

PLUMBING SCHEMATICS

Pellet Plumbing Planning Guide

- Plumbing layouts
- Thermal storage
- Cascade Systems



TARM BIOMASS[®]
Innovative Leaders in Alternative Heating Solutions

1-800-782-9927
www.pelletboiler.com



Hydraulic and Wiring Planning Guide

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Fröling Austria and Tarm Biomass®-Leaders in pellet heating

Dear Valued Tarm Biomass® Customer

Here at Tarm Biomass® we want to make your installation as smooth as possible. This document includes the most popular system designs that should assist with planning your installation.

The systems shown in this guide are only examples and they should not substitute for complete system planning.

We reserve the right to make technical changes without prior notice.

If more information is needed, please contact your local Tarm Biomass® dealer or call us directly at 1-800-782-9927.

How to use this guide

There are many plumbing options available for the Fröling Pellet boiler. This guide shows the most common applications. The Fröling Lambdatronic control is very powerful and can control not only the boiler itself, but also a back-up boiler, storage tank(s), domestic hot water tank(s), circulators and solar.

The plumbing examples are broken down into four categories:

- Hydraulic system 0 - No thermal storage tank installed.
- Hydraulic system 1 - Thermal storage tank installed with no back-up boiler.
- Hydraulic system 2 - Thermal storage tank installed with a back-up boiler.
- Hydraulic system 4 - Same as hydraulic system 2, but with 4 tank sensors.

About Tarm Biomass®

Tarm Biomass®, is a third-generation, family-owned business that has pioneered the sales and service of high efficiency biomass boilers in North America for over 30 years.

Tarm Biomass® primary objective is to offer innovative heating solutions, paired with a significant commitment to consumer education and environmental awareness. Exclusive partnerships with ISO 9001 certified manufacturers allows Tarm Biomass® to offer products with reliability and very high over-all efficiency, all while promoting the utilization of carbon-cycle biomass that is critical to the lowering of net greenhouse gas emissions.

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Components

Sensors

Immersion sensors

- Used as the boiler sensor, DHW tank sensor and thermal storage tank sensor.
- Item no. 18641



Collector sensor

- Item no. 67036



Sensor Specifications:

Resistance sensor type: KVT 20/KTY 10; approx. 2K Ω at 68° F.
Maximum cable length: 130 ft. with shielded cable.

Bus System

Hydraulic Module

- Includes enclosure
- Connection for two pumps and up to 6 sensors
- Max. up to 8 modules per system.



Two immersion sensors are included, which can be used for the following purposes:

- **Storage tank management:**
For boiler-controlled storage tank loading via 2 sensors.
- **Differential temperature control for boiler:**
For controlling the DHW tank loading pump; depending on the top storage tank temperature and DHW tank temperature.
- **Solar systems**
- **Circulation pumps**

Room Console RBG 3200

Digital multi-functional room device for easy operation of the entire system from the living area, for optimum ease of use.



- Max. 7 units per system.

Bus Cable

- Maximum cable length: 3200 ft.
- Cable type LIYCY paired 2x2x0.5 should be used for the bus connections between the modules. CAT 5 or CAT 6 cable can be used for short distances under 50 ft. Longer distances will need the shielded cable. The connection to the 5-pin plugs should be wired to the following diagram:



Sensor functions for standard systems

Storage tank top (sensor 0.1):

- Start signal for storage tank management.
- Signal for differential control of the DHW tank loading pump.
- Start/stop signal for a connected oil/gas boiler.

Storage tank bottom (sensor 0.2):

- Signal for differential measurement of boiler sensor for pump switching conditions.
- Stop signal for storage tank management.

DHW tank top (sensor 0.3):

- Start signal for DHW tank loading pump.
- Signal for differential measurement.

DHW tank bottom (sensor 0.4):

- Reference sensor for solar integration.

Oil/gas boiler (sensor 0.5):

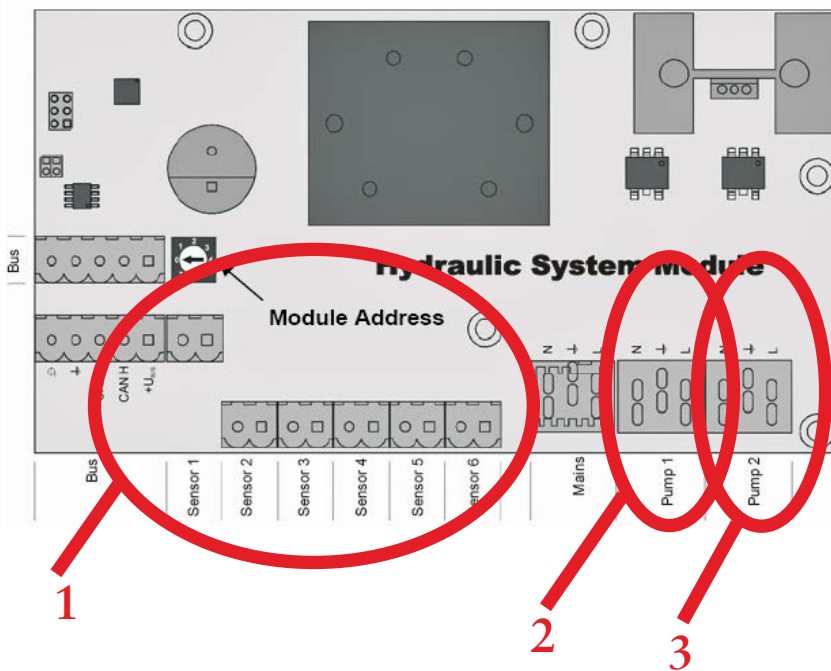
- Boiler measurement for pump control.

Connection Instructions

Oil/gas boiler output connection:



Hydraulic module connections

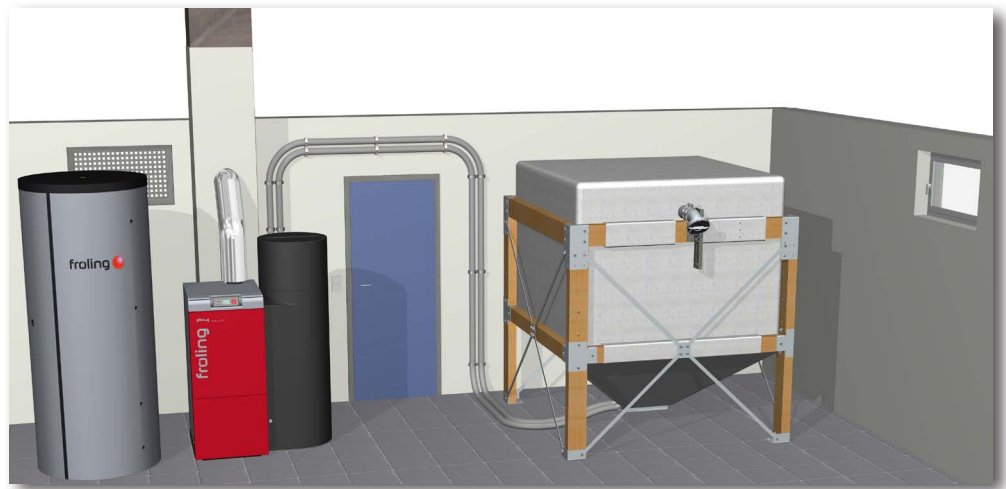


Connections:

