Best Practices for High Efficiency Tankless Coil / Combi Boilers

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National Oilheat Research Alliance

ACEEE
Hot Water Forum
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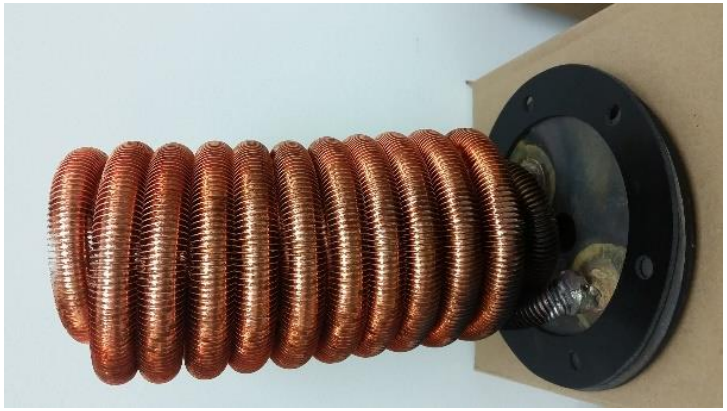

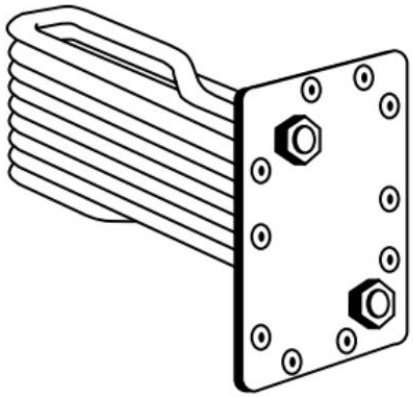

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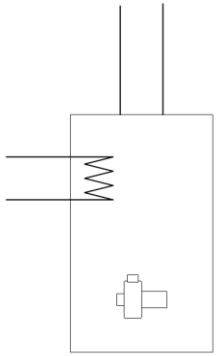
Tankless Coil Boilers



- A popular, low cost oil-heat option;
- Low annual efficiency as boiler must remain hot during non-heating season;
- Prior studies have shown common tankless coil boilers to have very high idle losses, leading to really poor annual performance;
- Over time, the heat transfer performance of coils decreases leading to the need for higher setpoints to meet DHW needs;
- One older tankless coil boiler removed from the field had an idle loss in the 4% range and a summer domestic hot water production efficiency in the 25% range;
- Poor performing tankless coil boilers often have significant uninsulated surface area;
- Some manufacturers produce tankless coil boilers with much lower idle loss but have no means to market the benefits of this.

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Tankless Coil Boilers

Major Project Tasks

1. Technology Review – meet with manufacturers, identify technologies for lab testing;
2. Lab Performance Testing – idle loss, steady state full load, emulated DHW Load profiles
3. Analysis and best practices guide

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Units Under Test

1. Conventional steel and cast iron tankless boilers
2. Cast iron tankless boiler with high capacity coil
3. Cast iron tankless boiler with old coil from the field
4. New oil-fired combi boiler with external plate heat exchanger

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Tests

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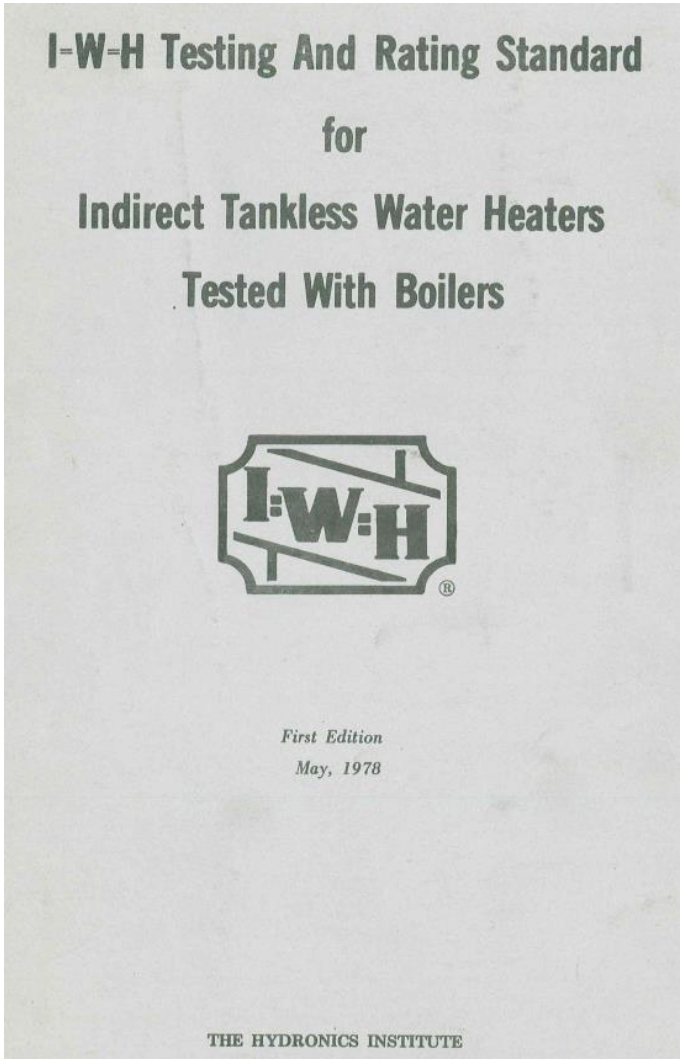
Coil Performance Rating

- Rating = gpm draw from 40 F to 140 F with 200 F boiler water temperature;
- Three 5 minute draw periods each followed by 10 minute recovery periods;
- Burner cycled manually – off @ 160 F above entering water temp and on @ 150 F above entering water temp.
- Test at 2 or 3 different flow rates;
- Rated flow – average of 100 F rise.



