

### GENERAL DESCRIPTION

The Sellers pressurized .005 deaerators condition make-up water and condensate returns to convert them into more desirable boiler feedwater. Super heating and atomization are used to remove oxygen and carbon dioxide before the water is pumped to the boiler. Pressurized deaerators are particularly desirable when blend temperatures exceed 180° F.

### MODEL DESCRIPTION

#### MODEL P5 SINGLE TANK

Sellers .005 deaerators are designed to heat boiler feedwater and to reduce oxygen and CO<sub>2</sub> to less than .005 cc/liter of water. This treatment protects the boiler and reduces corrosion. Single tank pressurized deaerators economically handle these requirements over a wide range of flow rates and temperatures.

Pumped return condensate and fresh make-up water are injected into the steam chamber to be pre-heated and partially deaerated. Further heating and scrubbing by steam impingement complete the process to provide .005 cc/liter quality water. Oxygen and CO<sub>2</sub> are vented through manual and automatic vents. Pressurized systems also are particularly adept at handling high temperature condensate. Large quantities (over about 10%) of high temperature condensate (over 227° F.) should be introduced through an optional under water injection tube.

A modulating pneumatic or float type level controller and valve admits fresh make-up to the bottom third of the receiver as needed. Valve is sized for each application based on the make-up percentage of the project.



#### MODEL PDK5 SPLIT TANK

Split tank deaerators provide one large ASME tank with an internal baffle to split the tank into two sections. High temperature condensate above 227° is returned to the deaerator section. Pumped low temperature condensate and fresh make-up water go to the surge section. First step deaeration occurs in the surge section as the mixture is sprayed into 5 psi steam.

A transfer pump moves the mixture to the deaerator section where steam impingement further heats, agitates and scrubs the water. Excess water overflows the internal baffle into the surge section to be mixed with and preheat the make-up and returns.

Boiler feed pumps force hot deaerated water from the deaerator section to the boilers.

Manual and automatic vent valves in the surge section allows oxygen, CO<sub>2</sub> and other gases to leave the unit while keeping steam venting to a minimum.

#### SURGE/DEAERATOR SYSTEM

A deaerator plus a separate surge tank for nearby or remote installation offers additional advantages over a single tank system.

The surge tank is vented to allow gravity condensate returns. Make-up is fed directly into the surge tank through a solenoid valve. This mixes with the condensate and preheats the make-up.

A transfer pump moves the water to the deaerator through a modulating transfer valve. Excess water is bypassed back through an orifice to the surge tank.

The deaerator operates similar to a single tank system except the make-up valve is eliminated and a modulating transfer valve with controller is added.

## PURPOSE OF DEAERATORS

Boiler corrosion is caused by oxygen reacting with steel to form rust. Increased temperatures, low pH, or the presence of CO<sub>2</sub> accelerate the corrosion rate. A deaerator economically removes the O<sub>2</sub> and CO<sub>2</sub> while greatly reducing the need for blowdown and chemicals. Heating water in the deaerator helps to break down residual calcium carbonate which would form CO<sub>2</sub> in the boiler. As CO<sub>2</sub> is removed, it helps to slightly improve the pH. The deaerated water is pumped to the boiler while hot so thermal stresses in the boiler are reduced.

The deaerator receiver provides storage space for returning condensate and the treated deaerator water. Vents remove the non-condensable oxygen and CO<sub>2</sub>.

Condensate return line corrosion due to carbon dioxide can be reduced by using a deaerator.

Heating assemblies keep the stored deaerated water hot for instant use by the boiler. Energy is stored in the deaerator to help meet peak steam demands. Stored energy helps to maintain an even steam pressure as pumps feed water to the boiler.

## DEAERATOR BENEFITS

Deaerators are the most acceptable method of providing low cost feed water to a steam boiler. Oxygen, carbon dioxide and other gases are removed from the water to protect the boiler system. If not removed, these gases quickly corrode and pit a boiler and its piping system. Costly boiler repairs result.

Cleaner steam is produced without the retarding effect of air films on heat exchangers or air pockets in lines and traps. Heat transfer improves to allow faster heat-up with less steam.

Chemical demands by the boiler are reduced, resulting in less chemical usage and shorter, less costly blowdowns. Ongoing savings continue.

