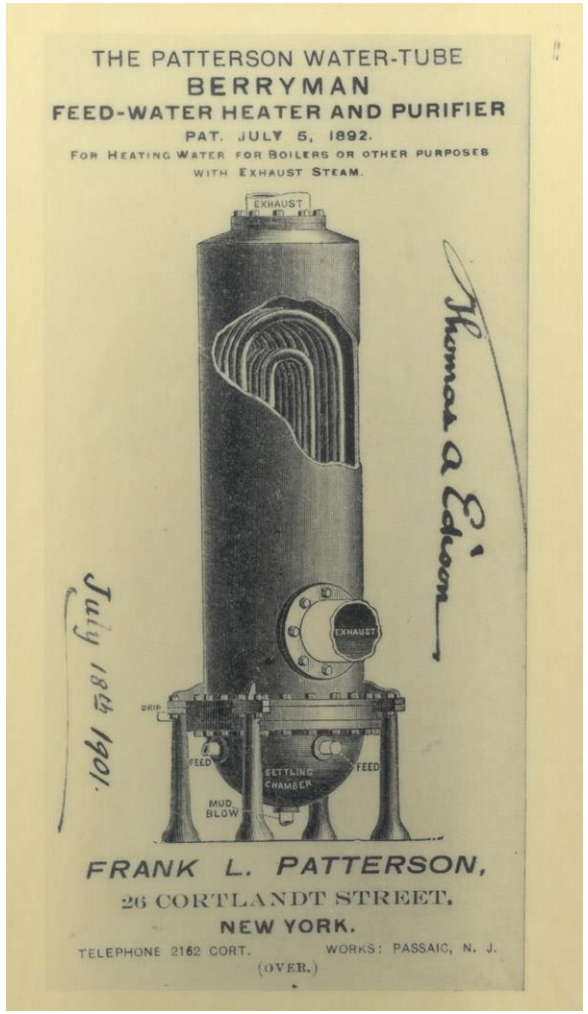
Electric Hybrid Boiler Systems

PATTERSON-KELLEY

PATTERSON-KELLEY HISTORY



A company heirloom autographed by Thomas A. Edison in 1901

Founded in 1880 as Benjamin F. Kelley & Company, Patterson-Kelley has evolved over the years, continually adapting and changing to lead the marketplace.

In fact, the company's very first product, feed water heaters, introduced pioneering technology with "U" tube bundles.

Following the death of its founder, the Kelley Company merged in 1917 with his son-in-law's organization, Frank L. Patterson & Company.

After World War II the business focus shifted from storage water heaters to more complicated, customer-engineered heat exchangers and other commercial and industrial products.

With over 125 years of experience and an innovative R&D pipeline, P-K is highly regarded for bringing value-added solutions to the marketplace.

PATTERSON-KELLEY HISTORY

PATTERSON-KELLEY HISTORY

P-K BOILER PORTFOLIO

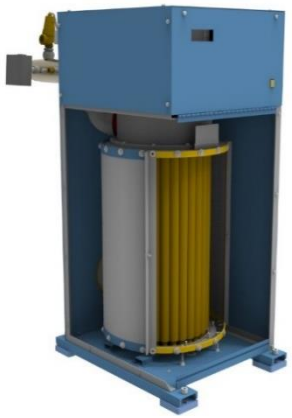
Condensing Boilers
Efficiencies> 86%

MACH®
SONIC®
STORM®
SOLIS®

Non-Condensing Boilers
Efficiencies</= 86%

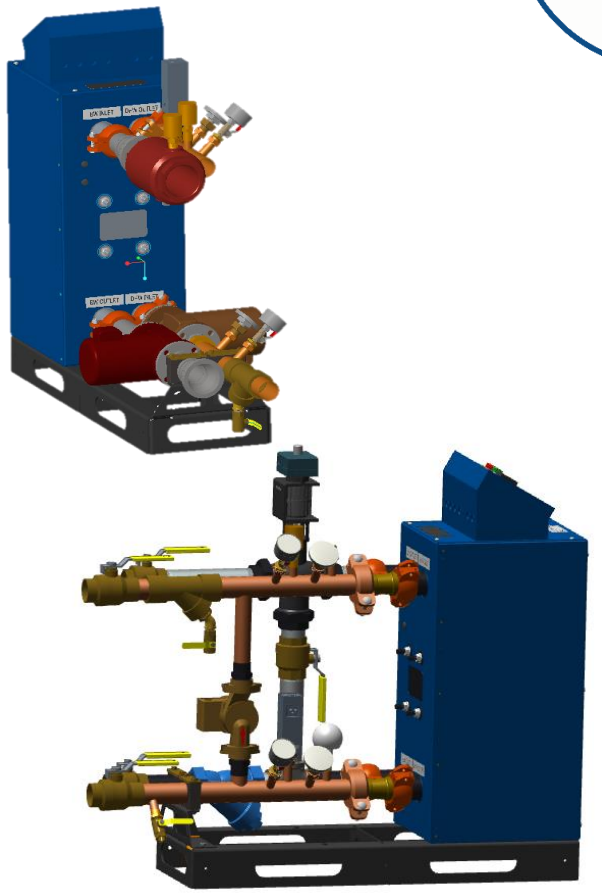
MFD®
Thermific VELOX®

P-K WATER HEATER PORTFOLIO



Gas-Fired Direct

Gas-Fired Indirect



Indirect

ELECTRIC HYBRID/DUAL FUEL BOILER SYSTEMS

- **Commercial boiler installations featuring both high efficiency condensing boilers and/or standard efficiency non-condensing boilers with an electrified appliance counterpart.**