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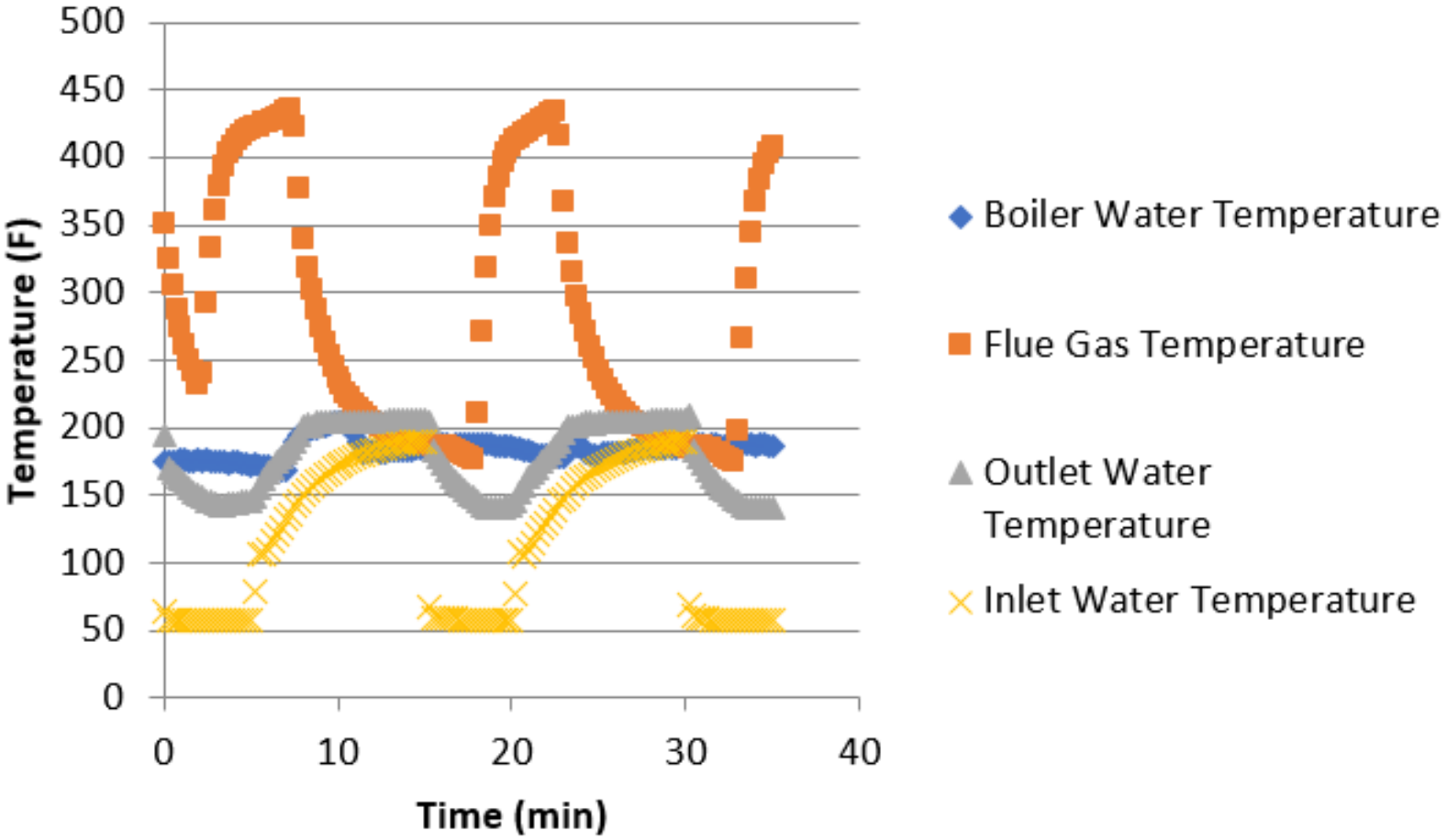
Coil Rating Test



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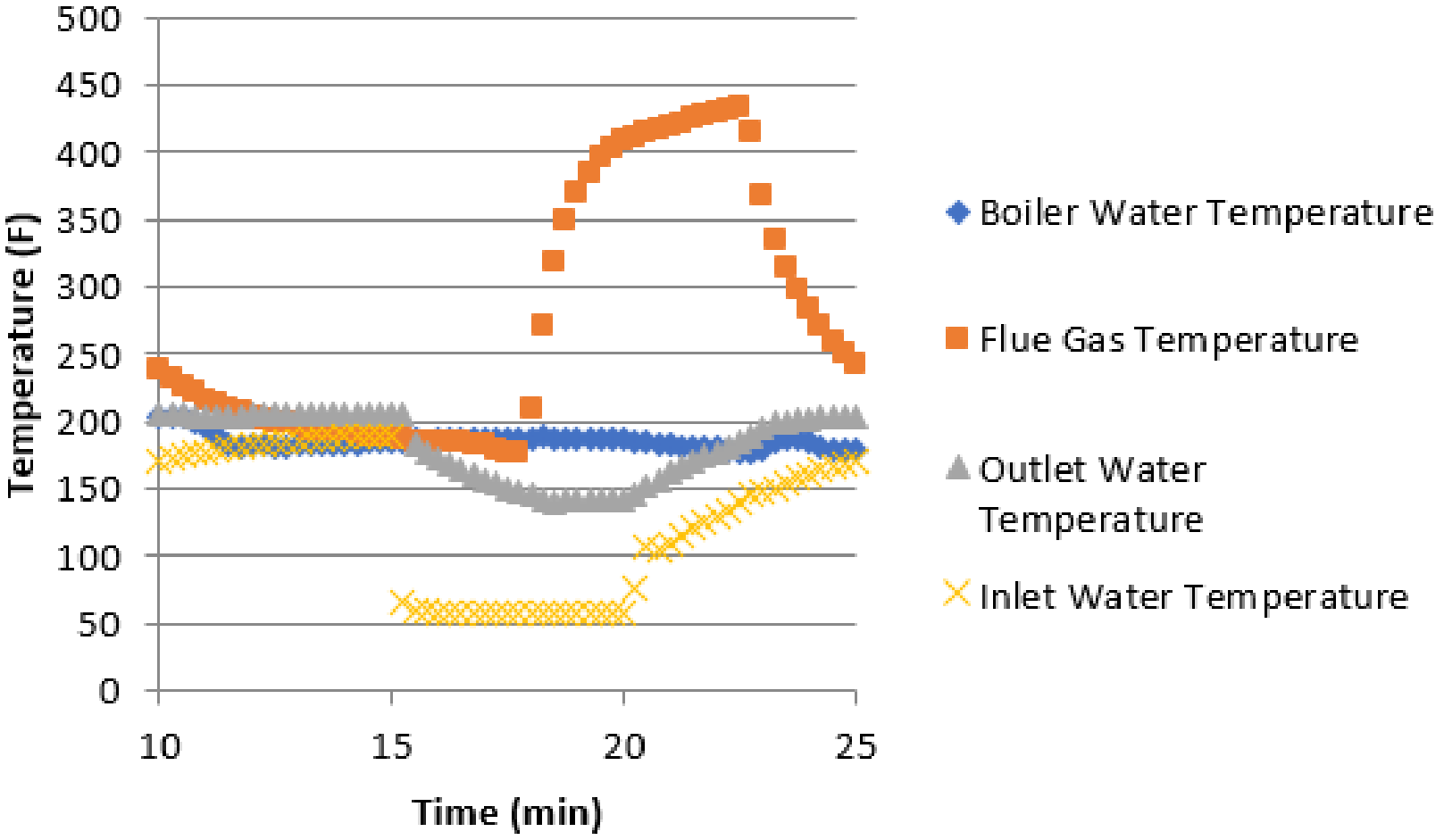