- 1 - Temperature sensors (0.1-0.6)
- 2 - Pump 0.1 (no electronically controlled pumps)
- 3 - Pump 0.2 (no electronically controlled pumps)

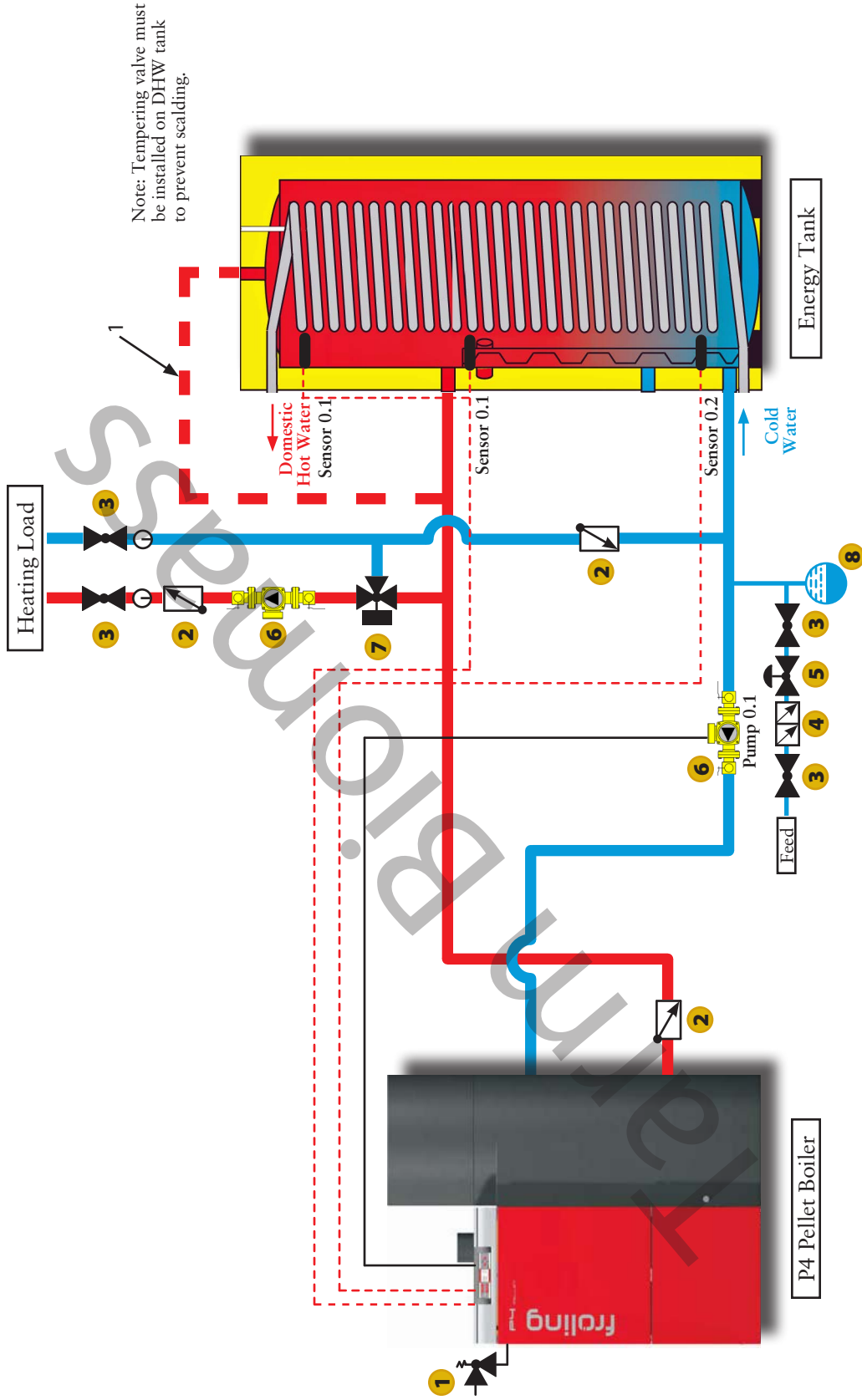
Thermal storage

Tank Sizing	
Model	gals
PE1 15 pellet	119
PE1 20 pellet	119
PE1 25 pellet	200
PE1 35 pellet	200
P4 48 pellet	300
P4 60 pellet	400
P4 80 pellet	600
P4 100 pellet	600



Currently our EPA approval for P4 boilers requires that residential P4 boilers be installed with thermal storage as per the chart below. However, P4 boilers do not require thermal storage for operation. PE1 boilers are EPA approved for use without thermal storage. The use of thermal storage is generally advised for reducing burner starts, reducing wear on cycling parts, and for decreasing emissions. In cascaded installations, thermal storage can double as a hydraulic separator. Some installations receive little to no benefit from thermal storage. Please consult with your engineer and/or Tarm Biomass to learn what is best for each installation.

Hydraulic System 1.1



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	5	Pressure reducing valve
2	Check valve	6	Circulator
3	Isolation valve	7	Mixing valve
4	Back-flow preventer	8	Expansion tank



