MADDEN
ENGINEERED PRODUCTS

Boiler Blowdown Equipment

General Education & Relevant Madden Products

Presentation Table of Contents

Company Overview

MADDEN
ENGINEERED PRODUCTS

All production operations are currently in Elkhart, IN.

Madden is a manufacturer of proven, rugged boiler blowdown equipment and chemical feed systems.

Competitive Strengths:

- Most Responsive Customer Service.
- Design & Engineering Assistance.
- BTU Recovery Calcs.
- Largest selection of standardized heat recovery system designs in the industry.
- Flexibility/Customization in Product Design.

Large Capacity HC Series Heat Recovery Sys.

HVX Series, Low Cost Heat Recovery Sys.

Blowdown Separators

Blowdown Tanks

Custom Chemical Feed Systems

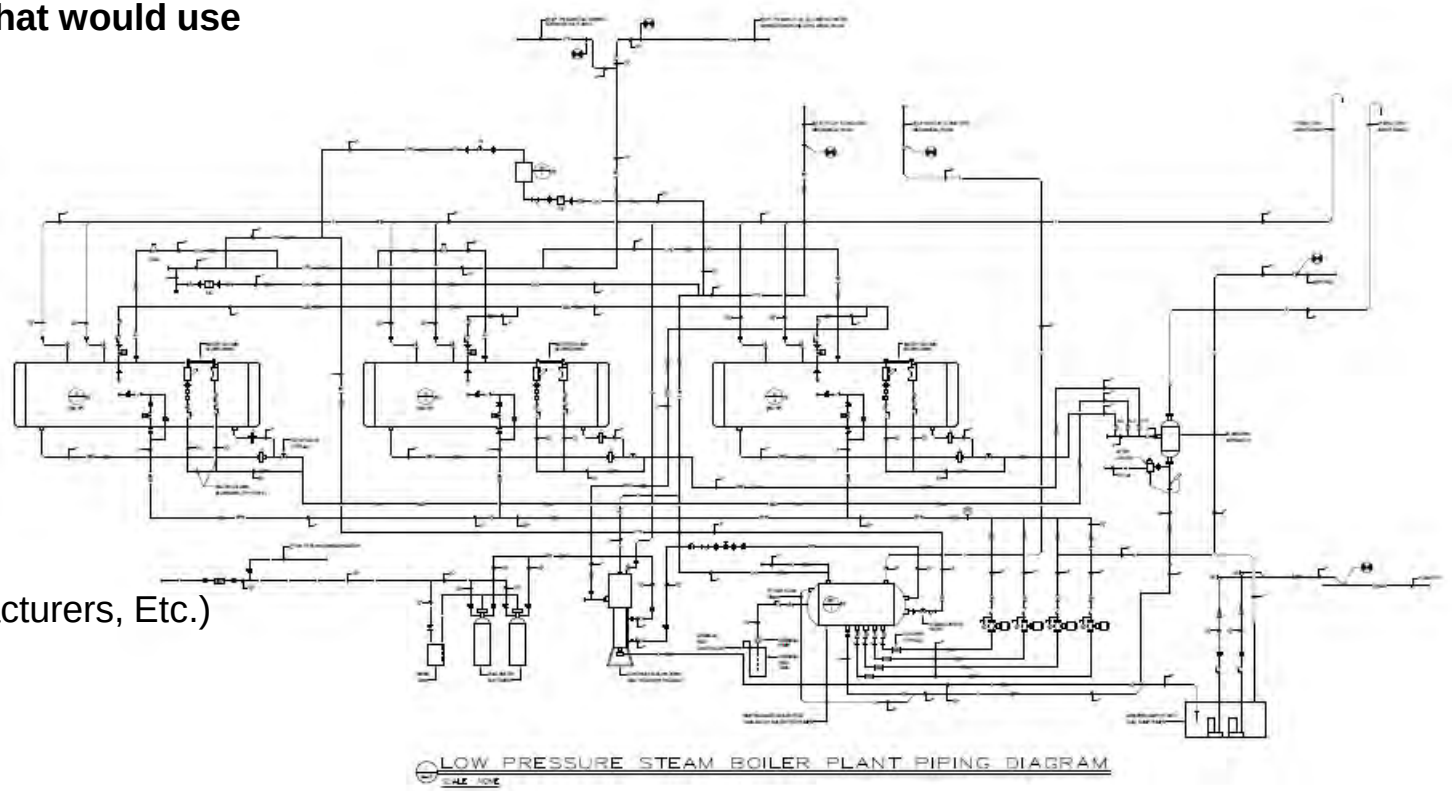
Where you'll see Madden B.D. Equipment

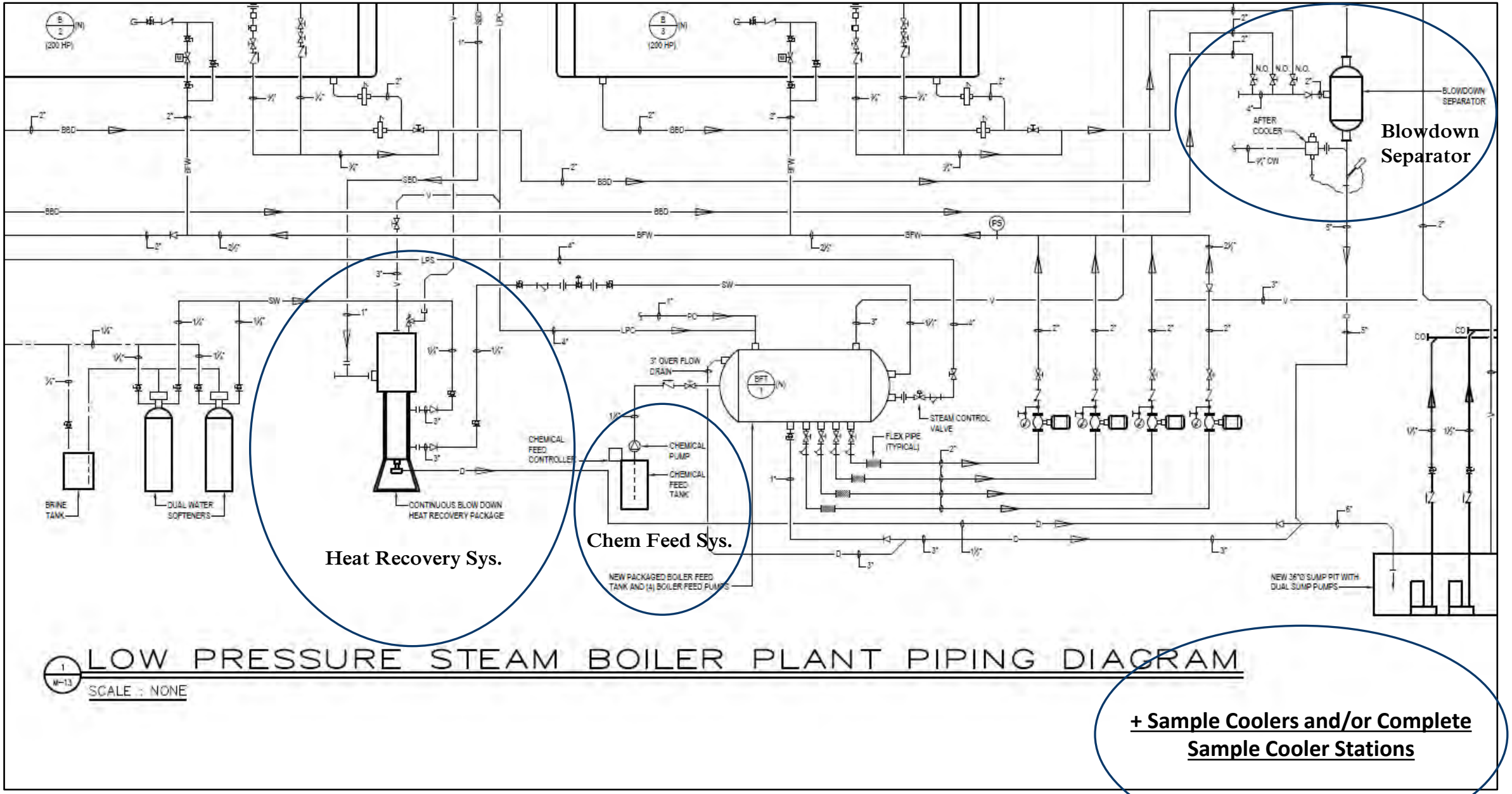
This list shows specific, common facilities that would use our larger heat recovery systems:

- Food & Beverage

  (Frito Lay, Tyson Foods, Gatorade)
- Air Force & Navy Bases
- Hospitals
- Paper Mills
- Prisons
- Universities
- Large Manufacturing Facilities

  (Goodyear Tire, Michelin Tire, Paint Manufacturers, Etc.)
- Power Plants




Blowdown Separator
Heat Recovery Sys.
Chem Feed Sys.
LOW PRESSURE STEAM BOILER PLANT PIPING DIAGRAM
SCALE : NONE
+ Sample Coolers and/or Complete Sample Cooler Stations

Madden's Complete Boiler Room Product Line (Less Chemical Feed Systems)

MADDEN
ENGINEERED PRODUCTS

Heat Recovery Systems for Boiler Continuous Surface Blowdown:

1. For boilers blowing down as little as 250 PPH, and as much as 50,000 PPH.
2. Largest available selection in the industry.
3. Recover otherwise lost BTU's – burn less fuel!
4. Systems commonly provide a service life beyond 20 years.

