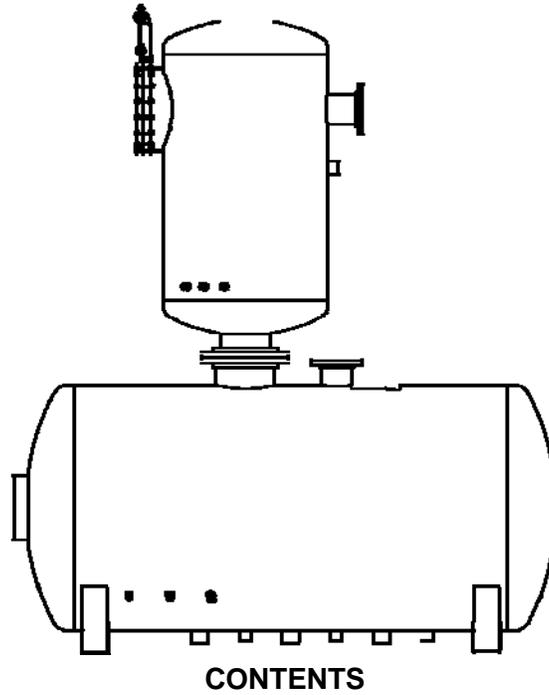


# TRAYMASTER DEAERATORS



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## FEATURES AND BENEFITS

The following features and benefits apply to the Traymaster Deaerator product line.

### **Less Mechanical Movement of Deaerator Components:**

- The water spray valve is the only internal moving component within the deaerator vessel.

### **Two-Stage Deaeration in a Common Vessel:**

- Recycle pumps are not required.
- Packaged for easy maintenance.

### **ASME Code Design (Section VIII):**

- Assures deaerator vessel quality in materials and fabrication to meet safety requirements.

### **Internal Stainless Steel Vent Condenser:**

- Protects deaerator vessel against corrosive gases while providing a means for removal of corrosive gases from boiler feedwater.

### **Self-Cleaning Water Spray Valve:**

- Maintains deposit-free surface.
- Reduces maintenance requirements.

### **Internal Automatic-Check Valve Prevents Steam Back-Flow:**

- The water spray valve is normally closed at no flow.
- Prevents steam back flow through the water spray valve at no flow conditions.

### **Stainless Steel Deaeration Assembly:**

- Ensures a longer life of wetted materials in intimate contact with corrosive liquids and released corrosive gases.

### **Pressurized Tank Reduces Flashing and Minimizes Venting:**

- Recovery of exhaust and turbine steam.
- Saves BTUs that would normally be exhausted to atmosphere.
- Improves plant efficiency.

### **Auto Vent Valve Eliminates Gases at Start-Up:**

- Atmospheric contamination virtually eliminated for incoming water.

### **Exceeds ASME Recommendations for Oxygen Level:**

- Cleaver-Brooks deaerator is guaranteed to remove oxygen concentrations to 0.005 cc/liter while operating between 5 and 100% capacity.
- Carbon dioxide concentration is practically reduced to zero.

**Integral Level Control Automatically Introduces Cold Water Make-Up to Supplement Condensate Only When Necessary to Meet Boiler Demand:**

- Saves BTUs by accepting condensate before cold make-up water. Maintains a minimal water level within the deaerator vessel to prevent damage to the boiler feedpumps, and to maintain system operation.

**Variety of Tank Sizes to Handle Volume-Swings in Condensate Return:**

- Provides flexibility for selecting a tank for specific applications to limit the loss of hot condensate to drain.

**Packaged Units for Cost Effective Installation:**

- Complete packages are pre-fabricated in the Cleaver- Brooks manufacturing facility to ensure piping alignment and control wiring function. The unit is partially disassembled, match marked for efficient field re-assembly.

**Internal Pump Suction Vortex Breakers:**

- Eliminates the problems of loss in NPSHA and cavitation associated with the creation of vortices within pump suction piping.

## *PRODUCT OFFERING*

Information in this section applies directly to Cleaver-Brooks packaged Traymaster deaerators ranging from 30,000 lbs/hr to 500,000 lbs/hr at 50 °F makeup.

The Traymaster deaerator is a pressurized low maintenance system designed to remove dissolved oxygen in boiler feed water to 0.005 cc per liter or less and eliminate carbon dioxide. A typical deaerator package includes the tray column and storage tank mounted on a stand of appropriate height along with all operating controls, feed pumps assembled and piped (typically knocked down for shipment and field assembly). The tank conforms to Section VIII of the ASME code.

The tray column design is best for handling high-temperature returns. The column is constructed of carbon steel. Built into the top of the tray box is a spring loaded self-cleaning water spray nozzle. Automatic and manual vent valves are built into the top of the vent condenser.

From experience, large industrial plants and utilities have learned that the most practical and economical way to remove oxygen from feedwater is through mechanical deaeration. The Traymaster deaerator economically effects oxygen removal through a design that is trouble free in performance.