Exhaust steam from blowoff tanks, processes, pumps, generators or other sources can be absorbed by the deaerator instead of being wastefully vented. A 10° rise in the feed water temperature will reduce fuel cost by 1%.

Preheating the water by the deaerator reduces boiler metal stress which can reduce maintenance problems in some sensitive boilers.

Boiler operation becomes smoother and responds quicker to load changes due to the available energy stored in the deaerator.

## SELECTION INFORMATION

Deaerators are particularly desirable when steam pressures exceed 50 psi. for lower steam pressures, a .03 deaerator or a Thermafeed heating assembly may be suitable. Large spread out steam systems with surging returns may require additional storage or a split tank system. High make-up requirements especially dictate the use of a deaerator. Pressurized deaerators must be selected when blend temperatures exceed 180° F.

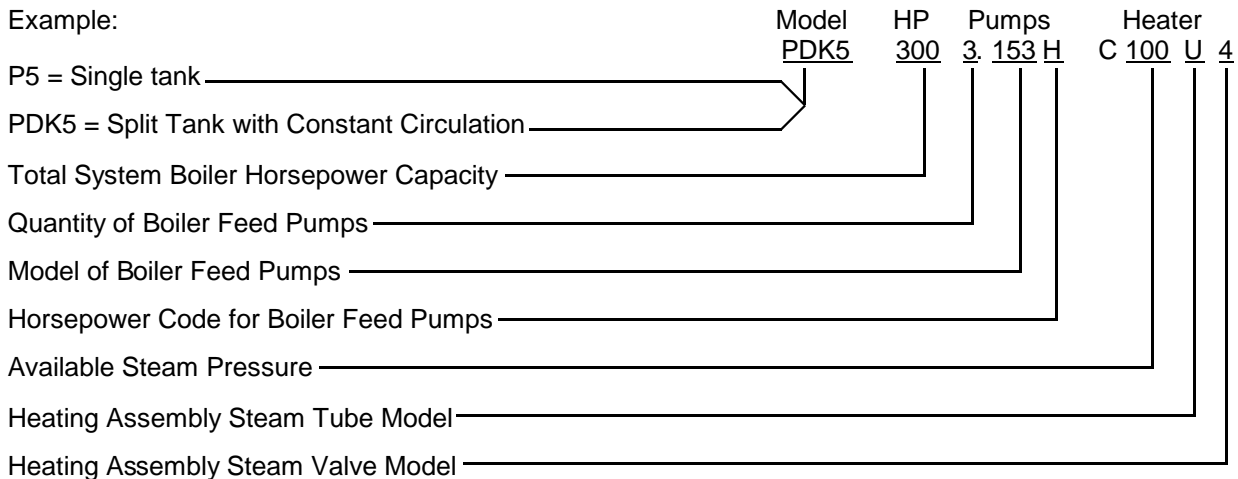
Horsepower refers to total system boiler capacity served by the deaerator. This capacity determines the size of the heating assembly, the openings, the overflow, the transfer pumps as well as the standard tank.

Model numbers do not show the transfer pump models for split tank systems, only the boiler feed pump models. Transfer pumps for split tank systems are determined by the system horsepower capacity.

## MODEL NUMBER SELECTION

The model number is composed of the base system type and the total boiler horsepower plus the number and type of boiler feed pumps plus the heating assembly model.

Example:



# .005 PRESSURIZED DEAERATOR

## HEATING ASSEMBLY SELECTION GUIDE

The heating assembly is based on the volume of water to be heated, the water temperature rise and the steam pressure available. High temperature returns over 227° do not need to be heated and should be admitted under the water line.

### Example:

Size a heating assembly for a 500 hp boiler system operating at 100 psi with 25% make-up at 50° F., 70% returns at 190° F., and 5% returns at 240° F.

### Step 1: Calculate the Blend Temperature

Calculate the blend temperature and required temperature rise:

$$\begin{aligned} 25\% \text{ make-up at } 50^\circ &= 12.5^\circ \text{ F.} \\ 70 \text{ returns at } 190^\circ &= 133^\circ \text{ F.} \\ 5\% \text{ returns at } 240^\circ &= 12^\circ \text{ F.} \\ \text{Blend temperature} &= 157.5^\circ \text{ F.} \end{aligned}$$

$$\text{Temperature rise} = 227^\circ - 157.5^\circ = 69.5^\circ \text{ F.}$$

### Step 3: Select Steam Tube Model

Select steam tube model based on required #/hr using TABLE I: (Tube should have a capacity that is equal to or greater than the required #/hr.)