Blowdown Tanks & Separators for Intermittent Bottom Blowdown:

1. Madden is an industry leader in designing and fabricating blowdown tanks, including NB-27 compliant designs.
2. Stocked BD Separators.
3. ASME Div 1, Sec VIII vessels.

Sample Cooler Stations for Boiler water, D/A water, Feed water, and Steam Samples:

1. Predesigned and custom options available.
2. Protects boiler operator.
3. Protects analyzing equipment.
4. Increases sampling accuracy.
5. Saves you time and labor costs on installation.

SECTION 2
Heat Recovery Systems

MADDEN
ENGINEERED PRODUCTS

Blogs - Heat Recovery

Before you begin, consider skimming some of these blogs:

- Difference between Surface Blowdown, and Intermittent Bottom Blowdown:
- https://www.maddenep.com/blog/what-are-the-differences-between-intermittent-bottom-blowdown-from-a-boiler-and-continuous-surface-water-blowdown-from-a-boiler/
- What are BTU's?:
- https://www.maddenep.com/blog/what-are-b-t-us-and-why-are-they-important-in-boiler-blowdown-processes-and-cost-savings/
- Overview, Heat Recovery, Part 1:
- https://www.maddenep.com/blog/how-to-recover-and-reuse-heat-from-boiler-blowdown-water-part-1-focusing-on-maddens-upper-vessel-of-a-hv-model-heat-recovery-system-the-flash-tank/
- Overview, Heat Recovery, Part 2:
- https://www.maddenep.com/blog/how-to-recover-and-reuse-heat-from-boiler-blowdown-water-part-2-focusing-on-maddens-lower-vessel-of-a-hv-model-heat-recovery-system-the-heat-excha/
- Advantages of Vertical Systems:
- https://www.maddenep.com/blog/what-are-the-advantages-of-using-a-vertical-heat-exchanger-in-a-boiler-blowdown-heat-recovery-system/

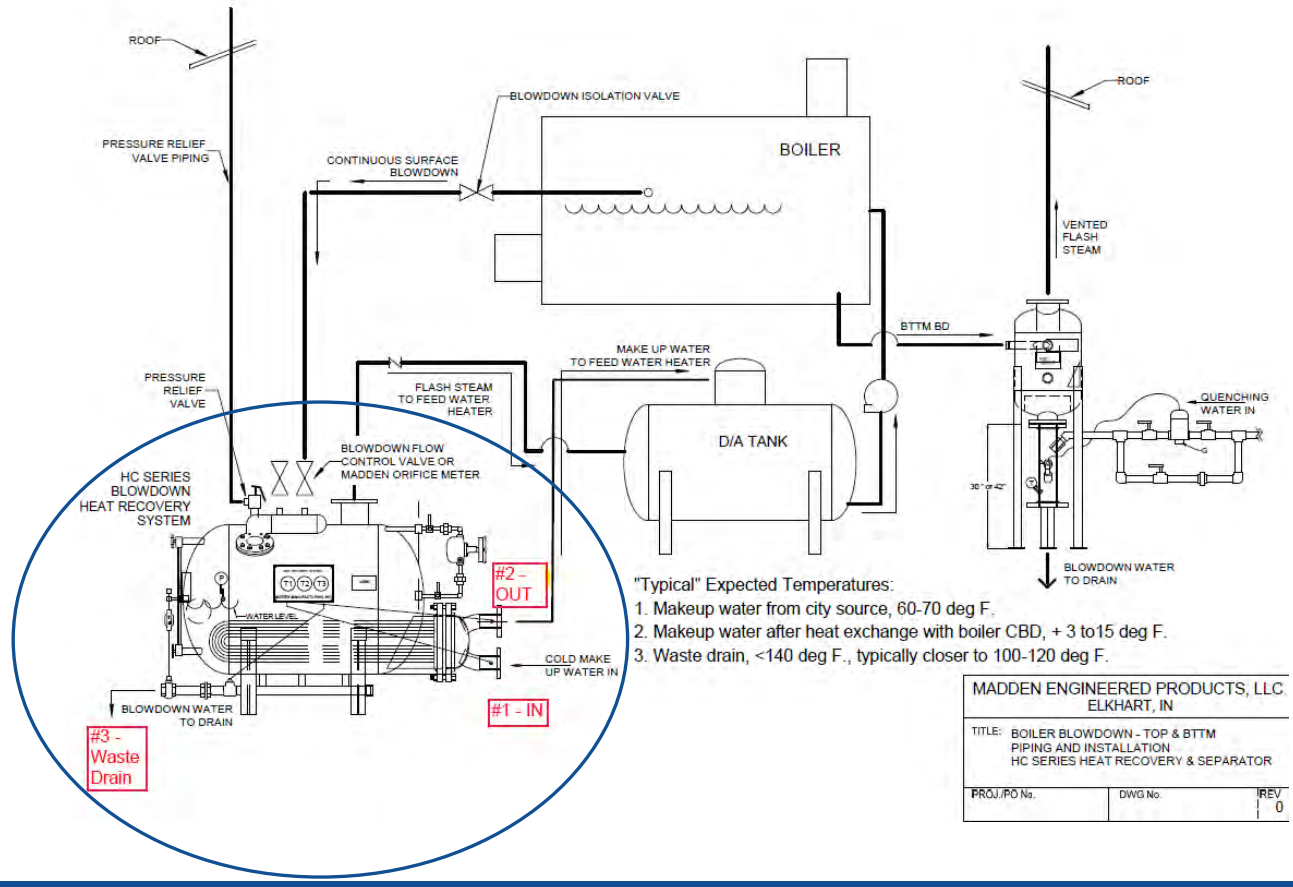
Function of Madden Heat Recovery Systems

Madden Heat Recovery Systems (HRS) accomplish (3) tasks. Flash steam recovery, preheating boiler makeup water, and cooling the surface wastewater to 140 deg F or less.

When hot boiler surface blowdown water enters a Madden HC, HV, or HVX series heat recovery system, it will immediately flash steam due to the pressure drop. Madden heat recovery systems are typically vented to a Deaerator system, and thereby operate at the same pressure. This is the first and most important phase of BTU recovery.

The remaining hot water then passes through a heat exchanger (coil or u-tube bundle) in the bottom of the HRS. On the opposite side of the heat exchanger, ideally, is fresh boiler makeup water. This cools the remaining blowdown to a safe temperature to be immediately disposed to the sewer, as well as provides a 3 to 15 deg F temperature pickup in the makeup water. The 2nd form of BTU recovery.

Document (below): Madden's "HC_Typical-P&ID_w-temps"



MADDEN
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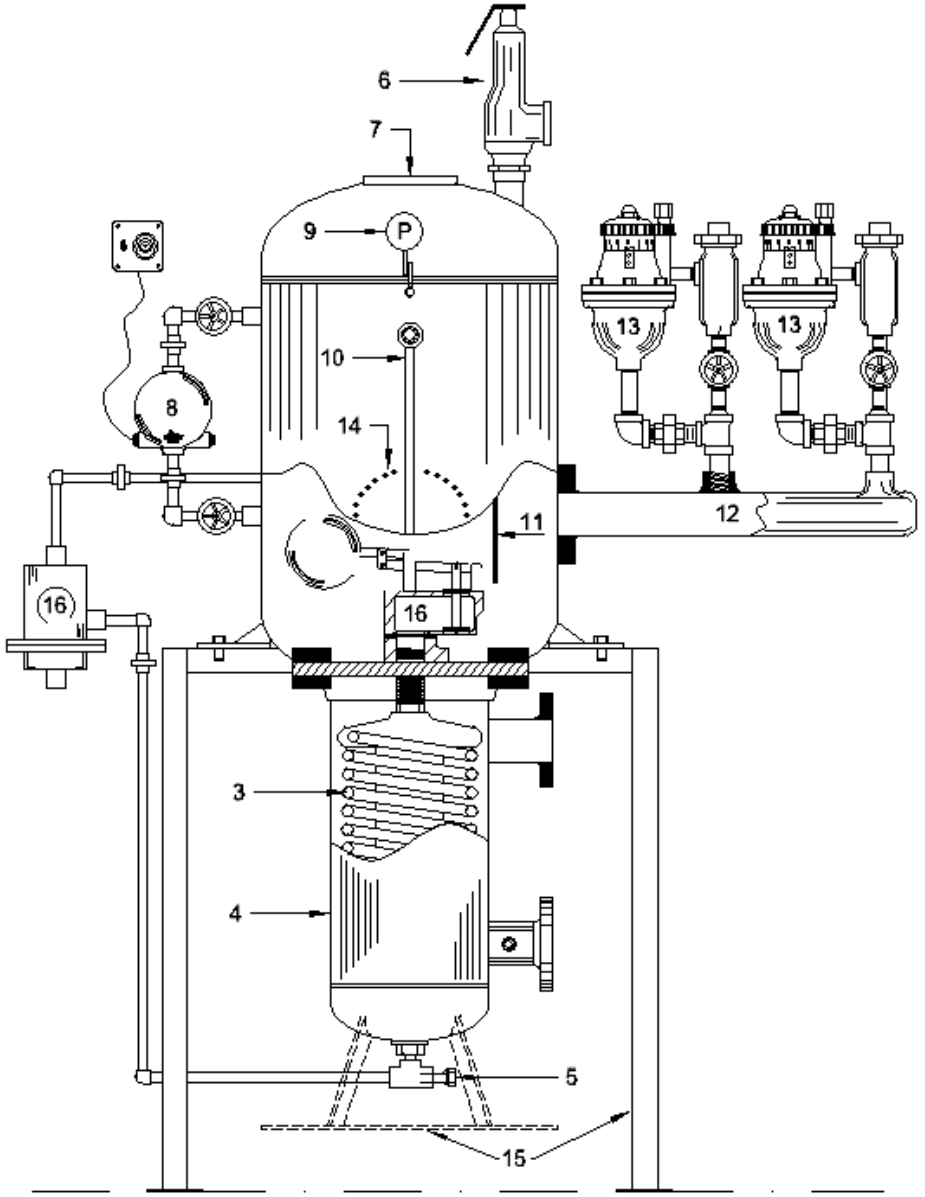
HV Series

- Vertical, compact heat recovery systems.
- Great for aftermarket sales where floor space is already spoken for.
- (5) Designs available with continuous blowdown capacities of 3,000, 5,000, 7,000, 9,000, and 12,000 PPH.
  - (Each system simply uses a taller/larger heat exchanger)
- No solids build up, self draining = incredible service life.
- Recovers 90% of lost heat (BTU's).
- Reduces temperature of blowdown discharge to meet statute limits.
- Pays for itself in a matter of months for some installations.

