

MADDEN

MANUFACTURING, INC.

Continuous Boiler Blowdown Package Heat Recovery Systems

20 Models from 1,200 pph to 50,000 pph Capacity

*Energy Efficient
& Cost Saving*



Type HV - Vertical Type



Type HX - For Smaller Boiler Systems



Type HC - Horizontal Type

MADDEN Manufacturing, Inc.

Madden Benefits

Three different styles and twenty standard models are available to match a Madden blowdown Heat Recovery System to your boiler system for the best performance and the most economical return on investment. Look at these Madden results:

- *Recover 90% of the heat energy in continuous top blowdown that would be lost down the drain*
- *Reduce temperature of blowdown discharge to drain to meet statute limits*
- *Fast investment payback from fuel, cooling water and makeup water savings, Madden systems usually pay for themselves in less than 12 months*
- *Durable, time proven designs, built to take the punishment of continuous, 24 hour a day service for years.*

How does it work?

Hot, high pressure continuous blowdown water drained from the boiler contains valuable heat energy. The continuous blowdown process helps control boiler water quality and operating efficiency by removing suspended and dissolved solids from the water in the boiler drum.

Recovery of up to 50% of the BTU's available may be accomplished by generating low pressure flash steam in a flash tank. This supply of steam can be used in the boiler D/A tank or other low pressure steam applications. As the flash steam is generated, the blowdown condensate that remains is used to preheat the

boiler feed water using a low pressure liquid to liquid heat exchanger. For smaller, lower pressure blowdown requirements, the HX Series heat recovery systems utilize a higher pressure liquid to liquid heat exchanger without a flash tank to do the heat recovery job. The Madden sales representative will recommend the model you need to maximize your fuel savings potential.

What is Continuous Top Blowdown?

To prevent scale buildup and to insure high steam quality and boiler operating efficiency, boiler water quality specifications must be maintained. Chemical treatment alone can't do the job, so water containing concentrated dissolved and suspended mineral solids is removed continuously through a top blowdown system. As the dirty blowdown water is removed from the boiler drum, it is replaced with fresh makeup water which improves the boiler water quality. Too much blowdown wastes heat and chemical treatment. Too little blowdown results in operation and maintenance problems. To get the full benefits of blowdown heat recovery, the blowdown flow must be continuous, not intermittent.

Madden System Features

Type HV and Type HC

- **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.
- **Low pressure heat exchangers** in the Type HC and Type HV systems - this reduces stress on equipment and makes scale buildup unlikely on the cooling side of the heat exchanger tubes. This is because the temperature rise of the makeup water cooling medium will usually be no more than 20° Fahrenheit.
- **Flash Tanks** designed for blowdown - baffles on the blowdown inlet create water droplets and turbulence to enlarge the surface area and increase flashing. Adequate vessel volume produces clean steam without water carryover. Surface area and retention time are engineered to facilitate flashing.

Madden Features - Orifice Meter



• Orifice Meter Flow Control Option

The adjustable orifice meter has 17 different orifices to select for accurate blowdown flow control. Durable, guaranteed for 10 years against cutting, wire drawing, or other distortion. One unit required for each boiler.

The Madden orifice meter enables the boiler operator to maintain accurate, repeatable flow control for continuous top blowdown.

Two models:

- OM250 - for boilers up to 250 psi.
- OM650 - for boilers up to 650 psi.

Features include:

- Sediment chamber w/stainless steel filter screen.
- Removeable adjustment key.
- Stainless steel, heat treated orifice plate.
- Drain valve and flush filter screen.