- **The electric heat pump(s) take the lead position and are given priority operation throughout the majority of the heating season.**
  - ✓ *The electric heat pumps are fully utilized when the system supply temperature is below 130°F.*

- **The boiler(s) take the lag position and are primarily reserved for the coldest days of the heating season.**
  - ✓ *The non-condensing boiler(s) are fully utilized when the system supply temperature is above 130°F.*

HYBRID BOILER SYSTEM OBJECTIVES

- **Reduce the equipment cost by balancing the load between heat pump technology and boilers.**

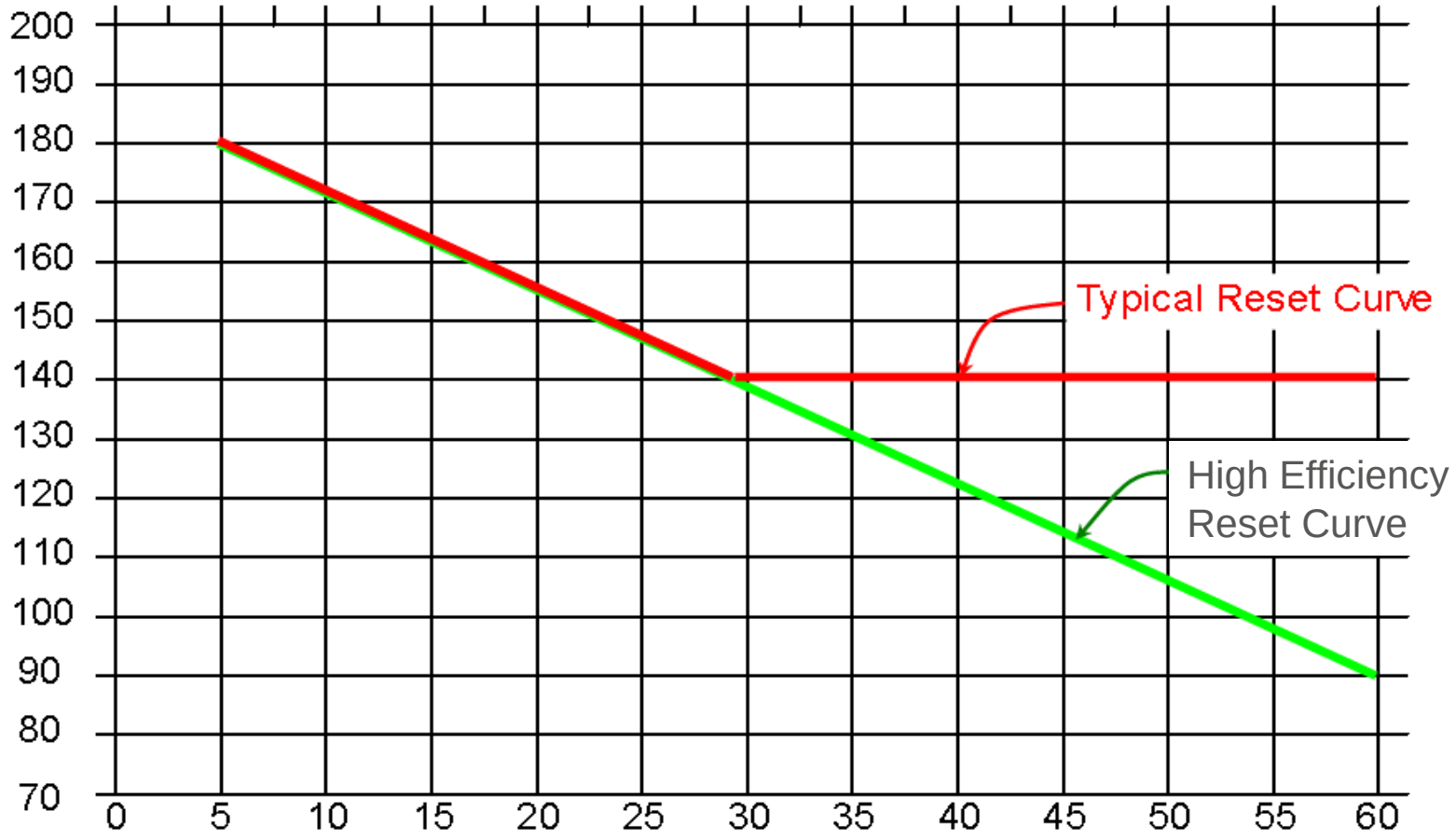
- **Normalize the equipment costs – pay a slight premium for heat pump capabilities but avoid overpaying.**
  - ✓ *Heat Pumps: Approximately $60 - $100+ per MBTUH*
  - ✓ *Boilers: Approximately $13- $33 per MBTUH*