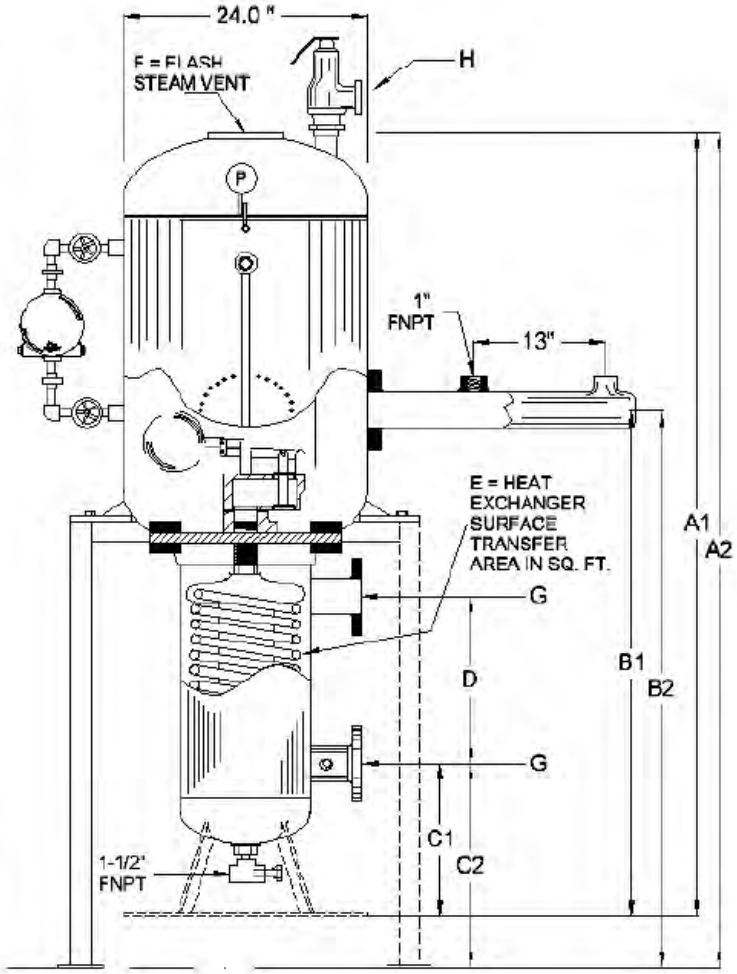
HV Series Features

1. ASME code welded flash tank and heat exchanger vessel, 150 PSI BPVC construction, ASME Div 1 Sec VIII, provided with U-1 forms and National Board Serial Number.
2. Temperature gauge panel to show drain water out, make up water in, and make up water out temperatures. Also acts as the name plate (not shown, sits in front of item 16).
3. Heat exchanger, 304SS, vertical coil type, various square foot capacities.
4. Heat exchanger shell, includes inlet and outlet for boiler makeup water to act as cooling water. Enters in a swirling action, this turbulence assures efficient contact and heat transfer.
5. Blowdown water discharge fitting.
6. Safety relief valve, normally set to 40 PSIG.
7. Flash steam outlet (3” or 4” in standard designs).
8. High water alarm (optional)
9. Pressure gauge, SS, 0-50 PSIG.
10. Sight glass and valve set for flash tank level indication.
11. Baffle, helps create water turbulence and flash steam separation.
12. Manifold for mounting Madden Orifice Meters for blowdown flow control. Orifice meters are optional.
13. Madden Orifice Meter (optional) – Extremely rugged and reliable blowdown flow control valve, manual operation. Several orifice plate sizes offers wide range of flow control.
14. 6” x 8” hand hole for standard float valve inspection.
15. Choice of base: standard, integral, compact base directly installed to lower vessel; or, “external/elevated” stand attached to upper vessel for easier removal of heat exchanger. The latter choice is a cost adder.
16. Choice of float control: standard, internal float and drain assembly valve; or, Armstrong float trap and piping to move float control outside of unit. The latter is a cost adder.




HEAT RECOVERY SYSTEM
BADDEN MFG. INC.

Model Number	HV30	HV50	HV70	HV90	HV120
Blowdown Capacity lb/hr	3,000	5,000	7,000	9,000	12,000
A1 (OAH)	77"	83"	89"	95"	104"
A2 (OAH)	84"	90"	96"	102"	111"
B1	49-5/8"	55-5/8"	61-5/8"	67-5/8"	76-5/8"
B2	56-5/8"	62-5/8"	68-5/8"	74-5/8"	83-5/8"
C1	15"	15"	15"	15"	15"
C2	22"	22"	22"	22"	22"
D	16-1/2"	22-1/2"	28-1/2"	34-1/2"	43-1/2"
E (HX Area SF)	17	21	25	29	35
F (Vent)	3" FLG	3" FLG	4" FLG	4" FLG	4" FLG
G (Makeup Water)	3" FLG	3" FLG	4" FLG	4" FLG	4" FLG
H (PRV Outlet)	1-1/2"	2"	2-1/2"	3"	3"
Ship Wgt.	1,250 lbs.	1,350 lbs.	1,450 lbs.	1,550 lbs.	1,750 lbs.



Dimensions & Model Selection - HV Heat Recovery Systems

MADDEN
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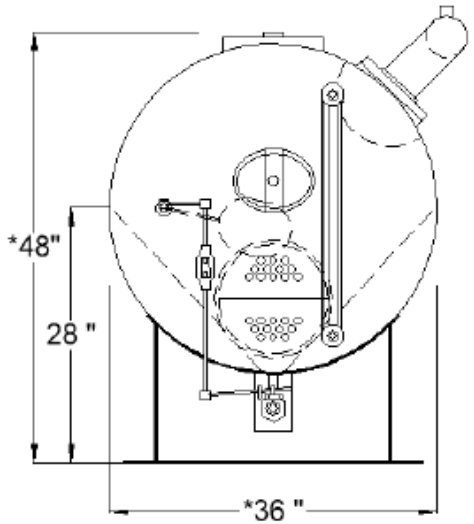
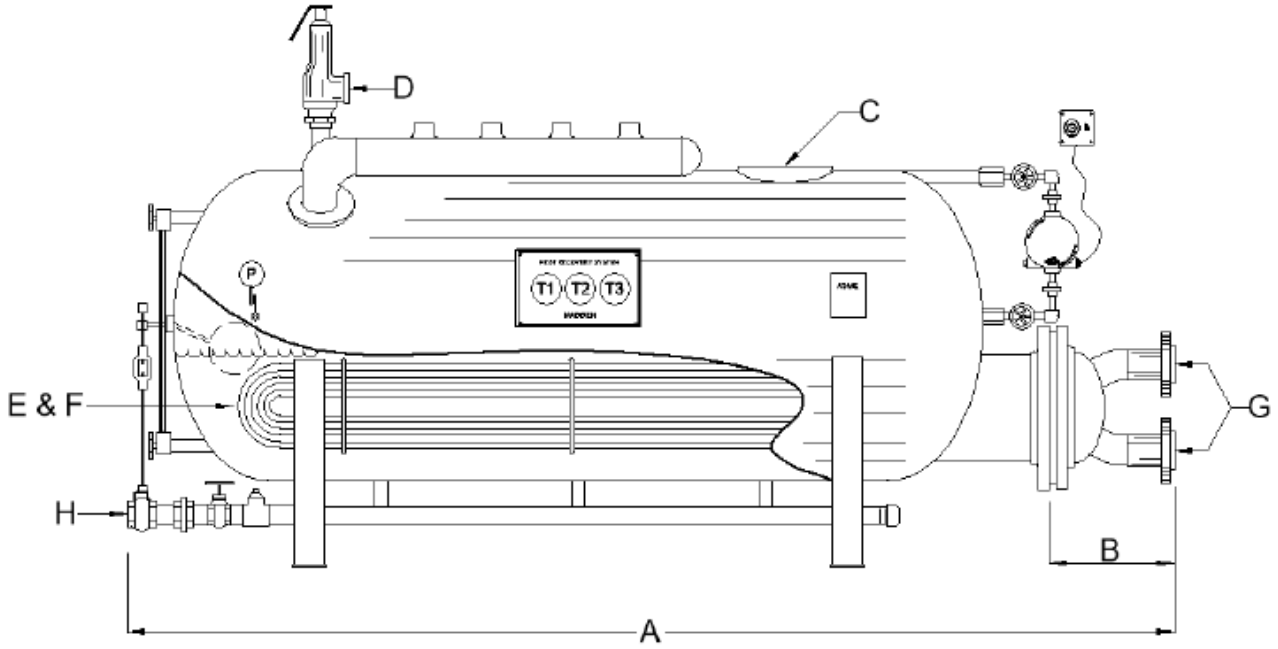
HC Series

- Largest Capacities, Horizontal Type
- (10) Predesigned Models Available, Blowdown capacity from 4,000 - 50,000 PPH
- Horizontal Type.
- U-tube bundle heat exchanger (more efficient heat transfer)
- No solids build up.
- Recovers 90% of lost heat.
- Reduces temp of blowdown discharge to meet statue limits.
- Pays for itself in a matter of months for some installations.
- Many level control devices easily integrated.