### Step 4: Select the Steam Valve

Select the steam valve using TABLE II based on the calculated steam required and the inlet steam pressure.

Example: 1,248.8 #/hr at 100 PSI = Model 4 valve.

Enter 4 as the last number in the model number.

### Step 2: Calculate the Steam Required

Calculate the steam required based on the temperature rise:

$$\text{Steam \#/hr} = \frac{\text{GPM feedwater} \times 500 \times \text{temperature rise}}{960 \text{ BTU/\#}}$$

$$\text{Example} = \frac{(550 \times .069) \times 500 \times 69.5}{960} = 1,248.8 \text{ \#/hr}$$

TABLE I

Model	Steam Capacity in #/hr
Q	845
R	1,261
S	1,924
T	3,354
U	7,501
UU	15,000*

\*Consult the factory for required capacities greater than 15,000 #/hr.

TABLE II

Inlet Steam Pressure	Heating Assembly Steam Valve Capacity										
	Steam Valve Model										
	2	3	4	5	6	8	10	12	16	20	24
*10	-	220	340	550	795	1,275	1,970	2,780	4,145	5,855	7390
*12	-	280	430	690	1,005	1,610	2,490	3,515	5,235	7,395	9340
25	190	365	595	955	1,345	2,105	2,985	5,025	7,400	11,475	16835
40	260	505	825	1,320	1,850	2,900	4,115	6,920	10,195	15805	—
50	310	600	975	1,560	2,190	3,430	4,870	8,185	12,060	—	—
75	420	805	1,315	2,105	2,955	4,630	6,570	11,050	16,275	—	—
100	550	1,060	1,725	2,765	3,885	6,080	8,630	14,515	—	—	—
125	670	1,290	2,100	3,370	4,730	7,405	10,510	17,680	—	—	—
150**	790	1,520	2,480	3,970	5,575	8,730	12,390	—	—	—	—

\*Note: Valves are suitable for 15 psi maximum inlet pressure. \*\*Consult the factory for steam pressures above 150 psi.

### Step 5: Select Relief Valves

Based on the steam valve selection in Step 4, select the proper number and size of relief valves that have a total capacity that exceed the steam valve capacity as shown in Table II. Multiple relief valves may be required.

Example: Model 4 capacity at 100 psi = 1,725 #/hr  
Using Table III, (1) 1.25" 6021G1 relief valve is required.

TABLE III

Relief Valve Model	Capacity at 50 psi
.75" 6021E1	681
1" 6021F1	1,065
1.25" 6021G1	1,746
1.5" 6021H1	2,720
2" 6021J1	4,456

## .005 SINGLE TANK PRESSURIZED DEAERATOR

### CAPACITIES

BASE SYSTEM MODEL NUMBER	BOILER PONDS STEAM PER HOUR	G.P.M.	OVERALL RECEIVER SIZE (INCHES)	FULL CAPACITY (GALLONS)	CAPACITY TO OVERFLOW		STANDARD MAKE-UP VALVE	SHIPPING WEIGHT (POUNDS*)
					GALLONS	MINUTES		
P5-100	3,450	6.9	36 X 73	293	231	33	EM2	1,375
P5-150	5,175	10.4	36 X 73	293	231	22	EM2	1,375
P5-200	6,900	13.8	36 X 73	293	231	17	EM2	1,375
P5-250	8,625	17.3	36 X 73	293	231	13	EM2	1,375
P5-300	10,350	20.7	42 X 76	408	339	16	EM2	1,550
P5-400	13,800	27.6	42 X 76	408	339	12	EM2	1,550
P5-500	17,250	34.5	42 X 130	732	604	18	EM2	2,175
P5-600	20,700	41.4	42 X 130	732	604	15	PM3	2,175
P5-800	27,600	55.2	42 X 130	732	614	11	PM3	2,450
P5-900	31,050	62.1	48 X 132	968	824	13	PM3	2,450
P5-1000	34,500	69.0	48 X 132	968	824	12	PM3	2,450
P5-1200	41,400	82.8	48 X 132	968	824	10	PM3	2,550
P5-1500	51,750	103.5	54 X 135	1,229	1,076	10	PM3	3,900

\*Does not include boiler feed pumps.

