Adapting a pellet boiler to a forced air heating system

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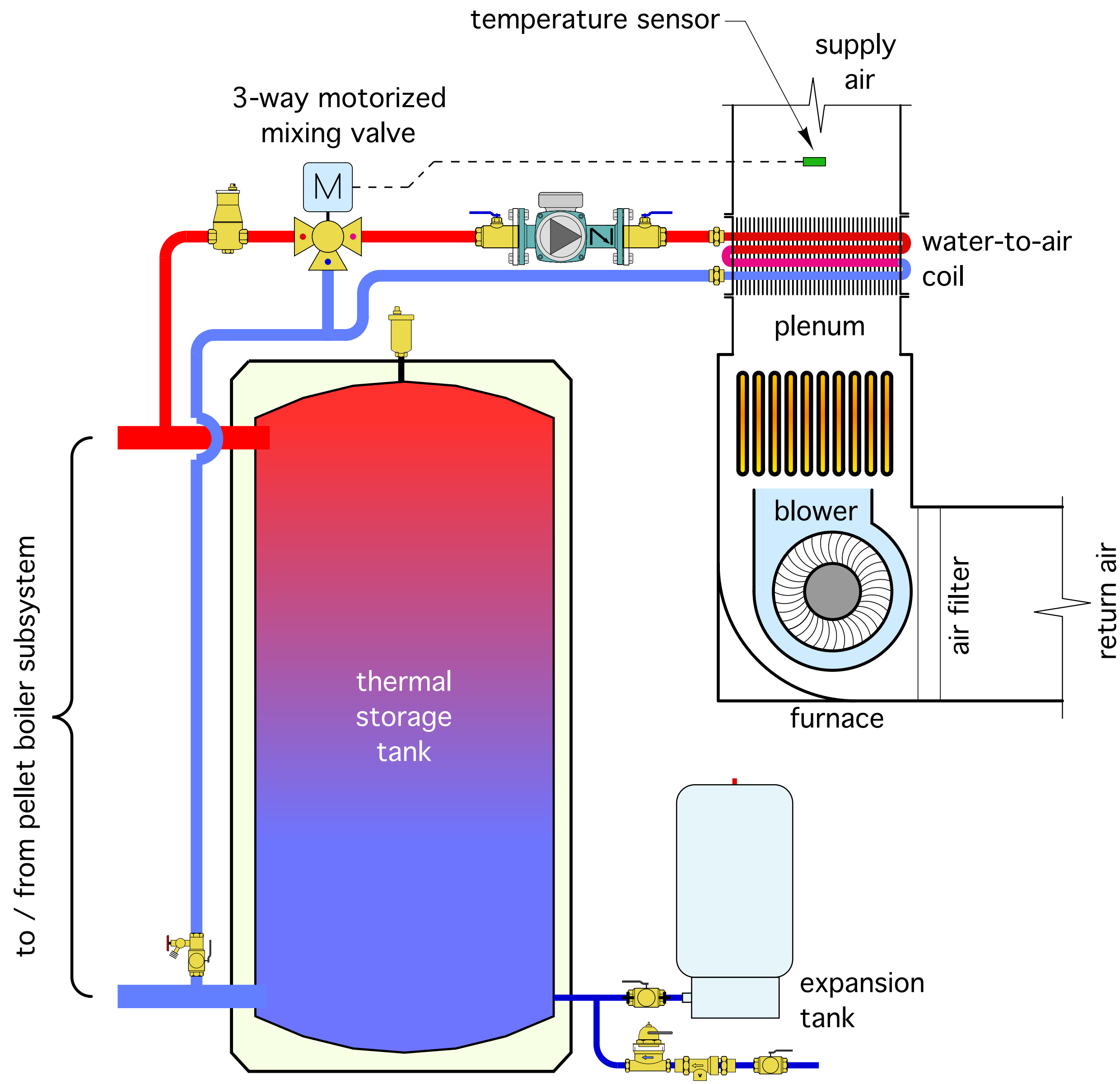

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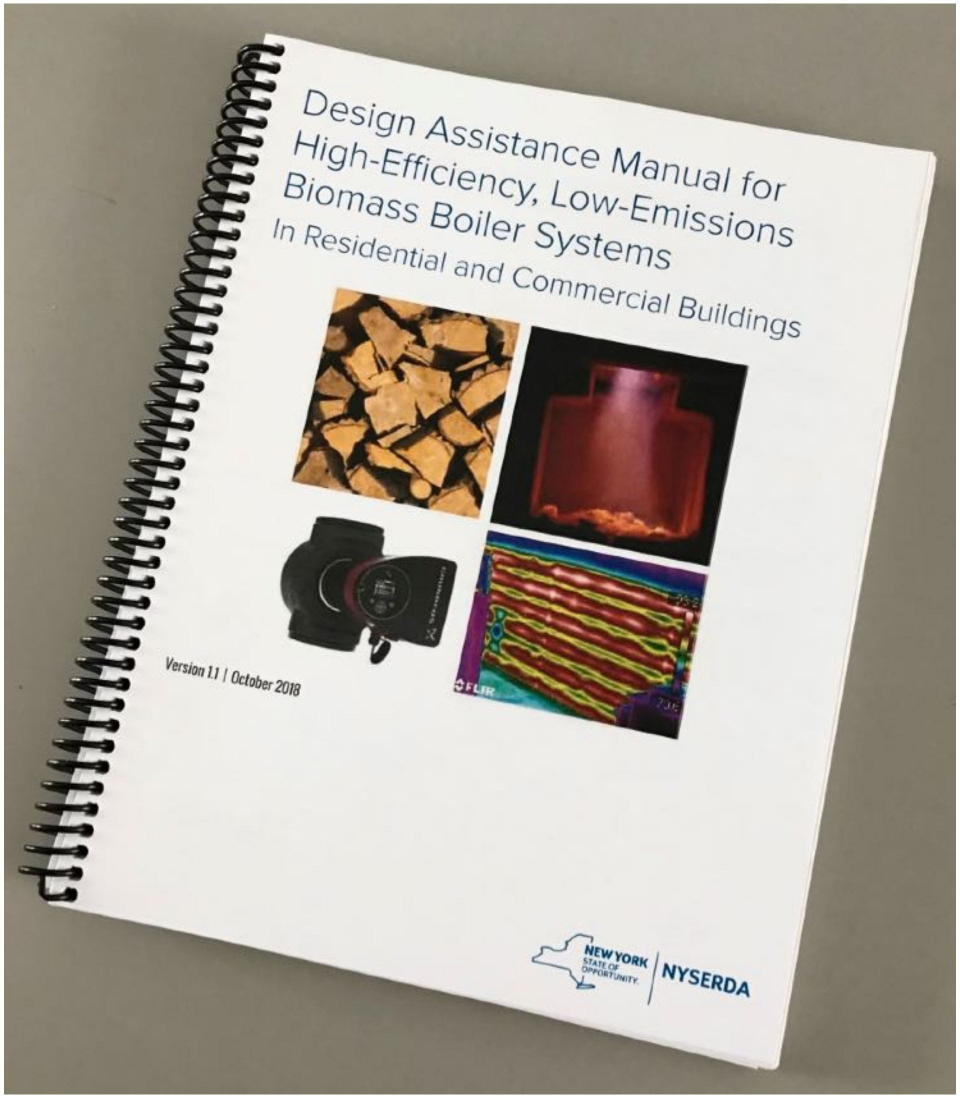
Multiple Pellet Boiler Systems