Model No.	HC 40-150	HC 80-150	HC120-150	HC160-150	HC200-150	HC240-150	HC280-150	HC320-150	HC360-150	*HC500-150
Blowdown Capacity (PPH)	4,000	8,000	12,000	16,000	20,000	24,000	28,000	32,000	36,000	50,000
A – (OAL)	64"	70"	75"	87"	99"	111"	130"	142"	154"	138"
B	8"	8"	13"	13"	13"	13"	20"	20"	20"	22"
C – (Vent)	3"	4"	4"	6"	6"	6"	8"	8"	8"	8"
D – (PRV Outlet)	2"	2-1/2"	3"	3"	4"	4"	4"	4"	4"	6"
E – (# of Tubes)	30	30	45	45	45	45	45	45	45	63
F – (HX Area SF)	44	47	79	97	115	132	150	168	186	250
G – (Inlet/Outlet)	3"	3"	4"	4"	4"	4"	6"	6"	6"	6"
H – (Drain)	1"	1"	1-1/4"	1-1/2"	1-1/2"	2"	2"	2"	2"	2"
Ship Weight	1,000 lbs.	1,200 lbs.	1,400 lbs.	1,900 lbs.	2,300 lbs.	2,700 lbs.	3,100 lbs.	3,500 lbs.	3,900 lbs.	4,500 lbs.

*NOTE: These dimensions do not account for ancillary equipment and they are specific to models HC40 through HC360. The HC500-150 is 48" wide X ~ 66" tall.

Dimensions & Model Selection - HC Heat Recovery Systems

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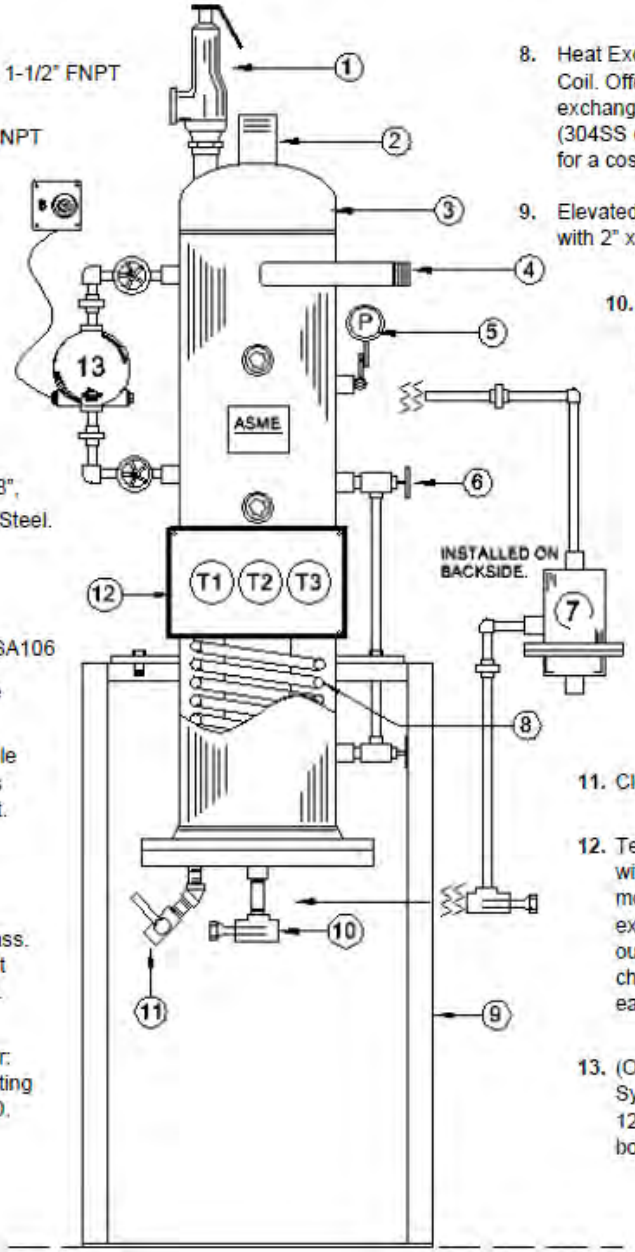
HVX Series - Hybrid

- *NEW* Our smallest, most efficient and cost-effective unit.
- (1) Predesigned model rated for 1,500 PPH of continuous surface blowdown.
- Vertical type.
- Vertical, copper coil (copper is most efficient material for heat transfer)
- No solids build up.
- Recovers 90% of lost heat.
- Reduces temperature of blowdown discharge to meet statue limits.

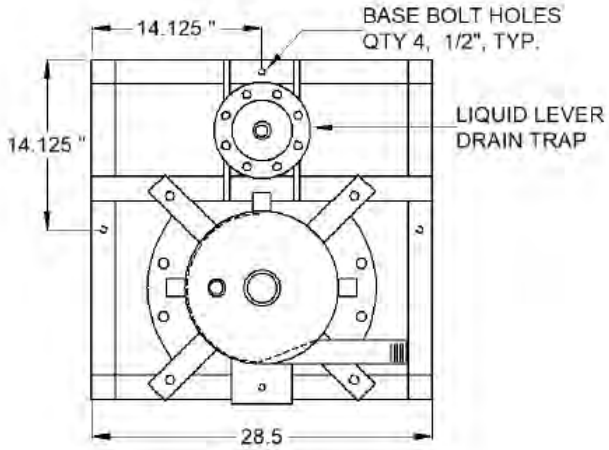
HVX Features

Overall Height: 93”

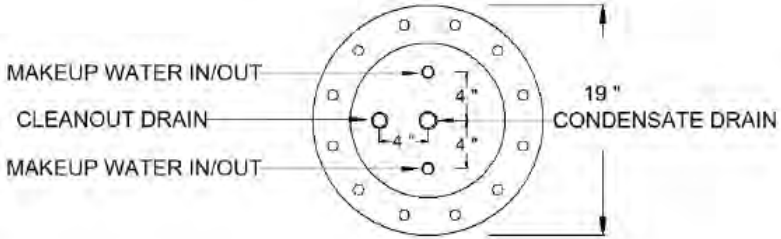
1. Pressure Relief Valve: 1-1/2” FNPT
2. Vent Connection: 2” MNPT
3. ASME Vessel: 12” x 48”, SA 516 Gr 70 Carbon Steel. 150 PSI Design, 0 to 450 deg F.
4. Inlet: 1” NPT, Sch 80 SA106
   a. Internal wear plate included.
   b. Manifold for multiple blowdown connections available upon request.
5. Pressure Gauge
6. Valve set and sight glass. Valve set includes vent and drain connections.
7. Level / Drain Controller: Armstrong’s Free Floating Lever Drain Trap, 3-LD.
8. Heat Exchanger: 7/8” OD, Copper Coil. Offers 9.8 SQ. FT. of heat exchanging surface area. (304SS coils can be made available for a cost adder).
9. Elevated leg support frame, made with 2” x 2” steel tube.
10. Boiler Makeup Water Connections – used as the heat exchanger’s cooling medium: 1” FNPT
11. Cleanout Drain
12. Temperature gauge panel with three 3-1/2” gauges to monitor drain water, exchange water inlet and outlet temperatures, makes checking system efficiency easy.
13. (Optional) High Level Alarm System. Includes Mercoid 123 series switch and alarm box.



TOP DOWN VIEW



BOTTOM UP VIEW



Heat Recovery System Summary

- Stress energy recovery, fuel savings, and water conservation.
- In order to size/propose unit, minimum Madden needs to know:
  - Boiler room steam capacity or expected max surface blowdown.
  - Operating pressure of boiler(s)
  - Ideally, also confirm D/A being used & what operating pressure