- **Leverage the overall system modulation/turndown to eliminate short-cycling of the boiler equipment.**

- **Establish an extended Outdoor Air Reset curve to promote the use of the high efficiency equipment.**

- **Provide suitable equipment redundancy.**

HYBRID BOILER SYSTEM STRATEGY



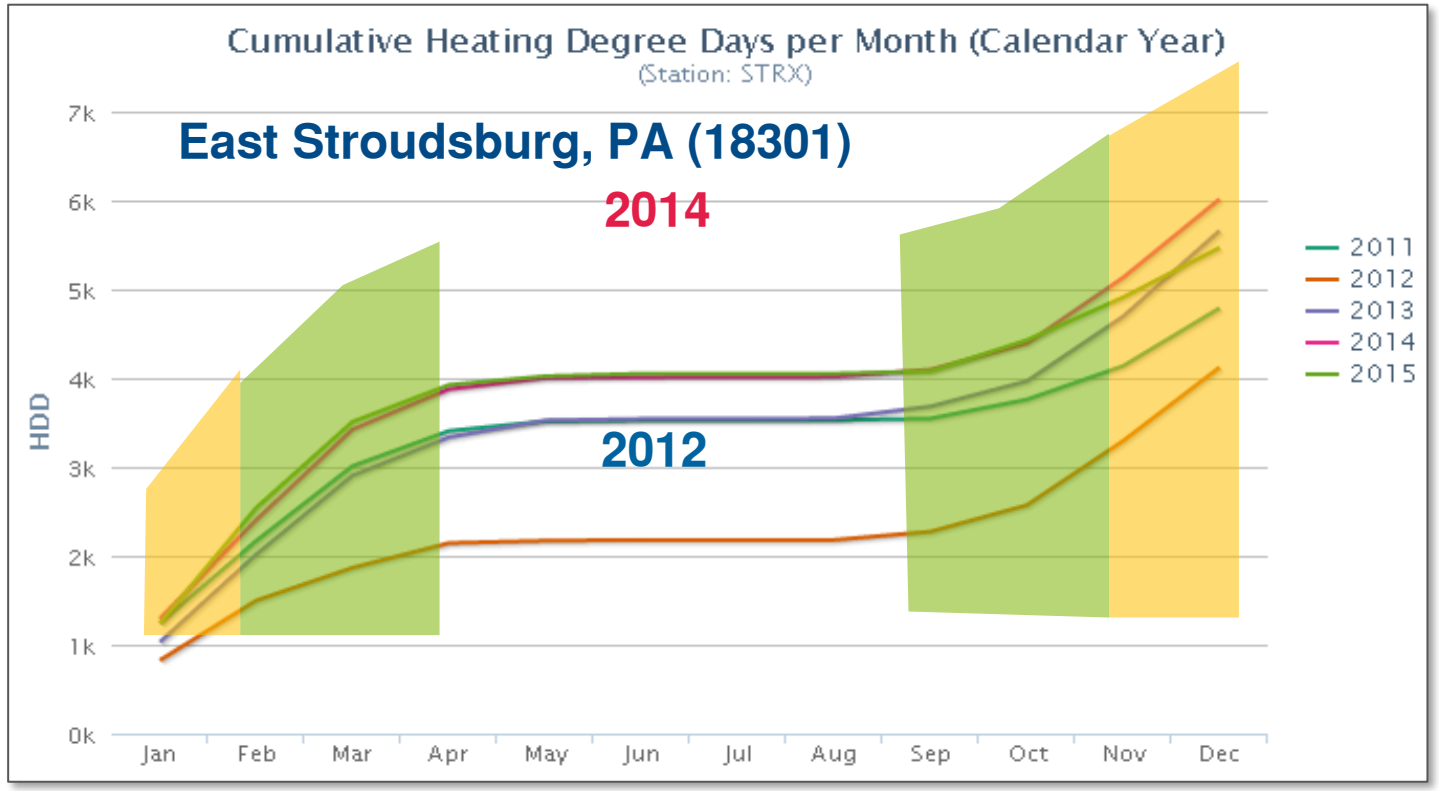
HYBRID BOILER SYSTEM STRATEGY

Avg T	BIN	to	Range	TOT	J	F	M	A	M	J	J	A	S	O	N	D	% TOT	% CUM	% LOAD
63	62		64	335				23	45	46	40	45	102	23	11		5.22	5.22	2.78
61	60		62	308				20	45	45	48	40	59	40	10	1	4.80	10.02	5.56
59	58		60	200				17	39	33	13	42	36	16	3	1	3.12	13.14	8.33
57	56		58	273	4		4	29	71	36	22	21	32	45	8	1	4.26	17.40	11.11
55	54		56	351	8	4	6	38	68	32	10	17	46	89	31	2	5.47	22.87	13.89
53	52		54	285	5	3	28	46	42	16	6	2	38	51	47	1	4.44	27.32	16.67
51	50		52	232	2	3	16	35	38	11	1		32	64	27	3	3.62	30.93	19.44
49	48		50	238	1	7	18	52	22	5			33	42	47	11	3.71	34.64	22.22
47	46		48	258		4	27	45	23	1			28	58	51	21	4.02	38.67	25.00
45	44		46	227	2	2	30	55	22				8	53	39	16	3.54	42.20	27.78
43	42		44	287	4	5	69	76	24				12	48	30	19	4.47	46.68	30.56
41	40		42	180	3	8	56	42	10				5	26	15	15	2.81	49.49	33.33
39	38		40	273	8	20	50	50	32				4	40	41	28	4.26	53.74	36.11
37	36		38	337	24	23	80	46	20				4	41	60	39	5.25	59.00	38.89