Description: The majority of houses in NY have forced air heating systems supplied by furnaces operating on fossil fuels. The webinar shows how a pellet boiler could be integrated into those systems to displace much of the fossil fuel used for space heating, and provide domestic hot water..

Learning Objectives:

- Understand how to adapt a boiler to a forced-air system in general.
- Learn proper sizing and placement of the water-to-air coil.
- Learn how to control supply air temperature .
- Learn how to use an air handler in parallel with furnace.

Design Assistance Manual
for High Efficiency Low Emissions Biomass Boiler Systems



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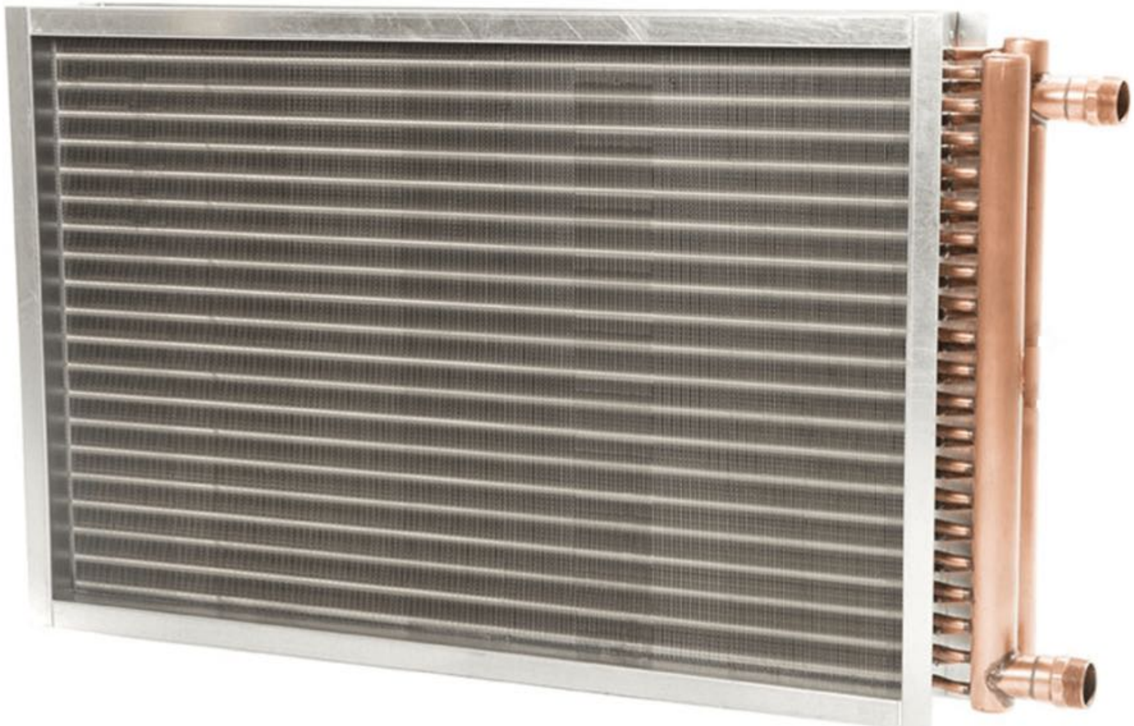
It's available as a FREE downloadable PDF at:

https://www.nyserda.ny.gov/-/media/Files/EERP/Renewables/Biomass/Design-Assistance-Biomass-Boiler.pdf

A water-to-air heat exchanger - commonly called a “coil” - is used to transfer heat to the furnace plenum.



Most water-to-air coils have one or more rows of smaller diameter copper tubing, arranged in parallel, and connected to supply and return headers

The copper tubing is mechanically fit to closely spaced aluminum fins

Air passes through the coil and absorbs heat by convection from the tubing and the fins.

The more “tube rows” the coil has the lower the water temperature for a given rate of heat exchange.