Madden Features - Type HX Heat Recovery Systems



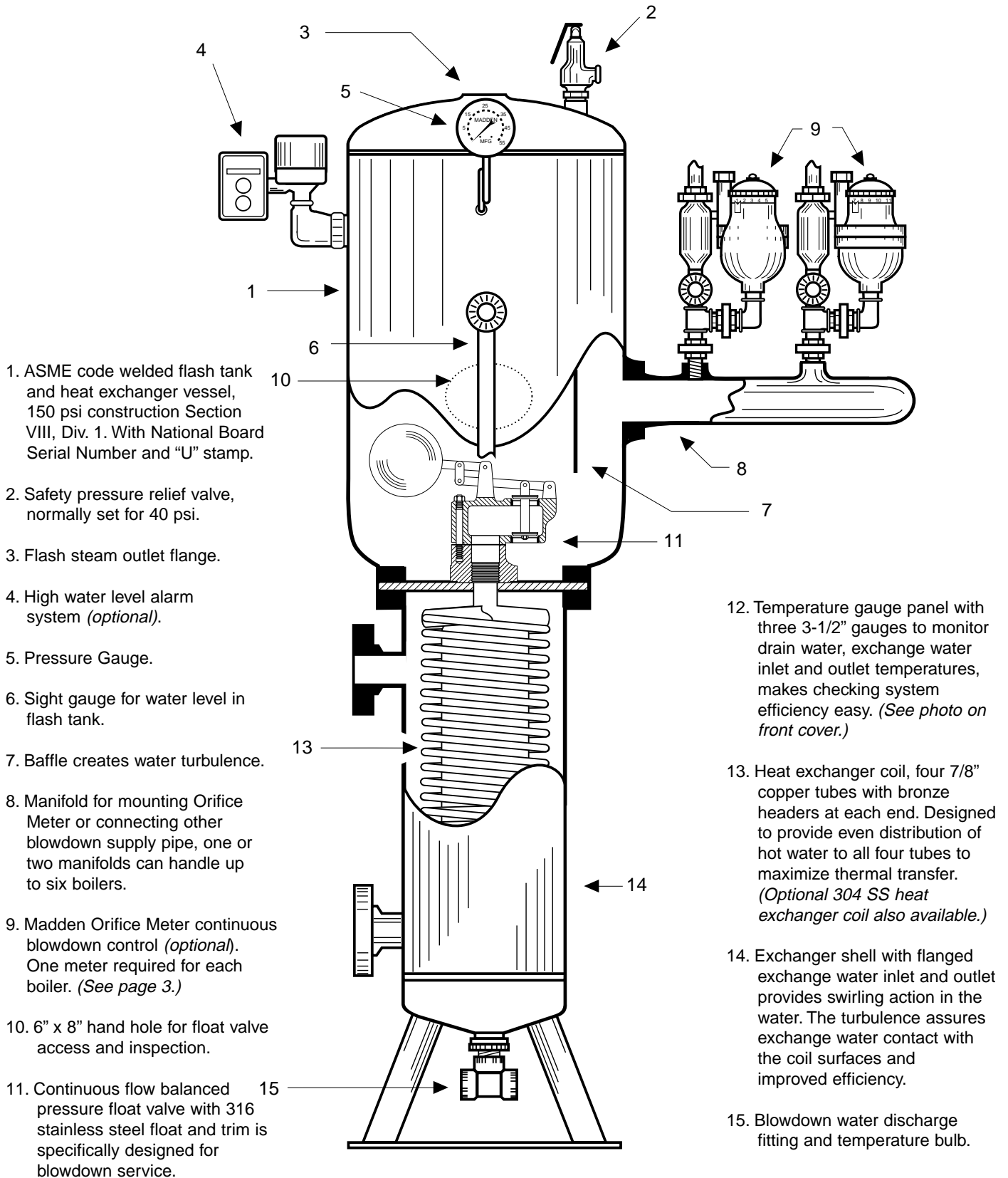
Type HX

These vertical blowdown heat recovery systems are inexpensive, yet durable. The hot blowdown water passes through a self cleaning vertical heat exchanger coil. Fresh makeup water is the shell side counter flow cooling media. No flash steam is created in these simple heat exchangers. Designed for blowdown flows up to 3,500 lbs. per hour from boilers up to 150 psi. ASME 150 psi shell construction. Copper or Stainless Steel coils available.

Models HX400A, HX450 and HX470 use 4 coils of 7/8" O.D. copper or stainless steel for the heat exchanger coil. Three temperature gauges indicate the drain, feedwater inlet and feedwater outlet temperatures. *See diagram on back cover.*

