CONTINUOUS BLOWDOWN SYSTEM PRODUCT GUIDE

Overview

Proportional blowdown heat recovery system is designed to operate with either an atmospheric boiler feed system or a deaerator.

- Model BDHR-S Series for single boiler applications.
- Model BDHR-M Series for multiple boiler applications.

Notes and Conditions

- Minimum Operating Pressure is 35 psig
- Maximum Operating Pressure is 250 psig
- A system can manage 1 – 6 boilers as described below.
- A surface blowdown tap on the boiler must exist and be used for this system.

FEATURES AND BENEFITS

BDHR-S and BDHR-M Series (High Pressure Steam Applications)

Integrated System Automatically Adjusts to Changing Demands:

- Recovers 90% of heat normally lost
- Automatically controls surface blowdown flow to maintain the desired concentration of dissolved solids within the boiler
- Automatically controls boiler dissolved solids
- Compact Size for Convenient Placement
- Reduced installation costs
- Removable Shell for Easy Inspection and Cleaning
- Reduces maintenance costs
- Significant Fuel Savings for Any Size Boiler
- Transfers the blowdown heat to the make-up, thereby decreasing fuel costs
- Saves chemical costs by reducing blowdown
- Blowdown is Cooled Before Discharging Into the Sewer
- Complies with discharge water codes

PRODUCT OFFERING

BDHR-S and BDHR-M Series

Continuous boiler surface blowdown is the most effective method of purging destructive solids from any steam boiler system. However, this protective procedure also results in a constant and costly heat loss, unless a blowdown heat recovery system is used.

Cleaver-Brooks blowdown/heat recovery systems adjust automatically to changing system demands, and recover 90% or more of the heat normally lost during boiler surface blowdown operation.

The blowdown/heat recovery systems will usually result in a payback in a few short months from fuel savings alone. Refer to Figure H12-1 for selection and payback calculations.

The Cleaver-Brooks Packaged Blowdown Heat Recovery System serves two primary functions.

1. It automatically controls the surface blowdown to maintain the desired level of total dissolved solids (TDS) in the boiler, reducing the amount of blowdown to a minimum.
2. It recovers the heat from the high temperature blowdown, and transfers it to the incoming cold make-up water, maximizing boiler efficiency. Use of BDHR also improves deaerator efficiency by reducing surges caused by adding large amounts of cold make-up water to the system.

The control valve within the unit performs two functions. The valve senses the flow of make-up, and positions itself to maintain the desired ratio of blowdown and make-up flows. As a result, the dissolved solids concentration within the boiler is maintained automatically.

The proportioning control also provides for very effective heat recovery since hot blowdown flows only when there is a corresponding flow of cold water (make-up).

Model BDHR-M Systems for multiple boiler installations include a flow control valve for each boiler. This allows for proportioning the overall system blowdown between different boilers, which may be operating at different loads. A strainer and sampling valve are also provided for each boiler, with a sample cooler mounted on the system. Thus, all boilers can be sampled at one convenient location.

The heavy duty blowdown heat exchangers are uniquely designed to handle the blowdown on the tube side. This allows many tube side passes, which ensures maximum heat transfer, and maintains high fluid velocities preventing scaling and fouling. Due to the severe service, tubes are stainless steel, and because of the abrasive nature of the fluid, return bends are fabricated of extra thick material. Since vibration is a common problem with blowdown exchangers, hold down devices are provided to clamp the tube bundle in place.

Each system is equipped with a blowdown outlet thermometer so that performance can be monitored. By logging data regularly, a cleaning schedule can be established for each exchanger.