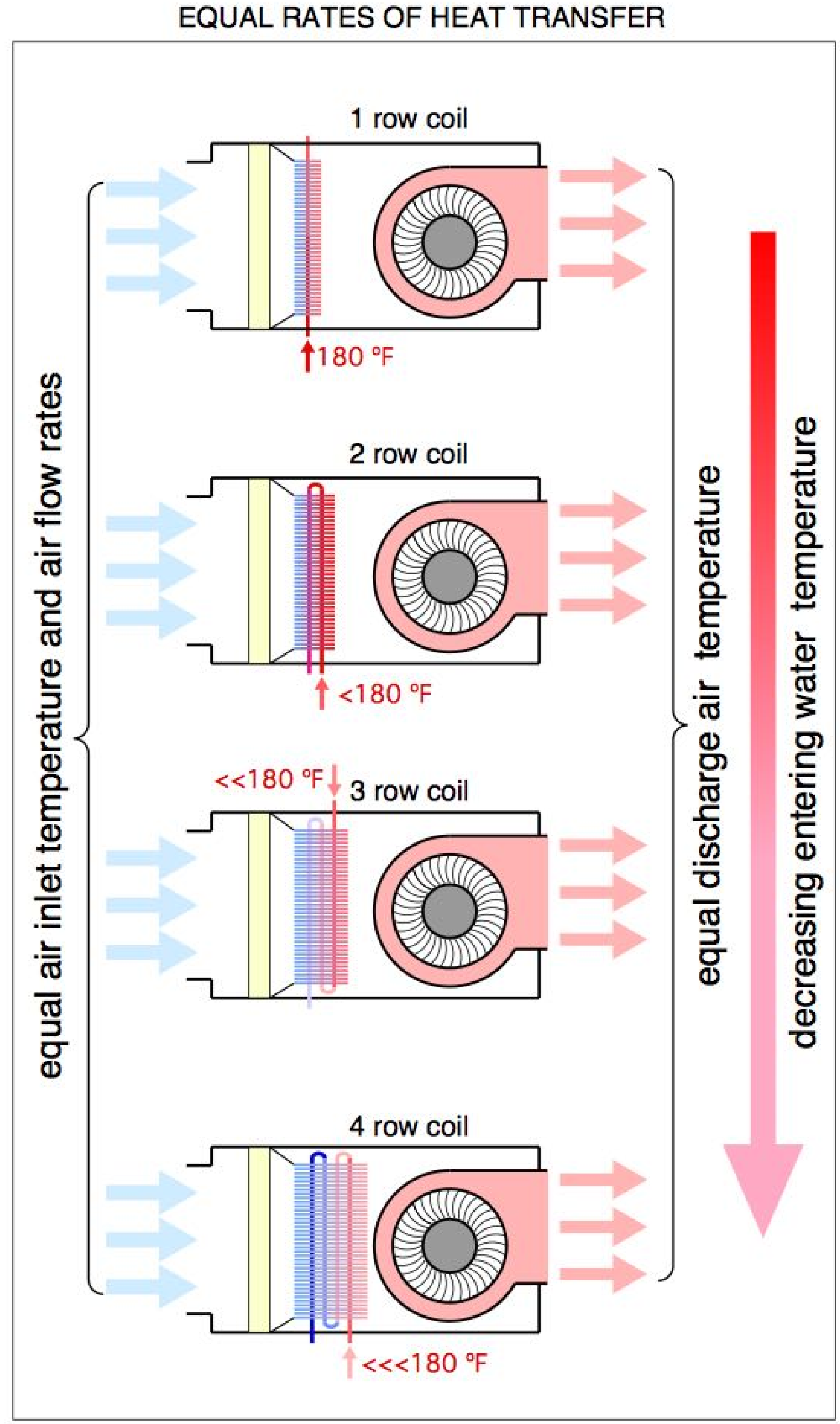
2 tube rows

10 tube rows

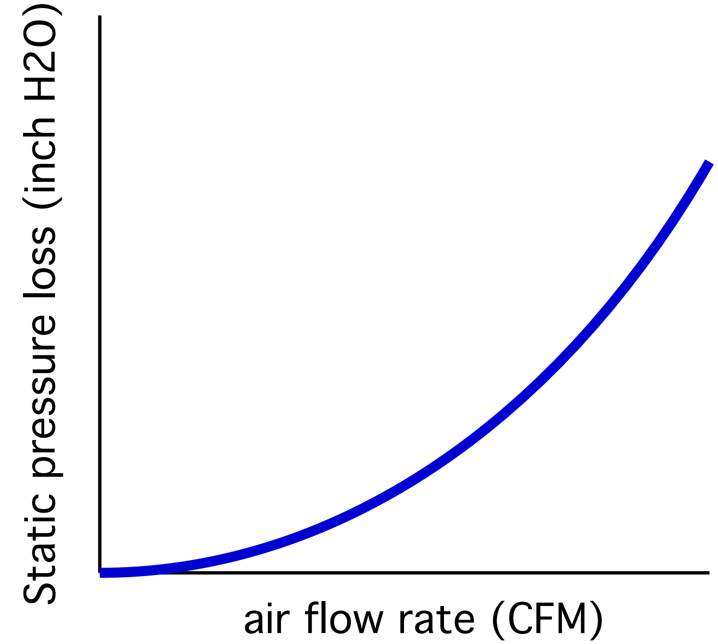
Note the sheet metal “flanges” on perimeter of coil to connect to similar flanges in ducting.

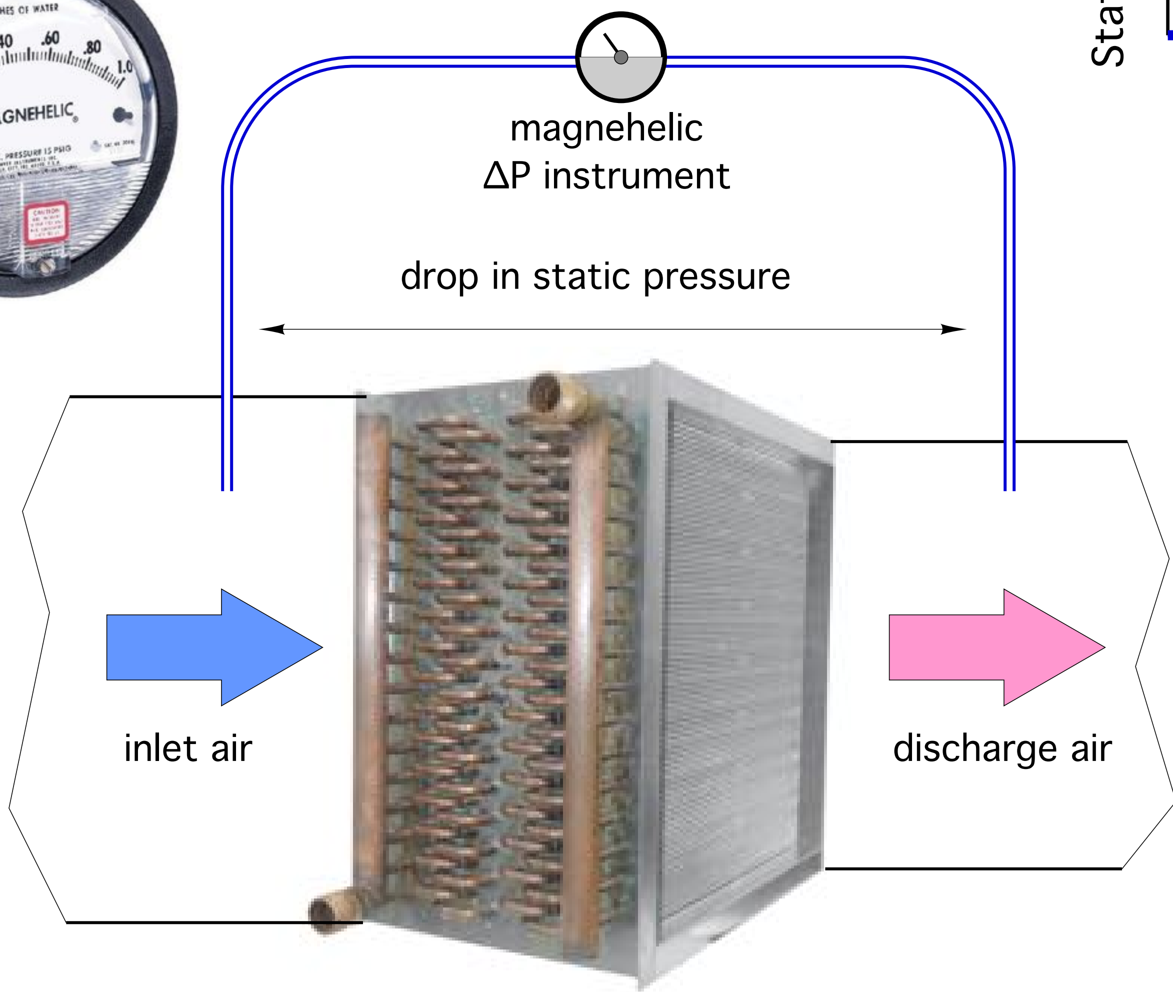
Coils with more tube passes allow a given rate of heat transfer at lower water temp.