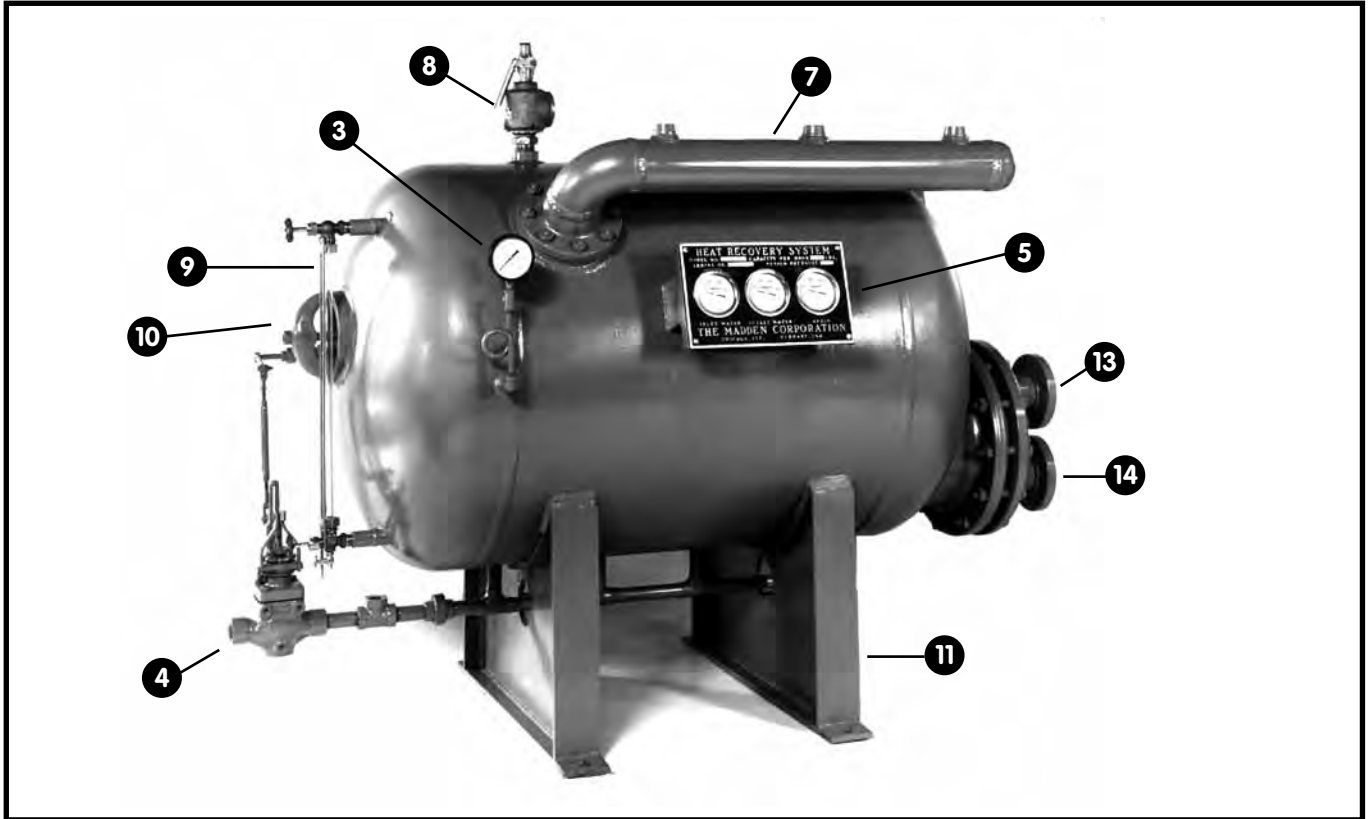
Madden Features - Type HV

5 Models - 3,000 to 15,000 lbs. per hour capacity



Madden Features - Type HC

Madden Type HC Continuous Boiler Blowdown Heat Recovery Systems feature blowdown capacities up to 50,000 lbs. per hour. Special designs for capacities up to 60,000 lbs per hour are also available (*See page 7 for dimensions*).



1. ASME code welded combined flash tank and heat exchanger vessel 150 psi construction.

2. U tubes of type 304 stainless steel. Tubes can be easily removed for inspection, cleaning and replacement.

3. Pressure gauge.

4. External float valve of balanced pressure design. Only float mechanism is inside flash tank. Maintains sufficient blowdown water level in the flash tank to cover exchanger tubes at all times.

5. Temperature gauge panel continuously shows performance of unit and furnishes data to calculate savings.

6. Orifice meter flow controls (*see page 3*) are precision instruments that accurately control the rate of blowdown. Proven in thousands of installations (*Available as an option*).

7. Customized inlet flow control manifold. Six boilers or more can easily be tied into one heat recovery system.

8. Relief Valve.

9. Gauge glass set.

10. 6" x 8" Hand hole for inspection.