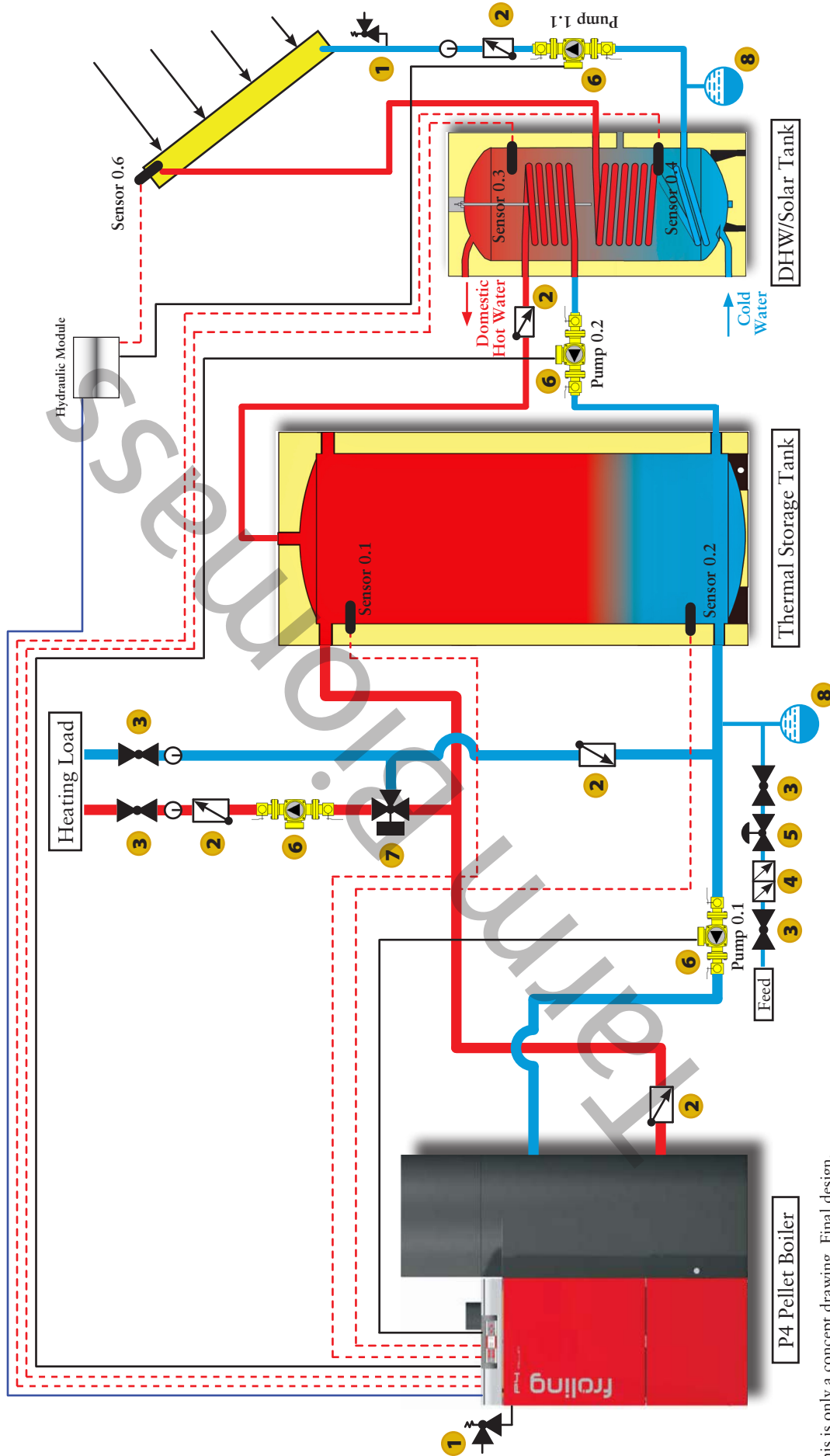
Drawing Name/System Type: Hydraulic System 1.1

DHW Controlled by boiler: Yes | Drawn by: TSP | Date: 6-13-2013

Notes: Variable mode must be set to "No".

1. Both options available for supply connection to Energy Tank

Hydraulic System 1.2



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	5	Pressure reducing valve
2	Check valve	6	Circulator
3	Isolation valve	7	Mixing valve
4	Back-flow preventer	8	Expansion tank

Drawing Name/System Type: Hydraulic System 1.2

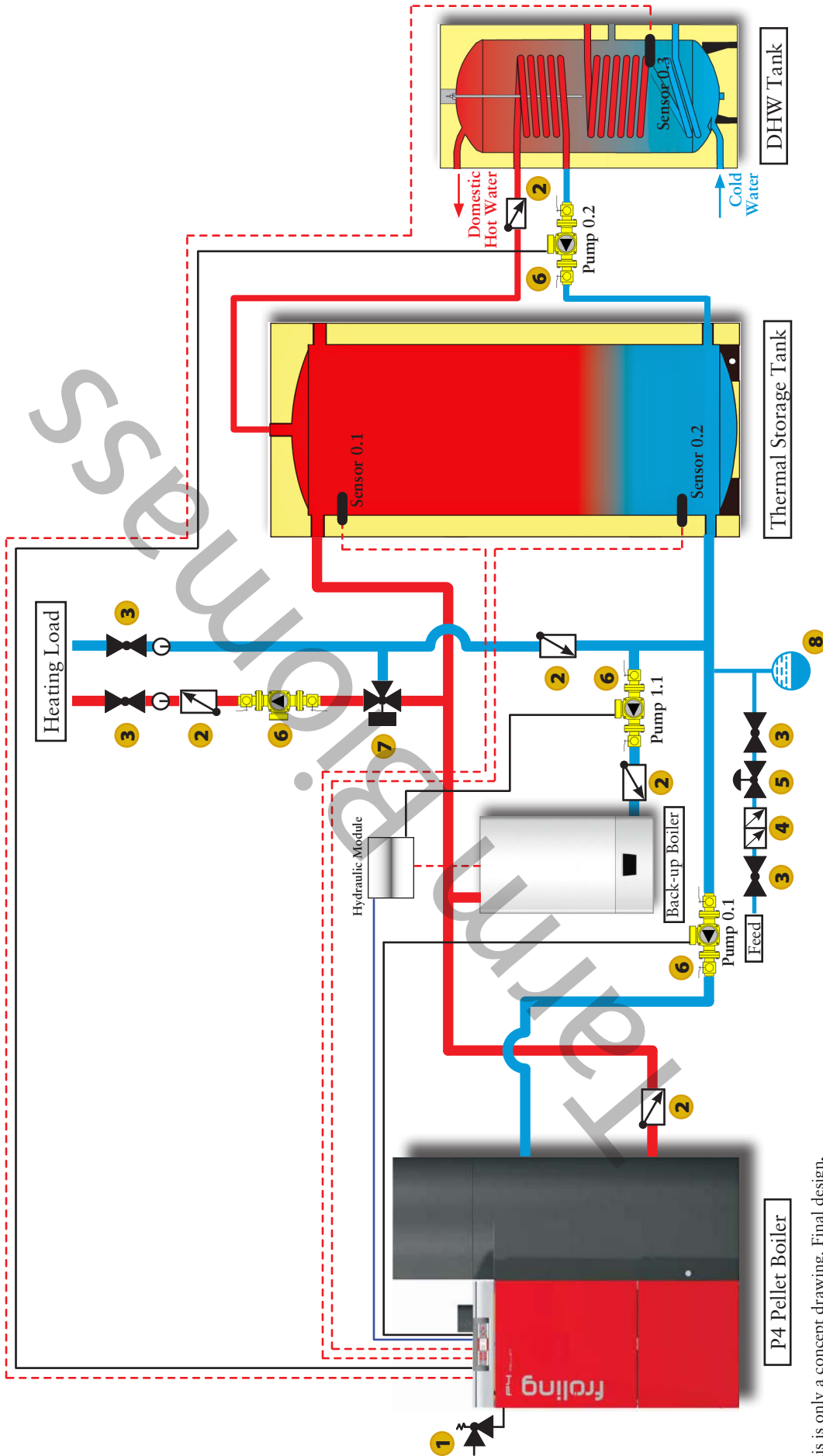
DHW Controlled by boiler: Yes

Drawn by: TSP

Date: 6-13-2013



Hydraulic System 2.1



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	5	Pressure reducing valve
2	Check valve	6	Circulator
3	Isolation valve	7	Mixing valve
4	Back-flow preventer	8	Expansion tank



Drawing Name/System Type: Hydraulic System 2.1

DHW Controlled by boiler: Yes	Drawn by: TSP	Date: 6-13-2013
Notes: Variable mode must be set to "No". Hydraulic module is needed for back-up boiler.		