35	34		36	257	24	31	39	28	11					18	59	47	4.01	63.00	41.67
33	32		34	313	46	50	53	8	4					10	69	73	4.88	67.88	44.44
31	30		32	360	50	62	71	9						9	68	91	5.61	73.50	47.22
29	28		30	298	44	79	45	12						4	49	65	4.65	78.14	50.00
27	26		28	187	45	32	34	6							22	48	2.92	81.06	52.78
25	24		26	207	85	28	28								13	53	3.23	84.28	55.56
23	22		24	142	62	24	32								1	23	2.21	86.50	58.33
21	20		22	180	45	45	30								7	53	2.81	89.30	61.11
19	18		20	155	37	47	17								1	53	2.42	91.72	63.89
17	16		18	105	38	33	7									27	1.64	93.36	66.67
15	14		16	113	38	47	3									25	1.76	95.12	69.44
13	12		14	85	46	22	1									16	1.33	96.45	72.22
11	10		12	54	18	31										5	0.84	97.29	75.00
9	8		10	52	21	26										5	0.81	98.10	77.78
7	6		8	38	22	14										2	0.59	98.69	80.56
5	4		6	21	17	4											0.33	99.02	83.33
3	2		4	16	12	4											0.25	99.27	86.11
1	0		2	17	14	3											0.27	99.53	88.89
-1	-2		0	13	9	4											0.20	99.73	91.67
-3	-4		-2	13	6	7											0.20	99.94	94.44
-5	-6		-4	4	4												0.06	100.00	97.22
-7	-8		-6														0.00	100.00	100.00

Wilkes-Barre, PA

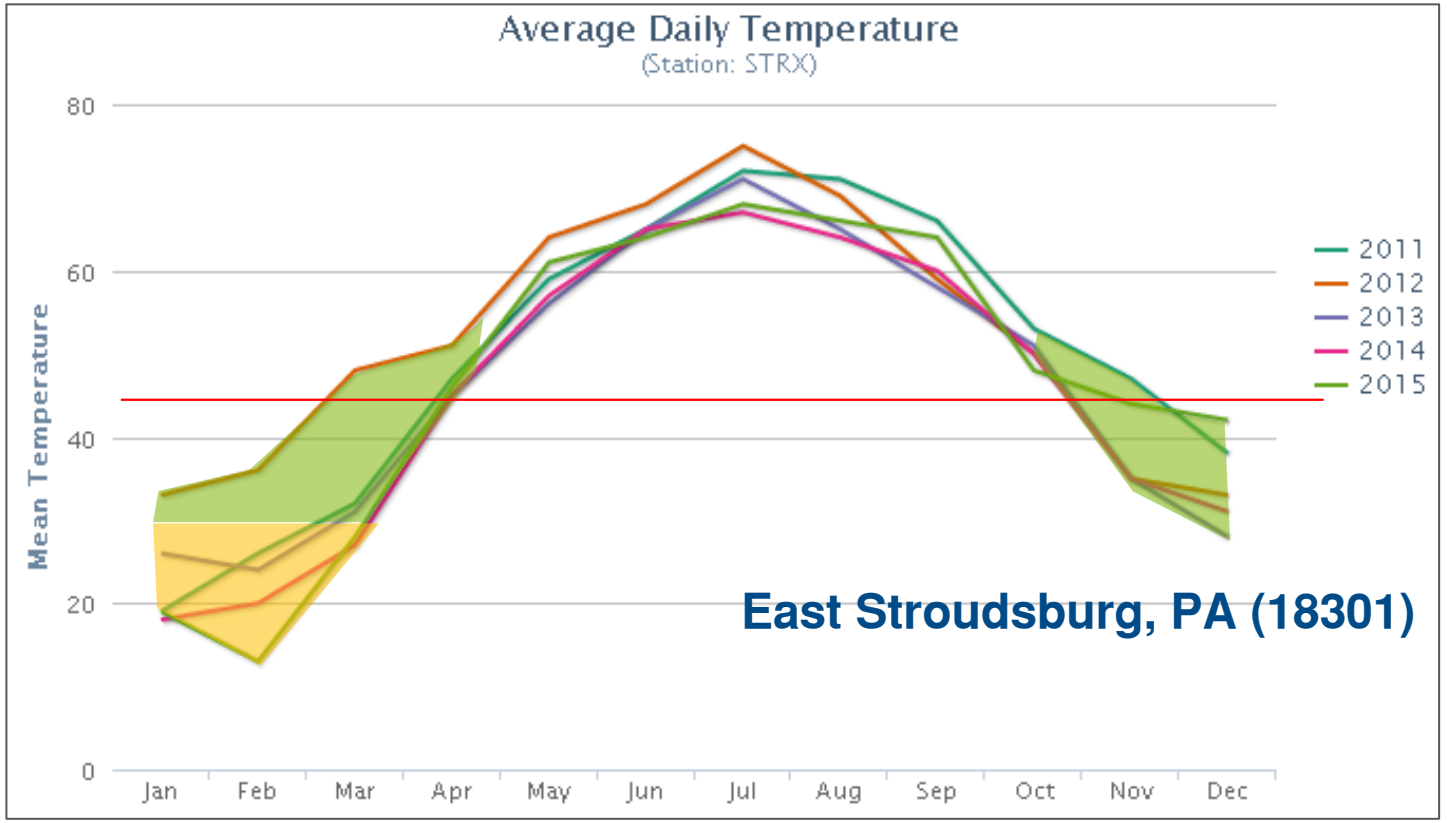
78.14% of Heating Season Can Use Condensing Temperatures in Wilkes-Barre