Coils that can deliver the required rate of heat transfer at lower water temperatures allows better utilization of thermal storage.



However, “deeper” coils (w/ more tube rows) create higher static pressure losses in the forced air system.





Get ΔP vs. air flow rate data for specific coil from manf.

The furnace has a rating of air flow rate versus static pressure of the duct system.

Airflow tables

Furnace Airflow (CFM) Vs. External Static Pressure (in. W.C.)							
Model	**Tap**		**0.1**	**0.3**	**0.5**	**0.7**	**0.9**
S9X1B040U3PSBA S9B1B040U3PSAA	1	SCFM	310	314	118	-	-
		Watts	34	43	52	-	-
	2	SCFM	532	341	150	-	-
		Watts	36	45	54	-	-
	3	SCFM	877	748	620	491	362
		Watts	91	104	118	131	144
	4	SCFM	933	813	693	573	452
		Watts	106	120	133	147	161
	5	SCFM	1056	950	843	737	631
		Watts	140	156	172	188	204
	6	SCFM	1111	1009	908	806	705
		Watts	157	174	190	207	223
	7	SCFM	1174	1078	983	887	791
		Watts	182	199	216	233	251
	8	SCFM	1376	1297	1218	1140	1061
		Watts	285	305	325	344	364
	9	SCFM	1512	1445	1378	1312	1245
		Watts	382	403	424	445	466

static pressure "seen" by furnace (expressed in inches of water column, in w.g.)

motor speed tap

SCFM = standard cubic feet per minute, air flow rate

The furnace has a rating of air flow rate versus static pressure of the duct system.

The static pressure against which the furnace blower operates includes the ducting and the ΔP across the coil

Suggest limiting the ΔP across the coil to not more than 0.3 inches w.g.

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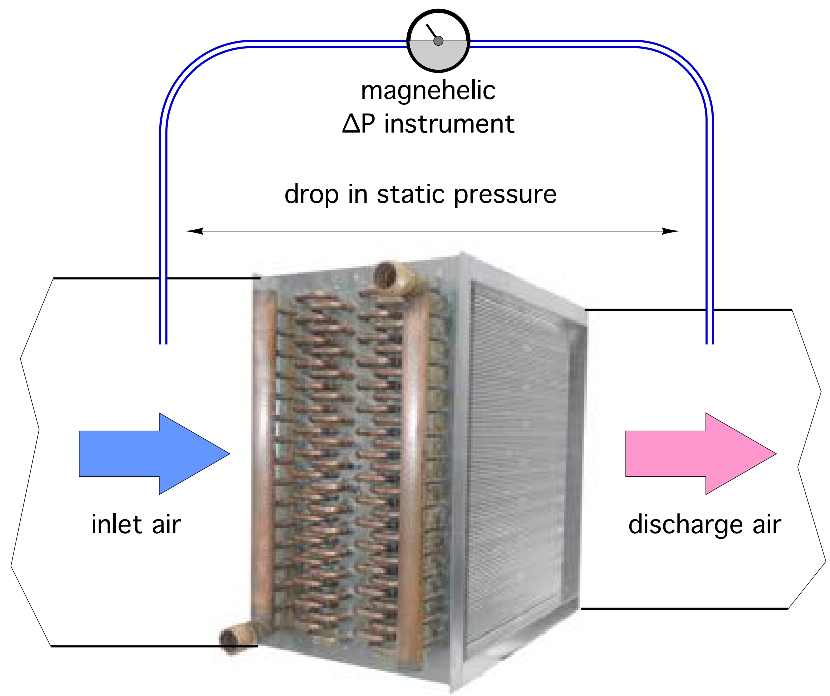
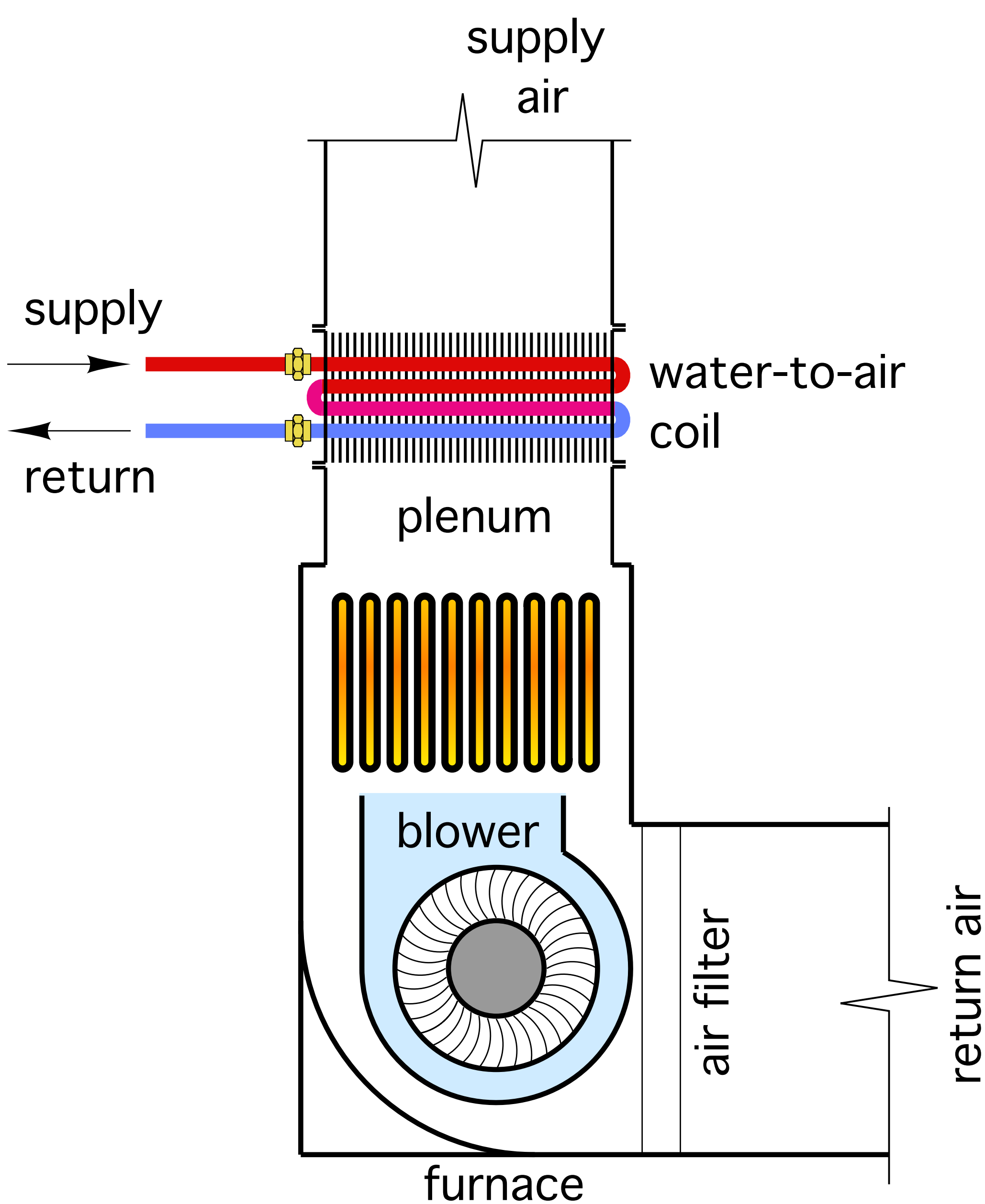


