PUBLISHED · CAIN INDUSTRIES · RE-MODELLED

VX-SHR — sensible heat recovery

Regional Hospital, United States: three FCR-1L3816ALS units on 300 HP steam boilers

A published installation by Cain Industries — duty, temperatures and flows are theirs. We re-ran the published inputs through the PULSE method to get the number a case study usually leaves out: how much of the fuel bill it actually is, in US, Vietnamese and metric units.

01 · PLANT PROFILE

Plant profile

CUSTOMER

Regional Hospital · Wisconsin, United States

APPLICATION

Hospital · steam boiler house · retrofit of an existing installation

BOILERS

3 × 300 HP steam boilers · 223.8 kW each · 2.28 t/h each · 671 kW installed

STEAM CONDITION

6.5 bar(g) · 94.3 psig · saturated steam 168.0 °C / 334.4 °F

RECOVERY EQUIPMENT

FCR-1L3816ALS × 3 — VX-SHR, sensible heat recovery only, no condensing stage

FLUE GAS

425 → 302 °F at 4,184 SCFM

HEAT SINK

22 GPM, +39 °F rise — boiler feedwater

RECOVERED DUTY (PUBLISHED)

408,000 BTU/h

SOURCE

Cain Industries — published case study

02 · BASELINE — BEFORE RECOVERY

Baseline — before recovery

The hospital’s boilers ran with no heat recovery on the flue: gas left the boiler at 425 °F and went to the stack, so 100 % of the fuel bill was spent to put steam into the hospital and part of that fuel went up the chimney as sensible heat.

The baseline is the published one — flue gas at 425 °F, 4,184 SCFM, feedwater entering the recovery unit at 22 GPM and leaving 39 °F warmer. Those are Cain’s design figures for this installation, not our measurement, and we have not altered them.

What the boundary contains

One boiler house: three steam boilers, their common flue path, and the feedwater loop the recovery unit heats. Fuel in, steam out, flue temperatures in and out of the unit, water in and out.

03 · SOLUTION — WHAT WAS INSTALLED

Solution — what was installed

Three **FCR-1L3816ALS** heat-recovery units were installed, one per 300 HP steam boiler, each taking sensible heat out of the flue gas and putting it into boiler feedwater. Flue gas leaves the boiler at 425 °F and leaves the recovery unit at 302 °F at 4,184 SCFM; the water side runs 22 GPM with a 39 °F rise.

This is a sensible-only installation. The sink available on site never goes below the flue's water dew point, so no latent heat is recovered and no condensate is produced — and therefore no water saving is claimed anywhere on this page.

Equipment

FCR-1L3816ALS, three units, one per boiler. Sensible heat recovery from the flue gas into feedwater.

Why not condensing

The existing sink runs at 227 °F, far above the 131 °F dew point of the flue gas. A condensing stage on that sink would recover nothing, so the installation stays as built.

Three units, one per boiler

The published case gives one total duty for the installation, not a figure per unit. The table below splits that total equally across the three units — equal-share arithmetic on Cain's published 408,000 BTU/h, not a separate per-unit measurement. The boiler ratings are Cain's.

UNIT	BOILER SERVED	MODEL	SHARE OF PUBLISHED DUTY
FCR-01	300 HP steam boiler · 2.28 t/h · 223.8 kW	FCR-1L3816ALS	136,000 BTU/h · 39.9 kW
FCR-02	300 HP steam boiler · 2.28 t/h · 223.8 kW	FCR-1L3816ALS	136,000 BTU/h · 39.9 kW
FCR-03	300 HP steam boiler · 2.28 t/h · 223.8 kW	FCR-1L3816ALS	136,000 BTU/h · 39.9 kW
Total	3 × 300 HP · 671 kW installed	—	408,000 BTU/h · 119.6 kW · 0.41 MMBtu/h

Installed cost in the published case is $19,234 for the three units together, which is what the 9.4-month payback is computed on. No per-unit cost is published, so none is shown.

04 · MEASURED RESULTS

Measured results

The duty and temperatures below are Cain Industries' published design data for their own installation. We have not re-measured them; what we changed is the arithmetic, expressed here in three unit systems so the same plant cannot be quoted two different ways.

3.25 %
of the fuel bill saved — dry stage only

0.41 MMBtu/h
recovered duty, published (408,000 BTU/h)

$24,480
fuel saving per year, modelled

9.4 months
payback, on a $19,234 installed cost

PUBLISHED DUTY, RE-EXPRESSED IN THREE UNIT SYSTEMS · ONE SET OF READINGS, NO CONVERSION MISTAKES

QUANTITY	Recovered duty
UNITED STATES	408,000 BTU/h · 0.41 MMBtu/h
VIETNAM	120 kW · 957 MWh/yr
OTHER (METRIC)	120 kW · 957 MWh/yr

QUANTITY	Flue gas temperature
UNITED STATES	425 → 302 °F
VIETNAM	218.3 → 150.0 °C
OTHER (METRIC)	218.3 → 150.0 °C

QUANTITY	Annual fuel (as saved)
UNITED STATES	40,800 therm
VIETNAM	4,304 GJ · 957 MWh
OTHER (METRIC)	3,444 GJ

QUANTITY	Annual saving
UNITED STATES	$24,480
VIETNAM	643,824,000 VND
OTHER (METRIC)	€22,522 · £19,339

QUANTITY	CO_2 avoided

QUANTITY	Recovered duty
UNITED STATES	408,000 BTU/h
VIETNAM	120 kW
OTHER (METRIC)	120 kW

UNITED STATES	238.4 short tons
VIETNAM	216.2 tonnes
OTHER (METRIC)	216.2 t

QUANTITY	Recovered duty
UNITED STATES	**408,000 BTU/h**
VIETNAM	**120 kW**
OTHER (METRIC)	**120 kW**

How to read the three columns

The three columns hold one set of readings, converted. Nothing is re-measured between them: 425 → 302 °F is the publisher's figure and 218.3 → 150.0 °C is the same figure converted. Where two columns repeat a value it is because the unit is the same, not because a second calculation produced it.