Pellet boilers without thermal storage

The use of thermal storage is highly recommended, but with its active cleaning design, fast ignition properties, temperature control capabilities, and other automation, the P4 and PE1 Pellet boiler excels compared to all other pellet boilers with or without thermal storage.

Constant circulation

When no thermal storage is utilized, the pellet boiler's circulator is always on at a fixed speed when the boiler is operating. It is crucial to have the proper flow rate through the boiler. Overly high flow rates will reduce output temperatures and low flow rates may cause the boiler to overheat. All systems without thermal storage must have a balancing valve installed to properly set the flow rate using the chart below:

Required flow rate		Pellet Boiler (Kw)									
ΔT	Units	8	15	20	25	32	38	48	60	80	100
10° C/18° F	gpm	3.8	5.7	7.6	9.5	12.1	14.4	18.1	22.7	30.2	37.8
15° C/27° F	gpm	2.5	3.8	5	6.3	8.1	9.6	12.1	15.1	20.2	25.2

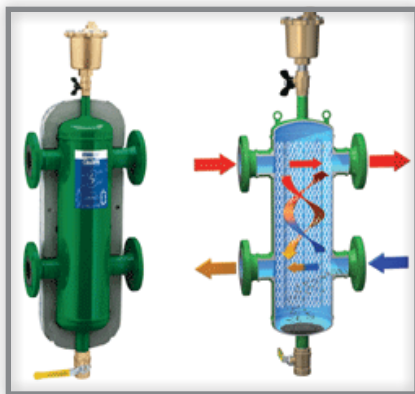
Adjusting flow rates

A balancing valve with built-in flow meter like the one pictured enables precise and simple adjustment. The volume flow rate is measured in gpm, so there is no need to spend time determining settings using diagrams or other aids. The volume flow rate value can be set using the scale of the meter integrated into the bypass, reading from the lower edge of the float. There is only flow through the bypass if the handle is pressed. If the systems are not balanced correctly, there is the possibility of excessive high flow volume through the boiler, which results in a relatively low temperature difference between the boiler flow and return.



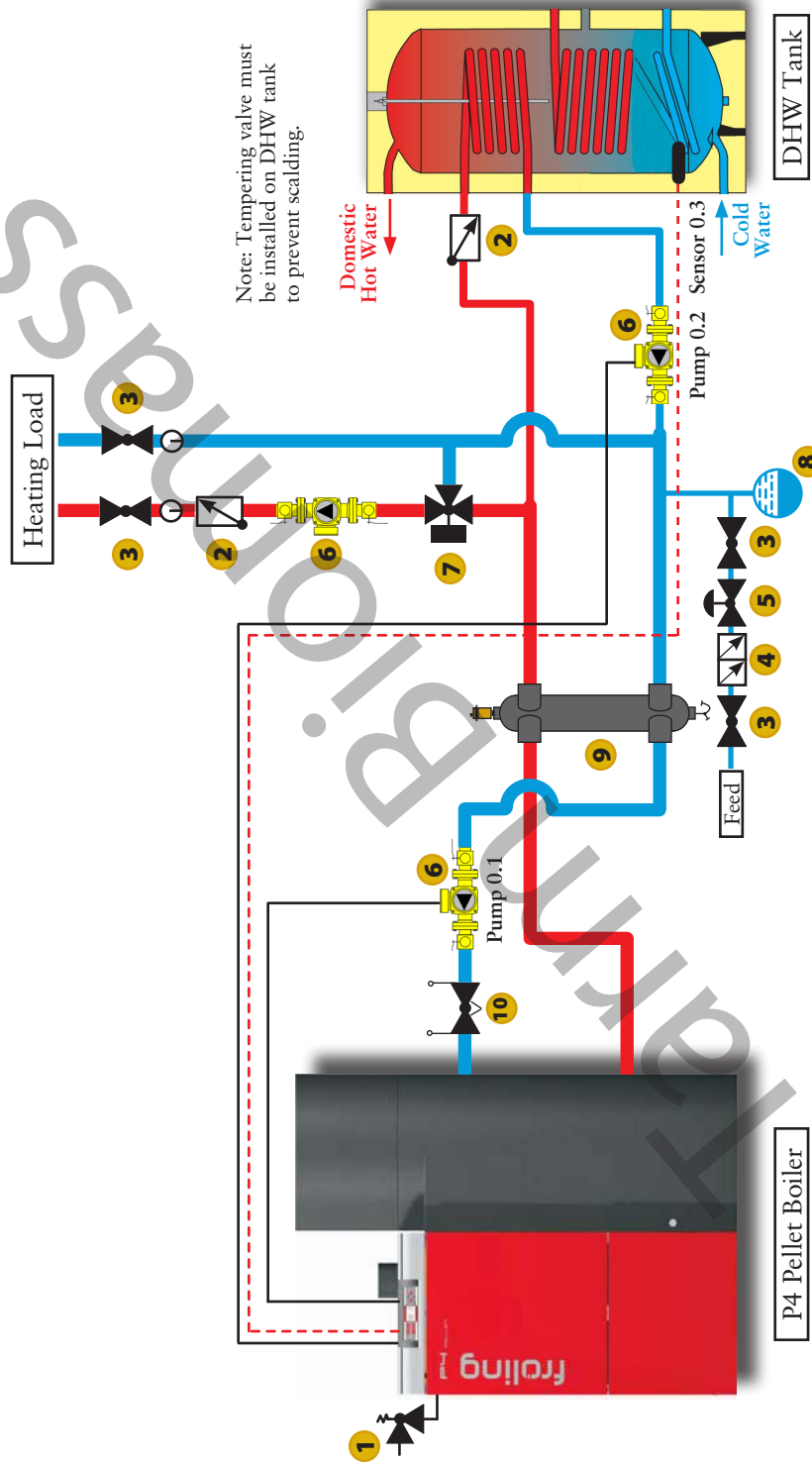
Hydraulic separators

Some systems will require the use of a hydraulic separator to isolate the flow of the boiler system from the rest of the heating system to allow the ability to have constant circulation through the pellet boiler. Use the chart below for proper sizing.