Package Description

The single boiler package consists of the following equipment:

- Thermostatic control
- Heat exchanger

- Thermometer
- Interconnecting pipe

The multiple boiler packages consist of the following equipment:

- Thermostatic control
- Heat exchanger
- Flow control valves
- Sample cooler
- Valve assemblies
- Thermometer
- Interconnecting pipe

All systems include an ASME “U” stamp for the heat exchanger

Packages

Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-2S	2	48	200
BDHR-4S	4	48	300
BDHR-9S	9	130	600
BDHR-14S	14	130	760
BDHR-22S	22	180	900

Blowdown system for one boiler

Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-2M-2	2	48	275
BDHR-4M-2	4	48	380
BDHR-9M-2	9	130	700
BDHR-14M-2	14	130	870
BDHR-22M-2	22	180	1,025

Blowdown system for two boilers

Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-2M-3	2	48	300
BDHR-4M-3	4	48	400
BDHR-9M-3	9	130	720
BDHR-14M-3	14	130	880
BDHR-22M-3	22	180	1,050

Blowdown system for three boilers

Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-4M-4	4	48	400
BDHR-9M-4	9	130	720
BDHR-14M-4	14	130	880
BDHR-22M-4	22	180	1,050

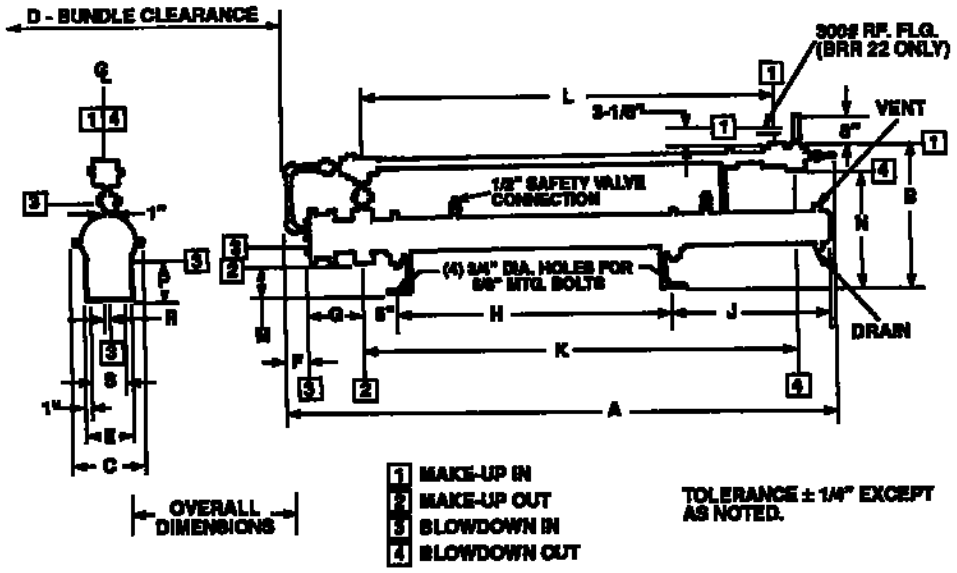
Blowdown system for four boilers

Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-9M-5	9	130	750
BDHR-14M-5	14	130	925
BDHR-22M-5	22	180	1,060

Blowdown system for five boilers

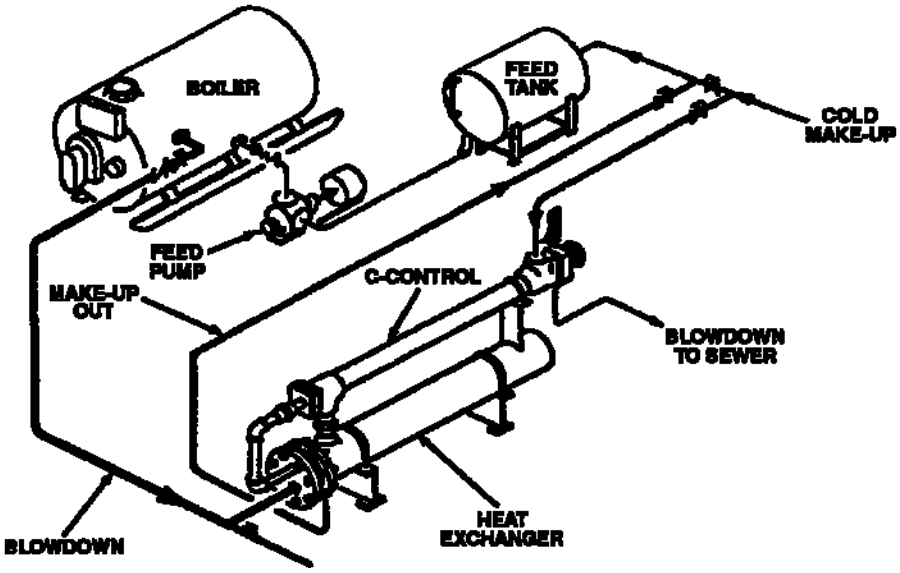
Model Number	Blowdown Total Max Capacities (gpm)	Make-up Total Max Capacities (gpm)	Shipping Weight (lbs.)
BDHR-22M-6	22	180	1,070