The coil should always be mounted on the DISCHARGE side of a furnace.



• Mounting the coil on the inlet of the furnace can cause the blower motor to overheat, leading to shutdown or burnout.

It also can invalidate the warranty on the furnace.

• It's typically necessary to have a sheet metal adapter fabricated to match the coil to the furnace outlet.

• Always mount the coil so that the "hot" side of the tubing is downstream relative to air flow. This provides COUNTERFLOW heat exchange.

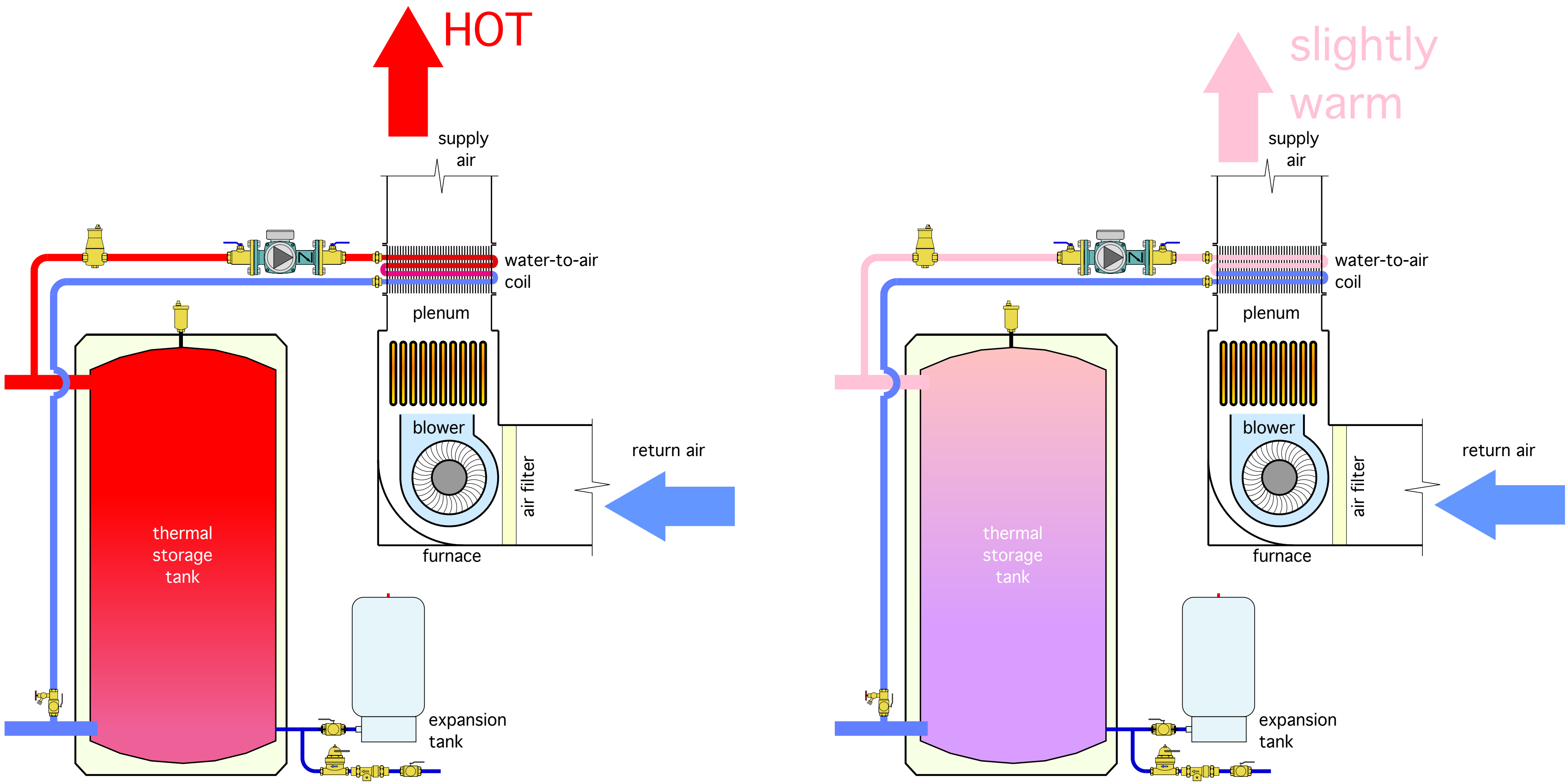
It's typically necessary to have a sheet metal adapter fabricated to match the coil to the furnace outlet.

horizontal coil

vertical coil

The design should prevent wide fluctuations in supply air temperature.