### STANDARD EQUIPMENT FURNISHED

**Receiver:** 50 psi ASME with 12 x 16 manhole.

**Epoxy Lining:** Receiver is sandblasted, lined with two coat/two color baked on epoxy lining.

**Stand:** Welded structural steel, 48" high with foot pads.

**Make-Up Valve:** EM2 Electric on 100 to 500 HP. Pneumatic valve on 600 HP and larger.

**Bypass:** Three valve around make-up valve.

**Vent Condenser:** Internal stainless steel spray type.

**Low Water Alarm:** Probe type to stop pumps and sound alarm.

**Air Filter Regulator:** Maximum 150 psi inlet pressure.

**Vent Valves:** Manual and automatic to vent liberated oxygen, CO<sub>2</sub>, and other gases.

**Water Gauge Set:** Brass safety type with check.

**Boiler Feed Pumps:** See pump bulletin.

**Temperature Gauge:** One 3" dial type.

**Pressure Gauge:** One 4.5" diameter on receiver.

**Overflow Drainer:** External float type to prevent flooding the receiver.

**Drain Valve:** One installed.

**Steam Valve:** Pneumatic with remote set point controller.

**Steam Strainer:** Screwed or flanged to match valve.

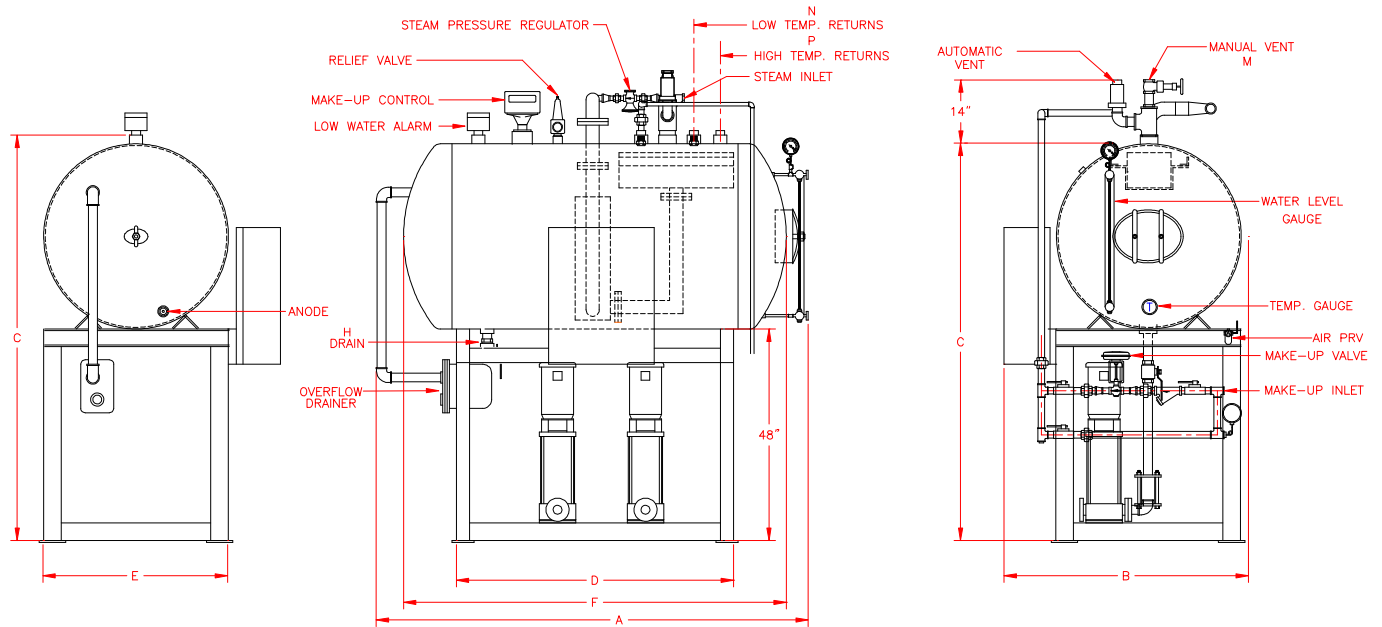
**Heating Assembly:** Two stage stainless steel with spring loaded spray nozzles.