Blowdown system for six boilers



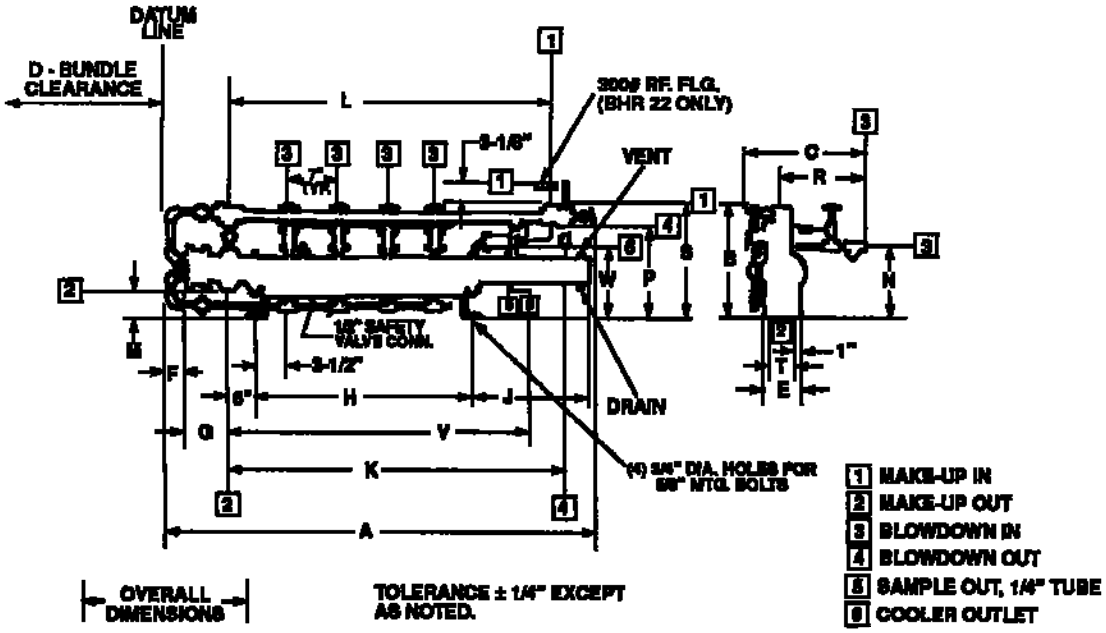
MODEL BDHR-S SERIES DIMENSIONS					
MODEL NO.	**BDHR-2S**	**BDHR-4S**	**BDHR-9S**	**BDHR-14S**	**BDHR-22S**
A REF	54-1/2	81-1/2	84	127	128
B	20-1/2	20-1/2	23-1/2	23-1/2	33
C REF	8	8	10	10	12-1/2
D REF	28	64	64	100	100
E REF	7	7	9-1/8	9-1/8	11-1/8
F EF	5-1/2	5-1/2	5-1/2	5-1/2	6
G	7-1/2	7-1/2	8	8	9-1/2
H + 1/8	16-1/2	38-1/2	38-1/2	64-1/2	64-1/2
J REF	9	22-3/4	22-3/4	33-1/2	31-1/2
K	35-3/4	62-5/8	62-5/8	107-1/2	105
L	33	60	60	105	96-1/2
M	4-1/2	4-1/2	4-3/8	4-3/8	4
N	16-1/2	16-1/2	19-1/2	19-1/2	24-1/2
P	7	7	7	7	7-1/2
R	1/2	1/2	*	*	3/4
S + 1/8	5	5	7-1/8	7-1/8	9-1/8
CONNECTIONS					
1	1-1/2 FPT	1-1/2 FPT	2 FPT	2 FPT	3FLG
2	1-1/2 FPT	1-1/2 FPT	2 FPT	2 FPT	3 FPT
3	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT	1 FPT
4	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT	1 FPT