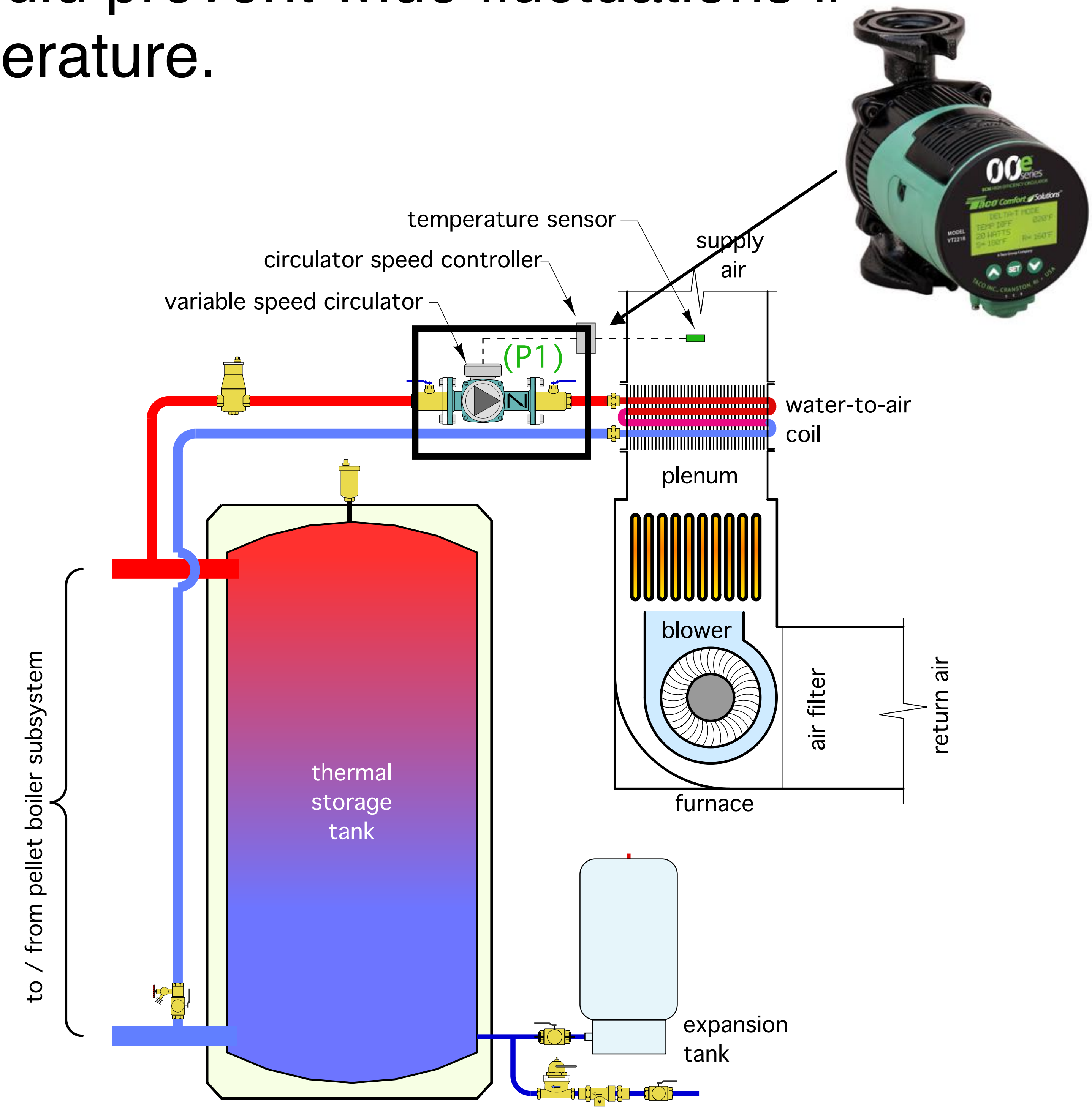
These fluctuation will “attempt” to occur as the thermal storage tank temperature decreases.



The design should prevent wide fluctuations in supply air temperature.

These variations can be minimized by controlling the hot water flow rate through the coil .

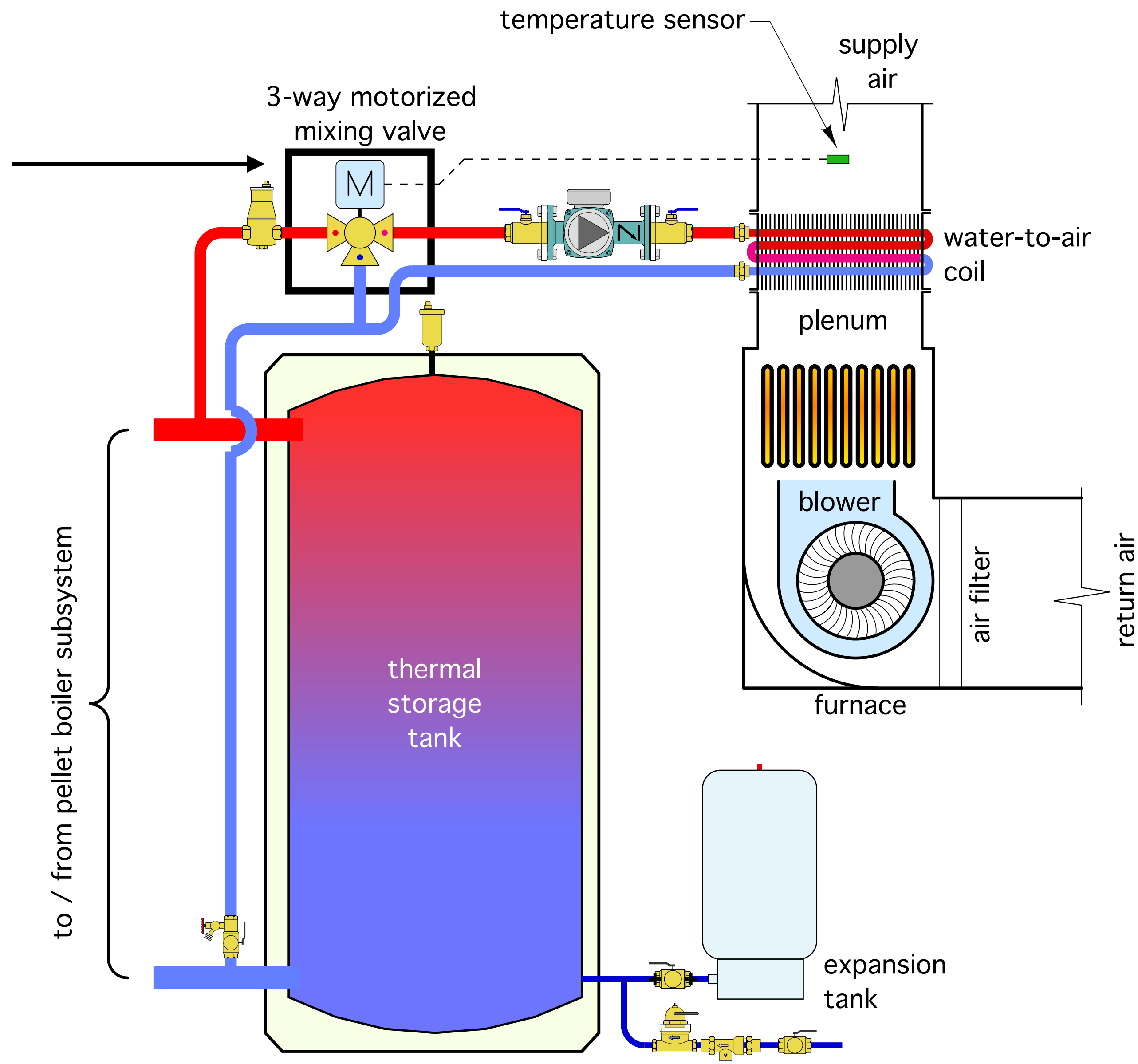
One option is to use a variable speed "setpoint" circulator to control flow rate through the coil, based on the air temperature downstream of the coil.