Raw water, untreated and not deaerated, contains as much as ten cubic centimeters of corrosion-causing oxygen per liter. Oxygen in water corrodes and shortens the life of boiler feed lines, boilers and condensate return lines.

The Cleaver-Brooks designed deaerator assures high purity effluent by removing oxygen and other dissolved gases in boiler feed. Thus, it is the answer to long- lasting boiler equipment for industrial and commercial boiler users. Built of corrosion-resistant alloys for lifetime service, the deaerator employs those basic principles of gas removal proved to most effective and economical to every boiler owner. Contact your local Cleaver-Brooks authorized representative for component and sizing information.

The design of the Traymaster deaerator offers simplicity in both operation and service. The tray section, the heart of the deaerator, requires no maintenance. There are no moving parts to adjust or maintain. Installation is simple and quick.

#### Standard Equipment

- Tray column.
- Deaerator storage tank.
- Stainless steel trays of riveted construction.
- Deaerator water inlet atomizing valve.
- Gauge glass.
- Deaerator manual and automatic vent valve.
- Steam pressure gauge.
- Feed water thermometer.
- Required tapings.

#### Optional Equipment

- Steam pressure reducing valve.
- Three valve bypass and strainer (PRV).
- Water level controller with make-up valve.
- Three valve bypass and strainer (MUV).
- Steam relief valves.
- High water alarm.
- Low water alarm.
- Low water pump cut off.
- High-temperature condensate diffuser tube (over 227 °F).
- Boiler feed pump and motor sets.
- Recirculation orifice or relief valve.
- Suction shutoff valve.
- Suction strainer.
- Suction flexible fitting.
- Discharge check valve.
- Discharge shutoff valve.
- Discharge pressure gauge.
- Discharge manifold.
- Overflow drainer.
- Control panel.
- Chemical feed quill.
- Vacuum breaker.
- Insulation and lagging.

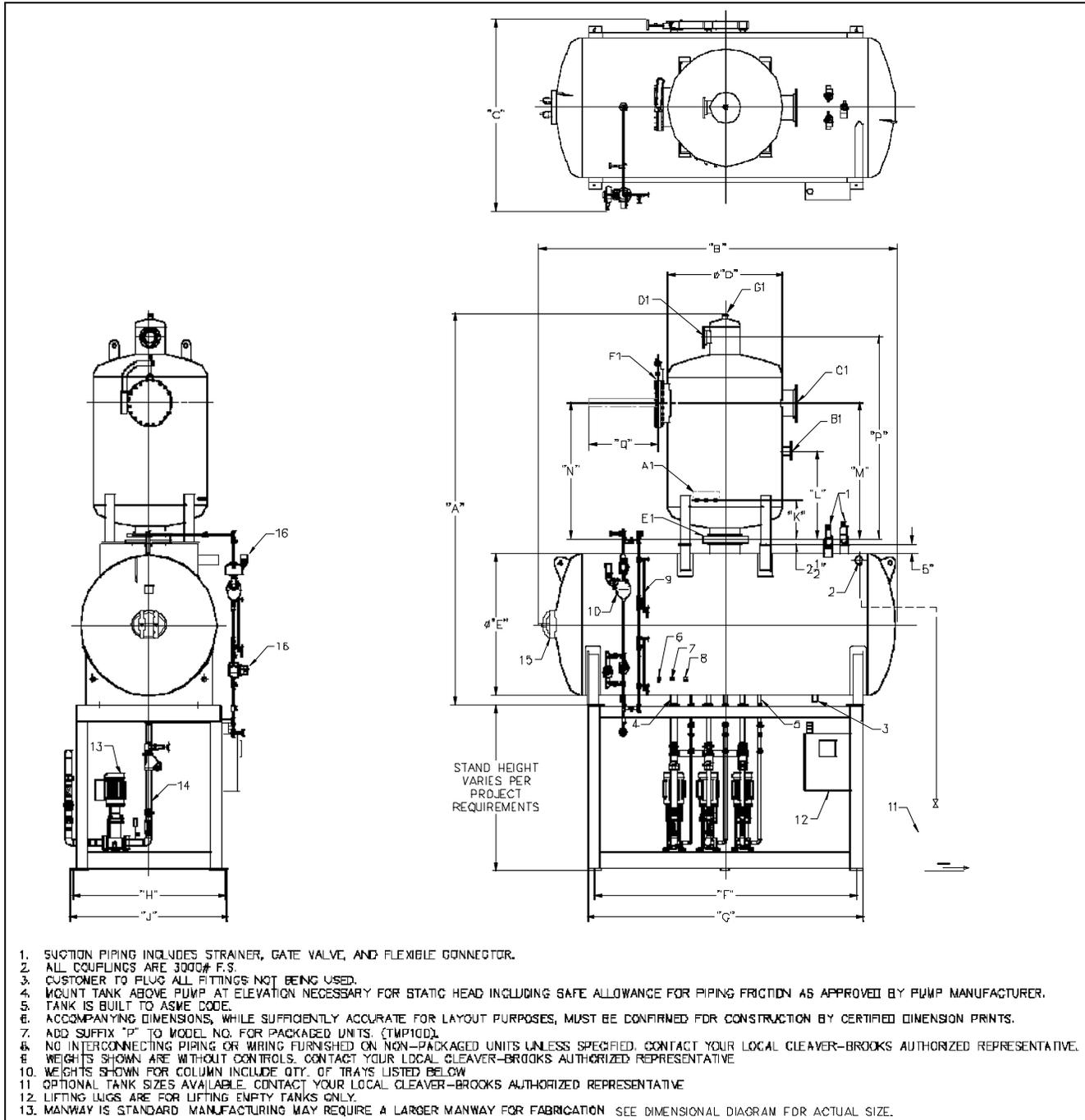
- Sentinel relief valve.
- Tank drain valve.
- Back pressure relief valve.
- Magnesium anode.
- Stand.