11. Heavy duty saddle type mounting base.

12. High level float with alarm (optional).

13. Makeup water inlet flanged connection.

14. Makeup water outlet flanged connection.

15. Flanged flash steam vent connection(*See drawing on page 7*).

Heat Recovery Systems Performance Data

Type HC and Type HV

BTU Recovery

Example for 1,000 lbs./hour of Blowdown

Boiler Pressure in P.S.I.G.	150	
Lbs. of Water Flashing @ 5 p.s.i.	146	
B.T.U. Recovery per Hour from Flash Steam @ 1155 B.T.U. per Hour	168,630	
Specific Volume of Flash in Cubic Feet per Hour	3,066	
Water Remaining after Flash in lbs. per Hour	854	
Heat in Unflashed Water @ 225° F. Temperature	192,150	
Recoverable Heat in Water with 60° F. Cooling Medium plus 10° F. Transfer Loss	132,370	
Total Heat Recovery from Boiler Blowdown in B.T.U. per Hour	301,000	

- Big BTU savings can result in fast investment payback and lower operating costs.
- Contact the factory or your sales representative for a computer analysis of your operating system today.

Fuel Savings Example

Blowdown Rate. 3,000 lbs. per hour
 Boiler Pressure. 150 p.s.i.
 BTU Savings 903,000 per hour
 Fuel Savings per Hour 113 lbs. of coal
 6 gallons of oil
 9 therms of gas

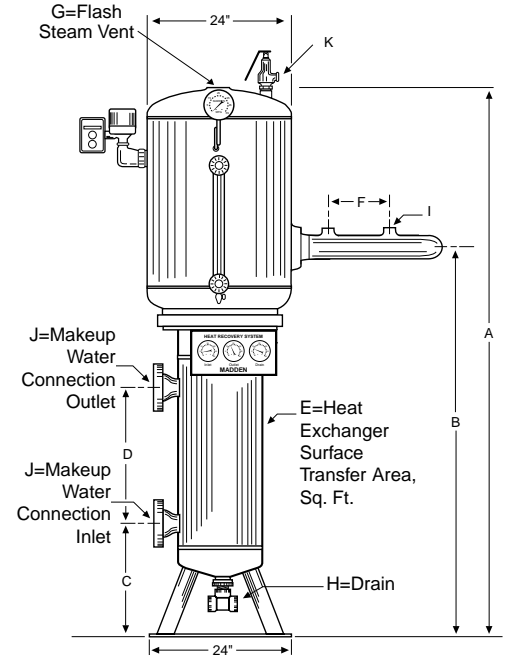
Fuel Savings per Year

- 678,000 lbs. of Coal, or
- 36,000 gallons of Oil, or
- 54,000 therms of Gas. **= \$**

Initial Pressure P.S.I.G.	Temp. of Liquid	Atmospheric Pressure	Percent of Flash at Reduced Pressures							
			5 lbs.	10 lbs.	15 lbs.	20 lbs.	25 lbs.	30 lbs.	35 lbs.	40 lbs.
100	338°	13	11.5	10.3	9.3	8.4	7.6	6.9	6.3	5.5
125	353°	14.5	13.3	11.8	10.9	10	9.2	8.5	7.9	7.2
150	366°	16	14.6	13.2	12.3	11.4	10.6	9.9	9.3	8.5
175	377°	17	15.8	14.4	13.4	12.5	11.6	11.1	10.4	9.7
200	388°	18	16.9	15.5	14.6	13.7	12.9	12.2	11.6	10.9
225	397°	19	17.8	16.5	15.5	14.7	13.9	13.2	12.6	11.9
250	406°	20	18.8	17.4	16.5	15.6	14.9	14.2	13.6	12.9
300	421°	21.5	20.3	19.	18.	17.2	16.5	15.8	15.2	14.5
350	435°	23	21.8	20.5	19.5	18.7	18	17.3	16.7	16
400	448°	24	23.	21.8	21	20	19.3	18.7	18.1	17.5
450	459°	25	24.3	23	22	21.3	20	19.9	19.3	18.7
500	470°	26.5	25.4	24.1	23.2	22.4	21.7	21.1	20.5	19.9
550	480°	27.5	26.5	25.2	24.3	23.5	22.8	22.2	21.6	20.9
600	488°	28	27.3	26	25	24.3	23.6	23	22.4	21.8
B.T.U. in Flash per lbs.		1150	1155	1160	1164	1167	1169	1172	1174	1176
Temperature of Liquid		212°	225°	240°	250°	259°	267°	274°	280°	287°
Steam Volume Cu. Ft. Lb.		26.8	21	16.3	13.7	11.9	10.5	9.4	8.5	7.8