The design should prevent wide fluctuations in supply air temperature.

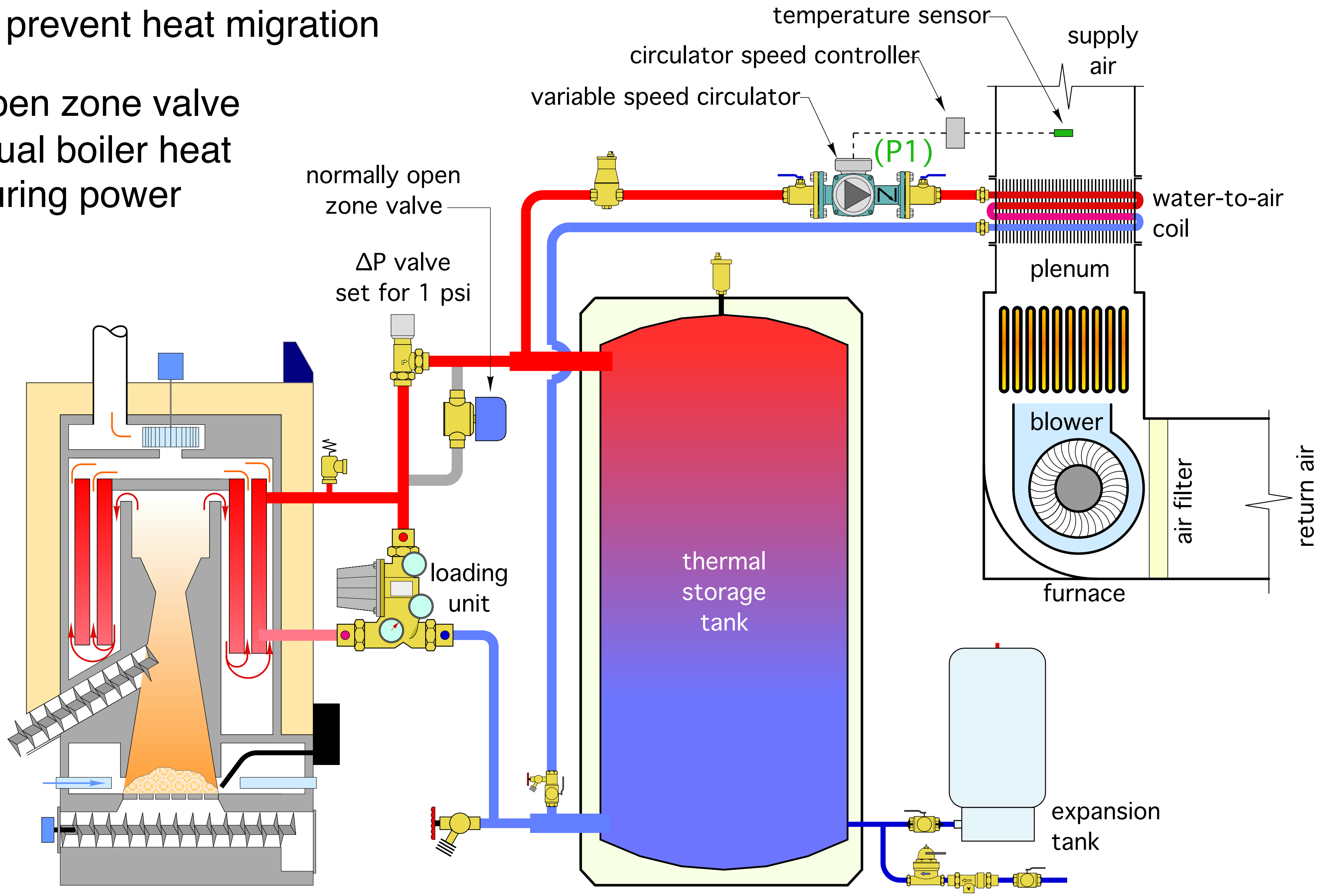
Taco iSeries mixing valve

Another option is to use a 3-way motorized mixing valve to control supply water temperature to the coil, based on the air temperature downstream of the coil.