Figure H12-2. Model BDHR-S Dimensions



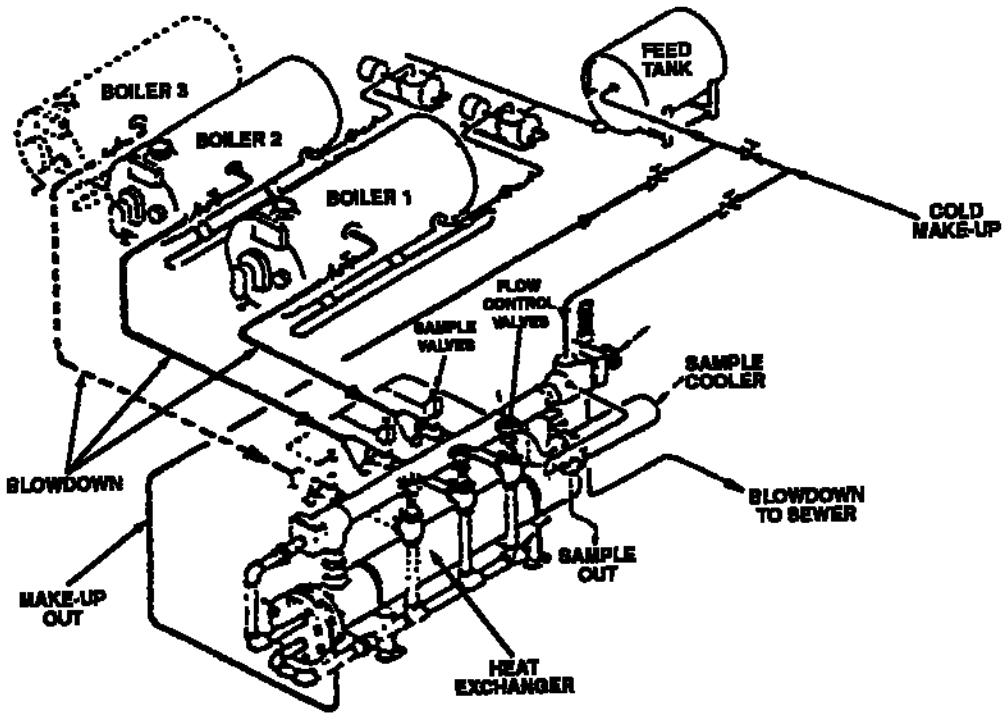
MAXIMUM CAPACITIES (GPM)		
Model No.	**Blowdown**	**Make up**
BDHR-2S	2	48
BDHR-4S	4	48
BDHR-9S	9	130
BDHR-14S	14	130
BDHR-22S	22	180