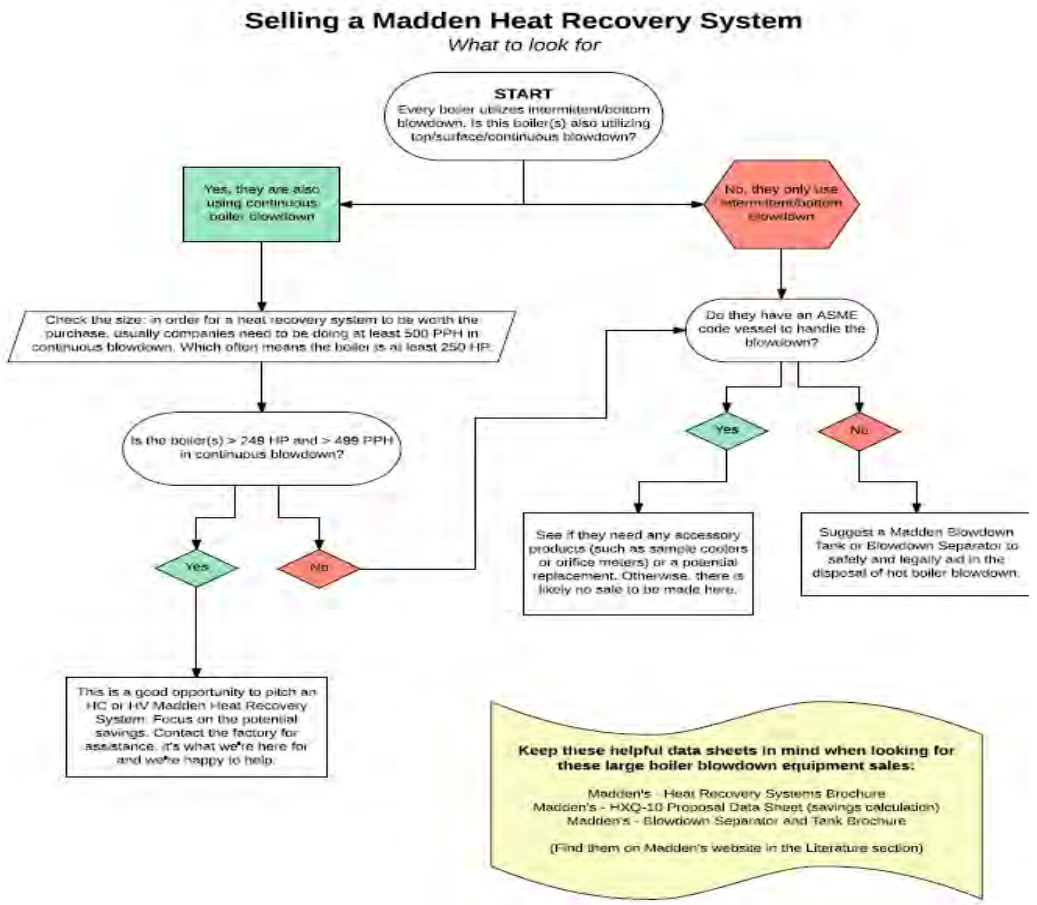
Don’t forget, Madden can provide a performance/savings estimate to show an expected R.O.I.

Heat Recovery System Summary

- The following final slides are informative guides to selling a heat recovery system, as well as cover frequently asked questions/ “issues”.

Selling Madden Steam Products

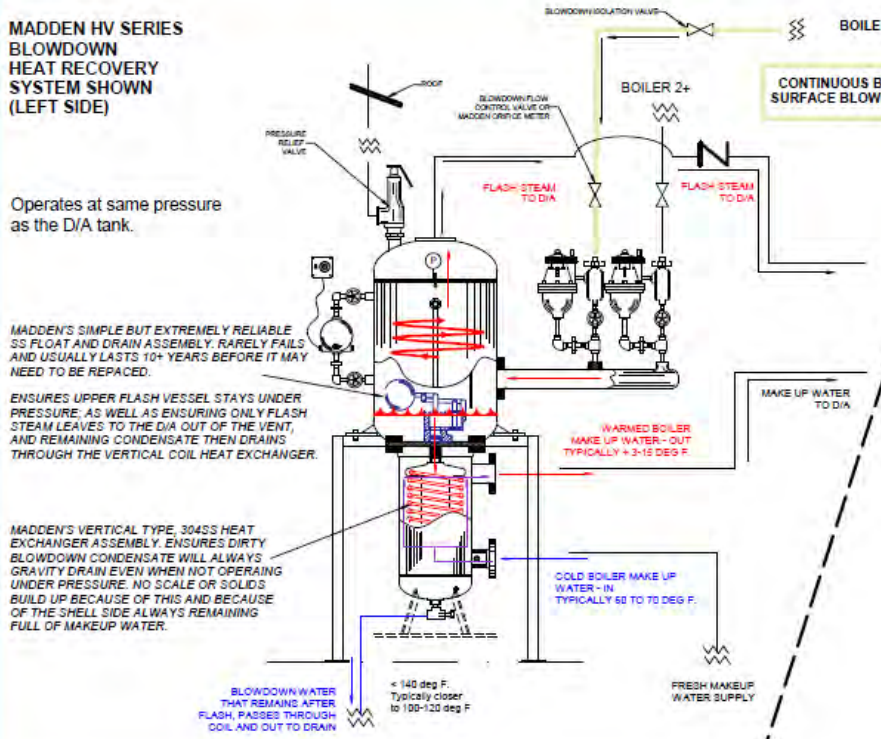
- Our heat recovery systems (H.R.S.'s) pay for themselves.
- Madden H.R.S.'s require very little operator training or routine maintenance.
- Most continuous surface blowdown flow rates are between 1-5% of boiler room max steam production, depending on water quality.
- Madden sizes heat recovery systems to be capable of handling 10% continuous blowdown as a result.
- **Look for boiler rooms with at least 250 total BHP between the operating boiler(s). This is a good indicator a H.R.S. will pay for itself in a year or less.**



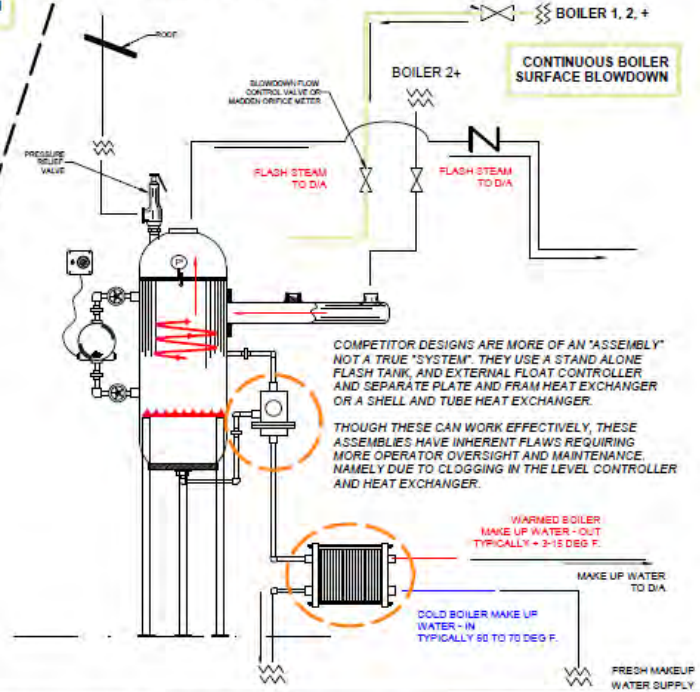
MADDEN HEAT RECOVERY "SYSTEMS" VS. COMPETITOR'S H.R. "ASSEMBLIES"

MADDEN HV SERIES BLOWDOWN HEAT RECOVERY SYSTEM SHOWN (LEFT SIDE)

Operates at same pressure as the D/A tank.



TYPICALL COMPETITOR ASSEMBLY DESIGN SHOWN (RIGHT SIDE)



CONTINUOUS SURFACE BLOWDOWN RECOVERY SYSTEMS BY MADDEN:

- Madden is a smaller, family owned manufacturer serving a niche market in boiler blowdown equipment. Our company is truly dedicated to being the number one solution for boiler blowdown systems, and in particular, surface blowdown heat recovery systems.
- The Madden vertical heat recovery unit is a true "system". Its design is entirely dedicated to being an operator friendly and durable design. Most systems last 15+ years before requiring any type of maintenance or replacement of the heat exchanger or level controller.
- The key benefit Madden heat recovery systems provide is in our vertical 304SS coil type heat exchanger and rugged level control and drain valve. This equipment ensures you will see no solids buildup. Madden systems are self-flushing, designed to use gravity flow to continuously clean itself. They operate without becoming clogged or fouled with solids contained in the dirty blowdown water.
- Madden also takes price in backing our heat recovery equipment with excellent customer service. We are happy to customize these designs to better fit the clients needs as well as provide supporting information like a performance and savings estimate.
- These systems typically pay for themselves in less than one year.

COMMON COMPETITOR HEAT RECOVERY DESIGN "ASSEMBLIES":

