet of Natural Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.3 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4"	.326	32	22	18	15	14	12	11	11	10	9	8	8	7	6
3/8"	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
1/2"	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
3/4"	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1"	1.049	520	350	285	245	215	195	180	170	160	150	130	120	110	100
1-1/4"	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1-1/2"	1.610	1,600	1,100	890	760	670	600	560	530	490	460	410	380	350	320
2"	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,500	990	930	870	780	710	650	610
2-1/2"	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3"	3.026	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,600	2,500	2,200	2,000	1,850	1,700
4"	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

TABLE B2

Maximum Capacity of Pipe in Thousands of Btu per Hour of Undiluted Liquified Petroleum Gases (at 11 Inches Water Column Inlet Pressure)

(Based on a Pressure Drop of 0.5 Inch Water Column)

Nominal Iron Pipe Size, Inches	Length of Pipe, Feet											
	10	20	30	40	50	60	70	80	90	100	125	150
1/2"	275	189	152	129	114	103	96	89	83	78	69	63
3/4"	567	393	315	267	237	217	196	185	173	162	146	132
1"	1071	732	590	504	448	409	378	346	322	307	275	252
1-1/4"	2205	1496	1212	1039	937	834	771	724	677	630	567	511
1-1/2"	3307	2299	1858	1559	1417	1275	1180	1086	1023	967	866	787
2"	6221	4331	3465	2992	2646	2394	2205	2047	1921	1811	1606	1498

Gas Headers (Propane)

1. Determine Btuh input for each bank of modules.

2. Determine the length of the header, which is typically dependent on the length of the bank of modules which it serves.Use the “Length” column in Figure A2. In most cases, the header is straight pipe only.

3. In Figure B2, find appropriate pipe length in upper portion of table under "Length of Pipe, Feet" heading.

4. Move down the column; match the Btuh input from Step 1. Higher capacity selection is acceptable.

5. Move across to the left-hand column "Nominal Iron Pipe Size, Inches" and read required pipe size.

Gas Main (Propane)

1. Determine Btuh input for the total heating plant.

2. Determine total equivalent length of gas main. Remember, if exact number/type of fittings are not known, for initial determination only, add 20% for fittings to the straight length of piping to get a total equivalent length.

3. In Figure B2, find appropriate pipe length in upper portion of table under "Length of Pipe, Feet" heading.

4. Move down the column; match the Btuh input from Step 1. Higher capacity selection is acceptable.

5. Move across to the left-hand column "Nominal Iron Pipe Size, Inches" and read required pipe size.

6. Once a diameter has been selected, verify the total equivalent length.

APPENDIX C: CONTROL GUIDELINES

CONTROL SYSTEM METHODS

The objective of Multi-Temp control systems is to relate fuel input to actual heating load by automatic step-firing, which means that more or fewer modules are operated in response to automatic controls. Step-firing can be accomplished in many different ways to suit system type & size. Hydrotherm has developed three basic control levels which meet most operating methods encountered.

Level I Control-Constant Supply Water Temperature: Multiple aquastats in return or supply header with settings spaced at small, equal increments provide low cost step-firing control for small heating plants (2-5 modules) which operate with constant supply water temperature (fan coil systems, etc.). From a cold start, all modules fire and "step out" as individual aquastats are satisfied.

Level II Control-Supply/Outdoor Reset Water Temperature (System J): Electronic, plug-in, modular control system designed to raise or lower the temperature of the supply water based on a proportional rise or drop in the temperature at the outside sensor by stage firing of the modular boiler heating plant. This is an effective, low cost control system for small to medium heating plants (2-6 modules) where it is desired to modulate supply water temperature in relation to the outdoor temperature such as in baseboard convector systems.

Level III Control-Outdoor Reset Supply Water Temperature: Especially designed for large heating plants, the Hydrotherm Model S Electronic Outdoor Reset Step Control provides stable, sequential firing of modules in up to 8 steps and are applicable for systems operating with constant or modulated supply tempera-