**Packaging**

- Fully packaged, factory piped and wired.
- Half packaged, suitable for field erection with interconnecting piping and wiring by others.

**DIMENSIONS AND RATINGS**

Dimensions and ratings for Traymaster Deaerators are shown in the following figures and tables.



**Figure H3-1. Traymaster Deaerator Dimension Diagram**

**Table H31. Dimensions, TM030-TM125**

TRAYMASTER DETAILS AND DIMENSIONS						
MODEL NUMBER		TM030	TM045	TM070	TM100	TM125
A	HEIGHT ABOVE STAND	143	154	169	179-1/2	197-1/2
B	OVERALL LENGTH	120-1/2	133	137	160	168
C	OVERALL WIDTH	75	78	85	91	97
D	COLUMN DIAMETER	36	36	48	54	54
E	STORAGE TANK DIA.	42	48	60	66	72
F	C/L TO C/L BOLT HOLES	79-1/2	95	95	112-1/2	112-1/2
G	STAND LENGTH	84-1/2	101	101	119-1/2	119-1/2
H	C/L TO C/L BOLT HOLES	55	59	68	73	80
J	STAND WIDTH	58	62	71	76	83
K	TEMP./PRESS. SENSOR	15-5/8	15-5/8	18	23-7/8	18-7/8
L	HIGH TEMP. RETURN	41-5/8	39-5/8	40	40-7/8	52-3/4
M	STEAM INLET	54-5/8	52-5/8	55	55-7/8	67-3/4
N	DAVITED MANWAY	54-5/8	52-5/8	55	55-7/8	67-3/4
P	WATER INLET	SEE "A"	81-3/8	84-1/4	87-1/8	99-1/8
Q	TRAY CLEARANCE	18	24	36	36	36
TRAY QTY.		20	20	20	30	36
COLUMN WEIGHT (LB)		1600	1800	2300	3000	3300
STORAGE TANK CAPACITY (GAL.)		600	900	1400	2000	2500
STORAGE TANK WEIGHT (DRY) (LB)		1500	1800	2400	3800	4300
STORAGE TANK WEIGHT (FLOODED) (LB)		6500	9300	14000	20500	25100
COLUMN CONNECTIONS						
MODEL NUMBER		TM030	TM045	TM070	TM100	TM125
A1	TEMP./PRESS. SENSOR	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT
B1	HIGH TEMP. RETURN	2" NPT	2" NPT	2-1/2" NPT	3" NPT	3" NPT
C1	STEAM INLET	6"-150# RFSO	8"-150# RFSO	8"-150# RFSO	10"-150# RFSO	10"-150# RFSO
D1	WATER INLET	2-1/2"-150# RFSO	3"-150# RFSO	3"-150# RFSO	4"-150# RFSO	4"-150# RFSO
E1	DOWNCOMER	10"-150# FFSO	12"-150# FFSO	14"-150# FFSO	16"-150# FFSO	16"-150# FFSO
F1	MANWAY	16"	18"	18"	20"	20"
G1	VENT PIPE	3/4" NPT	1-1/2" NPT	1-1/2" NPT	2" NPT	2" NPT