What is measured, and by whom

Nothing here is measured by us. Cain Industries published the flue temperatures, the 4,184 SCFM and the 408,000 BTU/h for their own installation, and those are the inputs to every number on this page. Our contribution is the model that turns them into a percentage of the fuel bill and a payback in months.

What the same duty is worth elsewhere

408,000 BTU/h is 119.6 kW of recovered heat. Run for 8,000 hours it is 957 MWh a year, which is what the metric column reports. At the published $0.60/therm that is $24,480; a hospital paying a different gas price moves the money, not the percentage.

05 · SAVINGS AND PAYBACK

Savings and payback

The arithmetic is short enough to redo by hand. A boiler putting out 10,042 MBH at 80 % efficiency burns 12,553,125 BTU/h of fuel. The recovery unit takes 408,000 BTU/h back out of the flue, so the saving is 408,000 / 12,553,125 = **3.25 %** of the fuel bill — the first number every case on this site reports.

At 8,000 running hours a year that is 40,800 therm of gas, and at $0.60/therm it is **$24,480 a year**. Cain publish a saving of $14,231/yr for the same installation, which implies roughly 4,651 running hours a year at that gas price; the difference between the two figures is run-hours, not efficiency. On an installed cost of $19,234 the modelled payback is **9.4 months**.

What the condensing case would add, and why it is not claimed here

With a cold sink — make-up water at about 80 °F — the same flue gas could be taken below its 131 °F dew point. The flue holds a further 1,810,595 BTU/h (14.42 % of fuel) below that point, but the sink could only absorb 440,000 BTU/h (3.51 % of fuel) at 22 GPM, and taking it all would need 91 GPM. Combined, the two-stage logic would reach 3.25 % + 3.51 % = **6.76 %** of fuel. Those numbers are modelled from published design data, not metered, and the installation as built is the 3.25 % case.

06 · VERIFICATION METHOD

Verification method

This is a manufacturer-published installation, not a site we instrumented. The duty, temperatures, flows and the published payback are Cain Industries' design figures for their own customer. What we did was re-run those inputs through the PULSE model and state every assumption so the arithmetic can be checked.

The same inputs are also seeded as a modelled site inside PULSE (`p_cain_ocono`), where the application's own efficiency calculation returns 3.48 % on the first boiler. The number on this page is reproducible in the product, not just in a spreadsheet.

On a real project the published design duty is replaced by meters: fuel, gas temperature before and after the unit, water in and out, and — where a condensing stage exists — condensate mass flow. That is what turns a design figure into a re-derivable saving under the M&V protocol.

What this page does not claim

It does not claim a measurement we made: there is no fuel meter, no flue-gas analyser and no water meter of ours on this site. It does not claim a condensing saving, because the installation is sensible-only. It does not claim a whole-plant saving either — the boundary is the boiler house, and 3.25 % of the fuel those three boilers burn is not 3.25 % of the hospital's gas bill if the boilers are only part of it.

What a metered version would add

Three readings per unit turn this from a design figure into a measured one: fuel flow at the burner, flue temperature before and after the recovery unit, and feedwater flow with its inlet and outlet temperature. Those five signals per boiler, sampled once a minute, are enough to re-derive the duty without trusting any summary table — and they are what the modelled `p_cain_ocono` site in PULSE already records.

07 · BEFORE AND AFTER

Before and after

BEFORE

425 °F

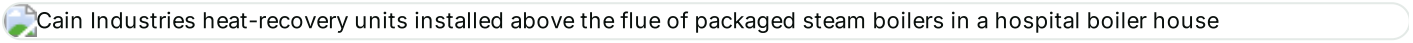
flue gas straight to the stack
fuel bill 100 %

→

AFTER

302 °F

3.25 % less fuel
$24,480 a year



Cain heat-recovery units over the flue of the packaged boilers — the installation this page re-models, as published by the manufacturer.

Photo: Cain Industries

08 · DOWNLOAD, SOURCES AND WHAT THIS DOCUMENT IS

Download, sources and what this document is

Download case study (PDF)

All case studies

What this document is. A published installation by Cain Industries, re-modelled by Vegax Energy. The customer is Cain's customer, not ours, and the plant is not instrumented by us. Design data is theirs; the percentages, the money and the condensing case are our model, stated with their assumptions so anyone can redo the arithmetic.

- Cain Industries — exhaust heat recovery case studies — customer, model, temperatures, flows, unit cost and published payback.
- Cain Industries — CXL single-stage and DXL two-stage condensing series, used for the condensing comparison.

The 55 °C line: flue-gas dew point

M&V protocol

All case studies