BASIC CONTROL RECOMMENDATIONS	SPACE HEATING							COMBINATION SPACE/WATER HEATING												
	Modules							Heat Exchangers and Modules												
								MC-2							MC-3					
	2	3	4	5	6	7	8	2	3	4	5	6	7	8	3	4	5	6	7	8
CONTROL LEVEL I																				
Dual Aquastat (L4081A)	1	1	2					1	1	2					1	1				
Single Aquastat (L4006A)	—	1	—					—	1	—					1	2				
Air Therm. (T6013A)	1	1	1					1	1	1					1	1				
L.W. Cutoff (#746 or RW700A)	1	1	1					1	1	1					1	1				
Manual Reset Hi-Limit (L4006A)	1	1	1					1	1	1					1	1				
Reverse Aquastat (L4006B)								1	1	1					1	1				
CONTROL LEVEL II (System J)																				
AR Reset Module	1	1	1	1	1			—	1	1	1	1			—	1	1	1		
Y Transformer Module	1	1	1	1	1			—	1	1	1	1			—	1	1	1		
S Stage Module	1	2	3	4	5			—	1	2	3	4			—	1	2	3		
AA Winter/Summer Circulator Starter	1	1	1	1	1			—	1	1	1	1			—	1	1	1		
L.W. Cutoff (#746 or RW700A)	1	1	1	1	1			—	2	2	2	2			—	2	2	2		
Manual Reset Hi-Limit (L4006E)	1	1	1	1	1			—	2	2	2	2			—	2	2	2		
SPDT Aquastat (L6006A)								—	1	1	1	1			—	1	1	1		
Dual Aquastat (L4081A)								—	1	1	1	1			—	1	1	1		
Single Aquastat (L4006A)															—	1	1	1		
2" Motorized Valve (V5045/2045)								—	1	1	1	1								
2-1/2" Motorized Valve (V51B/Q100A)															—	1	1	1		
D Temperature Display Module (Opt.)	1	1	1	1	1			—	1	1	1	1			—	1	1	1		
CLK Night Set-Back Prog. Clock (Opt.)	1	1	1	1	1			—	1	1	1	1			—	1	1	1		
CONTROL LEVEL III																				
Model S Step Control (Hydrotherm)	1	1	1	1	1	1	1	—	1	1	1	1	1	1	—	1	1	1	1	1
L.W. Cutoff (#746 or RW700A)	1	1	1	1	1	1	1	—	1	1	1	1	1	1	—	1	1	1	1	1
Manual Reset Hi-Limit (L4006E)	1	1	1	1	1	1	1	—	1	1	1	1	1	1	—	1	1	1	1	1
SPDT Aquastat (L6006A)								—	1	1	1	1	1	1	—	1	1	1	1	1
Dual Aquastat (L4081A)								—	1	1	1	1	1	1	—	1	1	1	1	1
Single Aquastat (L4006A)															—	1	1	1	1	1
2" Motorized Valve (V5045/2045)								—	1	1	1	1	1	1						
2-1/2" Motorized Valve (V51B/Q100A)															—	1	1	1	1	1

tures. Level III control system includes the Model S step control and an outdoor thermostat. As outdoor temperature drops below a present point, the Model S step control is energized and operates the modules to maintain the desired supply water temperatures.

CONTROL FUNCTIONS & DESCRIPTIONS

Intermittent Ignition Control: Provides ignition sequence, flame monitoring and safety shutoff for intermittent pilot.

Transformer: One per module is factory supplied. It's the power source for the control circuit and cannot be used as a power source for other controls.

Hi-Limit Aquastat: One per module is factory-supplied (well is factory-assembled on each module). Is a hi-limit temperature safety control only; it must not be used as an operating control. For mounting, see Section 5 in this manual.

Manual Reset Hi-Limit: Safety control used to shut off all boilers if system temperature exceeds the setting, usually 250° F. Must be reset manually by pushing red button in cover. Locate in supply piping downstream of connection of the last module, as previously discussed in Section 3 in this manual.

Low-Water CutOff: Electronic type or float type. Used to shut off boilers if water level should fall below its sensor location. Locate in supply header, as previously discussed in Section 3 in this manual.

Immersion Aquastats: Single and dual aquastats are used to open a control circuit in response to increasing water temperature. May be used in multiples to provide step firing in response to either supply or return water temperature. Dual aquastat, controlled through one temperature sensor probe, has two individually adjustable temperature actuated switches; single aquastat has one adjustable switch. Locate in return header; return water temperature is preferred method for controlling system.

Outdoor Air Thermostat: Switching device used to turn on system or system components at a desired outdoor temperature. Is also used as a heat starter to automatically switch on system power to start heating plant. It is generally set at an outdoor temperature of 65° F, has a 20-ft capillary tube with remote liquid filled bulb & comes with sunshield for mounting on a north wall where sun's effects are minimized; control box can be mounted anywhere within the length of the capillary tube.

System J: The basic control system consists of an "AR" reset module which accepts add-on "AA" winter/summer circulator starter, "Y" transformer module, and "S" staging modules. Optional add-on modules include "D" temperature display module and "CLK" night set-back programmable clock. Five pin connectors between modules speed installation time and eliminate potential wiring errors. The modules can be mounted on any wall surface or an optional DIN rail.

Motorized Valves: Commonly used on combination space and service water heating applications. Externally powered from a 24-volt source and controlled by a single-pole double-throw switching device, for fully open or closed positions. Typical application is to interrupt water flow to the space heating section of the heating plant whenever service water heating is in jeopardy, resulting in a priority for service water heating; this is accomplished by installing an aquastat in the heat exchanger shell, wired to the motorized valve control circuit so it will close off boiler water flow to space heating when the heat exchanger shell temperature falls below the aquastat setting. For mounting of motorized valve, see Section 3 in this manual.

