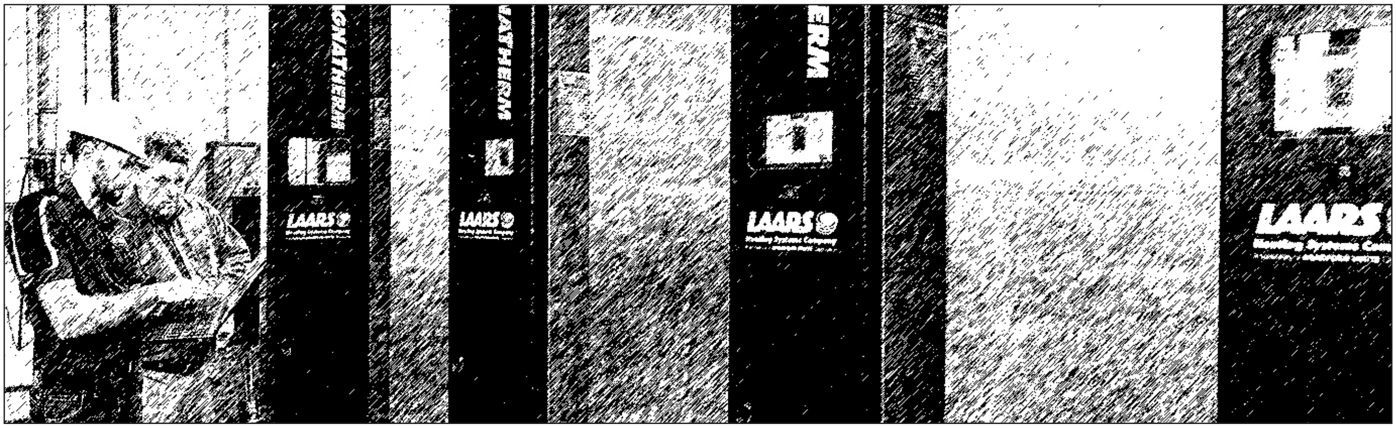

Laars Heating Systems Company has been a prominent manufacturer of low mass, high heat transfer boilers since 1948. Although some of the heat transfer materials have changed, Laars has used the same low mass, high heat transfer concept in the latest developments of our fully-condensing boilers.

Many manufacturers in the fully condensing boiler market have gone back to the fire tube designs, with higher water content, which is needed to support the fire tube design. Laars opted to design our products to be both space heating boilers and high volume water heaters. The water tube design facilitates both of those applications much better than a fire tube product.

Hydronic boilers can be piped in many ways. Boiler manufacturers have preferred methods, as do designers and installers, and there are always discussions about which methods are correct. The bottom line is that a piping method is "correct" when a boiler has proper water flow, and the system receives the BTUs and water flow that is needed to heat the space comfortably, and efficiently.

Primary-Secondary Systems

Laars prefers primary-secondary piping for its boilers, as this piping method most easily ensures that the boilers will have the water flow they need to operate correctly and efficiently. Primary-secondary is a solid piping system and has advantages over a single pump system. This method uses separate boiler and system pumps, and those pumps are not affected by one another. Variable flow systems, variable flow boilers, constant flow systems, constant flow boilers or any combination, are available to the designer that uses primary-secondary piping styles.

In primary-secondary systems, the boiler pump is energized only when the boiler has a call for heat. Since each boiler has its own pump, heated water never passes through an unfired boiler. Hot water passing through an unfired boiler is less efficient, as the heat exchanger in an unfired boiler becomes a radiator. In the past, when most boilers were atmospherically vented through the roof, heat would escape through the vent system. Most modern boilers use some kind of internal fan, so heat loss through an unfired boiler is not as pronounced as it was with atmospheric units, but it should still be a factor when considering a piping method.