Hydraulic Separator Sizing	
Size	Flow gpm
1"	11
1¼"	18
1½"	26
2"	37

Hydraulic System 0.1



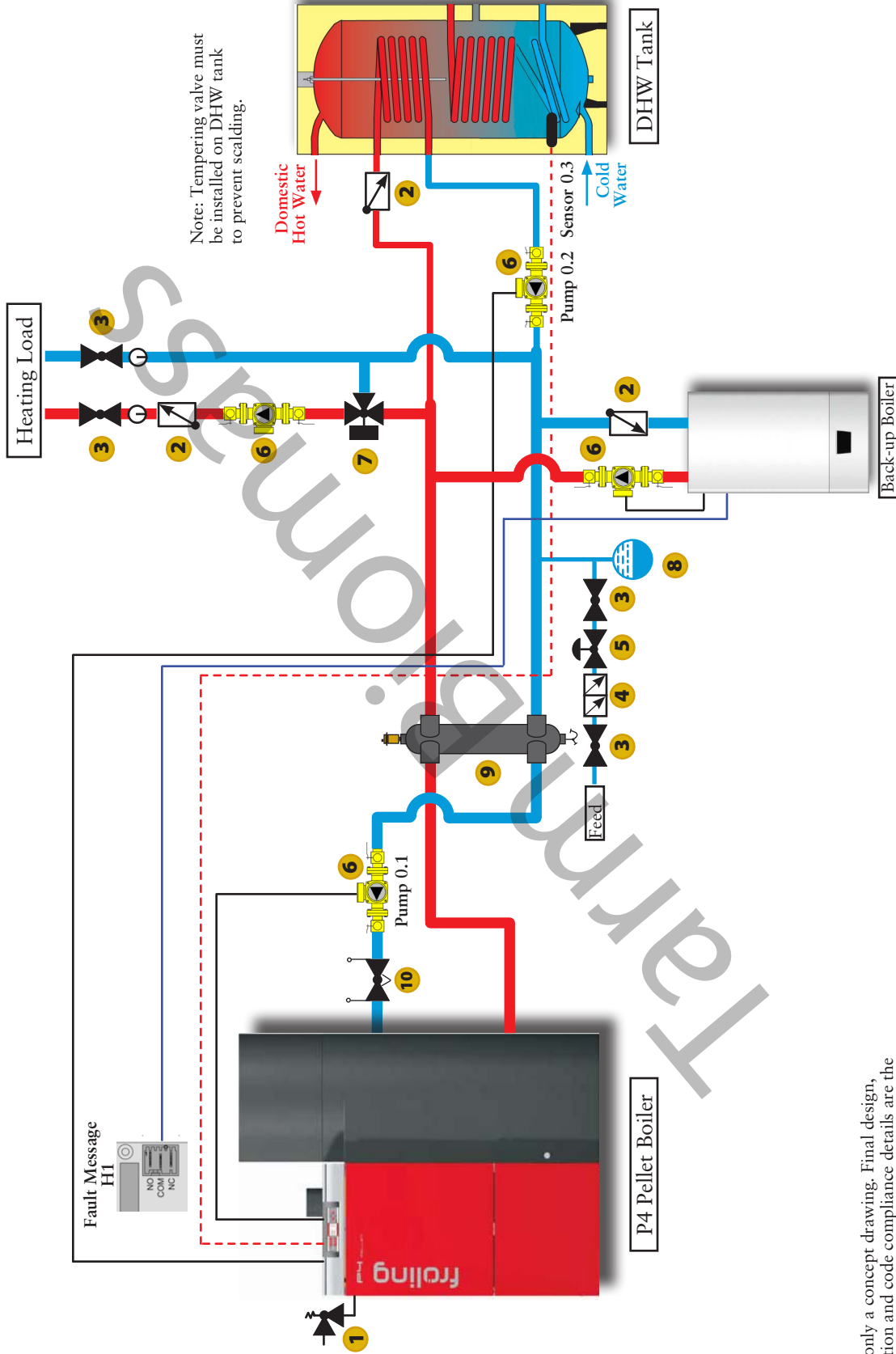
Note: Tempering valve must be installed on DHW tank to prevent scalding.

This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Drawing Name/System Type: Hydraulic System 0.1	
DHW Controlled by boiler: Yes	Drawn by: TSP
Date: 6-13-2013	
Notes: Set DHW priority to "yes". The minimum flow rate must be adjusted properly by using balancing valve (10).	

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Key:	
1	Pressure relief valve
2	Check valve
3	Isolation valve
4	Back-flow preventer
5	Pressure reducing valve
6	Circulator
7	Mixing Valve
8	Expansion tank
9	Hydraulic separator
10	Balancing valve



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	6	Circulator
2	Check valve	7	Mixing Valve
3	Isolation valve	8	Expansion tank
4	Back-flow preventer	9	Hydraulic separator
5	Pressure reducing valve	10	Balancing valve

Drawing Name/System Type: Hydraulic System 0.2

DHW Controlled by boiler: Yes	Drawn by: TSP	Date: 6-13-2013
Notes: Set DHW priority to "yes". The minimum flow rate must be adjusted properly by using balancing valve (10). Back-up boiler can be activated by "floating" fault switch from P4 Pellet boiler.		



Multiple boiler systems with Fröling cascade controller

For larger buildings, such as public buildings and schools, the heat requirement fluctuates considerably. The P4 Pellet boiler offers the necessary flexibility with the cascade control. With this intelligent solution, a cascade module can be added to combine up to four P4 Pellet boilers together, reliably providing a total output of up to 1.4MM Btu/hr. One advantage is the increased reliability of operation, as the heat is provided by several boilers. You can also see the advantages of a cascade during the warmer months. If the heat requirement is low, one boiler is often sufficient for hot water preparation.

Boiler control by priority

If two or more boiler systems with different rated heat outputs are used, different start priorities are given, so it is not the boiler with the highest rated heat output that starts first, but rather the boiler with sufficient heat output for the current task, e.g. domestic hot water preparation. If boilers with the same rated output are used and each boiler is given the same priority, the operating hours are used as a start criterion. This means the load is shared evenly and the heating system is highly efficient.

Boiler controller operating principles

The following parameters are set in the boiler's controller:

- Boiler temperature setpoint (parameter): 75° C
- Storage tank charge is 100% at boiler setpoint (parameter): 2° C
- Storage tank charge is 0% at (parameter): 20° C

This means that the storage tank shows a charge of 100% at an average storage tank temperature of 73° C.

Formula:

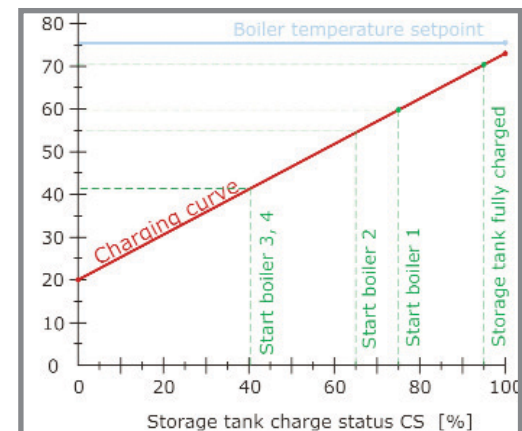
$$\text{Start/stop temperature} = 0\%_{\text{parameter}} + \frac{(100\%_{\text{parameter}} - 0\%_{\text{(parameter)}}) \times \text{start point(parameter)}}{100\%}$$

If the storage tank reaches a charge of 95% all of the boilers are switched off.

$$\text{Stop temperature} = 20^{\circ} \text{ C} + \frac{(73^{\circ} \text{ C} - 20^{\circ} \text{ C}) \times 95\%}{100\%} \approx 70.4^{\circ} \text{ C}$$