**Table H32. Dimensions, TM140-TM250**

TRAYMASTER DETAILS AND DIMENSIONS						
MODEL NUMBER		TM140	TM175	TM200	TM225	TM250
A	HEIGHT ABOVE STAND	200	218-1/2	218-1/2	232	232
B	OVERALL LENGTH	186	188	197	190-1/2	195-1/2
C	OVERALL WIDTH	97	107-1/2	107-1/2	119	119
D	COLUMN DIAMETER	60	72	72	72	72
E	STORAGE TANK DIA.	72	84	84	96	96
F	C/L TO C/L BOLT HOLES	137	135-1/2	137	127-1/2	137
G	STAND LENGTH	144	142-1/2	144	134-1/2	144
H	C/L TO C/L BOLT HOLES	80	88-1/2	88-1/2	99	99
J	STAND WIDTH	83	91-1/2	91-1/2	102	102
K	TEMP./PRESS. SENSOR	20	21-7/8	21-7/8	21-7/8	24-3/8
L	HIGH TEMP. RETURN	45	44-7/8	44-7/8	44-7/8	47-3/8
M	STEAM INLET	69-1/2	69-7/8	69-7/8	69-7/8	72-3/8
N	DAVITED MANWAY	69-1/2	69-7/8	69-7/8	69-7/8	72-3/8
P	WATER INLET	103-1/4	107-1/8	107-1/8	108-1/8	109-5/8
Q	TRAY CLEARANCE	36	36	36	36	36
TRAY QTY.		42	42	56	65	70
COLUMN WEIGHT (LB)		3700	3700	5600	5800	6000
STORAGE TANK CAPACITY (GAL.)		2800	3500	4000	4500	5000
STORAGE TANK WEIGHT (DRY) (LB)		4700	6600	6900	7900	8100
STORAGE TANK WEIGHT (FLOODED) (LB)		28000	35800	40200	45400	49800
COLUMN CONNECTIONS						
MODEL NUMBER		TM140	TM175	TM200	TM225	TM250
A1	TEMP./PRESS. SENSOR	3/4" NPT				
B1	HIGH TEMP. RETURN	4"-150# RFSO	6"-150# RFSO	6"-150# RFSO	6"-150# RFSO	8"-150# RFSO
C1	STEAM INLET	12"-150# RFSO	14"-150# RFSO	14"-150# RFSO	16"-150# RFSO	16"-150# RFSO
D1	WATER INLET	6"-150# RFSO				
E1	DOWNCOMER	16"-150# FFSO	18"-150# FFSO	18"-150# FFSO	18"-150# FFSO	20"-150# FFSO
F1	MANWAY	20"	24"	24"	24"	24"
G1	VENT PIPE	2" NPT	2-1/2" NPT	2-1/2" NPT	3" NPT	3" NPT



**Table H33. Dimensions, TM300-TM500**

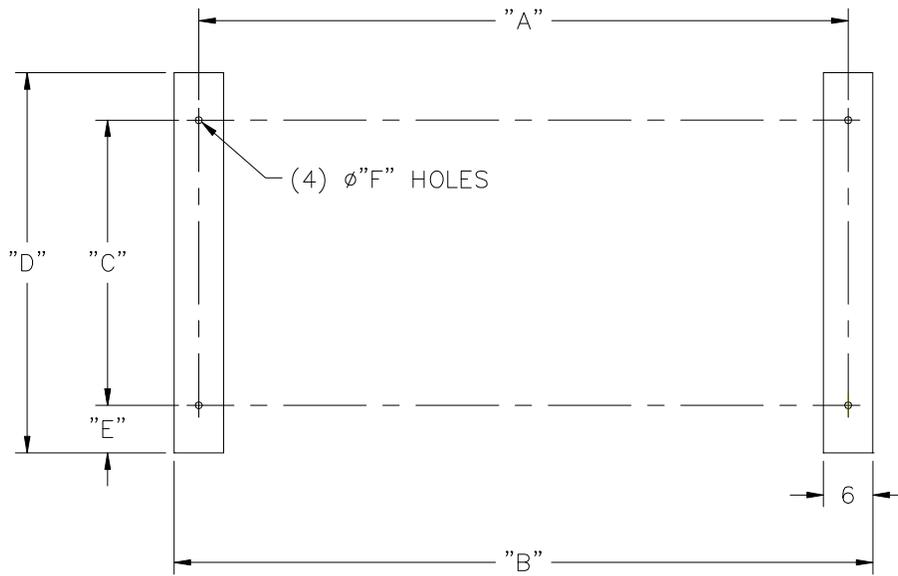
TRAYMASTER DETAILS AND DIMENSIONS						
MODEL NUMBER		TM300	TM350	TM400	TM450	TM500
A	HEIGHT ABOVE STAND	252	259	260-1/2	262-1/2	262-1/2
B	OVERALL LENGTH	198	205-1/2	246	258-1/2	304
C	OVERALL WIDTH	130	130	130	130	130
D	COLUMN DIAMETER	84	96	108	108	108
E	STORAGE TANK DIA.	108	108	108	108	108
F	C/L TO C/L BOLT HOLES	137	144	185	197	243
G	STAND LENGTH	144	151	192	204	250
H	C/L TO C/L BOLT HOLES	110	110	110	110	110
J	STAND WIDTH	113	113	113	113	113
K	TEMP./PRESS. SENSOR	24-1/4	27-1/2	28-3/4	28-3/4	28-3/4
L	HIGH TEMP. RETURN	41-1/4	43	44-1/4	40-1/4	40-1/4
M	STEAM INLET	68-1/4	70	71-1/8	71-1/4	71-1/8
N	DAVITED MANWAY	68-1/4	70	69-1/4	69-1/4	69-1/4
P	WATER INLET	112-3/8	119-3/8	102-5/8	120-5/8	119-5/8
Q	TRAY CLEARANCE	36	36	36	36	36
TRAY QTY.		84	98	120	132	144
COLUMN WEIGHT (LB)		7300	8500	10700	10900	11100
STORAGE TANK CAPACITY (GAL.)		6000	7000	8000	9000	10000
STORAGE TANK WEIGHT (DRY) (LB)		11000	11400	13200	13700	15700
STORAGE TANK WEIGHT (FLOODED) (LB)		61000	69700	79900	88700	99000
COLUMN CONNECTIONS						
MODEL NUMBER		TM300	TM350	TM400	TM450	TM500
A1	TEMP./PRESS. SENSOR	3/4" NPT				
B1	HIGH TEMP. RETURN	8"-150# RFSO	8"-150# RFSO	10"-150# RFSO	10"-150# RFSO	10"-150# RFSO
C1	STEAM INLET	18"-150# RFSO	18"-150# RFSO	20"-150# RFSO	20"-150# RFSO	22"-150# RFSO
D1	WATER INLET	8"-150# RFSO	8"-150# RFSO	8"-150# RFSO	8"-150# RFSO	10"-150# RFSO
E1	DOWNCOMER	24"-150# FFSO	30"-150# FFSO	36"-150# FFSO	36"-150# FFSO	36"-150# FFSO
F1	MANWAY	28"	28"	36"	36"	36"
G1	VENT PIPE	3" NPT	3" NPT	3" NPT	4" NPT	4" NPT