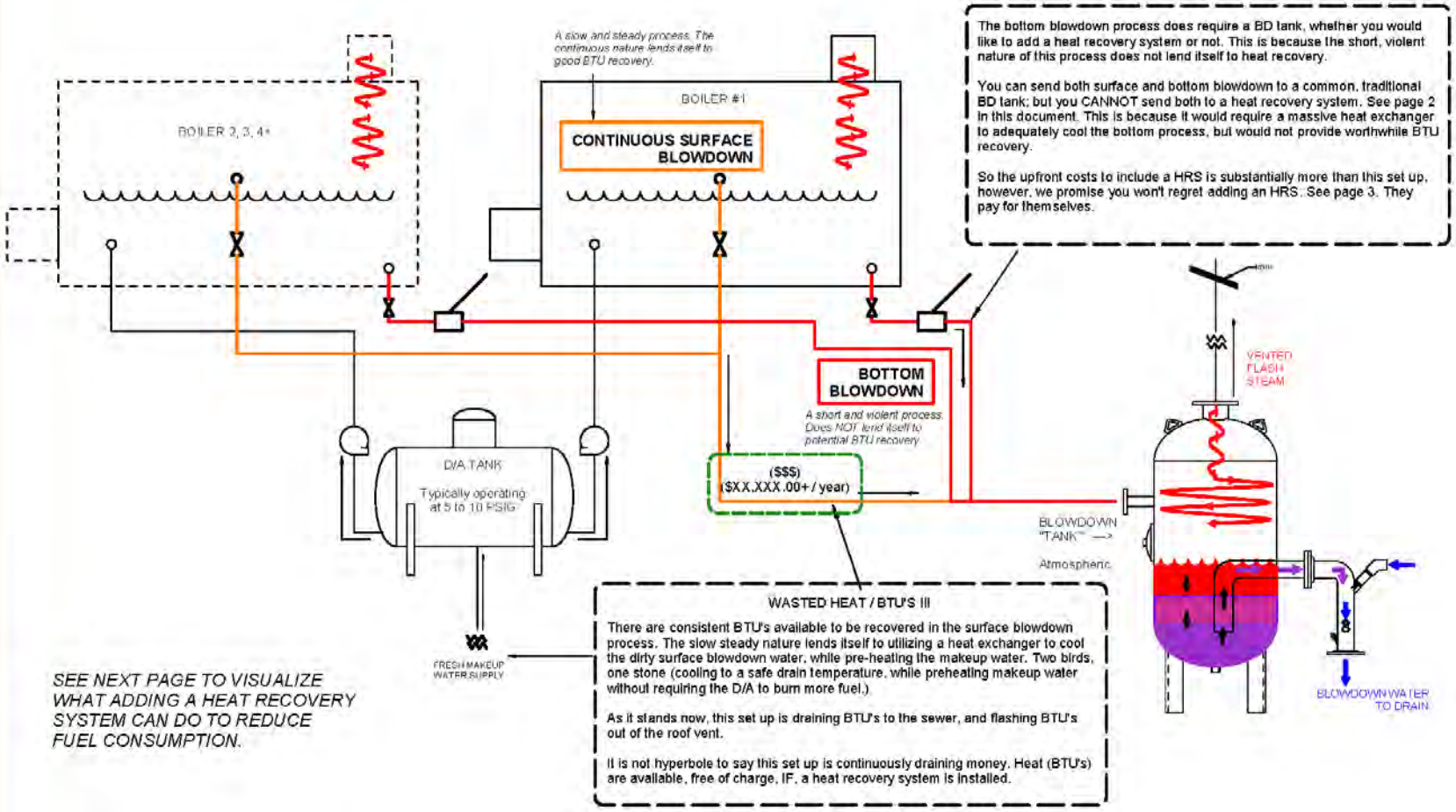
- Most of our competitors "assemble" their systems. We say "assemble" because most buy out each piece and put it all together to work as and assembly.
- This brings about inherent issues. Namely with clogging and general operator oversight required. One must continuously check to be sure the external float trap is not clogged and float is actuating, as well as ensure there isn't clogging in the heat exchanger.
- The heat exchangers used are typically plate and frame or shell and u-tube bundle type. Never vertical and self draining.
- It is also important to note, none of our competitors on the market currently have pre-designed heat recovery systems capabler of handling continuous blowdown flow rates over 15,000 PPH. For large industrial boiler rooms, this won't cut it. Madden HC horizontal heat recovery systems can handle up to 50,000 PPH of continuous boiler blowdown.

Website: maddenep.com
Ph: (574) 295-4292 | Email: info@maddenep.com

GENERIC P&ID OF BOILER BLOWDOWN SETUP - USING ONLY A "CATCH ALL" B.D. TANK

It is not uncommon to see boiler rooms that send surface blowdown, bottom blowdown, D/A overflow, and other process to a single traditional overflow style blowoff vessel.

With this 3 page document, Madden wants to help end users visualize where a significant fuel cost savings would occur if a heat recovery system was implemented...



The bottom blowdown process does require a BD tank, whether you would like to add a heat recovery system or not. This is because the short, violent nature of this process does not lend itself to heat recovery.

You can send both surface and bottom blowdown to a common, traditional BD tank; but you CANNOT send both to a heat recovery system. See page 2 in this document. This is because it would require a massive heat exchanger to adequately cool the bottom process, but would not provide worthwhile BTU recovery.

So the upfront costs to include a HRS is substantially more than this set up, however, we promise you won't regret adding an HRS. See page 3. They pay for themselves.

SEE NEXT PAGE TO VISUALIZE WHAT ADDING A HEAT RECOVERY SYSTEM CAN DO TO REDUCE FUEL CONSUMPTION.

WASTED HEAT / BTU'S !!!

There are consistent BTU's available to be recovered in the surface blowdown process. The slow steady nature lends itself to utilizing a heat exchanger to cool the dirty surface blowdown water, while pre-heating the makeup water. Two birds, one stone (cooling to a safe drain temperature, while preheating makeup water without requiring the D/A to burn more fuel.)

As it stands now, this set up is draining BTU's to the sewer, and flashing BTU's out of the roof vent.

It is not hyperbole to say this set up is continuously draining money. Heat (BTU's) are available, free of charge, IF, a heat recovery system is installed.

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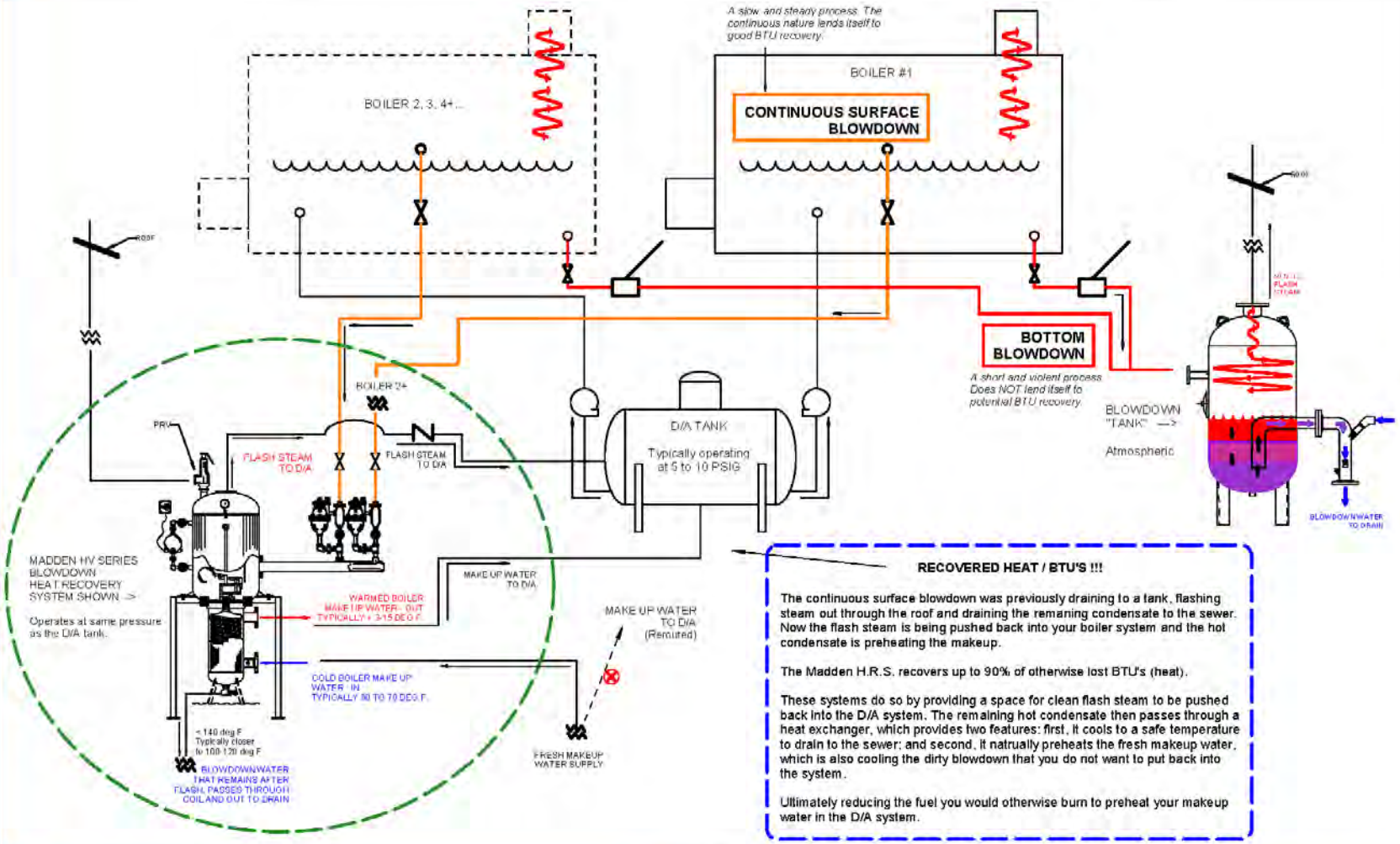
GENERIC P&ID OF BOILER BLOWDOWN SETUP - NOW INCLUDING A HEAT RECOVERY SYSTEM

There are additional up front costs to buy and install a heat recovery system, but it's worth it.

These systems reduce the amount of fuel required to produce "X" PPH of steam. If it would take "Y" amount of fuel to produce "X" PPH of steam without an H.R.S. It would now take "Y - HRS recovered BTU's" to produce "X" PPH of steam. (See Page 3 for an example of a Madden performace and savings estimate - ie., an R.O.I.)



RECOVERED HEAT / BTU'S !!!

The continuous surface blowdown was previously draining to a tank, flashing steam out through the roof and draining the remaining condensate to the sewer. Now the flash steam is being pushed back into your boiler system and the hot condensate is preheating the makeup.

The Madden H.R.S. recovers up to 90% of otherwise lost BTU's (heat).

These systems do so by providing a space for clean flash steam to be pushed back into the D/A system. The remaining hot condensate then passes through a heat exchanger, which provides two features: first, it cools to a safe temperature to drain to the sewer; and second, it natrually preheats the fresh makeup water, which is also cooling the dirty blowdown that you do not want to put back into the system.