HYBRID BOILER SYSTEM STRATEGY



Source:
http://www.weatherdatadepot.com/

HYBRID BOILER SYSTEM STRATEGY



Source: http://www.weatherdatadepot.com/

TERMINAL UNITS: BASEBOARD

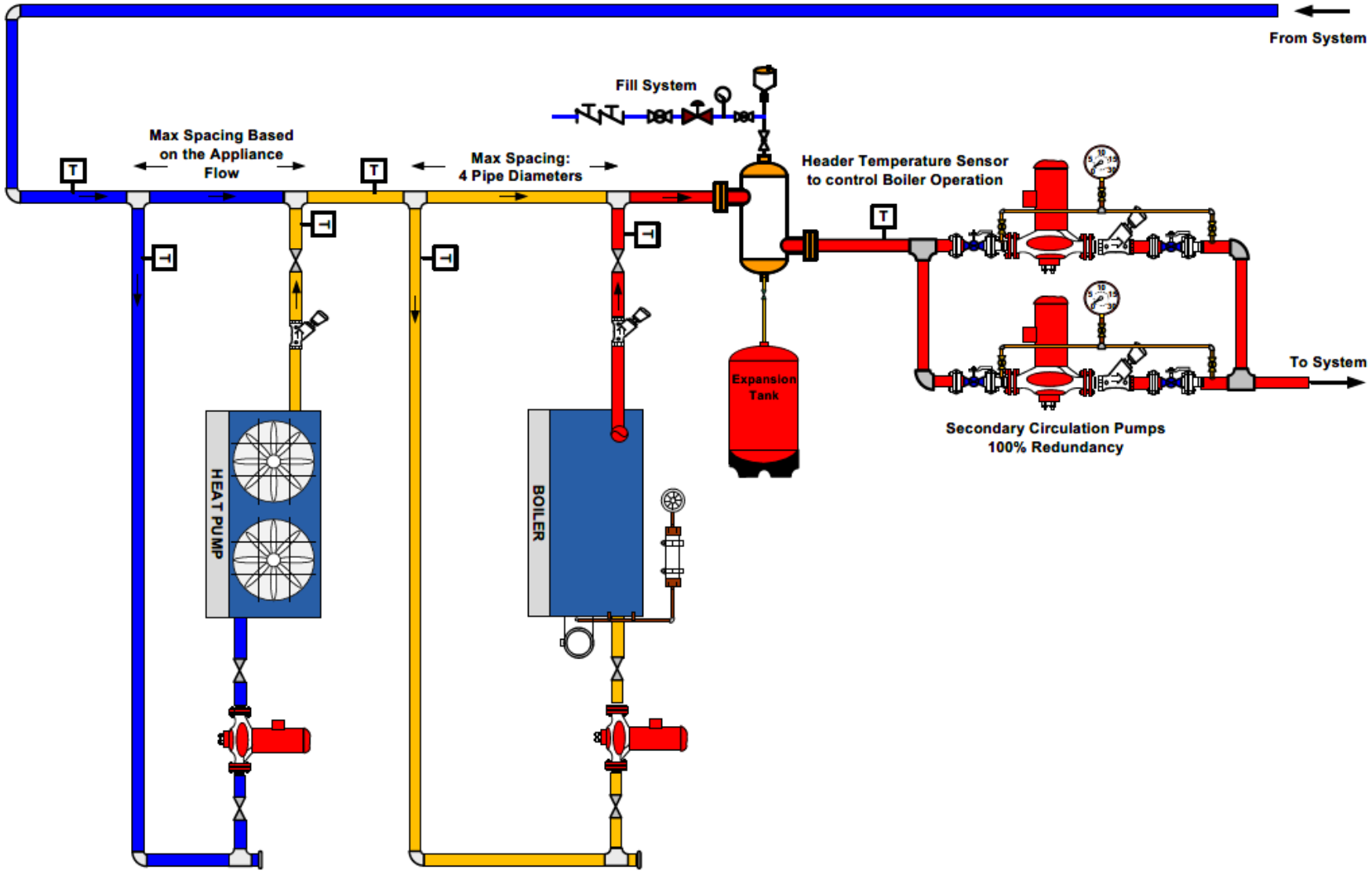
Tube Size & Material	Fin Size & Material	Fins Per Foot	Water Flow	Pressure Drop †	Steam 1 PSI* Btu/Hr. Per Foot	HOT WATER RATINGS* BTU/HR./FT. 110°F	120°F	130°F	140°F	150°F	160°F	170°F	180°F	190°F	200°F	210°F	220°F
3/4 copper	"3" x 3¼" x .024 aluminum	48	1 GPM	47	—	230	310	390	480	570	670	770	870	980	1080	1200	1320
			4 GPM	525		250	330	410	500	600	700	810	920	1040	1140	1260	1400
3/4" copper	2¾" x 2½" x .011" aluminum	55	1 GPM	47	—	210	290	360	440	520	610	710	800	900	1000	1100	1220
			4 GPM	525		230	300	380	460	550	650	750	850	960	1060	1170	1290
1" copper	3" x 2½" x .011" aluminum	48	1 GPM	13	—	210	290	360	440	520	610	710	800	900	1000	1100	1220
			4 GPM	145		230	300	380	460	550	650	750	850	960	1060	1170	1290
1-1/4" copper	3" x 3¼" x .020" aluminum	48	1 GPM	6	1160	220	300	370	450	540	640	730	830	940	1040	1140	1260
			4 GPM	63		230	310	390	480	570	670	780	880	990	1100	1210	1340
1-1/4" IPS steel	3" x 3¼" x .028 aluminized steel	48	1 GPM	3	980	190	250	320	390	460	550	630	710	810	890	980	1080
			4 GPM	41		200	270	340	410	490	580	670	750	850	940	1040	1150