**Pressure Relief Valve:** For steam pressures over 50 psi – full capacity valve. Under 50 psi – 1" sentinel valve.

**Control Panel:** UL Listed assembly with group dead front disconnect, IEC starters, integral circuit breakers, HOA switch and lights. Includes control transformer, alarm horn and silencing switch.

**Factory Assembly:** Complete unit factory assembled.

# .005 SINGLE TANK PRESSURIZED DEAERATOR



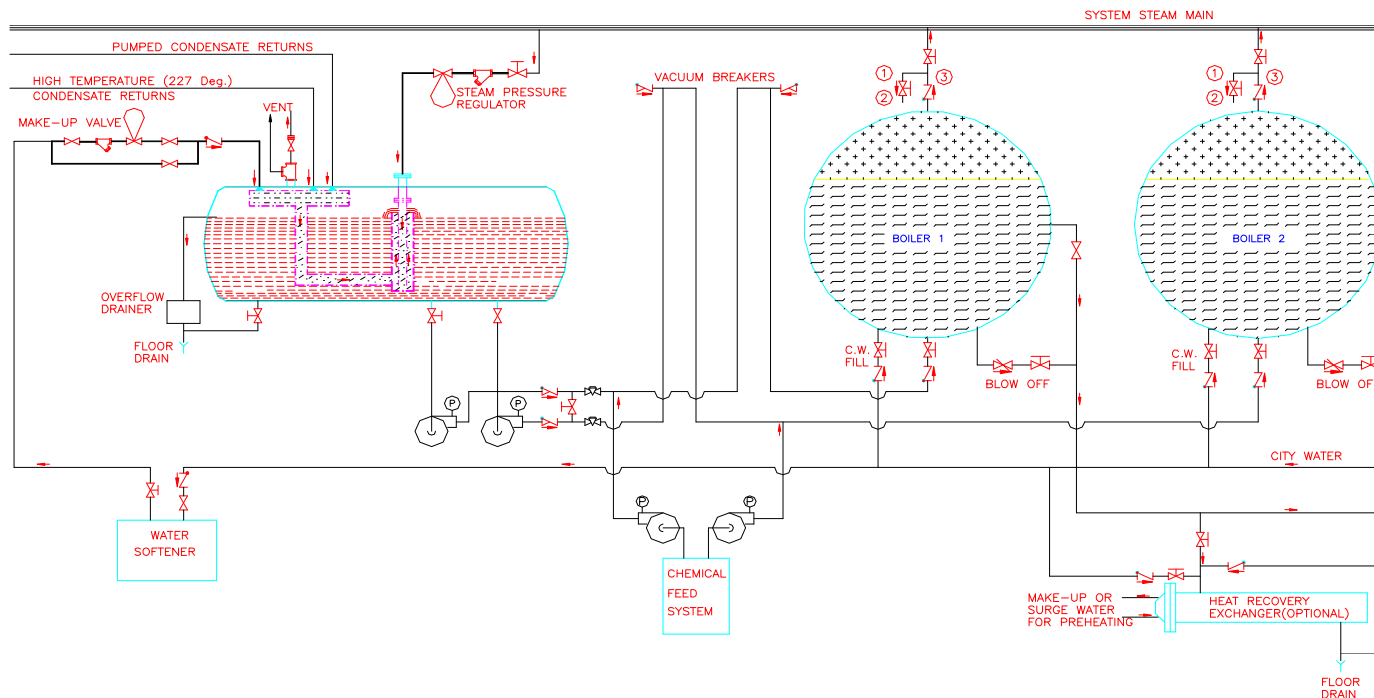
## DIMENSIONS

Model Number	A	B	C	D	E	F	H	J	M	N	P
P5-100	91	51	85	50	36	73	1	1.5	1	1.5	1
P5-150	91	51	85	50	36	73	1	1.5	1	1.5	1
P5-200	91	51	85	50	36	73	1.25	1.5	1	1.5	1
P5-250	91	51	85	50	36	73	1.25	2	1	1.5	1
P5-300	94	57	91	50	42	76	1.25	2	1	1.5	1
P5-400	94	57	91	50	42	76	1.5	2	1	1.5	1
P5-500	148	57	91	104	42	130	1.5	2	1	2	1
P5-600	148	57	91	104	42	130	1.5	2	1.25	2	1.5
P5-800	148	57	91	104	42	130	1.5	2.5	1.25	2.5	1.5
P5-900	150	63	97	104	48	132	1.5	2.5	1.25	2.5	1.5
P5-1000	150	63	97	104	48	132	2	2.5	1.25	2.5	1.5
P5-1200	150	63	97	104	48	132	2	3	1.25	3	1.5
P5-1500	154	69	103	104	54	135	2.5	3	1.25	3	1.5

## NOTES

1. Make-up supply line to valve should be a minimum of one pipe size greater than the valve size.
2. Dimensions A through F are approximate and may vary depending on options furnished.
3. Consult factory for over height shipping arrangements.
3. Pump orientation is typical. Quantity and type of pumps will determine final orientation.
4. All dimensions are in inches.
5. Stand height may increase as a result of pump selection.

## TYPICAL P5 DEAERATOR PIPING



1. Stop and check valves not required on single low pressure boilers.
2. Drain valve required between stop and check valve on boiler with manhole.
3. Check valve required on boiler over 15 psi.
4. Chemical feed may be directly to the deaerator if chemicals are guaranteed not to damage pumps.

Consult local, state and insurance regulations for final code and installation requirements.

Actual installation requirements will vary with plant operating conditions. Number of boilers, pumps and accessories should be changed to match the actual system design requirements.