Ultimately reducing the fuel you would otherwise burn to preheat your makeup water in the D/A system.

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MADDEN'S CONTINUOUS BLOWDOWN HEAT RECVOVERY SYSTEM

PERFORMANCE & SAVINGS ESTIMATE (EXAMPLE)

BOILER ROOM PARAMETERS:	
Boiler Operating Pressure:	150 PSIG
D/A Pressure:	5 PSIG
Flash Steam Percentage:	14.90%
Max Boiler Steam Production	(3) 41,400 PPH boilers, (2) operating, max
Average Boiler Steam Production	~ 50,000
Makeup Water Temperature	Assuming 70 deg F
Nominal Continuous Blowdown Flow Rate	Assuming ~ 3% of average steam production.

PRODUCT RECOMMENDATION:	Model no:	HV50	
	Blowdown capacity:	5,000	PPH
	Heat exchanger type:	SS	
GENERAL COMMENTS	1.) The HV50 offers ~10% continuous BD capacity per nominal steam conditions. This should provide at least a 2:1 safety factor		
	2.)		

CALCULATIONS

BOILERS:	Number of boilers:	3	BOILERS	
	Total steam generation capacity:	82,800	PPH	
	Operating pressure:	150	PSIG	
	Average steam generation: estimate	50,000	PPH	
	Average steam	50,000	PPH	
	Blowdown rate - pct	3.00%	PCT	
	Blowdown rate, average	1500	PPH	
BTU RECOVERY:	Flashed steam vessel pressure	5	PSI	
	Flash steam rate:	14.90%	RATE	
	Flash steam volume	223.5	PPH	
	Heat in flash steam:	1,155	BTU/LB	
A.	Heat recovery, flash steam:	258,143	BTU/hr	
	Hot water temperature after flash:	225	Deg. F.	
	Hot water rate:	85.10%	RATE	
	Hot water volume:	1,277	PPH	
	BTU recovery rate:	124	BTU/LB	
B.	Heat exchanger recovery:	158,286	BTU/hr	
	TOTAL BTU RECOVERY PER HOUR (A + B)	416,429	BTU	
OPERATING COST SAVINGS:	Fuel saved: @ 80% eff	5.21	Therms	
	Cost per Therm	0.75	per Therm	
	Savings per hour:	$3.90	per hour	
	Savings per day (24 hrs):	$93.70	per day	
	Savings per year (365 days):	$34,199.19	per year	
FEEDWATER HEAT RISE:	Makeup water rate: estimate	70	GPM	
		35,000	PPH	
	Temperature IN, makeup water	70	deg. F.	
	Temperature OUT, makeup water	75	deg. F.	
	Temperature RISE, makeup water	5	deg. F.	
	Waste water drain temperature:	101	deg. F.	

Boiler Room Inputs	
BOILER PRESSURE	150
STEAM RATE MAX	82,800
STEAM RATE-AVG	50,000
BLOWDOWN-PPH	1500
HX TUBE-COPPER	370
HX TUBE-304 SS	244.9
HX TUBE SURFACE-SQ FT	21
BLOWDOWN TEMP (DEG. F.):	225
FEEDWATER TEMP (DEG. F.):	70
RECOVERABLE BTU'S	124
HEAT EXCHANGE CAPACITY	
STAINLESS-BTU/HR	318,860
NOTE: Madden assumes an 80% efficiency rate of heat transfer through 3/4" O.D. X 0.049" 304SS Coil	
GAS - COST/THERM $.	0.75
FEED WATER RATE - PPH	35000
FEEDWATER RATE - GPM	70
FLASH STEAM PRESSURE	5
BTU IN FLASH STEAM	1155
FLASH STEAM PCT	0.149

Website: maddenep.com
Ph: (574) 295-4292 | Email: info@maddenep.com

SECTION 3
Blowoff Vessels for Intermittent Bottom Blowdown

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Blogs – BD Tanks & Separators

Before you begin, consider skimming some of these blogs:

- What's the difference between surface and bottom blowdown?

https://www.maddenep.com/blog/what-are-the-differences-between-intermittent-bottom-blowdown-from-a-boiler-and-continuous-surface-water-blowdown-from-a-boiler/

- What's the difference between a "tank" and a "separator"?

https://www.maddenep.com/blog/whats-the-difference-between-a-blowdown-separator-and-a-blowdown-tank/

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BLOWDOWN SEPARATORS

Purpose:
The purpose of a blowdown separator is to cool off the intermittent boiler blowdown flow so the wastewater can be safely discharged into a public sewer system and so that the flash steam can be safely vented into the atmosphere. They are smaller and more cost effective than traditional blowdown tanks, but they utilize cooling water (tanks do not) to immediately quench the blowdown to a safe temperature.

Function:
High temperature and high-pressure blowdown water enters the centrifugal inlet and vortexes around the interior wear plate and wall of the flash vessel. Flash steam is created and the remaining 212°F hot water and dirt is drained into the aftercooler. The flash steam exits to the atmosphere through the vent connection. In the aftercooler the hot water is mixed with cooling water. Cooling water is normally provided via self operating temperature regulating valve with temperature sensor. A baffle is placed to assist the mixing of the two liquids. Both the blowdown and cooling water are then sent off to the public sewer.

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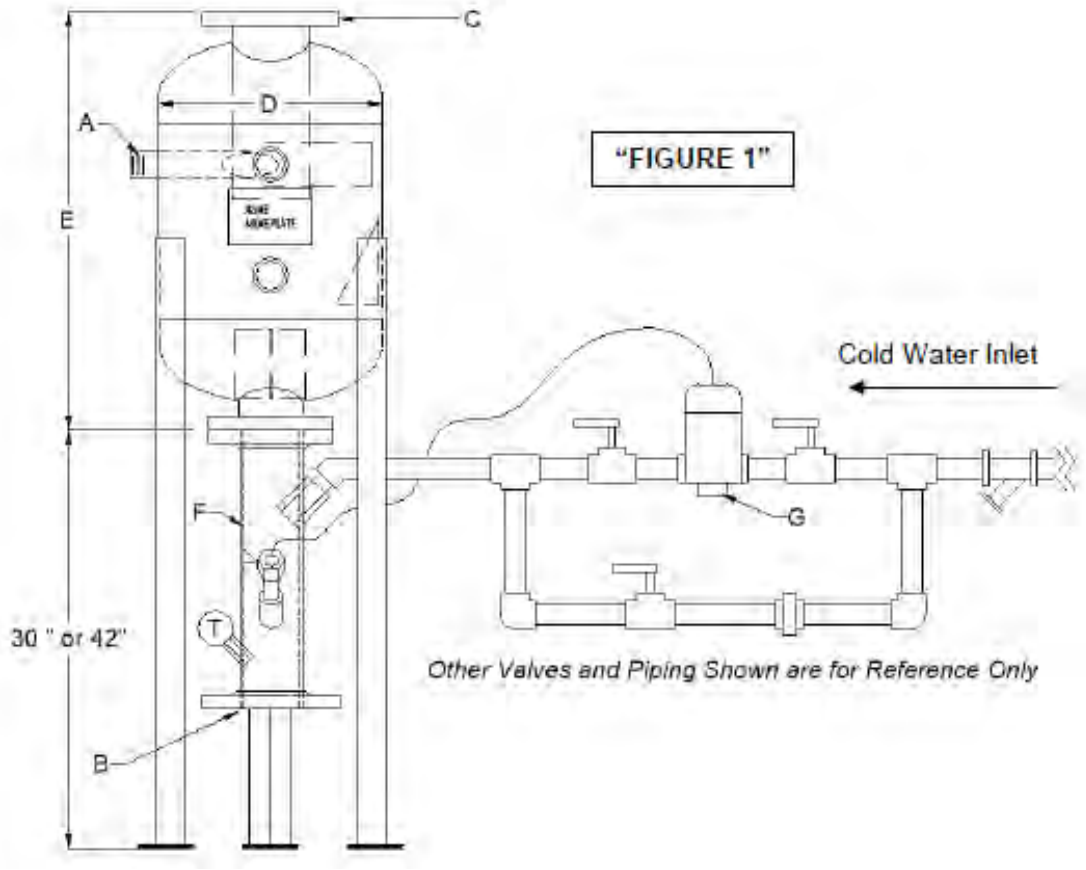
Madden BD Separators - Features

1. We stock are most common models for boilers operating at 150 PSIG or less.
2. We stock aftercooler parts and regulating valves for quick turnaround.
3. Predesigned sizes allow for quick and easy selection of the appropriate model for your boiler room.
4. Need something custom? Madden will build to order as well.
5. All vessels are ASME Sec VIII, Div 1, and come with a U stamp and National Board Serial Number.