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Efficiency/Test Draw Pattern

For efficiency comparison;
55 gal/day total (medium use);
24 hour test

Draw	Gallons	gpm	Time
1	15	1.7	0:00
2	2	1.0	0:30
3	9	1.7	1:40
4	9	1.7	10:30
5	5	1.7	11:30
6	1	1.0	12:00
7	1	1.0	12:45
8	1	1.0	12:50
9	1	1.0	16:00
10	2	1.0	16:15
11	2	1.7	16:45
12	7	1.7	17:00

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Summer Idle Loss Rate

No heat draw;
Burner fires periodically to maintain set Low Limit;
Energy consumption recorded over 2-3 day period.

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Results

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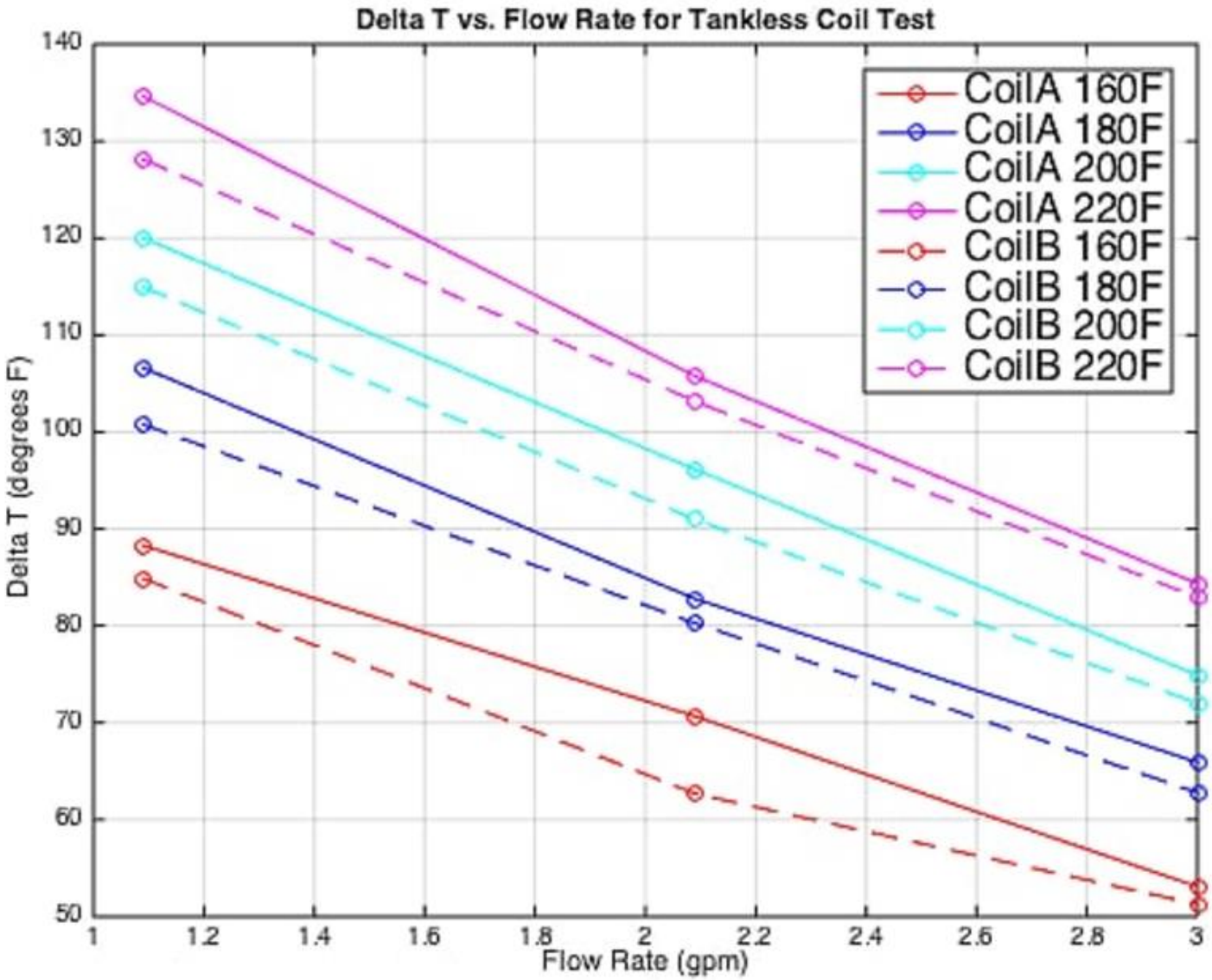
Coil Rating Test

Cast iron boiler
Round coil
A = stock, 3 gpm
B = aftermarket, 5 gpm



Efficiency – 24 hour simulated use test with conventional in-boiler coil

Unit	Efficiency
Steel boiler - 3 gpm coil	33.9
Cast iron boiler - 5 gpm coil	38.5
Cast iron boiler - 3 gpm coil	40.8

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Efficiency – 24 hour simulated use test with combi-boiler with external plate heat exchanger