**Table H34. Connections and Trim**

MODEL NUMBER		TM030 - TM500
1	RELIEF VALVE SIZE	CONTACT YOUR LOCAL CLEAVER-BROOKS AUTHORIZED REPRESENTATIVE
2	OVERFLOW SIZE	
3	DRAIN SIZE	
4	SUCTION SIZE	
5	RECIRC.	
6	THERMOMETER (3/4" NPT)	
7	SAMPLE (1/2" NPT)	
8	CHEM. FEED (1" NPT)	
9	GAUGE GLASS ASSEMBLY	
10	LEVEL CONTROLLER	
11	OVERFLOW DRAINER (OPT)	
12	CONTROL PANEL (OPT)	
13	FEED PUMP/MOTOR (OPT)	
14	SUCTION PIPING (OPT)	
15	MANWAY 12" X 16"	
16	LEVEL ALARMS (OPT)	
17	VACUUM BREAKER	



Figure H3-2. Storage Tank Saddle Footprint



TANK CAPACITY (GAL.)															
	600	900	1400	2000	2500	2800	3500	4000	4500	5000	6000	7000	8000	9000	10000
TANK DIA.	42	48	60	66	72	72	84	84	96	96	108	108	108	108	108
A	79	94	95	113-1/2	113-1/2	138	136-1/2	138	128	138	138	145	186	198	244
B	84-1/2	100	101	119-1/2	119-1/2	144	142-1/2	144	134	144	144	151	192	204	250
C	34-1/2	38	44-3/4	50	70	70	62	62	72	72	83	83	83	83	83
D	46	48	57	66	52	52	82	82	92	92	104	104	104	104	104
E	5-3/4	5	6-1/8	8	9	9	10	10	10	10	10-1/2	10-1/2	10-1/2	10-1/2	10-1/2
F	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8

## RETURN ON INVESTMENT

Payback for a pressurized deaerator versus an atmospheric boiler feed system is based on an additional capital expenditure required divided by the yearly operating cost savings. The differential in yearly operating costs are in the following areas:

- Flash steam
- Exhaust steam
- Blowdown
- Chemical treatment
- Makeup water
- Sewer
- Intangibles

### Flash Steam

A percentage of the high-pressure condensate returns will flash to steam and be lost in an atmospheric vessel application. This flash steam loss can be converted to an energy loss and associated fuel cost.

### Exhaust Steam

Exhaust steam cannot be recovered in an atmospheric vessel application. This exhaust steam loss can be converted to energy loss and associated fuel cost. An example would be steam turbine exhaust.

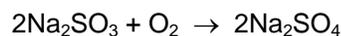
### Surface Blowdown

Increased makeup water is required because of lost flash and exhaust steam. This increase in makeup water requires an increase of surface blowdown. This is directly related to cycles of concentration in the boiler. The additional blowdown loss can be converted to an energy loss and associated fuel cost. The additional surface blowdown may also result in an increase in capital expenditure for a larger blowdown heat recovery system.

### Chemical Treatment

Dissolved oxygen content in an atmospheric boiler feedwater system is a function of water temperature. Lowering the dissolved oxygen content below what is naturally present, based on mixed water temperature at atmospheric pressure, requires the addition of a chemical treatment program. The most common oxygen scavenger used is sodium sulfite. Sodium sulfite reacts with dissolved oxygen as follows:

Theoretically, it takes approximately 8 ppm of sodium sulfite as  $\text{Na}_2\text{SO}_3$  to scavenge 1 ppm of dissolved  $\text{O}_2$



### Makeup Water

Increased make-up water is required because of lost flash steam, lost exhaust steam, and additional surface blowdown. This additional makeup water can be associated to a cost. Makeup water cost should be a combination of the utility charge plus pretreatment equipment consumable costs.