Figure H12-3. Model BDHR-S Ratings/Capacities



MODEL BDHR-M SERIES DIMENSIONS					
MODEL	**BDHR-2M**	**BDHR-4M**	**BDHR-9M**	**BDHR-14M**	**BDHR-22M**
MAX NO.OF BOILERS	4	4	5	5	6
A REF	54-1/2	81-1/2	84	127	128
B REF	22	22	24	24	28
C REF	19-1/4	17-1/4	18-1/2	18-1/2	19-1/2
D REF	28	64	64	100	100
E EF	7	7	9-1/8	9-1/8	11-1/8
F REF	5-1/2	5-1/2	5-1/2	5-1/2	6
G	7-1/2	7-1/2	8	8	9-1/2
H + 1/8	16-1/2	38-1/2	38-1/2	64-1/2	64-1/2
J REF	9	22-3/4	22-3/4	33-1/2	31-1/2
K	35-3/4	62-5/8	62-5/8	107-1/2	105
L	33	60	60	105	96-1/2
M	4-1/2	4-1/2	4-3/8	4-3/8	4
N	14	14	16	16	20
P	13-1/2	13-1/2	15-1/2	15-1/2	21
R	11-1/2	11-1/2	11-1/2	11-1/2	11-1/2
S	20-1/2	20-1/2	23-1/2	23-1/2	33
T + 1/8	5	5	7-1/8	7-1/8	9-1/8
V	25-1/2	61-1/4	61-1/4	92-1/4	95-3/4
W	15-1/2	15-1/2	18	18	22-1/2
CONNECTIONS					
1	1-1/2 FPT	1/1/2 FPT	2 FPT	2 FPT	3 FPT
2	1-1/2 FPT	1-1/2 FPT	2 FPT	2 FPT	3 FPT
3	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT
4	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT	1 FPT
6	1/4 FPT	1/4 FPT	1/4 FPT	1/4 FPT	1/4 FPT

Figure H12-4. Model BDHR-M Dimensions



MAXIMUM CAPACITIES (GPM)		
MODEL	**BLOWDOWN**	**MAKE-UP**
BDHR-2M	2	48
BDHR-4M	4	48
BDHR-9M	9	130
BDHR-14M	14	130
BDHR-22M	22	180

Figure H12-5. Model BDHR-M Ratings/Capacities

Freight

Pricing is based upon F.O.B. factory - Oconomowoc, WI 53066

Cleaver-Brooks

DIVISION OF AQUA-CHEM, INC.
P O BOX 421 • MILWAUKEE, WIS. 53201

BLOWDOWN HEAT RECOVERY SYSTEM SELECTION & PAYBACK

Job Name _____ Sales Agency _____

Location _____ Date _____

CAUTION: BHR SYSTEMS ARE FOR BOILER PSIG OF 35 MINIMUM TO 250 MAXIMUM.

1.0 DEFINITIONS/DATA:

1.1 THERM = 100,000 BTU.
1.2 Steaming Rate Lbs./Hr = (34.5) (Max HP Usage).
1.3 Lbs. Water/Hr ÷ 500 = GPM.
1.4 MU = Makeup.
1.5 BD = Blowdown.
1.6 TDS = Total Dissolved Solids.
1.7 C = Concentration = $\frac{\text{Boiler TDS}}{\text{MU TDS}} = \frac{\text{Gross MU}}{\text{BD}}$
1.8 Net MU = (Max Lbs/Hr) (1 - Fraction Ret'd Condensate).
1.9 Gross MU = Net MU + BD.

1.10 Saturated Steam Tables

PSIG	TEMP °F
75	320
90	331
100	338
125	353
150	366
175	377
200	388
250	406

2.0 BOILER OPERATING CONDITIONS (obtained from Owner)

Par →	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9
Boiler No.	Max HP Usage	Steam, Max Lbs/Hr	Operating PSIG	Operating Temp °F	Fraction Returned Condensate	Boiler Eff. %	MU Temp °F	ppm MU TDS	Operating Hrs/Yr
1									
2									
3									
4									
TOTAL									

3.0 FUEL DATA (obtained from Owner): % Gas = _____ ; % Oil = _____

3.1 Gas Cost ——————→ = $ _____ /THERM

3.2 Oil Cost = ($___/Gal) (100000) ÷ (150000 BTU/Gal) = $ _____ /THERM

3.3 Average Cost = (Fraction Gas) (Gas Cost) + (Fraction Oil) (Oil Cost) = $dollars/THERM.
Average Cost = ( ) ( ) + ( ) ( ) = $_____/THERM.