Electronic Outdoor Reset Step Control: (Hydrotherm Model S Control) Designed specifically to reset system supply water temperature in relation to outdoor temperature for large heating plants by step-firing the required number of boiler modules for the desired system supply temperature. Consists of all solid state components:

1. Control box for mounting in boiler room includes microprocessor, L.E.D. indicating lights, and supply and air temperature digital read out.

2. Outdoor temperature sensor & sunshield for mounting on a north wall, and supply water temperature sensor for mounting in supply header (no capillaries; both wired electronically).

Optional equipment includes night set-back and time/cycle monitor. Follow installation instructions packaged with controls.

WIRING DIAGRAM EXAMPLES

This manual provides several examples of heating plant control method applications for your use. For additional information, contact your local Hydrotherm sales representative or the Hydrotherm factory directly.

Space Heating Only Applications: Level I Control, Figure C2; Level II Control, Figure C3; Level III Control, Figure C4.

Space & Volume Water Heating Applications With MC Heat Exchanger: Level I Control, Figure C5; Level II Control, Figure C6; Level III Control, Figure C7.

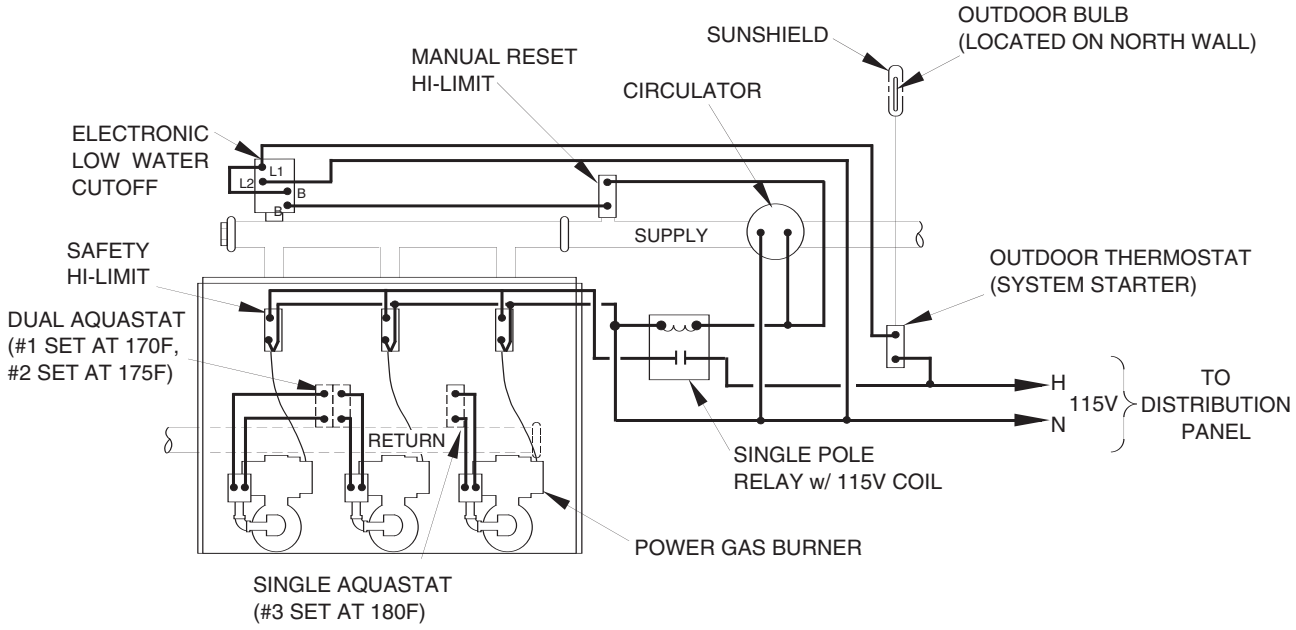


FIGURE C2: EXAMPLE OF LEVEL I CONTROL FOR SPACE HEATING ONLY

When outdoor temperature falls below setting of outdoor thermostat, the system is energized and circulator is turned on. All modules will fire until temperature in return header reaches setting of modulating aquastats. Aquastats will then shut off modules until a point is reached where modules still firing are just able to satisfy heat load. Example (3-module system), as return temperature rises, dual aquastat "steps-out" module #1 (i.e. at 170F), then module #2 (i.e., at 175F). Single aquastat "steps out" module #3 at maximum return temperature (i.e., at 180F).