The arrangement shown with one pump for each boiler is the most common and the most maintenance free. Pumps can also be manifolded with modulating feed water valves on the boilers. Feed water valves require extra pump pressure and capacity for the protective pump recirculation lines

Only key water and steam piping system components are shown in the above illustration. Completion of other services including electrical will be required.

Consult the owners manual for complete installation and operation details.

## DEAERATOR INSTALLATION ADVANTAGES

- Reduced return line corrosion
- Recovery of exhaust waste steam
- Conservation of flash steam from condensate
- Reduced boiler chemical costs
- Reduced boiler blowdown
- Reduced boiler stress with hot feedwater available to the boiler.
- Cleaner steam with less air for improved heat transfer

## .005 SPLIT TANK PRESSURIZED DEAERATOR

### CAPACITIES

BASE SYSTEM MODEL NUMBER	BOILER PONDS STEAM PER HOUR	G.P.M.	OVERALL RECEIVER SIZE (INCHES)	FULL CAPACITY (GALLONS)	CAPACITY TO OVERFLOW		STANDARD MAKE-UP VALVE	SHIPPING WEIGHT (POUNDS*)
					GALLONS	MINUTES		
PDK5-100	3,450	6.9	36 X 73	293	231	33	E2	1,875
PDK5-150	5,175	10.4	42 X 76	408	339	33	E2	2,075
PDK5-200	6,900	13.8	42 X 76	408	339	25	E2	2,075
PDK5-250	8,625	17.3	36 X 127	531	415	24	E2	2,500
PDK5-300	10,350	20.7	42 X 130	732	604	29	E2	2,700
PDK5-400	13,800	27.6	42 X 130	732	604	22	E2	2,775
PDK5-500	17,250	34.5	48 X 132	968	824	24	E2	2,900
PDK5-600	20,700	41.4	54 X 135	1,229	1076	26	E2	3,925
PDK5-800	27,600	55.2	60 X 137	1,542	1374	25	E2	4,350
PDK5-900	31,050	62.1	60 X 137	1,542	1374	22	E3	4,400
PDK5-1000	34,500	69.0	66 X 137	1,812	1638	24	E3	5,150
PDK5-1200	41,400	82.8	66 X 137	1,812	1638	20	E3	5,200
PDK5-1500	51,750	103.5	72 X 144	2,301	2102	20	E3	6,375
PDK5-1800	62,100	124.2	66 X 195	2,596	2346	19	E4	7,150
PDK5-2100	72,450	144.9	72 X 197	3,235	2956	20	E4	8,100
PDK5-2400	82,800	165.6	72 X 197	3,235	2956	18	E4	8,100
PDK5-3000	103,500	207.0	84 X 190	4,050	3764	18	E5	10,900

\*Does not include boiler feed pumps.