Mode	24 Hour Efficiency (%)
Fixed Temperature	49.4
Fixed Temperature with added insulation on piping	51.8
Fixed Temperature with added insulation on piping and off cycle air damper	56.0
Cold Start	62.5
Cold Start with 2 minute heat-up and added insulation	67.1
Cold Start with 2 minute heat-up, added insulation and off cycle air damper.	67.0

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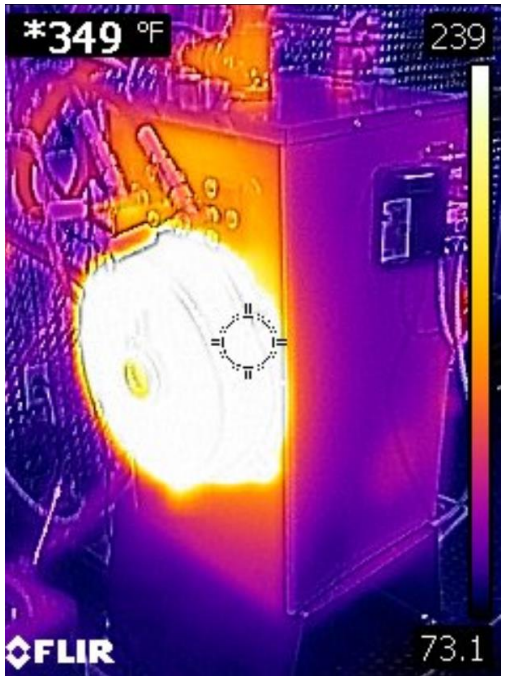

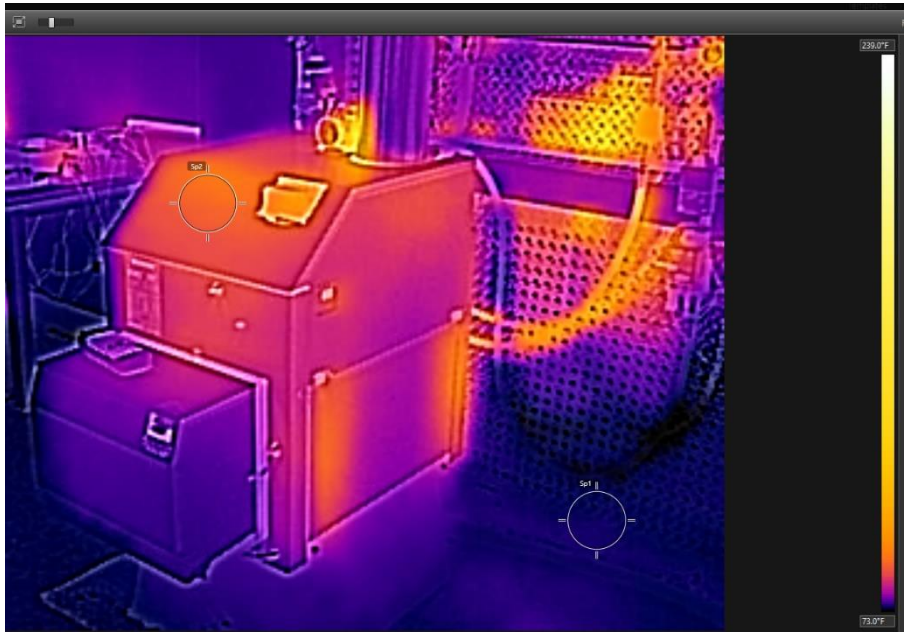

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Idle Loss

1. Conventional Tankless Coil – 2.6%
2. Combi – 0.92 % (Fixed Temperature Mode)

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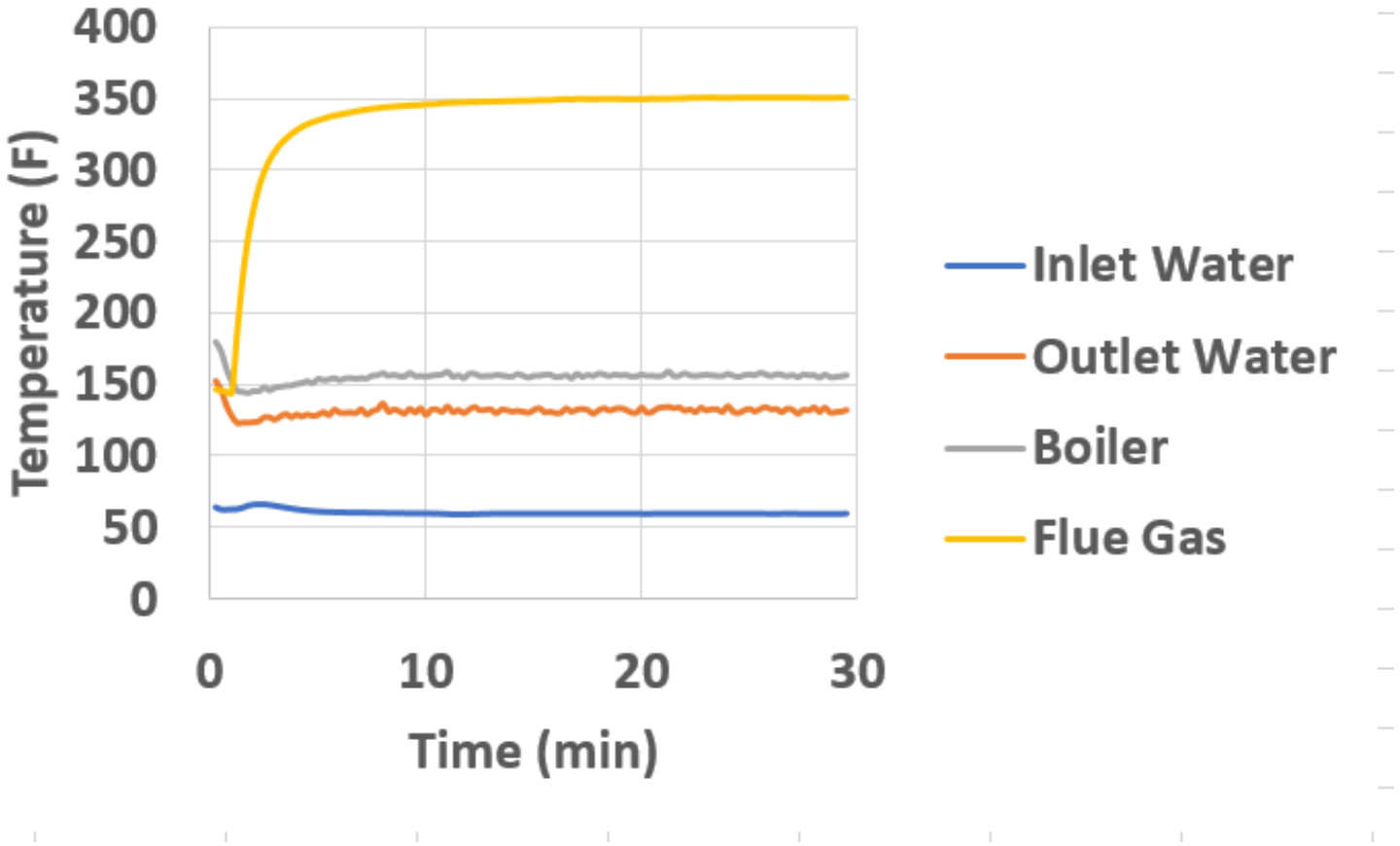
Capacity – 3 gpm draw - combi