4.0 BOILER TDS LEVEL REQ'D (obtained from Owner) = _____ ppm

5.0 C (Concentrations) = $\frac{\text{TDS Boiler}}{\text{TDS MU}} = \frac{\text{Par 4.0}}{\text{Par 2.6}} = \left\{\_\_\_\_\_\right\}$ = _____ C

6.0 NET MU = (Max Lbs/Hr) (1 - Fraction Returned Condensate)
NET MU = (Par 2.2) (1 - Par 2.5) = ( ) ( ) = _____ Lbs/Hr.

7.0 BD = $\frac{\text{(Net MU)}}{\text{(C-1)}} = \frac{\text{(Par 6.0)}}{\text{(Par 5.0-1)}} = \left\{\_\_\_\_\_\right\}$ = _____ Lbs/Hr = _____ GPM

8.0 GROSS MU = (Net MU) + (BD) = (Par 6.0) + (Par 7.0) = ( ) + ( ) = _____ Lbs. Hr.
= _____ GPM

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BLOWDOWN HEAT RECOVERY SYSTEM SELECTION & PAYBACK

9.0 EQUIPMENT SELECTION TABLE

9.1 Select Model with maximum GPM capacities which are adequate for the GPM of BD (Par 7.0) and Gross MU (Par 8.0). DO NOT EXCEED MAX GPM VALUES FOR MODELS TO AVOID DAMAGING EROSION AND VIBRATION.

9.2 Where practical, select next larger size because:
(a) Larger sizes will better accommodate MU surges caused by large and abrupt steam demands, and ....
(b) Larger sizes recover more BD energy, and .....
(c) Systems have a sufficiently fast Payback and high ROI to cost justify the added first costs of larger systems.

9.3 Table of Models, BHR SYSTEMS:

Model	Max BD GPM	Max Gross MU GPM	MU Pressure Drop at Max GPM
BHR-2	2 GPM	48 GPM	1.5 PSI
BHR-4	4 GPM	48 GPM	2.0 PSI
BHR-9	9 GPM	130 GPM	7.5 PSI
BHR-14	14 GPM	130 GPM	10.0 PSI
BHR-22	22 GPM	180 GPM	3.5 PSI

10.0 MODEL SELECTED = _____ (using Par 9.3]).

11.0 HEAT RECOVERY EFFICIIENCY (at Par 7.0 BD GPM & Par 5.0 "C" value) = _____
(reference Efficiency curves, Par 18.0 Page 3)

12.0 HEAT RECOVERED = (Efficiency (BD Lbs/Hr) (Oper Temp - MU Temp)
= (Par 11.0) (Par 7.0) (Par 2..4-Par 2.7) ÷ (100000)
= ( ) ( ) ( ) ÷ (100000)
= _____. THERMS/Hr.

13.0 ENERGY SAVED = (Heat IRecovered) ÷ (% Boiler Efficiency - 100)
= (Par 12.0) ÷ (Par 2.6 ÷ 100)
= ( ) ÷ ( ) = _____ THERMS/Hr.

14.0 $ SAVINGS/YEAR = (Energy Saved) (Hrs/Year) (Fuel Cost)
= (Par 13.0) (Par 2.9) (Par 3.3)
= ( ) ( ) ( ) = $ _____ /Yr.

15.0 $ EQUIPMENT COST (from pricing date) = $ _____

16.0 PAYBACK IN YEARS = (Equipment Cost) ÷ ($ Savings per Year)
= (Par 15.0) ÷ (Par 14.0)
= ( ) ÷ ( ) = _____ Yrs = _____ Mos.

17.0 % RETURN ON INVESTMENT = (100) ($ Savings per year) ÷ ($ Equipment Cost)
$= \frac{(100)\ (\text{Par } 14.0)}{(\text{Par } 15.0)} = \frac{(100)\ (\quad)}{(\quad)} =$ _____ %.

BLOWDOWN HEAT RECOVERY SYSTEMS SAMPLE SPECIFICATIONS

CONTENTS

PART 1 GENERAL

1.1 GENERAL

The following sample specifications are provided by Cleaver-Brooks to assist you in specifying your customer's requirements.