### STANDARD EQUIPMENT FURNISHED

**Receiver:** 50 psi ASME with 12 x 16 manhole.

**Epoxy Lining:** Receiver is sandblasted, lined with two coat/two color baked on epoxy lining.

**Stand:** Welded structural steel, 48" high with foot pads.

**Make-up Valve:** Solenoid valve with probe type controller.

**Bypass:** Three valve around make-up valve.

**Transfer Pump:** One providing 125% capacity. Centrifugal type with mechanical seals and low NPSH requirements. Standby transfer pump is optional.

**Transfer Piping:** With suction valve, flexible coupling, discharge check valve and balancing cock.

**Bypass Valve:** Emergency bypass between compartments.

**Inlet Baffle:** Stainless steel to prevent undeaerated water from contacting the shell.

**Low Water Alarm:** Probe type to stop pumps and sound alarm.

**Air Filter Regulator:** Maximum 150 psi inlet pressure.

**Boiler Feed Pumps:** See pump bulletin.

**Factory Assembly:** Complete unit factory assembled.

**Vent Valves:** Manual and automatic to vent liberated oxygen, CO<sub>2</sub>, and other gases.

**Water Gauge Set:** Brass safety type with check.

**Vent Condenser:** Internal stainless steel spray type.

**Temperature Gauge:** Two 3" dial type.

**Pressure Gauge:** One 4.5" diameter on receiver.

**Overflow Drainer:** External float type to prevent flooding the receiver.

**Drain Valve:** Two installed.

**Steam Valve:** Pneumatic with remote set point controller.

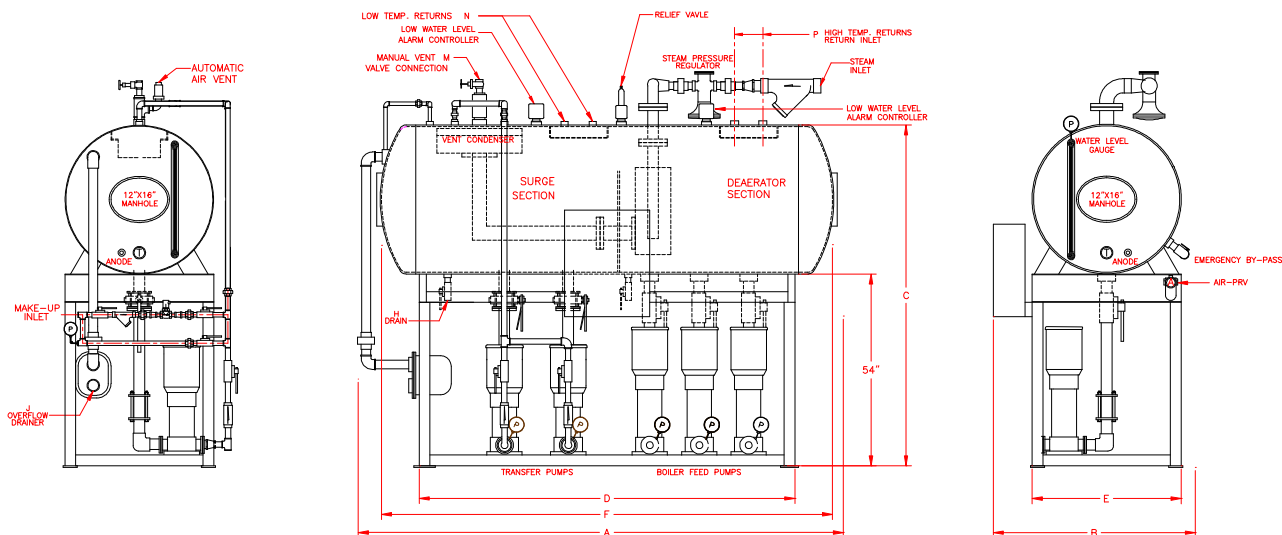
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**Control Panel:** UL Listed assembly with group dead front disconnect, IEC starters, integral circuit breakers, HOA switch and lights. Includes control transformer, alarm horn and silencing switch.