The formula shown above gives the following temperatures as the start points for boilers 1, 2, 3 and 4 (if present):

Start point boiler 1:	CS 75%	59.8° C
Start point boiler 2:	CS 55%	49.2° C
Start point boiler 3 and 4:	CS 40%	41.2° C
Quick start (%/10 min):	15%	8° C



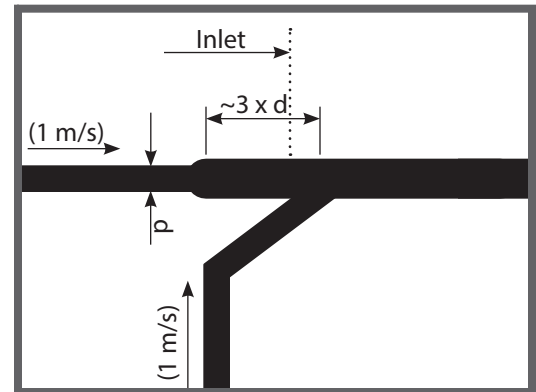
Observing flow volumes

With larger flow volumes with a multiple boiler system you should ensure that the connections to the tank match the pipe size that is needed. If a single tank cannot be used, multiple tanks can be utilized and connected using the Tichelmann reverse return principle.

Pipe connections for proper flow dynamics with multiple boilers

Option 1:

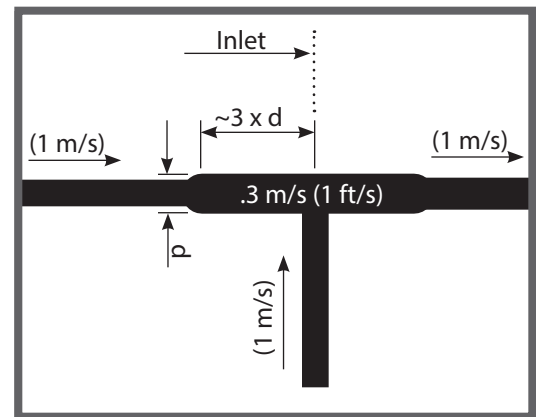
In this type of connection, the pipe is expanded before the connection of the supply and return lines to the appropriate size to handle total boiler output. The second or third boiler's supply and return pipes are connected at a 45° angle in the direction of flow. The inlet section should be about 3 times the length of the previous diameter. The new section should be designed to have a flow rate of 1 m/s (3.3 ft/s).



Option 2:

It is recommended that a pipe manifold in the area of the second boiler's supply or return pipe connect. If a pipe manifold is not installed and the pipes are the incorrect size for the output of the boiler, the flow will speed-up because the pipe is too small. This can generate noise with the higher flow rates and can lead to layering problems in the storage tank. If a pipe manifold is installed of the appropriate length, the speed is reduced briefly to 0.3 m/s (1 ft/s).

The inlet and the calming section of the pipe manifold should have a length 3 times larger than the manifold, and at least 12" (30cm) long. The pipes connected to the manifold should be designed to move the boiler's rated output with a flow rate of approximately 1 m/s (3.3 ft/s).

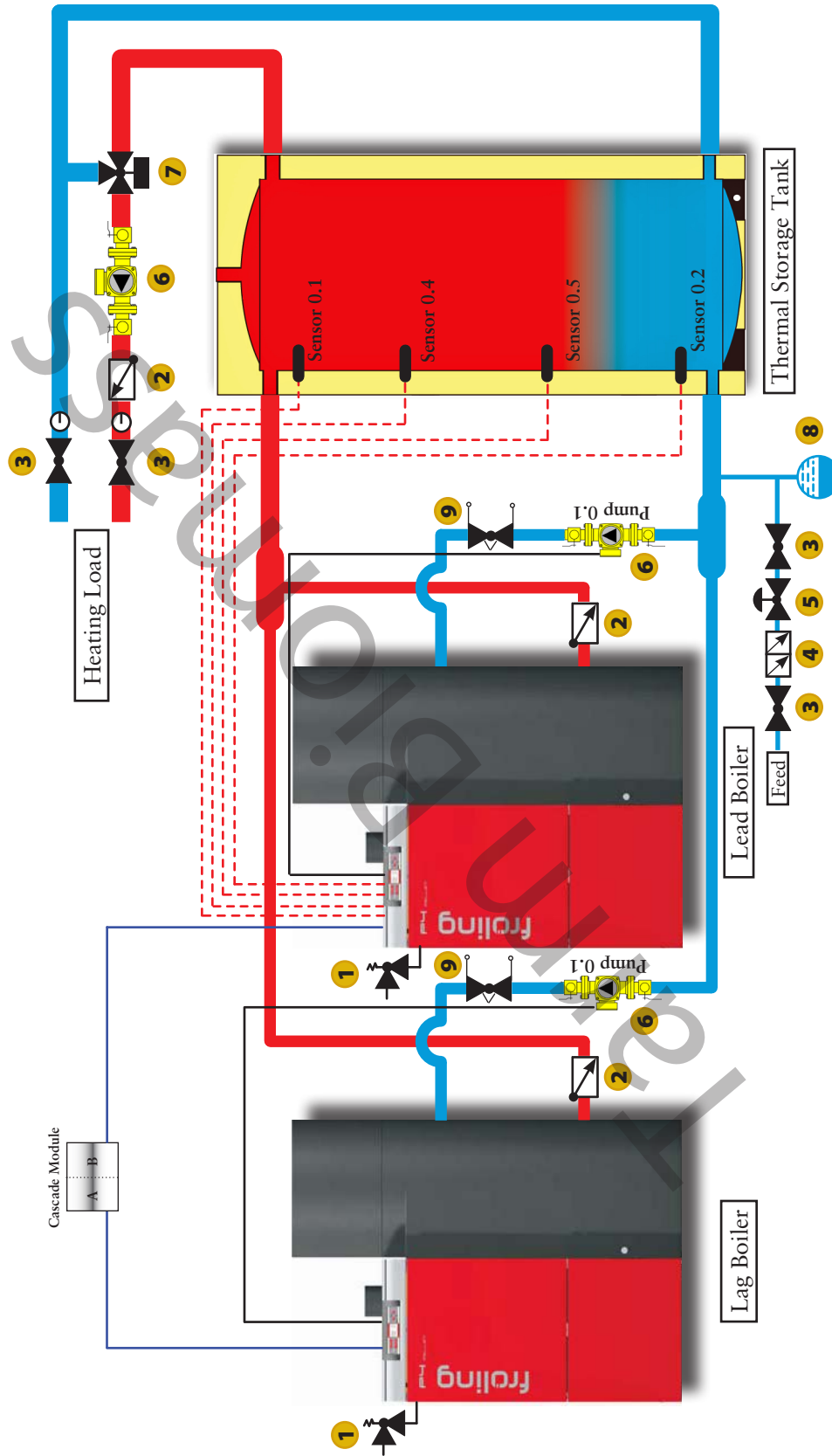


Proper pipe dimensions

The following tables represents the recommended pipe diameter with a recommended 1 m/sec (3.3ft/sec) flow rate. First, find your flow rate from the upper chart by choosing your ΔT and boiler system output in total kilowatts. Now, match the flow rate to closest number in the lower chart and round up. This is your recommended pipe diameter.