PART 2 PRODUCTS

2.1 BDHR-S SERIES

A. Furnish _____ Cleaver-Brooks Model BDHR-S Package blowdown heat recovery system designed to handle a maximum blowdown rate of _____ gpm (2 to 22) and a maximum make-up rate of _____ gpm (48 to 180).

B. The heat recovery system shall be designed for a boiler of _____ hp (150 - 1500), hp operating at _____ psig (35 to 250). The unit shall be designed to cool the blowdown to within 30 °F of the make-up water temperature. The unit shall have a 250 psig rating at 400 °F.

C. The heat recovery system shall consist of a differential temperature control valve that shall automatically regulate the blowdown of make-up flow. The flow of blowdown shall be regulated by the thermal expansion of the inner brass tube pressing against a valve seat. The inner tube will contract only when cold make-up water passes through the brass jacketed steel outer tube shell, allowing the blowdown to cool and go out the exchanger.

D. The system shall also have a heat exchanger, including a removable U-tube bundle manufactured of 19 gauge, 304 stainless steel tubes and steel sideshell with hold down clamps to stop tube bundle vibration. The vessel shall be ASME code stamped for 250 psig at 400°F. The system shall have interconnecting piping of steel and stainless steel. The exchanger shall have a minimum sq-ft of surface area. The flow of the blowdown make-up shall flow in opposite directions for maximum heat transfer efficiency of _____ percent.

E. A heat treated stainless steel valve seat and plunger shall manually control the blowdown flow by a handwheel.

F. A blowdown thermometer Weksler Type 152 shall be furnished at the blowdown outlet.

G. The entire system shall be supported by steel channel legs with 3/4" diameter holes for customer-supplied 5/8" diameter anchor bolts.

H. The system will be painted with a hard enamel coating.

2.2 BDHR-M SERIES

A. The following sample specifications are provided by Cleaver-Brooks to assist you in specifying your customer's requirements.

B. Furnish _____ Cleaver-Brooks Model BDHR-M package blowdown heat recovery system designed to handle a maximum blowdown rate of _____ gpm (2 to 22) and a maximum make-up rate of _____ gpm (48 to 180).

C. The heat recovery system shall be designed for boilers of _____ hp (250 - 1500), hp operating at _____psig (35 to 250). The unit shall be designed to cool the blowdown to within 30 °F of the make- up water temperature. The unit shall have a 250 psig rating at 400°F

D. The heat recovery system shall consist of a differential temperature control valve that shall automatically regulate the blowdown and make-up flow. The flow of blowdown shall be regulated by the thermal expansion of the inner brass tube pressing against a valve seat. The inner tube will contract only when cold make-up water passes through the brass jacketed steel outer tube shell allowing the blowdown to cool and go out the exchanger.

E. The system shall also have a heat exchanger, including a removable U-tube bundle manufactured of 19 gauge, 304 stainless steel tubes and steel sideshell with hold down clamps to stop tube bundle vibration. The vessel shall be ASME code stamped for 250 psig at 400°F. The system shall have interconnecting piping of steel and stainless steel. The exchanger shall have a minimum sq-ft of surface area. The flow of the blowdown make-up shall flow in opposite directions for maximum heat transfer efficiency of _____ percent.

F. A heat treated stainless steel valve seat and plunger shall manually control, the blowdown flow by means of a handwheel. A blowdown outlet thermometer Weksler Type 152 shall be furnished at the blowdown outlet.

G. A flow control assembly shall be furnished for each boiler. The assembly shall consist of a _____ inch Hancock #4595 flow control valve rated at 300 psig, bronze construction and a _____ inch cast steel strainer with a stainless steel screen and have a 250 psig pressure rating.

H. A SC-22 sample cooler with isolation valves and interconnecting piping will be supplied.

I. The entire system shall be supported by steel channel legs with 3/4" diameter holes for customer-supplied 5/8" diameter anchor bolts.

J. The system will be painted with a hard enamel finish coating.

Notes