Table 2 - Predesigned Blowdown Separator Sizing Selection Chart									
Blowdown Separator Model #	Blowdown Inlet -A-	Drain -B-	Vent -C-	Vessel Dia. x H (-D x E-)	Aftercooler Part No. -F-	Cold Water Inlet	After Cooler Size	C.W. Valve Number	Valve Size -G-
Predesigned for Boilers Operating Between 15 - 150 psig.									
BDS130A22	3/4"	2-1/2"	2-1/2"	10" x 30"	AC2H2	3/4"	2-1/2"	AC102	3/4"
BDS130B23	1"	2-1/2"	3"	10" x 30"	AC2H2	3/4"	2-1/2"	AC102	3/4"
BDS230C44	1-1/4"	4"	4"	16" x 30"	AC403D	1"	4"	AC103D	1" (D)
BDS230D45	1-1/2"	4"	5"	16" x 30"	AC404D	1-1/4"	4"	AC104D	1-1/4" (D)
BDS230E66	2"	6"	6"	16" x 30"	AC605D	1-1/2"	6"	AC105D	1-1/2" (D)
Predesigned for Boilers Operating Between 151 - 300 psig.									
BDS242B34	1"	3"	4"	16" x 42"	AC303	1"	3"	AC103	1"
BDS242C46	1-1/4"	4"	6"	16" x 42"	AC404D	1-1/4"	4"	AC104D	1-1/4" (D)
BDS242D58	1-1/2"	5"	8"	16" x 42"	AC505D	1-1/2"	5"	AC105D	1-1/2" (D)
BDS242E68	2"	6"	8"	16" x 42"	AC606D	2"	6"	AC106D	2" (D)
STOCKED DESIGNS Most jurisdictions do not permit reducing the boiler's integral blowdown connection size until after passing through a flash tank. For this reason, Madden's stock designs have 2" inlets (you can always 'bush up', but not down).									
BDS130B23	1"	2-1/2"	3"	10" x 30"	AC2H_	(TBD)	2-1/2"	(TBD)	(TBD)
BDS230E44	2"	4"	4"	16" x 30"	AC40_	(TBD)	4"	(TBD)	(TBD)
BDS230E66	2"	6"	6"	16" x 30"	AC60_	(TBD)	6"	(TBD)	(TBD)

Note 1: Standard connection types are NPT for 3" or less, and Class 150 Flange for > 4".
Note 2: Custom vessels are available upon request.



"FIGURE 1"

Dimensions & Model Selection – Blowdown Separators

NOTE See our BD Separator Data Sheet for required cooling water flows.

BLOWDOWN TANKS

Purpose:

The purpose of a blowdown tank is the same as a “separator”; the vessel allows for dirty, bottom boiler water to be flushed into a safe vessel where flash steam can release. The difference is, cooling water isn’t required, these vessels are designed to cool boiler blowdown by natural convection.

Function:

For a Blowdown Tank – after the flash steam is vented, these units use natural convection over a 6-12 hour period to allow the intermittent bottom boiler blowdown to cool. When the next intermittent bottom blowdown is released from the boiler to the tank, that hot blowdown mixes with the previous blowdown water. This previous blowdown water we are referring to is the remaining blowdown water that did not reach the level of the overflow drain on the tank. Since this previous blowdown water has now cooled over a 6-12 hour window, it immediately quenches the entering hot blowdown water, resulting in a mixed temperature of ≤ 140°F. The blowdown tank’s water level then rises to, and out of the overflow drain. This processes is repeated every 6-12 hours.

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Madden BD Tank Features

1. Madden is an industry leader in the design and fabrication process for traditional boiler blowdown vessels.

2. Madden can recommend an appropriate size vessel for many different blowdown applications in the boiler room, not just intermittent bottom blowdown.

    - IE., add D/A overflow, condensate return, and other discharge processes. We just need to know pressure and line sizes.

3. All tanks are built to order.

4. Do you want to strictly follow the NB-27 guideline for designing blowoff vessels? Madden can quickly and easily walk through this with you to understand exactly how large or small your tank needs to be.

5. All vessels are ASME Sec VIII, Div 1, and come with a U stamp and National Board Serial Number.

6. For intermittent bottom blowdown applications only (no continuous flow), quenching water is NOT required.

BLOWDOWN TANKS VS. BLOWDOWN SEPARATORS

Considerations for selecting a full Traditional Blowdown "Tank" vs. simple Blowdown "Separator" - especially for smaller boiler rooms.

All boiler rooms utilize intermittent, bottom blowdown. This is a "necessary evil", normally occuring for 15 to 30 seconds, once a day. Often times it is also recommended to continuously blowdown from the surface level connection. For continuous surface blowdown, Madden often recommends a heat recovery system. But for boiler rooms producing less than ~7,000 PPH, this often isn't worth while. Most clients choose to blow down both the continous surface blowdown and the intermittent bottom blowdown into a common blowoff vessel when their steam production is below ~ 7,000 PPH.

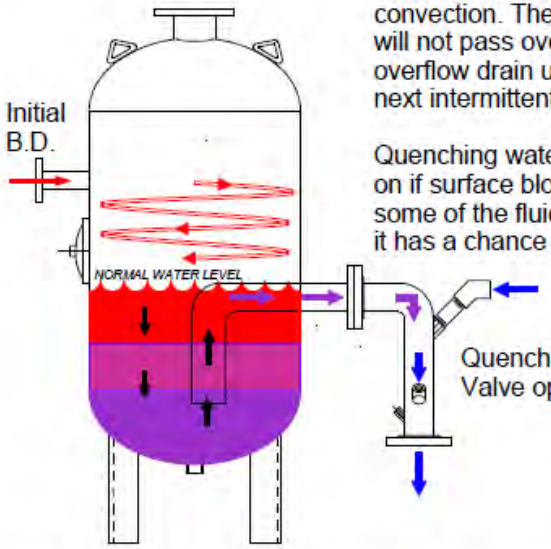
This diagram is intented to help choose when to use a traditional "Tank" vs. a smaller "Separator" in this situation.

1.) The blowdown water colors in the tank depict how water moves and cools through a traditional overflow style BD tank.

2.) This said, after start up, most of the time this water is room temperature. Waiting on the next bottom blowdown.

On average it takes 4-6 hours to cool to room temperature via natural convection.

I.E., The stagnant water is "blue" (~75 deg F), then fresh "red" (212 deg F) blowdown water enters, quenching everything to "purple" (< 140 deg F). Exiting at a safe temperature without the need for injecting fresh cold water.



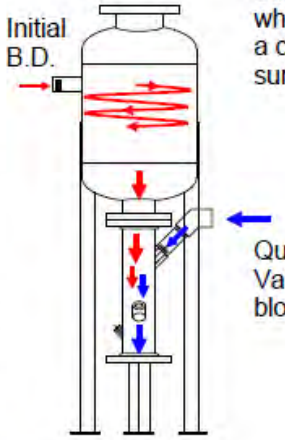
0.) Hot blowdown enters and immediately flashes. The condensate then begins cooling via natural convection. The condensate will not pass over the overflow drain until the next intermittent blowdown.

Quenching water only turns on if surface blowdown pushes some of the fluid out before it has a chance to cool naturally.

Quenching water supply. Valve opens sparingly.

0.) Hot blowdown enters and immediately flashes. Quenching water always kicks on. Perfect for applications only doing intermittent bottom blowdown.

Still an appropriate choice when cost and floor space is a concern and very little surface blowdown occurs.



Quenching water supply. Valve is always on during blowdown.

Pro's:

1.) Cold quenching water requirements greatly reduced.
2.) Longer service life.
3.) Easier to design for serveral different BD processes.

Con's:

1.) More expensive, usually $15K to $30K.
2.) Takes up more floor space.

Pro's:

1.) Lower initial cost, usually $6K to $10K.
2.) Requires very little floor space.

Con's:

1.) Constantly requires quenching water to kick on.
2.) Not easily adapted for more than (2) BD processes.

SECTION 4
Sample Cooler Stations

Type 1 Sample Coolers

- Miniature heat exchangers designed to reduce high temperature liquid samples to safe, usable temperatures for analysis
- Tubing: 316 Stainless Steel & Copper, Inconel is also available though not common
- Side shell pressure rating 150 psi
- Stainless Steel shell available for the type 1s

Type 1 sample cooler models have all the piping connections for the sample and the cooling water on the threaded cap on the top of the sample cooler. All coils are 1/4” OD tubing, and all piping connections are 1/4” NPT. Cooling water enters on the left (right in this picture, all caps are labeled) and exits opposite on the right. Sample inlet connection is vertical on the top, and the cooled sample exits from the spout.

Type 2 Sample Coolers

- Miniature heat exchangers designed to reduce high temperature liquid samples to safe, usable temperatures for analysis
- Tubing: 316 Stainless Steel & Copper, Inconel is also available though not common
- Carbon Steel shell
- Side shell pressure rating 150 psi

Type 2 sample coolers offer both 1/4” and 3/8” OD tubing coils. Sample connections are 1/4” NPTF and are made on the top plate. Cooling water connections are 3/8” NPTF located on both top and bottom plates.

Cooling water
Sample

Complete Sampling Stations

- Pre-assembled sampling stations for boiler feed water, Deaerator water, direct boiler blowoff water, condensate return, and steam.
- Single grab stations designs for water and steam.
  - Model SC201-0003: water
  - Model SC201-106: steam
  - See our SCS_DataSheet_V3.0 for details.
- Plus, complete sampling stations with multiple units.
  - Standard (2) water and (1) steam designed cooler, complete sample station design is Model No. SC203-0003-106.
  - Madden will also build to order.

SECTION 5
Chemical Feed Systems

Chemical Feed Systems

- Madden specializes in build to order chemical feed systems (right 2 pictures).
- However, we also have (5) predesigned systems to help start the conversation.
- Check out our main brochure on our website:

https://www.maddenep.com/wp-content/uploads/2022/05/ChemFeedSysBroc21.pdf

- Don’t need a full system? Check out some of our mini dosing skids (below) which save you time and costs on ancillary valves, fittings, and labor.

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What questions do you have?

Contact us at 574-295-4292 // info@maddenep.com

Or, visit our websites:
www.maddenep.com (boiler blowdown systems)
www.maddenpump.com (pumps)