Volume flow rate of water in m ³ / h															
	Boiler total kW output														
ΔT	10	15	20	25	32	38	48	60	80	100	120	180	200	300	400
10°C/18°F	0.86	1.29	1.72	2.15	2.75	3.26	4.12	5.16	6.87	8.59	10.31	15.47	17.18	25.78	34.74
15°C/27°F	0.57	0.86	1.15	1.43	1.83	2.18	2.75	3.44	4.58	5.73	6.87	10.31	11.46	17.18	22.91
20°C/36°F	0.43	0.64	0.86	1.07	1.37	1.63	2.06	2.58	3.44	4.30	5.16	7.73	8.59	12.89	17.18
	Nominal pipe diameter (inches)														
	½"	¾"	1"	1½"	1¾"	2"	2½"	3"	4"	5"	6"	7"	8"	10"	12"
1 m/sec	0.64	1.12	1.84	2.89	4.50	7.00	11.9	18.0	28.0	44.0	64.0	87.0	112	176	252

Hydraulic System 1. Cascade 1



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	6	Circulator
2	Check valve	7	Mixing Valve
3	Isolation valve	8	Expansion tank
4	Back-flow preventer	9	Balancing valve
5	Pressure reducing valve		

Drawing Name/System Type: **Hydraulic System 1.Cascade 1**

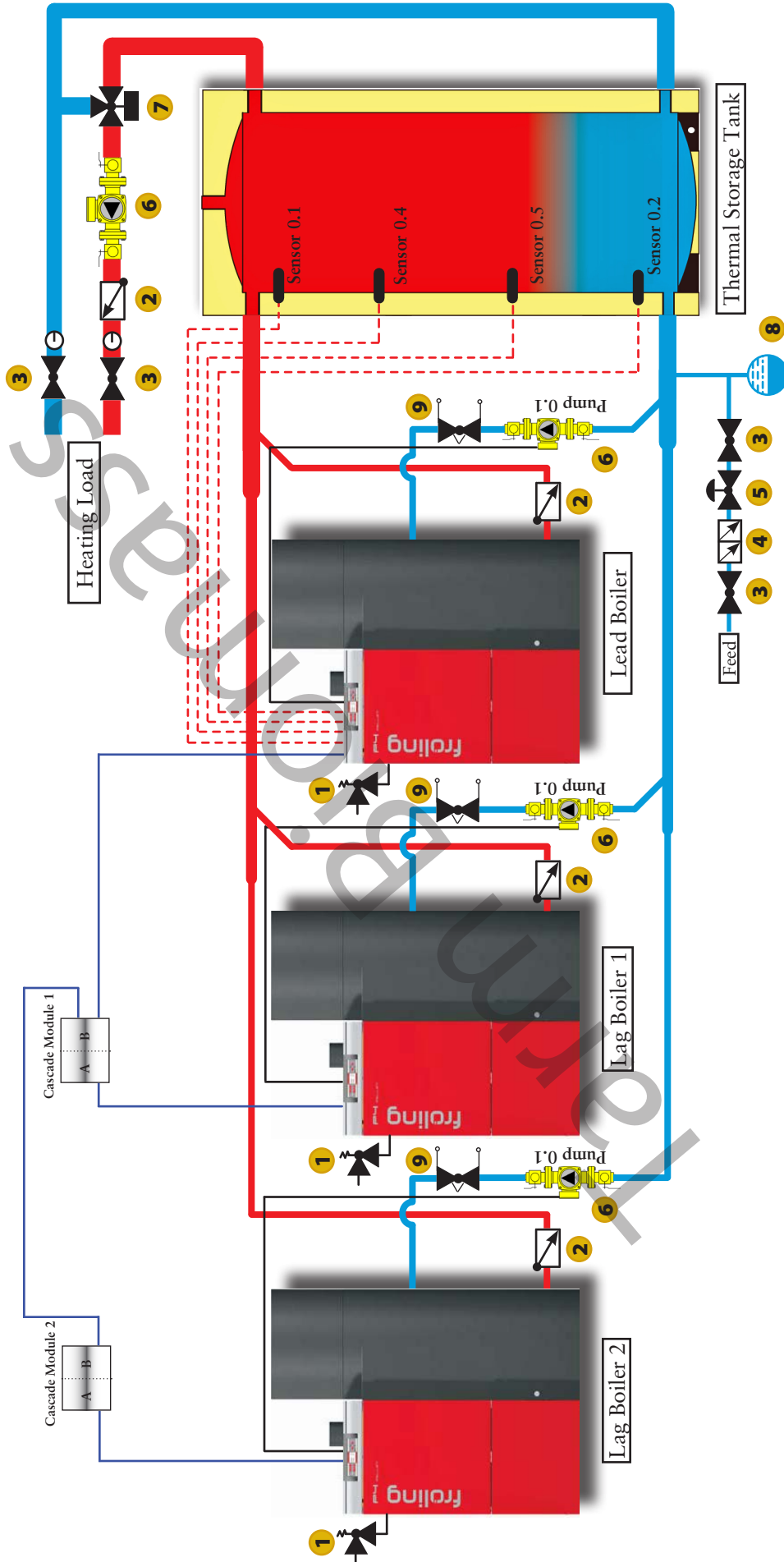
Drawn by: TSP

Date: 6-13-2013

Notes: Two boiler cascaded system.