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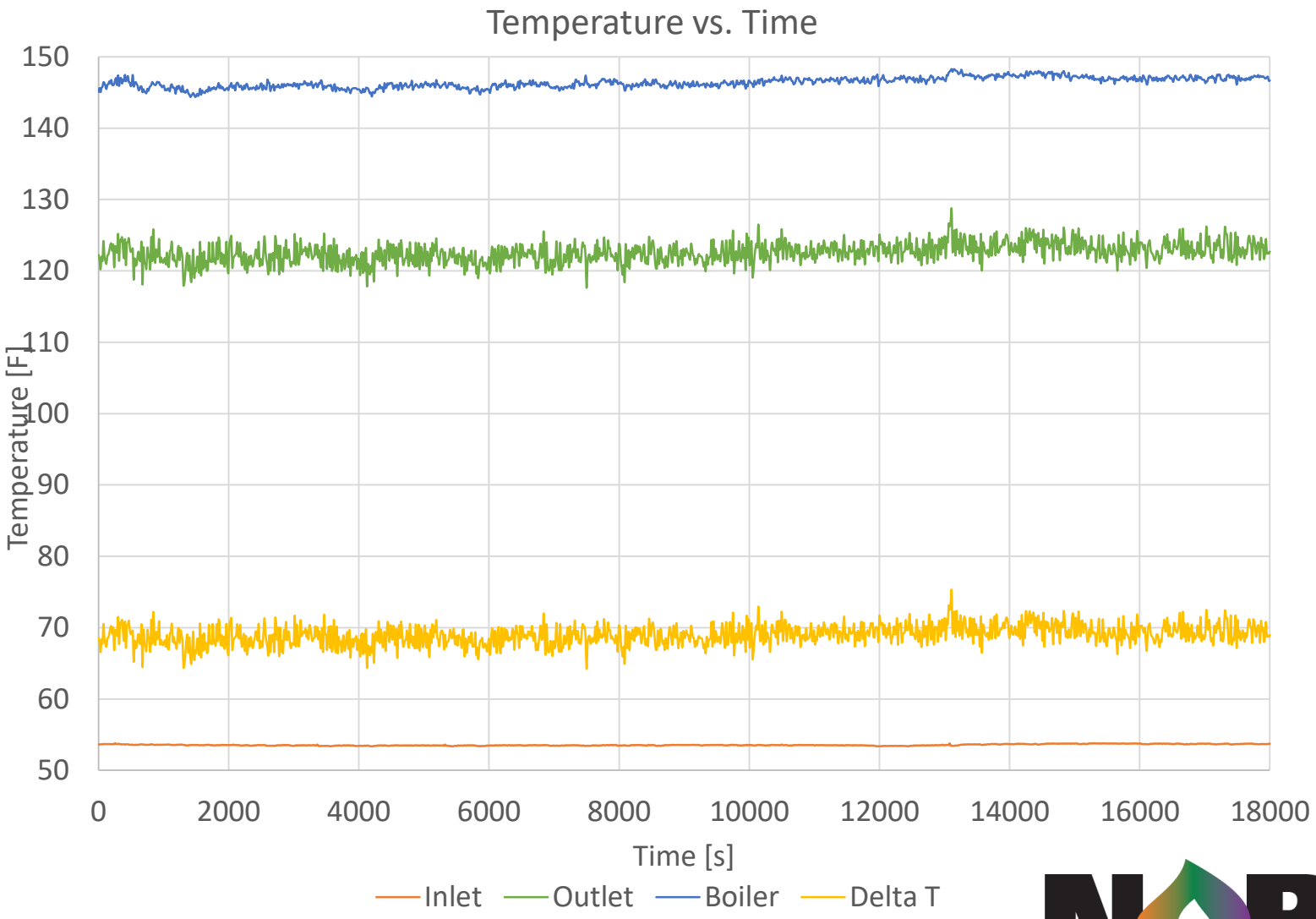
Steady state test of combi-system at 3.2 gpm draw. 5 hours, steady state efficiency = 86.4 %