See Figure 1 on page 2

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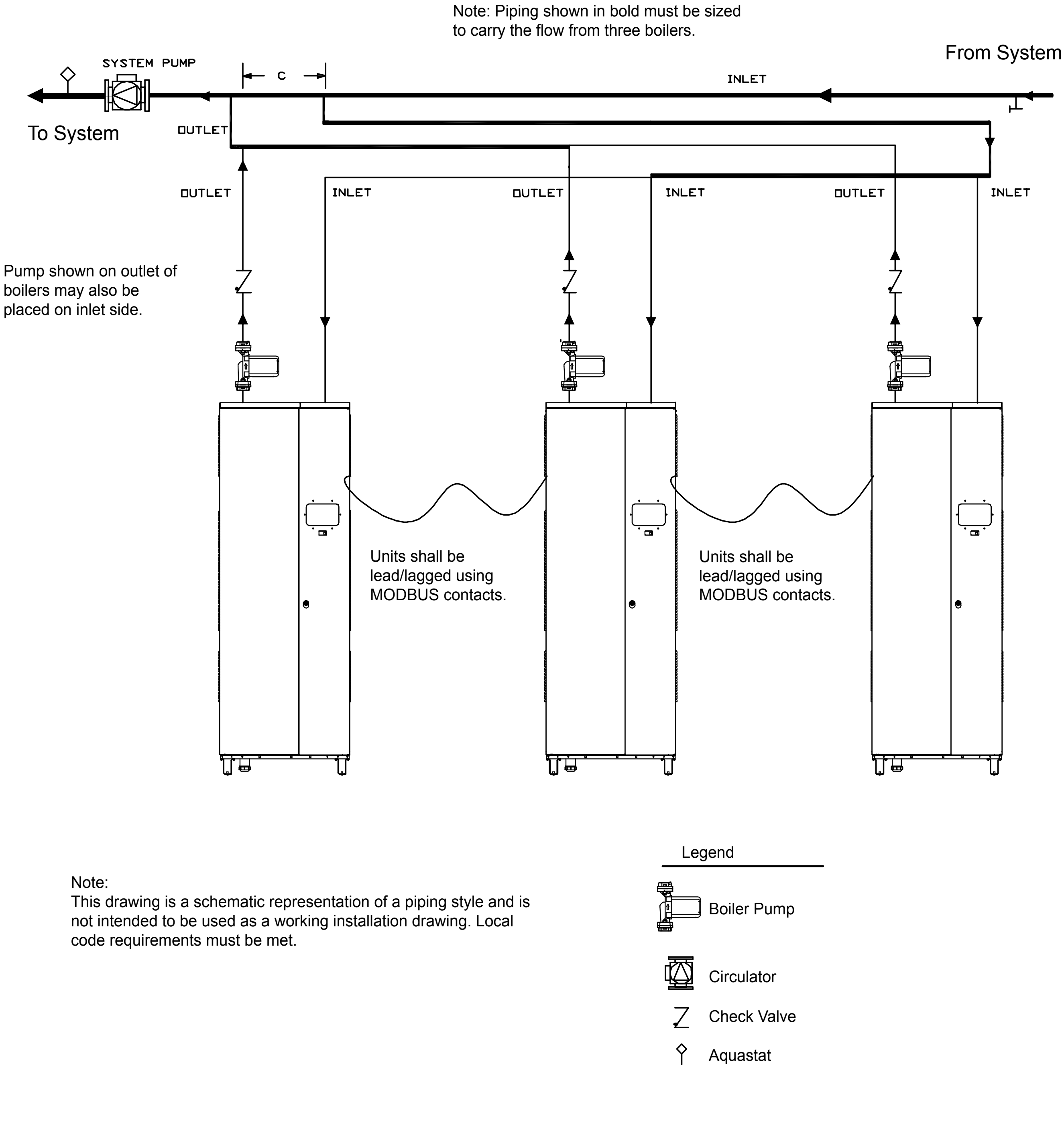

Figure 1. Typical Primary-Secondary Piping Style

Single Pump Systems

There is sometimes a misconception that water tube boilers can only be installed in primary-secondary systems. One alternate piping method uses just one pump that serves the boiler(s) and the system, and Laars water tube boilers can easily be used in these systems. The pump is sized for the necessary water flow through the boiler(s) and the total headloss of the system and the boiler(s).

An example can be found in Figure 2. Assume the following:

- MagnaTherm MGH3000 boilers
- System headloss = 10 feet
- 30°F temperature rise

Boiler data:

- Water flow required for one MGH3000 with a 30°F temperature rise = 190 gpm
- Headloss through one MGH3000 at that flow rate is 34.2 feet.

There are three boilers, and the pump must be sized for all of them, so multiply the water flow by three: 190 gpm x 3 = 570 gpm

The highest headloss through the boilers would be that of one boiler, which is 34.2 feet. Because the boiler piping is parallel, the resistance through two boilers is less than the resistance through one, because the water flow now has two paths to take, so headloss is not added together.

With the data above, we know that the pump would need to deliver 570 gpm with 34.2 feet of headloss.

The pump can either be constant circulation, or variable speed. Most of the time, the pump runs water through the system, unless the system is in a warm weather shutdown mode (based on outdoor temperature). A boiler will be called to fire when the system needs heat, based on a system temperature sensor. The system sensor may be connected to the boiler controls, to a system control, or to a building automation system. Within the duration of the call for heat, the boiler may modulate up and down, or cycle on and off.

With this type of system, water will flow through the boiler(s) regardless of whether the boiler is energized or not. This increases the chance of heat loss through an unfired boiler. The motorized valve system shown in Figure 2 offers a way to minimize the heat loss associated with this scenario, while also protecting the system pump from dead-heading.