### Sewer

Utilities often base a sewer charge on make-up water usage. Increased makeup water usage with an associated increase in surface blowdown can affect these costs.

### Intangibles

Some cost savings are difficult to calculate - in general, best practices in deaeration will prolong the life of boiler room equipment, reducing repair and maintenance costs.

# SECTION H3 TRAYMASTER SERIES DEAERATORS

## SAMPLE SPECIFICATIONS

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2.16 Deaerator Manuals and Warranty .....H3-16

The following sample specifications are provided by Cleaver-Brooks to assist you in specifying your customer’s specific needs and application.



## PART 1 GENERAL

### 1.1 Packaged Deaerator Specification

- A. Provide one Cleaver-Brooks Model TM \_\_\_\_\_ tray type, pressurized, deaerator rated at \_\_\_\_\_ pounds per hour. The system shall be of the two tank design and shall guarantee oxygen removal to not more than 0.005 ccs/liter (7 ppb) in the effluent throughout all load conditions between 5 and 100 percent. The deaerator shall be designed for operation at 5 PSIG, but shall be suitable for use from 2 to 15 PSIG.

## PART 2 PRODUCTS

### 2.1 Deaerator

- A. A vertically oriented deaerator section shall be  $Y$  ft. -  $Y.1$  in. x  $Z$  ft. -  $Z.1$  in. shell length. The deaerator shall be of the counter flow design. Undeaerated water shall enter through the top of the column into a true Internal Direct Contact Vent Condenser. *Units not implementing a True Internal Direct Contact Vent Condenser shall not be accepted.* The water shall be evenly sprayed through a spring-loaded, self-cleaning, adjustable stainless steel spray valve(s) over the trays. The valves shall be constructed of type 304 stainless steel material. Trays shall be all riveted construction using 16 gauge type 430 Stainless Steel material. *Welded trays shall not be accepted.* Trays shall be stacked within a stainless steel tray box with a minimum thickness of 1/4". The tray box shall be constructed using type 304 Stainless Steel material. The tray box shall include a wear plate at the saturated steam inlet area to ensure durability. The tray box shall have an access door for ease of inspection of the trays. This access area to the tray box shall be through a  $X$  in. round davedited manhole located on the shell of the deaerator. The tank shall be designed in accordance with ASME, Section VIII of the Pressure Vessel Code for 50 PSIG at 650 °F and stamped accordingly. Connections shall include steam inlet, vent, water inlet, high temperature return, and downcomer to the storage vessel. Unit shall provide proper internal vent condensing and water distribution at any load between 5 and 100 percent of rated capacity.
- B. All internal surfaces, which come in contact with un-deaerated water, shall be constructed of stainless steel. Automatic vent valve shall be thermostatically controlled to provide a fast means of venting when a sudden buildup of gases occurs, such as seen at start up. The manual vent valve shall have an orifice for continuous minimum venting. Venting rate shall not exceed 0.1 of 1% of the rated deaerator capacity at 5 PSIG.

### 2.2 Deaerator Vessel

- A. The deaerated water storage tank shall have \_\_\_\_\_ minutes of storage and have a capacity of \_\_\_\_\_ gallons measured to overflow. The tank shall be \_\_\_\_\_ diameter x \_\_\_\_\_ long. An 12 x 16 elliptical manhole shall be provided for access. All nozzles 3" and under shall be 3000 lbs forged steel couplings and over 3" shall be 150 LB. flat face flanges. Heads to be ASME torispherical type constructed of ASTM A516 GR 70 carbon steel with a minimum thickness of 0.25 inches. Shell plate to be fabricated of ASTM A36 carbon steel with a minimum thickness of 0.25 inches. The tank shall be designed in accordance with ASME, Section VIII of the Pressure Vessel Code for 50 PSIG at 650 °F and stamped accordingly. Certification shall be required. Joint efficiencies to be 70% circumferential per Table UW-12, which does not require stress relieving or nondestructive examination.

The tank shall be factory-insulated and lagged with blanket insulation, pins, clips, and a durable steel jacket. The blanket insulation is to be fiberglass, 2" thick, 1 LB/ CU-

FT, and have a rating of R3.85. Pins are to be located on 18" centers and holding clips attached. The steel jacket or lagging shall have a shell thickness of 22 gauge (0.299") minimum and head thickness of 12 gauge (0.1046") minimum.

The magnesium or sacrificial anode shall provide cathodic protection against galvanic corrosion. This rod shall be 1-5/16" diameter with a 1/4" steel core to assure a good electrical contact and added strength. The design shall have a small weep hole to signal it has been consumed.

The high temperature diffuser or sparge tube shall be located beneath the normal tank water level. The tube shall be constructed of 2-1/2 inch pipe. This tube shall provide even distribution and blending of high-temperature condensate returns.

The chemical feed quill shall be located beneath the normal tank water level. The quill material shall be constructed of stainless steel. The tube shall provide even distribution and blending of chemical.