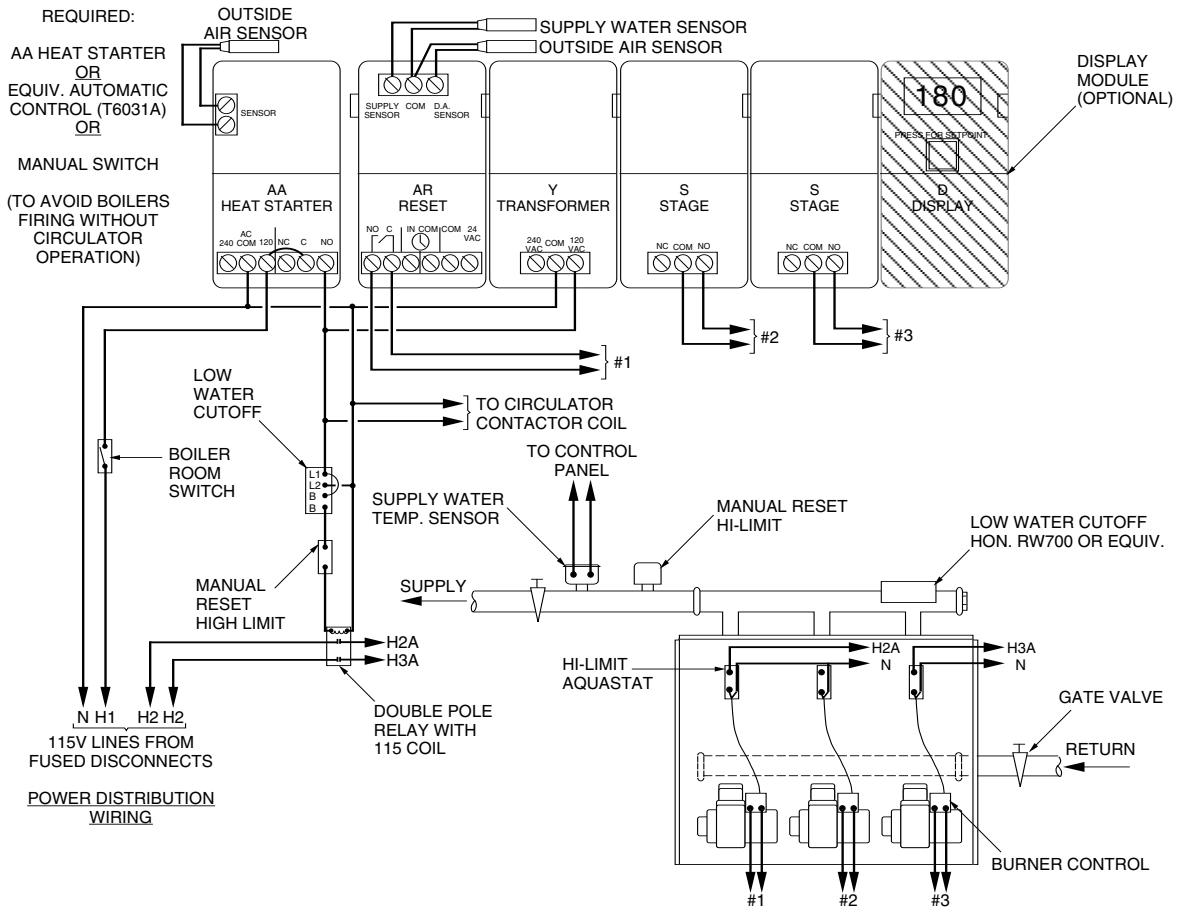


FIGURE C3: EXAMPLE OF LEVEL II CONTROL FOR SPACE HEATING ONLY

When outdoor temperature falls below setting of outdoor thermostat, the distribution panel is energized and circulator is turned on. Reset module regulates supply water temperature in relation to outdoor temperature. Individual stage modules turn on more modules as the outdoor temperature falls below their settings.