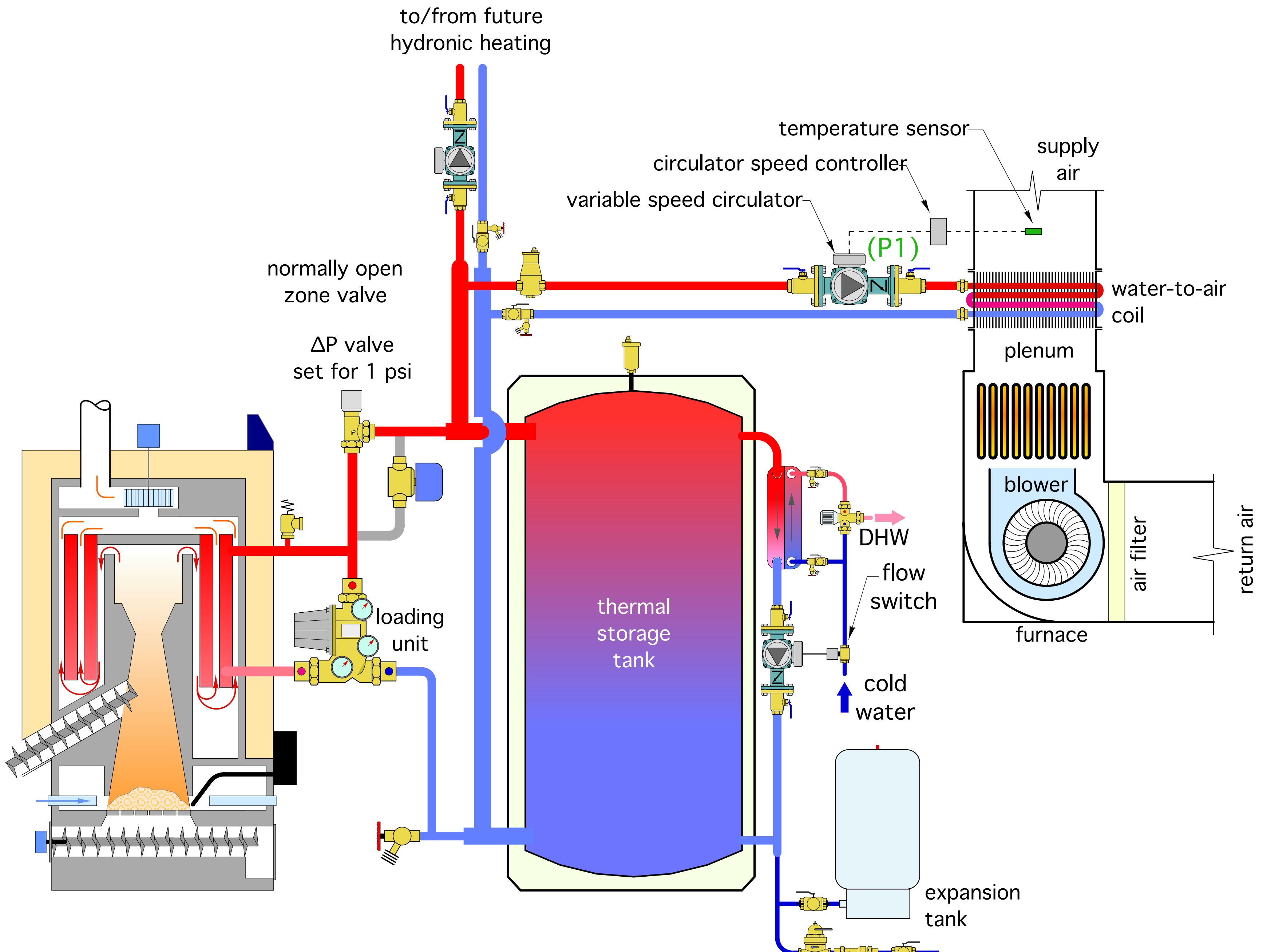


One possible system

- 2-pipe buffer tank
- Loading unit for anti-condensation control
- ΔP valve to prevent heat migration
- Normally open zone valve to allow residual boiler heat dissipation during power outage

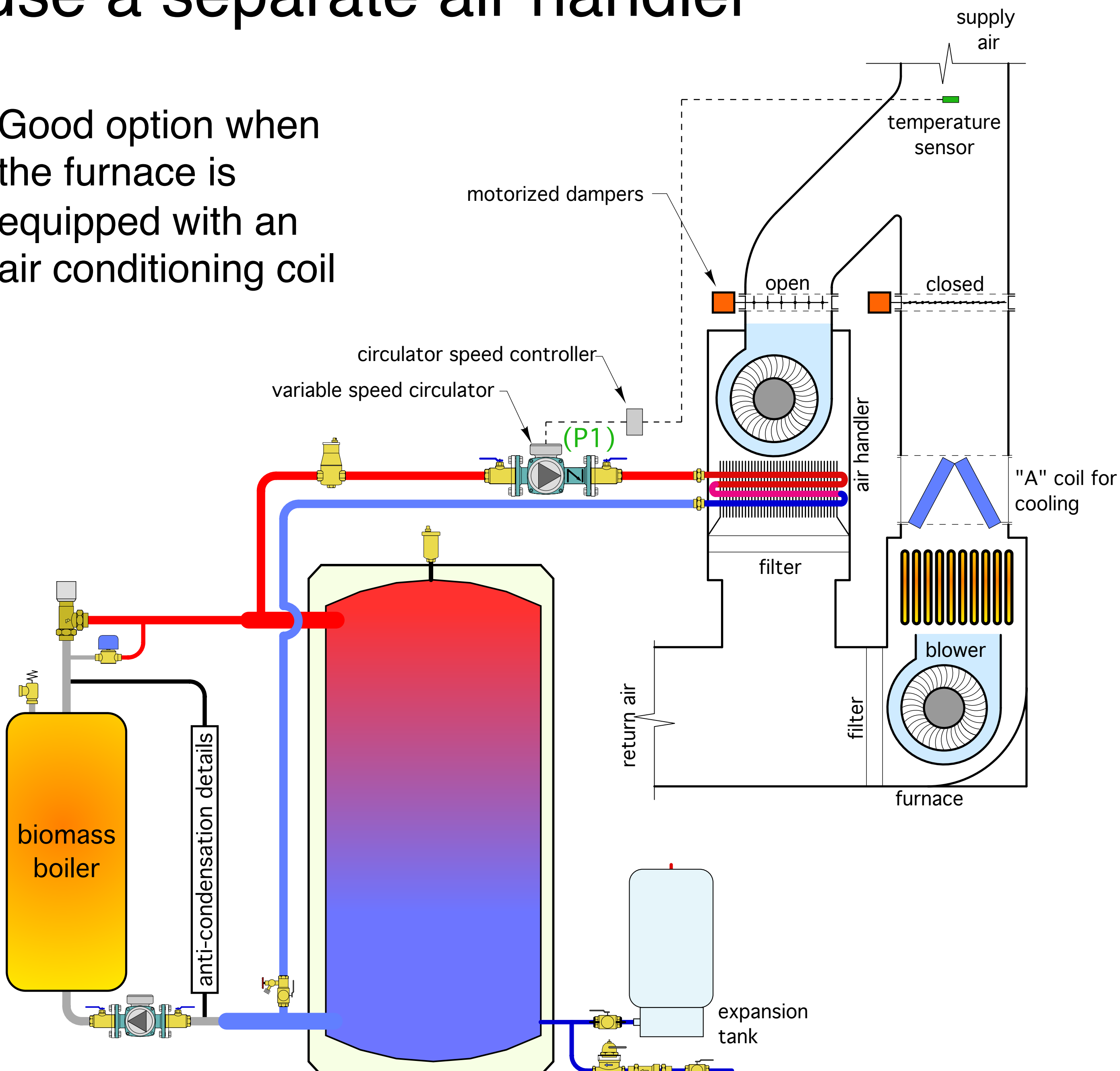


It’s also possible to expand the “base” system using hydronic heat emitters, and/or an external SS heat exchanger for domestic water heating.



If static pressure loss of coil is high, it's possible to use a separate air handler

Good option when the furnace is equipped with an air conditioning coil



Example of an air handler with hydronic coil

Thanks for attending this series of webinars.

November 2021

Title: Case study: Designing from scratch: What's possible when a pellet boiler is planned into new building construction

Description: Many of the previous webinars have focussed on adapting a pellet boiler into an existing hydronic heating system. This webinar describes an unfettered design development when a pellet boiler is incorporated into new construction. Details that leverage low temperature distribution systems, and optimal configuration of thermal storage for providing space heating and domestic hot water.

All of these webinars will be posted on NYSERDA's Renewable Heat NY website - under "training opportunities" link.

QUESTIONS ?