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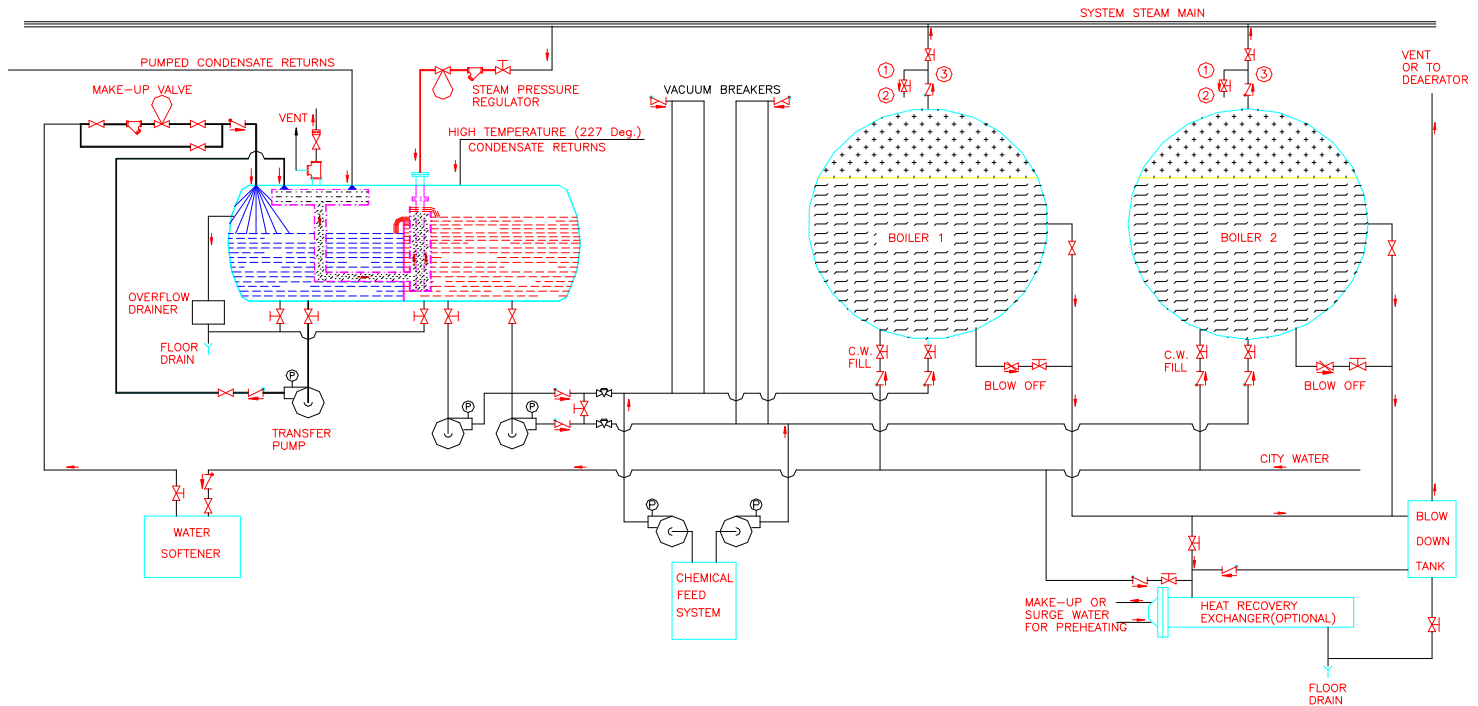


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PDK5-500	150	63	97	106	48	132	1.5	2	1	2	1
PDK5-600	152	69	103	106	54	135	1.5	2	1.25	2	1.5
PDK5-800	156	75	109	106	60	137	1.5	2.5	1.25	2.5	1.5
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PDK5-1000	156	75	109	106	66	137	2	2.5	1.25	2.5	1.5
PDK5-1200	156	75	109	106	66	137	2	3	1.25	3	1.5
PDK5-1500	162	87	121	106	72	144	2.5	3	1.25	3	1.5
PDK5-1800	209	81	115	160	66	195	2.5	3	1.25	4	1.5
PDK5-2100	216	87	121	160	72	197	2.5	3	1.25	4	1.5
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PDK5-3000	208	99	133	160	84	190	3	4	1.25	4	1.5

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