Hydraulic System 1. Cascade 2



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

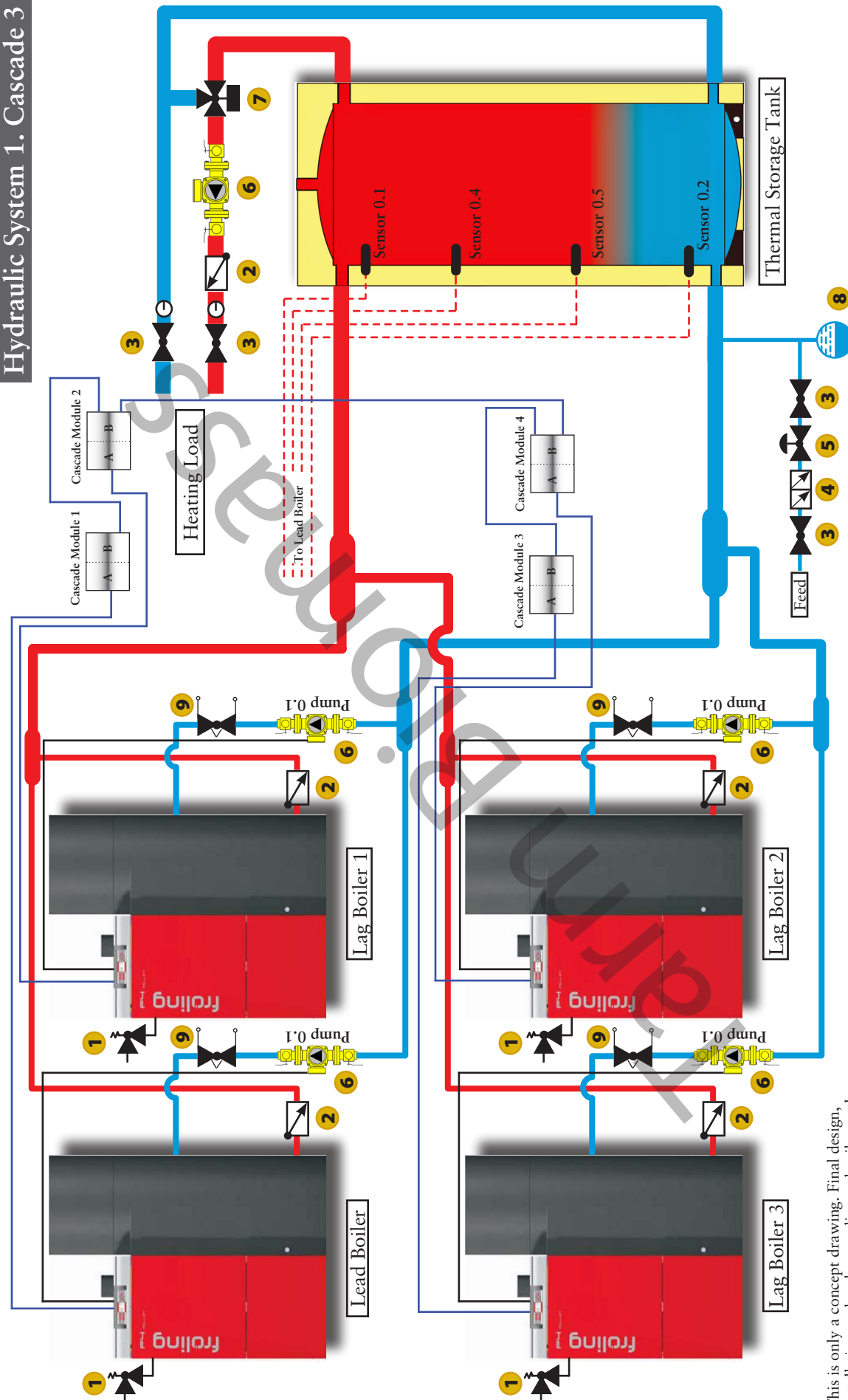
Key:

1	Pressure relief valve	6	Circulator
2	Check valve	7	Mixing Valve
3	Isolation valve	8	Expansion tank
4	Back-flow preventer	9	Balancing valve
5	Pressure reducing valve		

Drawing Name/System Type: Hydraulic System 1.Cascade 2	
Drawn by: TSP	Date: 6-13-2013
Notes: Three boiler cascaded system.	



Hydraulic System 1. Cascade 3



This is only a concept drawing. Final design, installation and code compliance details are the responsibility of the designer/installer of the system.

Key:

1	Pressure relief valve	6	Circulator
2	Check valve	7	Mixing Valve
3	Isolation valve	8	Expansion tank
4	Back-flow preventer	9	Balancing valve
5	Pressure reducing valve		

Drawing Name/System Type: Hydraulic System 1.Cascade 2

Drawn by: TSP

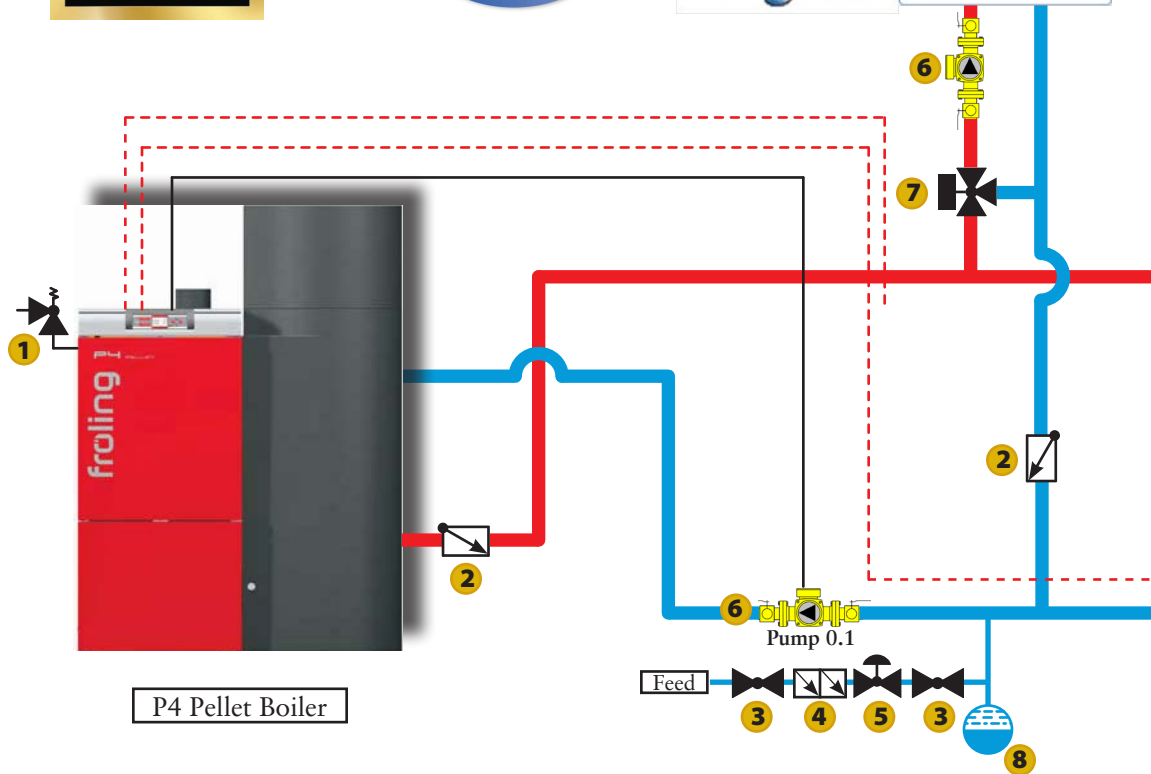
Date: 6-13-2013

Notes: Four boiler cascaded system.

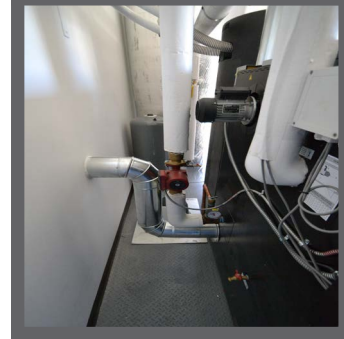


Notes:

Please visit WWW.TARMBIOMASS.COM for our dealer locator, downloadable specification sheets and plumbing diagrams. While you are there, please visit our blog <http://blog.woodboilers.com/>!



P4 Pellet Boiler



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