Motorized valves are placed at the inlet of each boiler. The valve associated with the lead boiler is connected to the system pump contacts, so that it opens whenever the system pump is energized. The valves for the other boilers are connected to each boiler’s pump contacts, so that they open only when those boilers are calling for heat, allowing you to optimize system efficiency when using a single system pump.

See Figure 2 on page 4

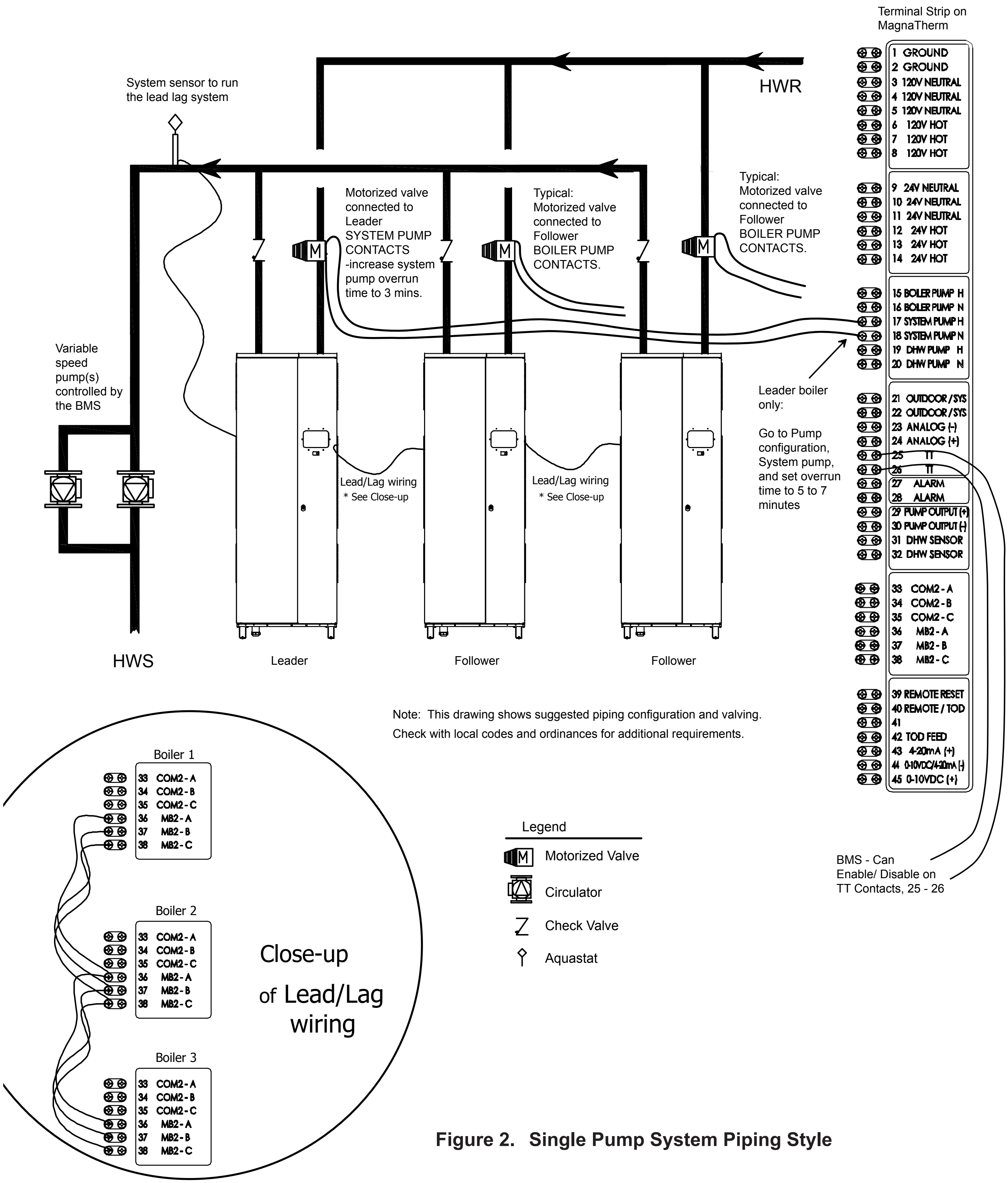

Figure 2. Single Pump System Piping Style

System efficiency in water tube designs and fire tube designs are comparable, even though the water tube designs have higher headloss. For either type of boiler, a system with one variable primary pump becomes less efficient when the boilers are not operated with electronic valves to prevent water circulating through unfired boilers.