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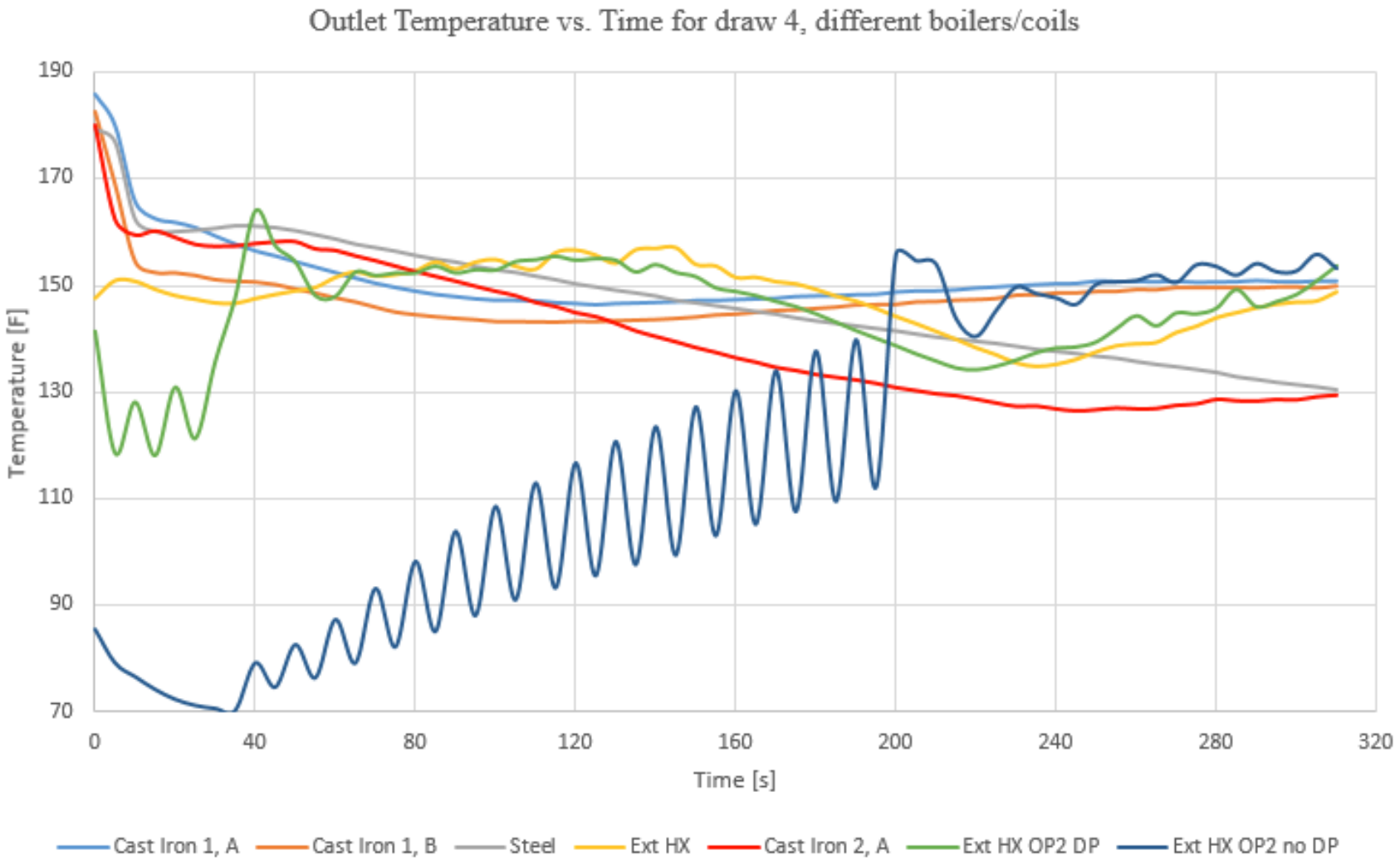
Delivered water temperature after a long off-period (draw 4 in 24 hour simulated use test) comparison



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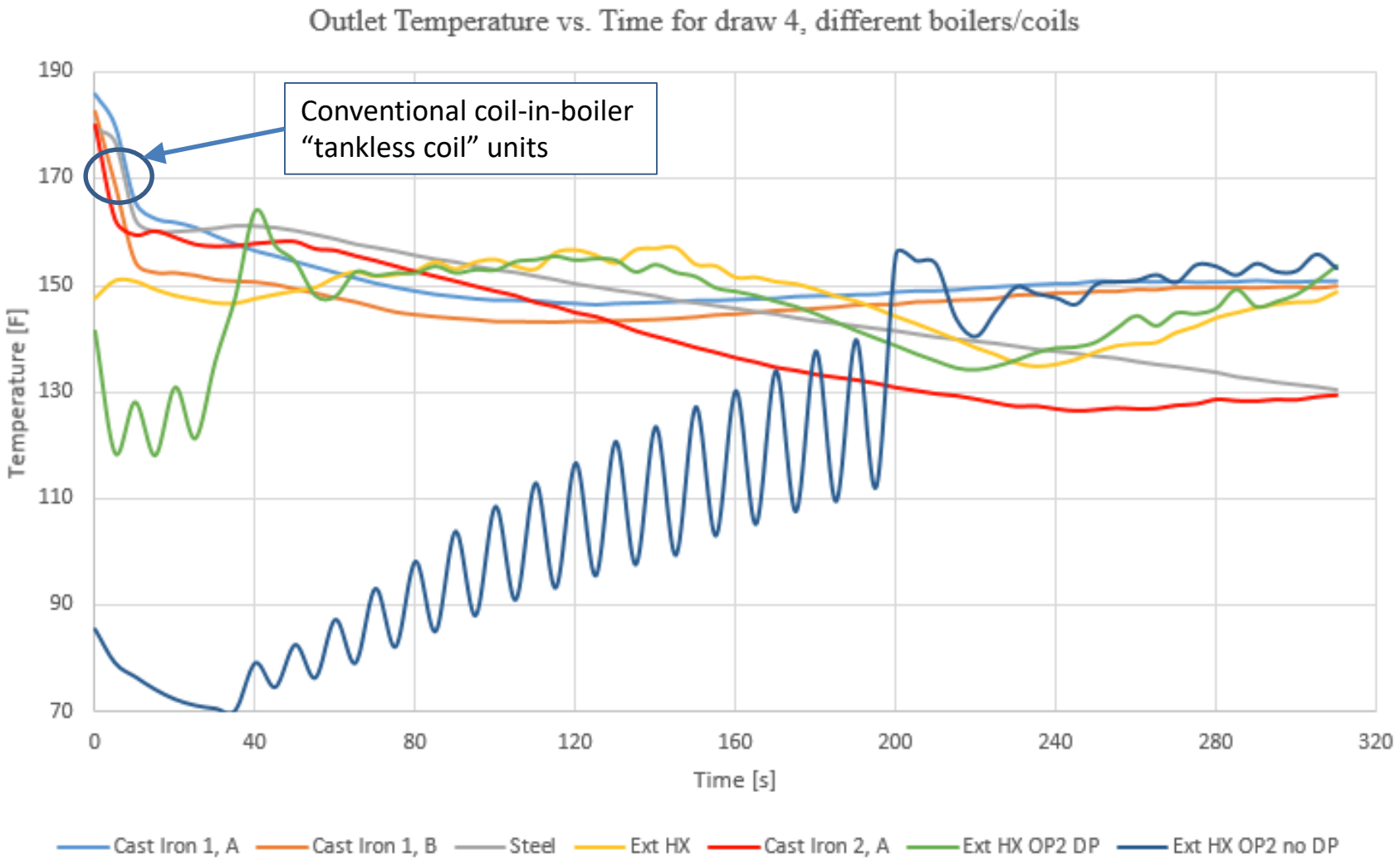