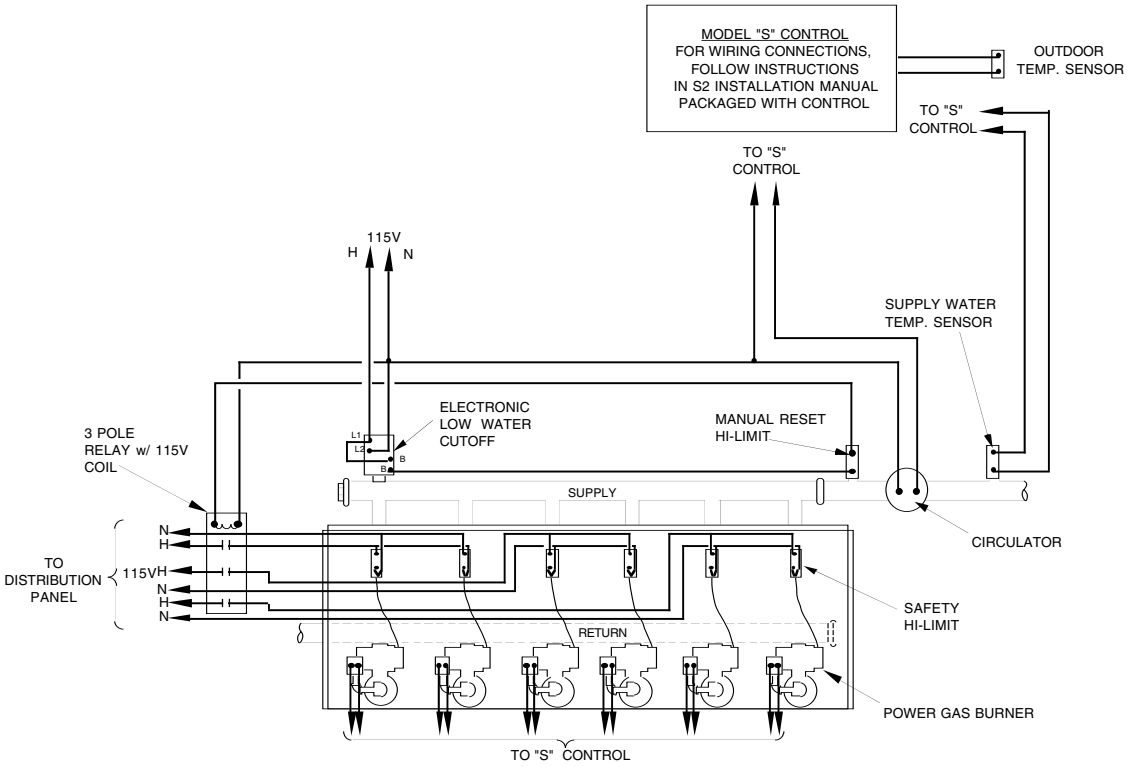


FIGURE C4: EXAMPLE OF LEVEL III CONTROL WITH MODEL "S" CONTROL FOR SPACE HEATING ONLY

When outdoor temperature falls below setting of outdoor temperature sensor, the circulator and Model "S" control circuits are energized. The Model "S" control will begin to fire boiler modules until sufficient temperature is present at the supply water temperature sensor to meet the demands of the Model "S" control. As the outdoor air temperature (as detected by the outdoor temperature sensor) decreases, the Model "S" control again causes modules to fire, until a higher supply water temperature is reached.

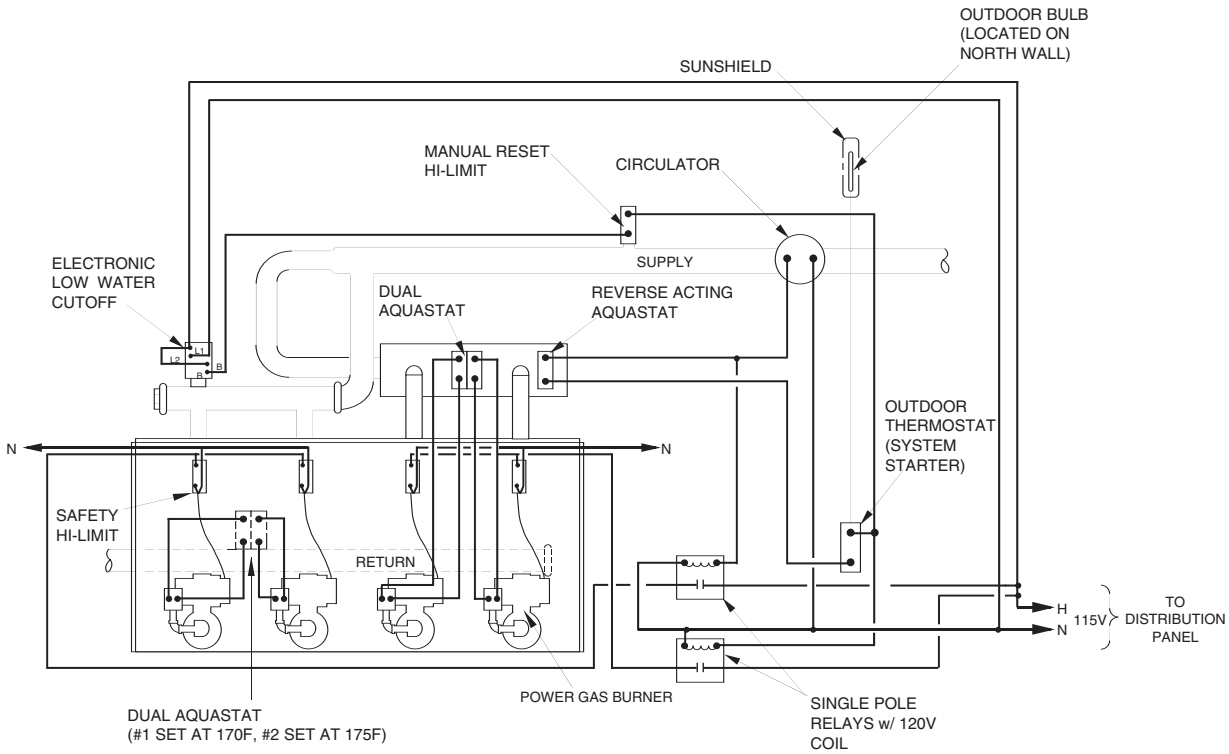


FIGURE C5: EXAMPLE OF LEVEL I CONTROL FOR COMBINATION SPACE & SERVICE WATER HEATING

Two modules maintain service hot water by dual modulating aquastat mounted in heat exchanger for year-round operation. When outdoor temperature drops below its setting, outdoor thermostat energizes system circulator and remaining two modules to provide heat to heating system. If water temperature in the heat exchanger drops below a pre-set minimum, reverse acting aquastat cuts out circulator until temperature rises above minimum. Single pole relay ensures that heating system boilers do not fire without circulator being energized.