**2.3 Deaerator Load Specification**

The surge tank loads shall be as specified in the following table.

LOAD	PERCENTAGE	LBS/HR	TEMP	PRESSURE
Make up				
Low Temp Returns (<210 °F)				
Medium Temp Returns (211 – 230 °F)				
High Temp Returns (>230 °F)				

**2.4 Deaerator Standard Trim and Accessories**

- A. The basic deaerator shall be equipped with the following trim and accessories. Piping on packaged units shall comply with ASME Power Piping Code B31.1.

## 2.5 Deaerator Make-Up Valve and Controller

- A. \_\_\_\_\_ " inlet water regulating lever valve with \_\_\_\_\_ body and \_\_\_\_\_ connections. Rated for \_\_\_\_\_ GPM at \_\_\_\_\_ PSIG inlet pressure. This valve shall be suitable for temperatures up to 300 °F. The valve manufacture shall be \_\_\_\_\_, Model \_\_\_\_\_. This valve shall be mechanically controlled by an external float cage with cast iron body and 8" stainless steel float. The float cage manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_. A McDonnell & Miller 93-7B level controller shall electronically control the make-up valve.
- B. \_\_\_\_\_ " inlet water motorized regulating valve with steel body and threaded NPT connections. Motor shall be 110V bi-directional, with a permanently lubricated gear train, and be directly coupled to the valve stem. Rated for \_\_\_\_\_ GPM at \_\_\_\_\_ PSIG inlet pressure. This valve shall have teflon seats and be suitable for temperatures up to 300 °F. The motorized valve manufacturer shall be \_\_\_\_\_. This valve shall be electronically controlled by a solid state control with internally mounted capacitance probes. The electronic solid state control shall be able to set desired level point and acceptable deviation. The electronic solid state control shall include a selection for automatic and manual operating mode. The internals shall include two additional probes for high and low water alarm. The controller manufacturer shall be Model TW82.
- C. \_\_\_\_\_ " inlet water diaphragm actuated regulating valve with cast iron body and \_\_\_\_\_ connections. The valve shall be globe type with proportional control and a spring opposed diaphragm actuator arranged for 3 - 15 PSIG operating signal. The valve shall be normally open on loss of air. Rated for \_\_\_\_\_ GPM at \_\_\_\_\_ PSIG inlet pressure. This valve shall have stainless steel trim with TFE packing and be suitable for temperature up to 410 °F. The diaphragm actuated valve manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_. This valve shall be pneumatically controlled by an external proportional type sensor. The sensor shall be a 14" displacer that produces a pneumatic output signal. The controller manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_. A filter regulator is to be provided to reduce 50 PSIG instrument air supply to 3 – 15 PSIG for proper operation.
- D. The make up valve shall include a ANSI Class 125 LB three-valve bypass with inlet Y-type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

## 2.6 Deaerator Steam Pressure Reducing Valve (PRV) Station

- A. \_\_\_\_\_ " steam pressure reducing valve with cast iron body and \_\_\_\_\_ connections. The valve shall be a self-contained unit capable of reducing \_\_\_\_\_ PSIG saturated steam to the operating pressure of the deaerator at a flow rate of \_\_\_\_\_ LB./HR. The valve shall be 250 lb class with stainless steel trim and an adjustable pilot. The valve manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_.
- B. \_\_\_\_\_ " diaphragm actuated steam pressure reducing valve with cast iron body and \_\_\_\_\_ connections. The valve shall be globe type with proportional control and a spring opposed diaphragm actuator arranged for \_\_\_\_\_ PSIG operating signal. The valve shall be normally closed on loss of air. The valve shall be capable of reducing \_\_\_\_\_ PSIG saturated steam to the operating pressure of the deaerator at a flow rate of \_\_\_\_\_ LB./HR. This valve shall be 250 LB class and have stainless steel trim. The diaphragm actuated valve manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_. This valve shall be pneumatically controlled by an external transmitter. The transmitter set pressure shall be adjustable. The transmitter manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_.
- C. The steam pressure reducing valve shall include a three valve bypass with Y-type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

**2.7 Deaerator Safety Relief Valve(s) (SRV)**

- A. Quantity \_\_\_\_\_, \_\_\_\_\_" relief valves sized to relieve full capacity of the pressure reducing valve in the event of its failure. Valves to meet Paragraph UG-125 of ASME Unfired Pressure Vessel Code, Section VIII. Valve body to be of \_\_\_\_\_ construction. Relieving set pressure to be 50 PSIG. Relief valve manufacturer to be \_\_\_\_\_, Model \_\_\_\_\_.

**2.8 Deaerator Water Level Alarms**

- A. **High Level Alarm** - NEMA 1 This shall be an externally mounted float type switch. The switch shall make contact on rise and break on fall. The float cage construction shall be cast iron.
- B. **Low Level Alarm** - NEMA 1 This shall be an externally mounted float type switch. The switch shall make contact on fall and break on rise. The float cage construction shall be cast iron.