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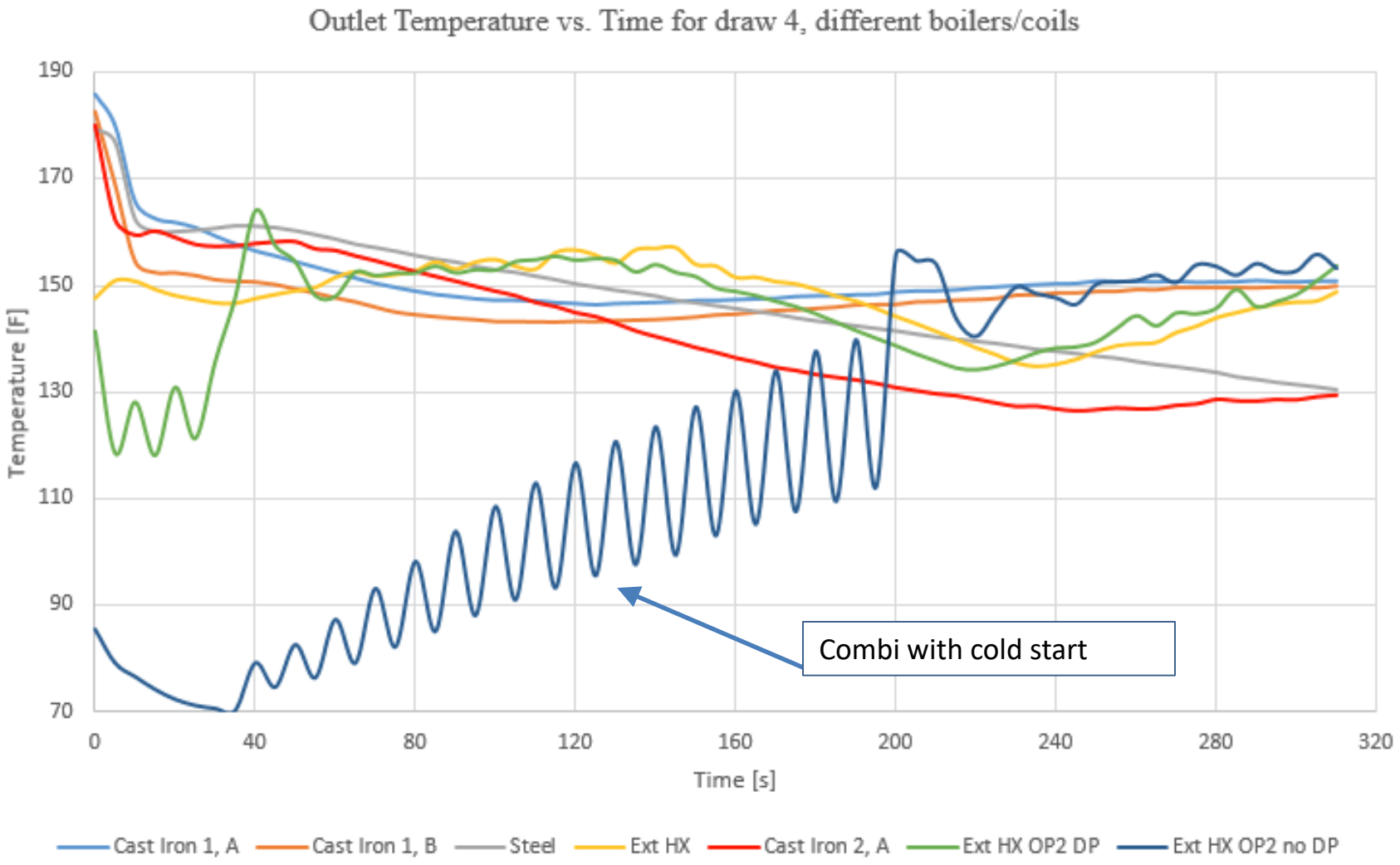