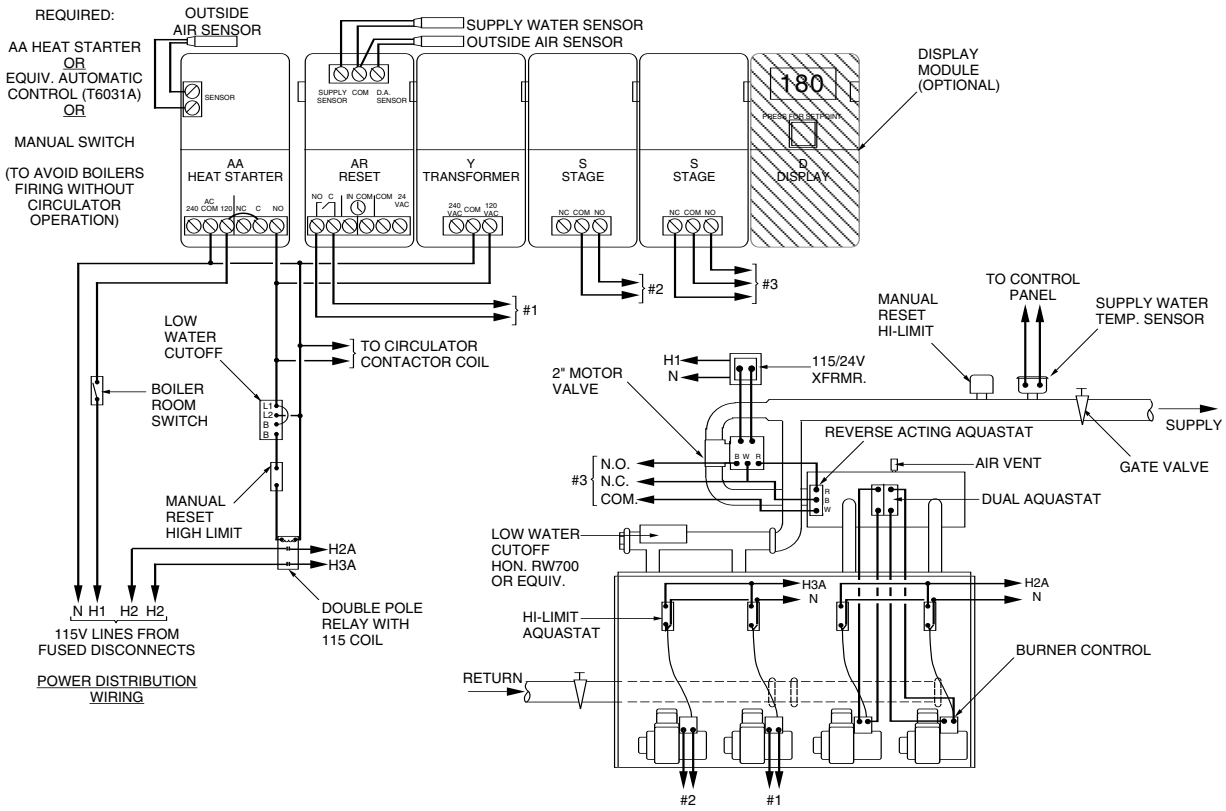


FIGURE C6: EXAMPLE OF LEVEL II CONTROL FOR COMBINATION SPACE & SERVICE WATER HEATING

Two modules maintain domestic hot water by modulating aquastats mounted in the heat exchanger for year-round operation. When the outdoor temperature falls below the setting of the heat starter module, the circulator is energized. The reset module will fire the first module to maintain the supply water temperature according to the setting of the control. As the outdoor temperature decreases below the setting of the stage modules, additional modules will fire. As the outdoor temperature decreases below the setting of the last stage module, the motorized valve will open, allowing domestic hot water modules to contribute to space heating. If the water temperature in the heat exchanger falls below the setting of the low limit aquastat, the motor valve will close, retaining all the capacity in the heat exchanger for domestic hot water.