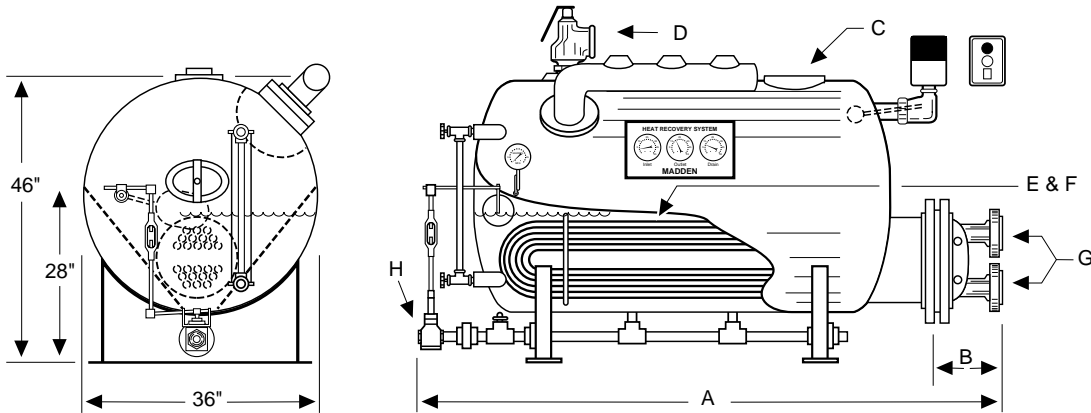
Dimensions Type HV Heat Recovery Systems

Model Number	HV030	HV050	HV070	HV090	HV120	HV150
Blowdown						
Capacity lb/hr	3,000	5,000	7,000	9,000	12,000	15,000
A (OAH)	77"	83"	89"	95"	104"	124"
B	49-5/8"	55-5/8"	61-5/8"	67-5/8"	76-5/8"	94-5/8"
C	15"	15"	15"	15"	15"	15"
D	16-1/2"	22-1/2"	28-1/2"	34-1/2"	43-1/2"	61-1/2"
E	17	21	25	29	35	46
F	13"	13"	13"	13"	13"	13"
G	3" FLG	3" FLG	4" FLG	4" FLG	4" FLG	4" FLG
H	1-1/2" NPTF	1-1/2" NPTF	1-1/2" NPTF	1-1/2" NPTF	1-1/2" NPTF	1-1/2" NPTF
I	*1"	*1"	*1"	*1"	*1"	*1"
J	3" FLG	3" FLG	4" FLG	4" FLG	4" FLG	4" FLG
K	1-1/2"	2"	2"	2"	2"	2"
Ship Wgt.	1,200 lbs.	1,300 lbs.	1,400 lbs.	1,500 lbs.	1,700 lbs.	1,900 lbs.



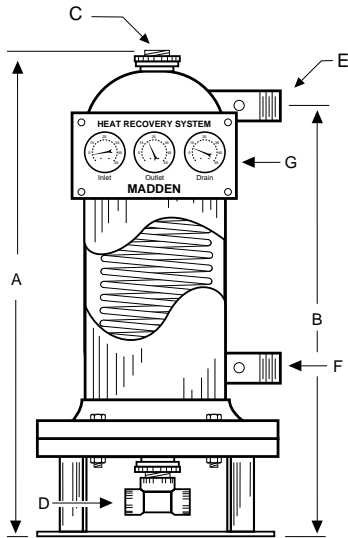
* I Dimension 1-1/4" when Model 650 Orifice Meter is used.

Dimensions Type HC



Model Number	HC 40-150	HC 80-150	HC 120-150	HC 160-150	HC 200-150	HC 240-150	HC 280-150	HC 320-150	HC 360-150	HC 500-150
Blowdown										
Capacity lb/hr	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)	1-1/4"	1-1/2"	2"	2"	2"	2"	3"	3"	3"	4"
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 Wgt.	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.

Dimensions Type HX



Model No.	HX400A	HX400B	HX450A	HX450B	HX470A	HX470B
Capacity (PPH)	2,500	2,000	3,000	2,500	3,500	3,000
Coil Area (SF)	17	17	21	21	25	25
Coil Material	copper	304 SS	copper	304 SS	copper	304 SS
A (OAH)	42"	42"	48"	48"	54"	54"
B	22"	22"	28"	28"	34"	34"
C-BD Inlet NPTF	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
D-Blowdown Drain NPTF	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
E-Shell Inlet NPT	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"
F-Shell Outlet NPT	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"
G-Temp. Gauges	3	3	3	3	3	3

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