**2.9 Deaerator Overflow Drainer**

- A. \_\_\_\_\_" overflow drainer sized to relieve full capacity at the operating pressure of the deaerator. The overflow drainer shall be a float type trap. The construction is to be a steel housing with stainless steel float ball. The overflow drainer manufacturer shall be \_\_\_\_\_, Model \_\_\_\_\_.

**2.10 Deaerator Suction Piping**

- A. Suction piping for pumps shall consist of a \_\_\_\_\_" gate valve, cast iron Y-type strainer with replaceable stainless steel screen and flexible connector or hose. This piping assembly shall be 125 LB class construction. The vortex breaker shall be located in the tank nozzle.

**2.11 Boiler Feedwater Pump and Motor Set**

- A. **Intermittent** - Intermittent Quantity \_\_\_\_\_, turbine type boiler feedwater pump and motor set. Pump to be rated for \_\_\_\_\_ GPM at \_\_\_\_\_ feet TDH with \_\_\_\_\_ feet NPSH required. Pump to be \_\_\_\_\_ materials of construction and have \_\_\_\_\_ seals for a maximum water temperature of 250 °F. Pump impeller to be hydraulically balanced. The pump shall be mounted on a steel baseplate and flexibly coupled with an OSHA type coupling guard to a \_\_\_\_\_ HP, \_\_\_\_\_ phase, \_\_\_\_\_ Hz, \_\_\_\_\_ Volt, \_\_\_\_\_ RPM, \_\_\_\_\_ enclosure motor. Motor to be non-overloading at the rated condition without using any portion of the service factor. Pump and motor set to be factory aligned prior to shipment. Pump manufacturer to be \_\_\_\_\_, Model \_\_\_\_\_, size \_\_\_\_\_" x \_\_\_\_\_".
- B. **Continuous** - Continuous Quantity \_\_\_\_\_, centrifugal type boiler feedwater pump and motor set. Pump to be rated for \_\_\_\_\_ GPM at \_\_\_\_\_ feet TDH with \_\_\_\_\_ feet NPSH required. Pump to be \_\_\_\_\_ materials of construction as defined by the Hydraulic Institute and have \_\_\_\_\_ seals for a maximum water temperature of 250 °F. Pump impeller to be hydraulically balanced. The pump shall be mounted on a steel baseplate and flexibly coupled with an OSHA type coupling guard to a \_\_\_\_\_ HP, \_\_\_\_\_ phase, \_\_\_\_\_ Hz, \_\_\_\_\_ Volt, \_\_\_\_\_ RPM, \_\_\_\_\_ enclosed motor. Motor to be non-overloading at the rated condition without using any portion of the service factor. Pump and motor set to be factory aligned prior to shipment. Pump manufacturer to be \_\_\_\_\_, Model \_\_\_\_\_, size \_\_\_\_\_" x \_\_\_\_\_".

A stainless steel recirculation orifice is to be supplied with the pump and shipped loose for field installation to provide minimum bypass flow.

**2.12 Deaerator Support Stand**

- A. The \_\_\_\_\_ feet high stand shall elevate the deaerator tank to provide the net positive suction head required by the pump at the rated condition to prevent cavitation plus a 1-1/2 foot safety factor. The stand shall be constructed of heavy square steel tubing for the legs and 1/4" steel plate covering the floor.

**2.13 Deaerator Control Panel**

- A. Control panel shall be in a NEMA 1 enclosure and wired to the National Electric Code. The wire shall be black number coded. The assembly is to contain individual motor starters with 120 Volt holding coil and fuse protection. Individual green oil-tight pump run lights shall be provided. All switches and lights to have nameplate identification. The assembled panel shall be given a factory continuity test prior to shipment.

**2.14 Electric Components**

- A. Audible and visual high and low water alarm function shall be provided by a bell or horn with silence switch and individual red oil-tight lights. Control circuit transformer to supply 110-120 Volts, single-phase power supply. The transformer shall be mounted, wired and fused. Auxiliary contacts shall be furnished for chemical feed pump initiation. Contacts shall be normally open.
- B. The deaerator shall have a gauge glass assembly that covers the entire tank diameter. The gauge glass shall be quartz, 0.625 inch diameter by 24 inch maximum length. Each length of glass shall be furnished with a bronze gauge cock set and protector rods. The deaerator shall be supplied with a pressure gauge that has a 4-1/2 inch dial with a 0-60 PSIG range and a thermometer with a 50 to 300 °F range. Packaged units are required to have both gauges bracket-mounted at eye level.

**2.15 Deaerator Preparation And Packaging**

- A. The deaerator is to be hand cleaned with a solvent to SSPC- SP-1 standards prior to painting. Prime coated to not less than 1 mil thick and finish coated with an enamel paint to not less than 1 mil thick prior to shipment.
- B. Unit is to be knocked down for shipment. Piping is to be matched marked.

**2.16 Deaerator Manuals and Warranty**

- A. Three, bound, Operating and Maintenance manuals to be provided. Warranty period to be twelve months after start-up or eighteen months after shipment, whichever comes first.