Variable Speed Systems

System efficiency can be maximized when any piping style is used, by adjusting the water flow and modulation rate of the boilers. Matching water flow and BTUs to the load, based on outdoor temperature, is now the basis for most system designs. Variable speed pumping can be used with single pump systems or primary-secondary systems. In primary-secondary systems, the boiler pumps and the system pump can all be variable speed.

Variable speed pumps can be interlocked with Laars condensing boilers, via the Vari-Prime controller (standard on all MagnaTherm boilers). As the need for BTUs in the system increases and decreases, the water flow will speed up and slow down. In response, the boiler's firing rate will also increase and decrease, to maintain the desired boiler temperature rise. When using variable speed pumps, the minimum allowable boiler flow must be known. Charts that show minimum water flow for Laars MagnaTherm and NeoTherm boilers are shown in Table 1 and 2.

Model Size	Input	25° F Temp Rise	Headloss Feet*	30° F Temp Rise	Headloss Feet*	35° F Temp Rise	Headloss Feet*	40° F Temp Rise	Headloss Feet*
1600	Max	122	19.4	100	14.0	87	10.0	76	8.0
	Min	26		22		19		16	
2000	Max	150	30.0	128	23.5	109	17.1	95	13.6
	Min	33		28		24		21	
2500	Max	190	34.0	158	23.6	136	17.6	119	13.6
	Min	41		34		30		26	
3000	Max	226	47.0	190	34.2	164	25.8	142	18.9
	Min	49		41		35		31	
3500	Max	266	41.0	222	30.6	190	23.6	166	18.6
	Min	57		48		41		36	
4000	Max	300	48.0	255	38.2	218	28.5	190	22.5
	Min	66		55		47		41	

* Headloss is for the boiler only (no piping)

Table 1. MagnaTherm Model MGH Minimum and Maximum Flow Rates

Model Size	Input	20° F Temp Rise	Headloss Feet*	25° F Temp Rise	Headloss Feet*	30° F Temp Rise	Headloss Feet*	35° F Temp Rise	Headloss Feet*	40° F Temp Rise	Headloss Feet*	45° F Temp Rise	Headloss Feet*
80	Max	7.6	14.9	6.1	10.1	5.1	7.1	4.3	5.8	3.8	4.6	N/A	
	Min	3.5		3.5		3.5		3.5		3.5			
105	Max	10.0	23.1	8.0	17.0	6.7	12.4	5.7	9.6	5.0	7.6	N/A	
	Min	3.5		3.5		3.5		3.5		3.5			
150	Max	14.3	28.5	11.4	19.0	9.5	13.8	8.1	11.2	7.1	8.8	N/A	
	Min	3.5		3.5		3.5		3.5		3.5			
210	Max	20.0	24.1	16.0	16.7	13.4	11.6	11.3	9.0	9.9	6.9	N/A	
	Min	4.0		3.5		3.5		3.5		3.5			
285	Max	27.0	25.5	22.0	17.5	18.0	14.0	15.0	10.5	13.0	8.0	N/A	
	Min	5.5		4.4		3.5		3.5		3.5			
399	Max	39.0	28.0	31.0	20.0	25.0	14.5	22.0	11.0	19.0	9.0	N/A	
	Min	8.0		6.5		5.5		4.5		4.0			
500	Max	48.0	24.0	38.0	16.0	32.0	12.0	27.0	9.0	24.0	8.0	N/A	
	Min	10.2		8.0		7.0		6.0		5.0			
600	Max	58.0	44.0	46.0	31.0	38.0	22.0	33.0	18.0	29.0	15.0	N/A	
	Min	12.2		9.8		8.2		7.0		6.2			
750	Max	72.0	37.0	58.0	23.0	48.0	17.0	41.0	13.0	36.0	10.0	N/A	
	Min	15.3		12.3		10.2		8.8		7.7			
850	Max	81.0	33.0	65.0	22.0	54.0	15.0	46.0	10.0	41.0	8.0	N/A	
	Min	17.4		14.0		11.6		9.9		8.7			
1000	Max	95.0	30.0	75.0	20.0	62.0	15.0	54.0	11.0	48.0	9.0	42.0	7.0
	Min	15.0		15.0		15.0		15.0		15.0		15.0	
1200	Max	114.0	37.0	91.0	26.0	76.0	18.0	65.0	13.0	57.0	10.0	51.0	8.0
	Min	11.6		15.0		15.0		15.0		15.0		15.0	

* Headloss is for the boiler only (no piping)

Table 2. NeoTherm NTH Minimum and Maximum Flow Rates

In summary, many piping styles can be used with modern condensing boilers, although Laars prefers primary-secondary piping, after years of proven success. The goal is to adapt products to multiple applications to maximize system efficiency.

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