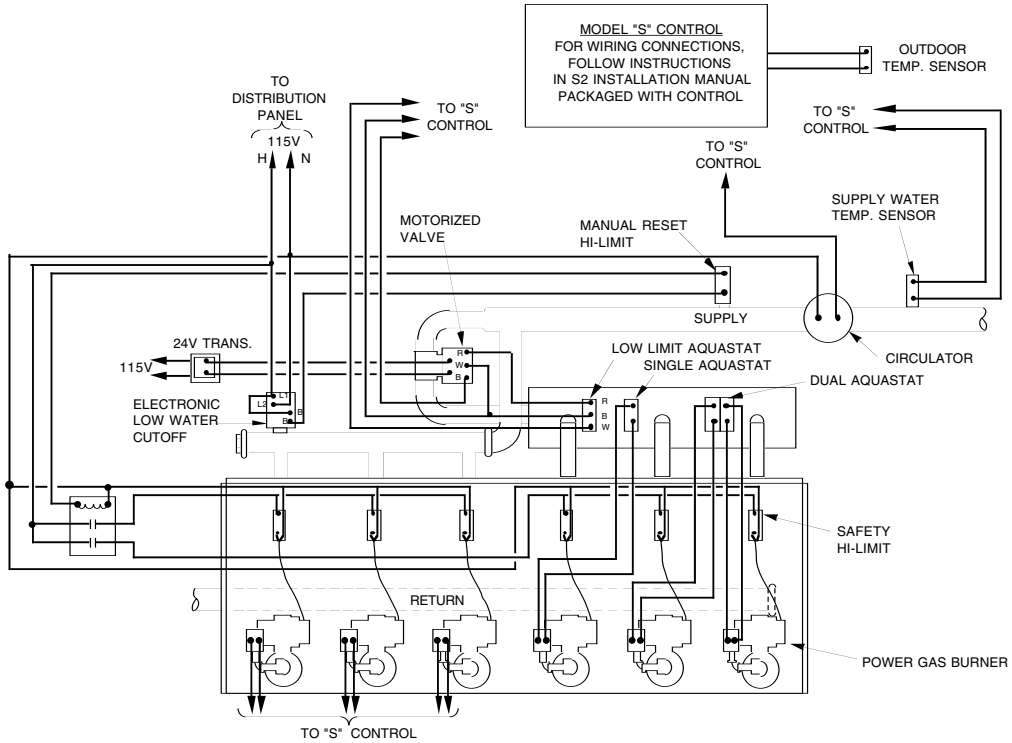


FIGURE C7: EXAMPLE OF LEVEL III CONTROL FOR COMBINATION SPACE & SERVICE WATER HEATING

Three modules maintain domestic hot water by modulating aquastats mounted in the heat exchanger for year-round operation. When outdoor temperature falls below the setting of the outdoor temperature sensor, the circulator and Model "S" control circuits are energized. The Model "S" control will begin to step fire modules until sufficient water temperature is present at the supply water temperature sensor to meet the demand of the Model "S" control. When the heating load is great enough to operate Step 8 of the Model "S" control, the motorized valve will open, allowing the domestic hot water modules to contribute to the space heating. If the water temperature in the heat exchanger falls below the setting of the low limit aquastat, the motorized valve will close, retaining all of the capacity of the heat exchanger for domestic hot water.

MODEL MG REPLACEMENT PARTS LIST

REF NO.	NAME OF PART	PART NO.	MG 385 MOD
1	Absorption Unit	BM-3111	1
2	Section, Base	BM-9688	1
3	Section, Middle	BM-9689	3
	Section, Middle (1/2" tap)	BM-9690	1
4	Section, Top	BM-9691	1
5	Push Nipple	53-1373	5
6	Dome - 8"	01-2105	1
7	Hi-Limit Aquastat (L4006A)	BM-4897	1
9	Tie Rod- 5/16 x 20" with N. & W.	57-1014	2
10	Double-swing Barometric Draft Control	BM-5298	1
11	Base Assembly w/combustion chamber	BM-3303	1
12	Combustion Chamber	BM-8192	1
13	Gas Burner (Refer to Hydrotherm Commercial Trade Price Book)		1
14	T/P Indicator (For 30# R.V.) **MO Only**	20-1015	1
	Temp./Press. Indicator (For 50# R.V.)	20-1003	1
	Temp./Press. Indicator (For 75/100# R.V.)	20-1011	1
16	Press Relief Valve – 30 psi	22-1203	1
	Press Relief Valve – 50 psi	22-1200	1
	Press Relief Valve – 75 psi	22-1803	1
	Press Relief Valve – 100 psi	22-1201	1
17	Bracket, Dome	55-3800	2
18	Tube Ass'y-Observation Port	03-2456	1
19	Filler Pad	45-1120	2
27	Cover - Observation Port	03-2458	1
28	Front Panel-Chamber Hsg.-Separately	03-2422	1
29	Drain Cock	51-1203	1

ORDERING INFORMATION

When ordering replacement parts, provide the model and serial number shown on the unit rating plate as well as the part number and name as shown in the parts list. Parts may be obtained from your local Hydrotherm heating contractor.