NOTE: Approximately 50% Reduction in Heating Capacity from 140°F to 110°F

HYBRID BOILER SYSTEM ESSENTIALS

- **Heat Pump(s) MUST be upstream of boiler(s).**
  - ✓ *Prioritizes electrified equipment*
  - ✓ *Optimizes performance*
- **Control system's temperature sensor MUST be downstream of all appliances in order to measure their contribution to the heating system.**
- **Control system MUST prioritize the heat pump(s).**
- **Control system MUST protect the heat pumps from high incoming (return) water temperatures.**
- **Tune the ODA reset curve for the lowest possible operating temperatures throughout the year based on terminal unit capacities.**

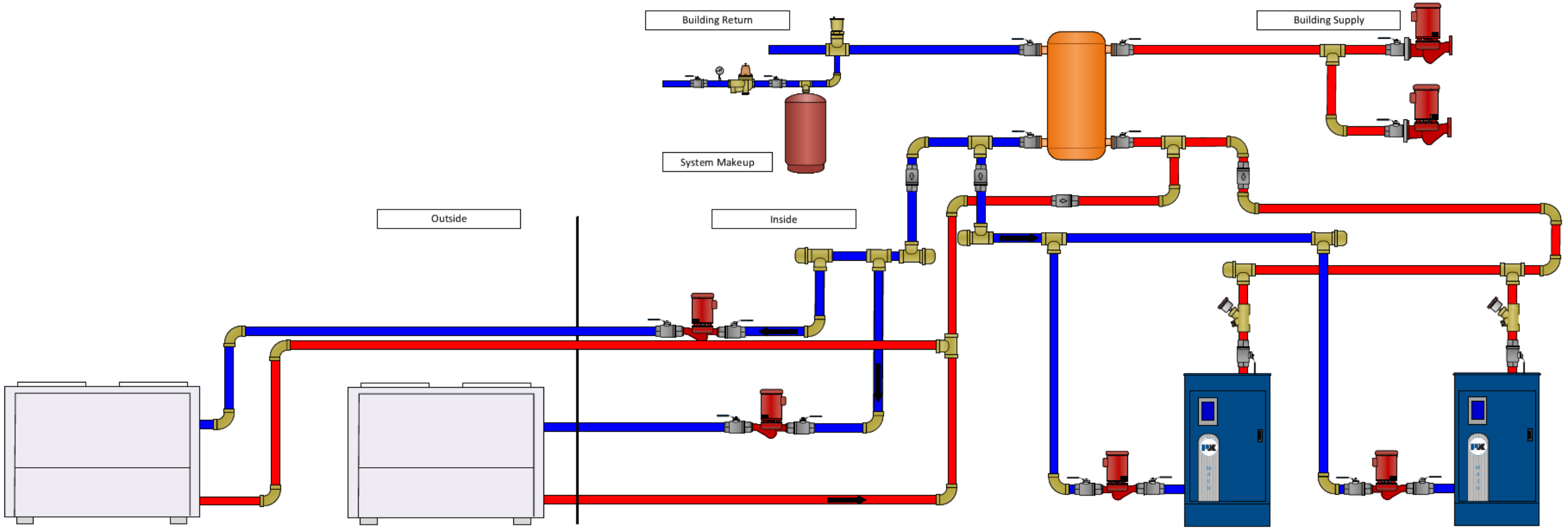
SEQUENTIAL PRIMARY/SECONDARY



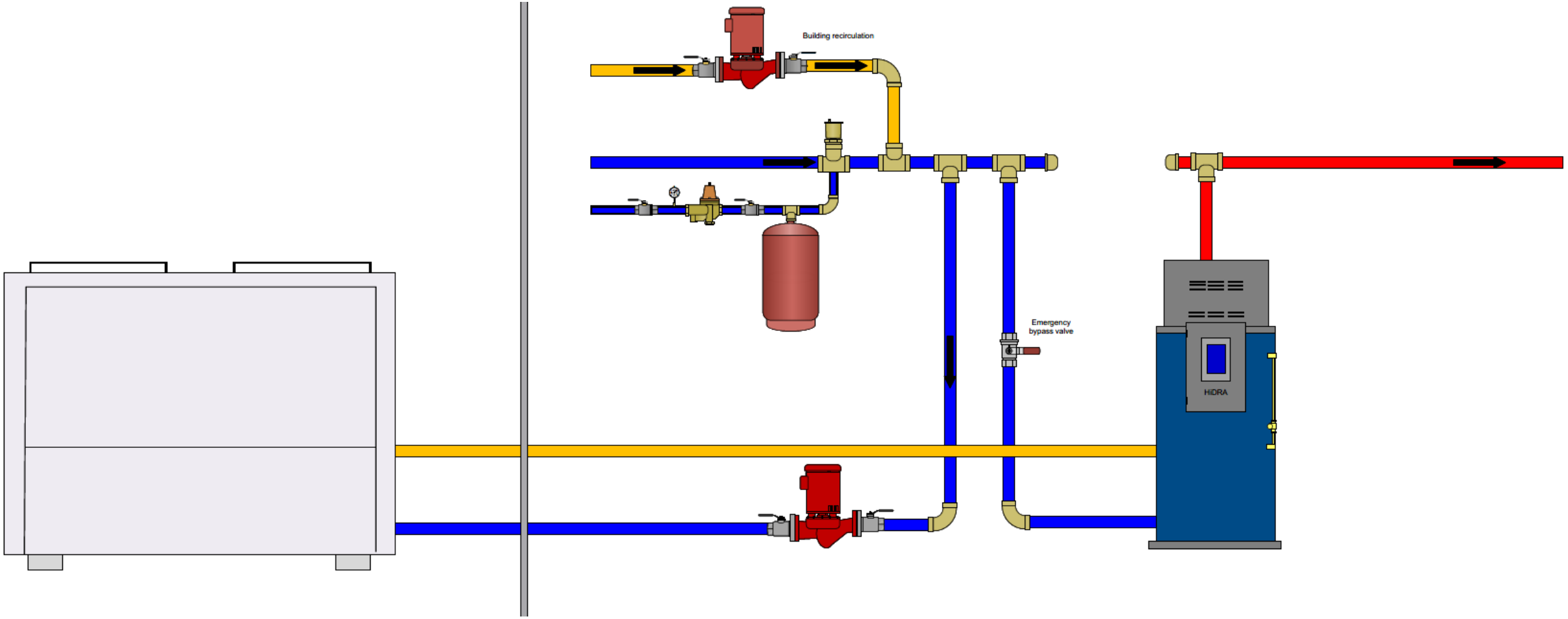
Heat Pump Upstream

Boiler Downstream

HEAT PUMP WITH LOW LOSS HEADER



HEAT PUMP FOR DHW APPLICATION



HYBRID BOILER SYSTEM PERKS

- **Minimize first cost & installation cost by reusing operable equipment:**
  - ✓ *Keep existing operable boilers for backup and redundancy*
  - ✓ *Install heat pumps for priority operation and carbon reduction goals*

- **Opportunities for dual fuel operation / interruptible service:**
  - ✓ *Heat Pumps: Electric*
  - ✓ *Boilers: Natural Gas, Propane Gas, Fuel Oil*

- **Achieve higher system ΔT → Lower return temperatures**
  - ✓ *More condensing opportunities throughout the heating season*

- **Requires relatively simple installation methods with significant fuel savings – excellent ROI potential!**