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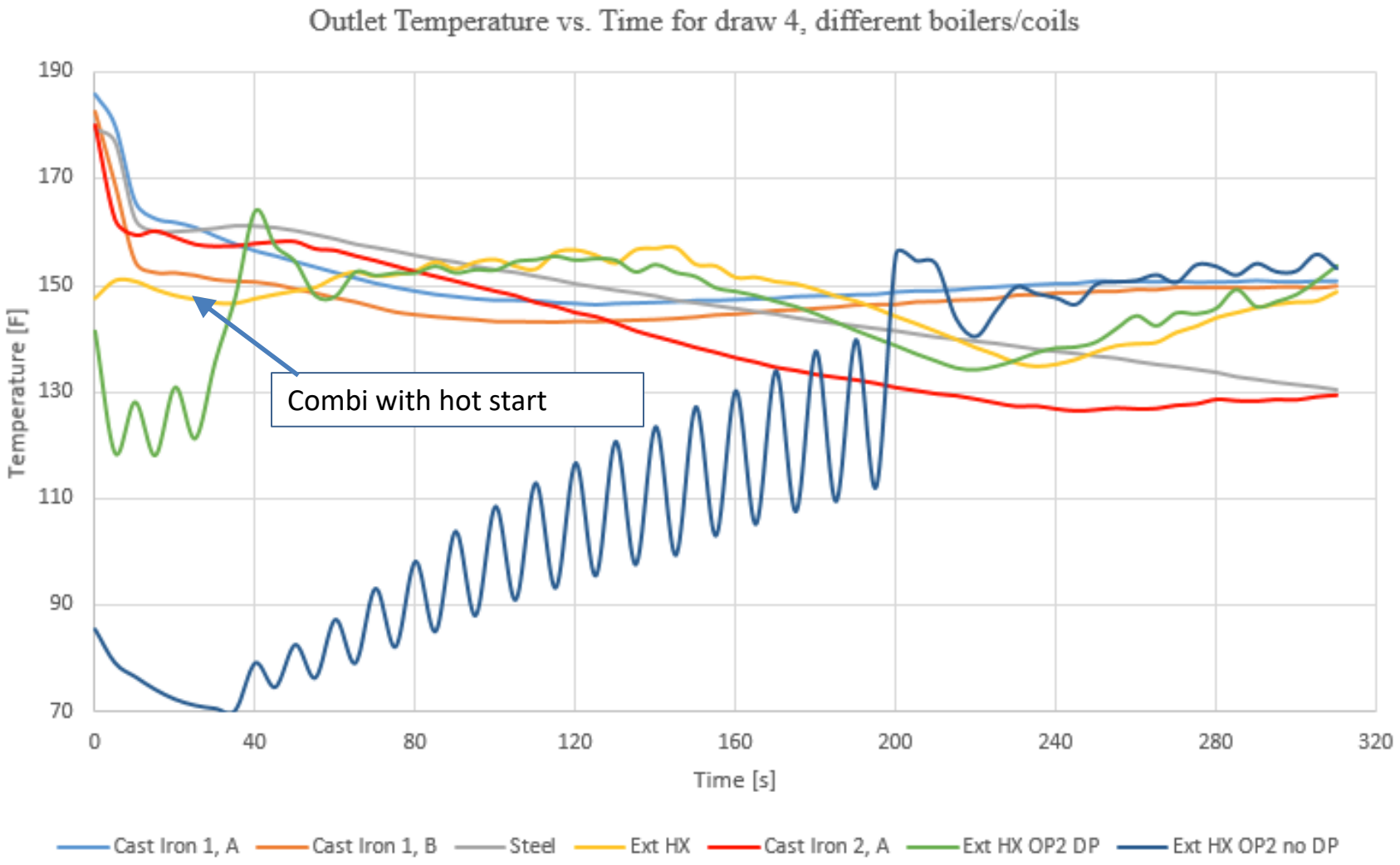

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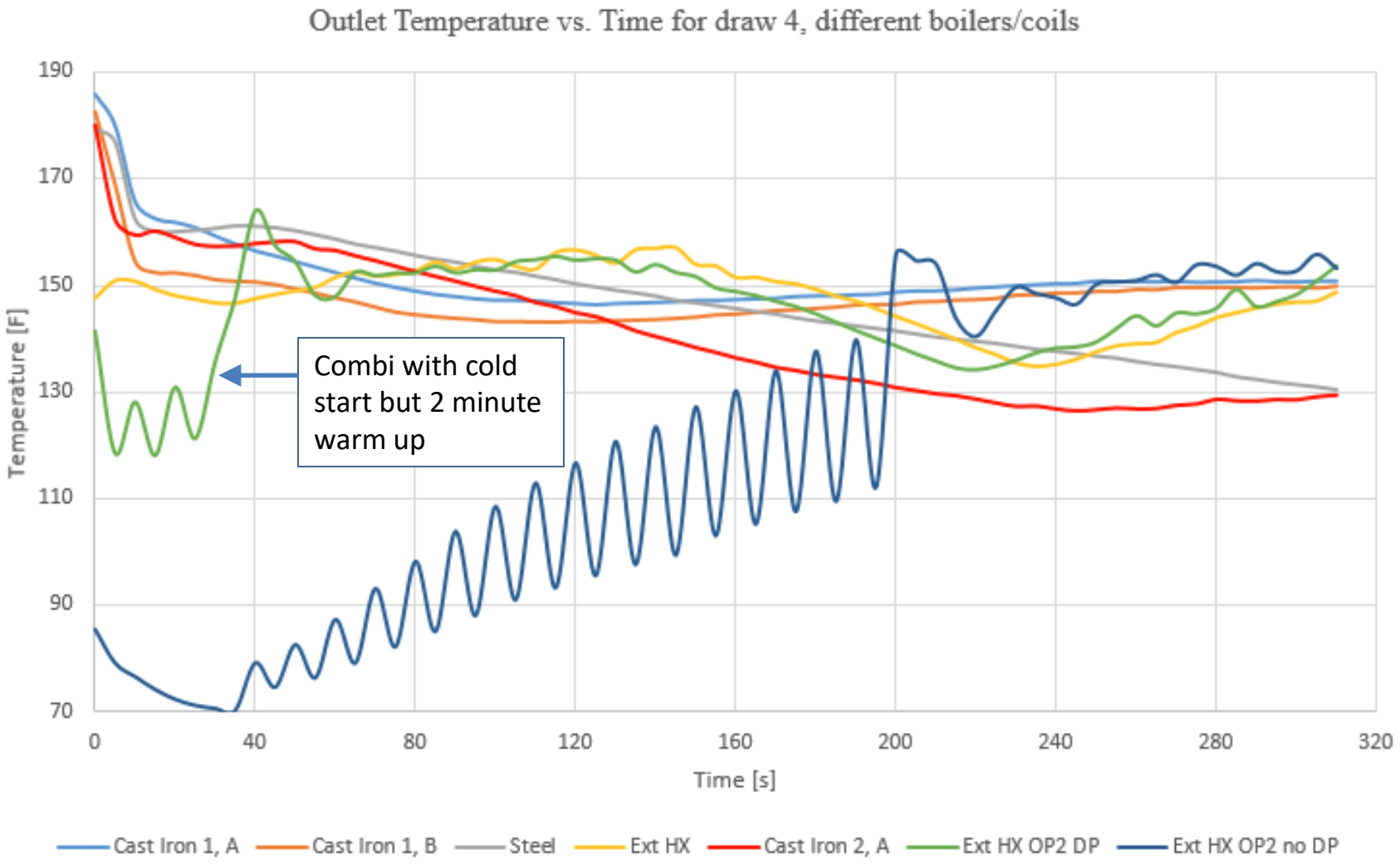

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Elements of Best Practices

1. Best possible thermal contact between boiler water and domestic hot water.
2. Keep boiler water temperature as low as possible.
3. Control concepts to allow boiler to “go-cold” during periods of no domestic hot water draw.
4. Insulate piping and improve boiler insulation.

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