		MULTI-TEMP JACKET PARTS LIST "A" BATTERY (2 MODULES)		MULTI-TEMP JACKET PARTS LIST "B" BATTERY (3 MODULES)	
		PART NO.	770	PART NO.	1155
	Jacket - Complete	03-1071	1	03-1073	1
	Left Side Panel	03-1071.1	1	03-1071.1	1
	Right Side Panel	03-1071.2	1	03-1071.2	1
	Front Panel	03-1071.3	1	03-1073.3	1
	Rear Panel - Lower	03-1071.4	1	03-1073.4	1
	Rear Panel - Upper	03-1071.5	1	03-1073.5	1
	Left Top Panel	03-1060.4	1	03-1060.4	1
	Center Top Panel	03-1060.5	1	03-1060.5	2
	Right Top Panel	03-1060.6	1	03-1060.6	1
	Rear Cover Plate	03-1081	2	03-1081	3

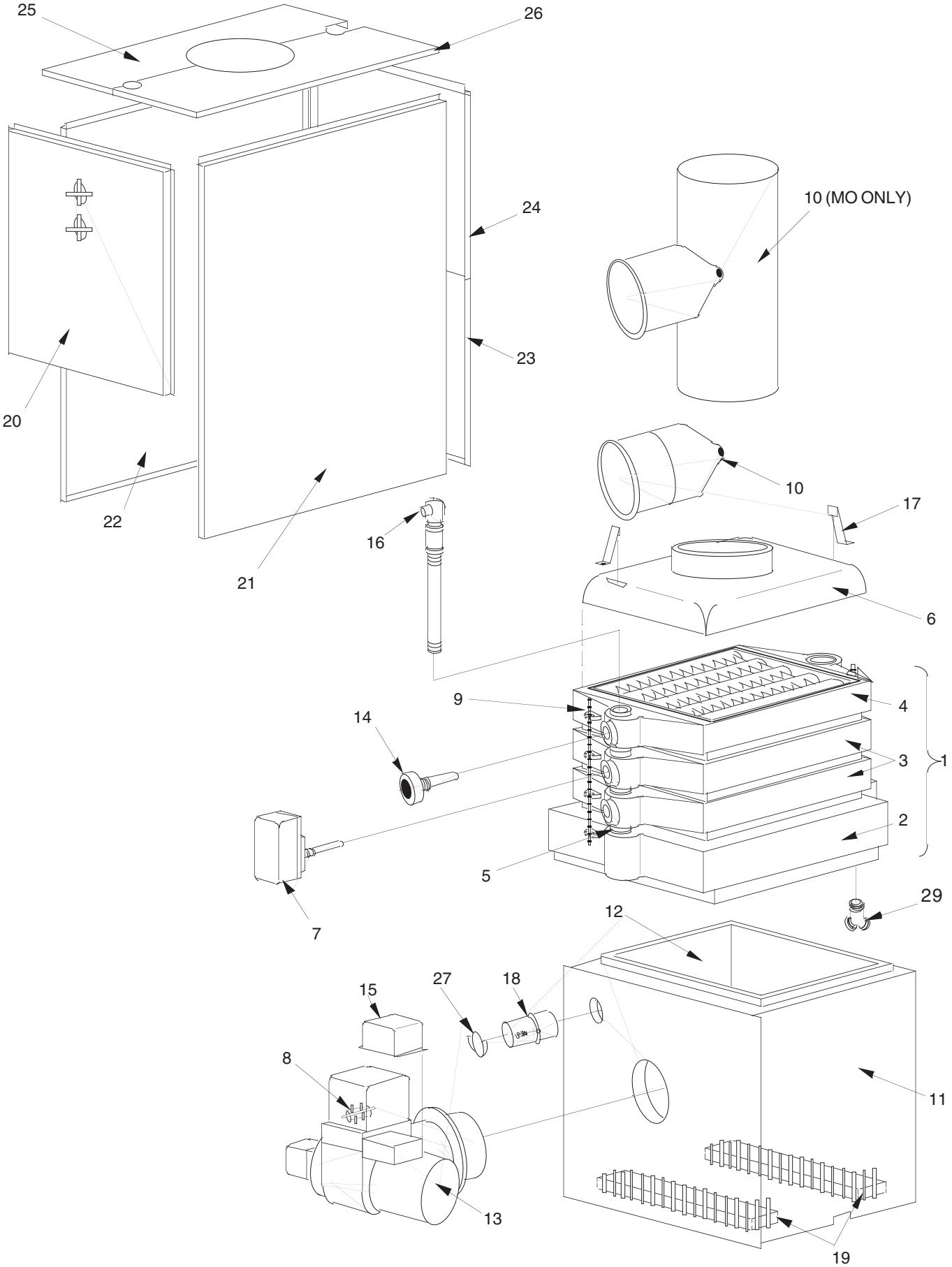


FIGURE 1: GENERAL ASSEMBLY