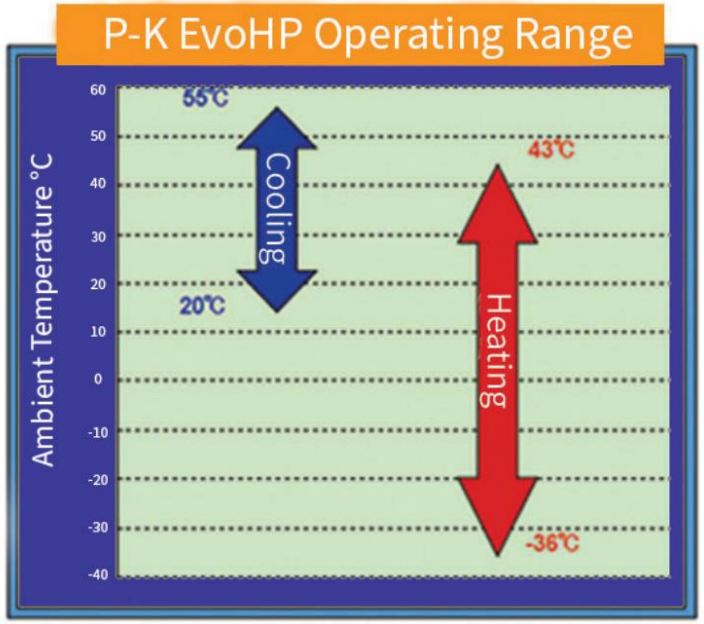
PK Heat Pump EvoHP HP700

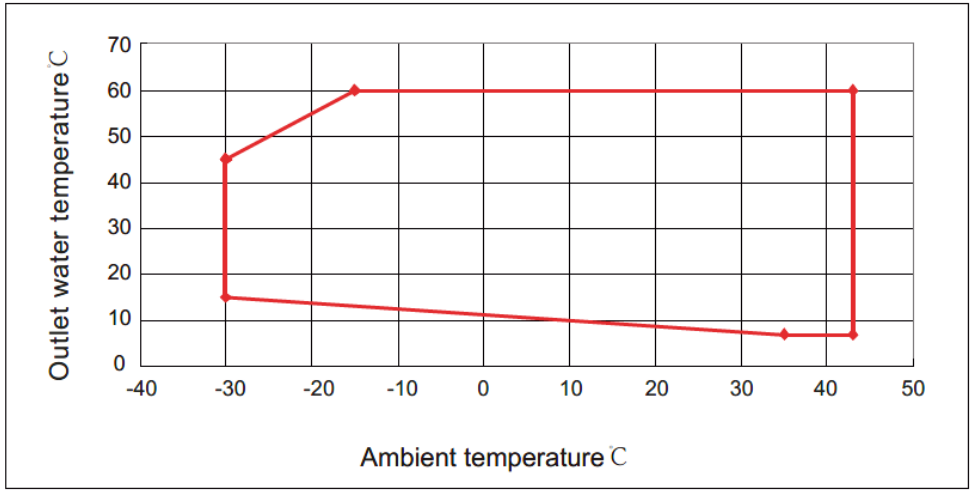
- **Compact External Rotor DC Motors**
  - High-performance compact external rotor DC motors and integrated design help to maintain low noise and high efficiency.

- **Large Type C Finned Heat Exchanger**
  - The fins adopt anti-frost coating and corrugated edge spoilers to further enhance the effect of spoilers at strong wind side, which improves heat transfer coefficient, extends frost-free operation time by more than 50% and improves COP.

PK Heat Pump EvoHP

- **Wide Operating Range**
  - Equipped with multiple technologies to improve stability and reliability, aiding with extreme temperature challenges and stable operation.
- **Min operating ambient temp:**
  - -32 F
- **Max operating ambient temp:**
  - 131F





PK Heat Pump EvoHP

HEAT PUMP RATINGS	HP700
EFFICIENCY (CoP)	3.71 (371%)
REFRIGERANT	R410A
MAX BTU/HR INPUT	249,415
MAX KW INPUT	73.1
MAX BTU/HR OUTPUT	853,000
MAX KW OUTPUT	250
MIN FLOW @ IGNITION (GPM)	85.3
MIN FLOW @ IGNITION (LITRES/SEC)	5.4
MIN BTU/HR INPUT	62,354
MIN KW INPUT	18.3
MIN BTU/HR OUTPUT	213,250
MIN KW OUTPUT	62.5

HEAT PUMP RATINGS	HP700
INDOOR/OUTDOOR	OUTDOOR
TURNDOWN	4:1
FUEL EC=ELECTRIC	EC
DEPTH (IN / MM)	137 / 3480
WIDTH (IN / MM)	52.4 / 1330
HEIGHT (IN / MM)	92.9 / 2360
SHIPPING WEIGHT (LBS/KILOS)	2508 / 1140
ELECTRICAL REQUIREMENTS	440-480V 3ph 60hz 167 amps
OPERATING WEIGHT (LBS/KILOS)	2508/ 1104
FLW RATE 20°F ΔT GPM (LT/SEC)	85.3 / 5.4