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# Engineering Guidelines

by INDUSTRIAL STEAM

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Section 9 - Blowdown Systems - EG 9.2

April 30, 1998

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## Engineering Guidelines

are offered by INDUSTRIAL STEAM to assist in the application, sizing and selection of deaeration and feed water conditioning systems. If you have questions on any of the topics discussed or questions about the information provided, please contact one of the people in our sales or engineering groups for

## Selection of Blowdown Systems

### What is Boiler Blowdown?

Blowdown occurs when water is removed from a steam boiler while the boiler is operating. Boilers are "blown down" to remove suspended solids and bottom sludge from steam boilers.

Removal of suspended solids helps insure the boiler generates high quality steam. It also prevents foaming at the water surface which can lead to unstable water levels and excessive carryover of liquid in the steam.

When blowdown water is taken from a boiler, it is at the boiler operating temperature and pressure. For example, a boiler operating at 100 psig would discharge blowdown water at 338°F. When this water is discharged to a drain at atmospheric pressure some of the water will flash into steam in order to give up enough energy to drop the temperature to 212°F. If not controlled, this flash steam could cause safety problems and housekeeping problems in the boiler room.

### Safe Blowdown Water Discharge?

In order to prevent the uncontrolled flashing of steam in the boiler room, the blowdown water should be discharged into a vessel in which the flashing can occur in a controlled manner. The vessel should be vented to a safe location.

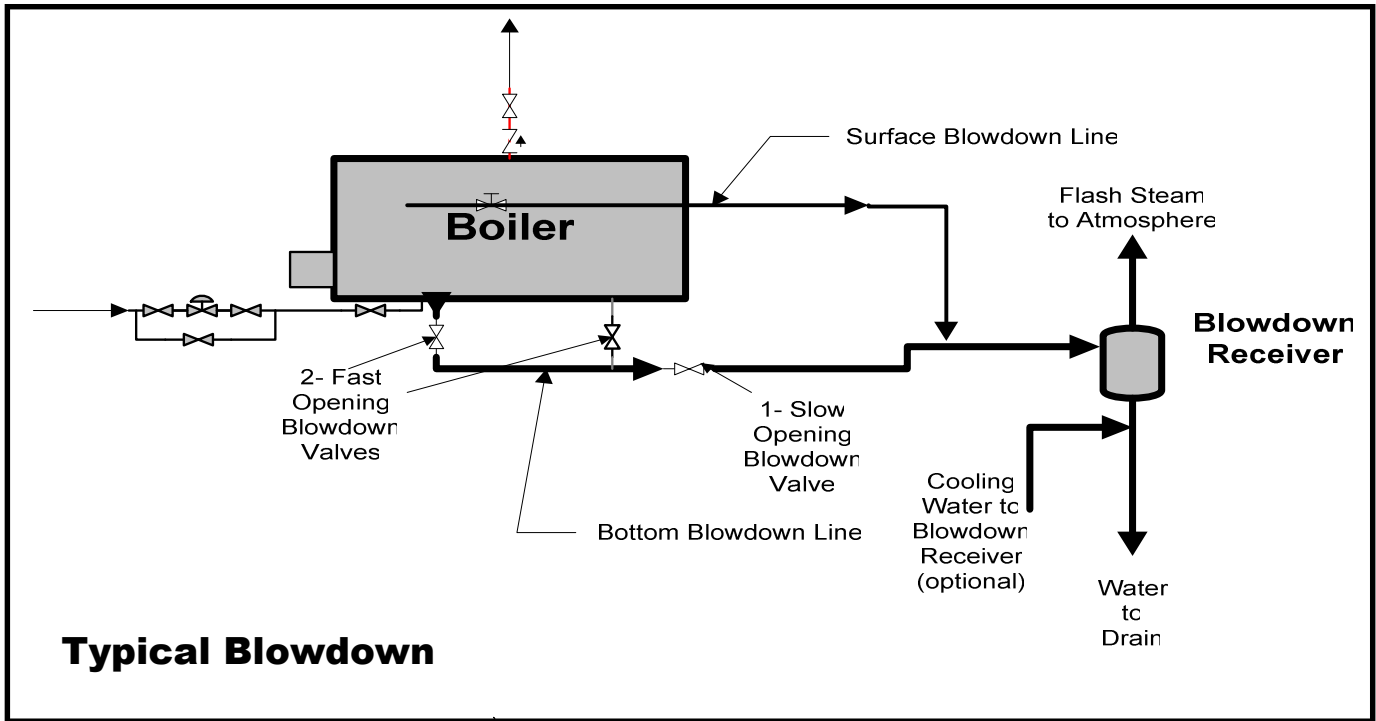
Environmental regulations limit the temperature at which hot water can be discharged to a sewer system. Hot water can lead to degradation in the sewer lines and it can promote excessive growth of bacteria. These regulations require that additional steps be taken to reduce the temperature of the blowdown water from the boiling point to 140°F or less.

### Sources of Blowdown Water

There are two sources of blowdown from a steam boiler, bottom blowdown and surface blowdown.

**Bottom blowdown** is the removal of the sludge which accumulates in the bottom of a firetube boiler, or in the mud drum of a watertube boiler. The sludge is removed regularly to prevent buildup which could foul the heat transfer surfaces and lead to vessel or tube failure. Bottom blowdown is always done on an intermittent basis, usually once a day or once a shift. The valve(s) is opened manually for a brief period of time to allow the accumulated sludge to pass from the vessel.

**Surface blowdown** is the removal of the suspended solids from the surface of the water in a steam boiler. The amount of suspended solids will depend on the water quality. The more impurities and the more chemical treatment required, the greater the amount of surface blowdown required. If the amount of make-up required increases, the need for surface blowdown will also increase because greater amounts of impurities are introduced to the system on a continuous basis.



## Types of Blowdown Systems & Their Use

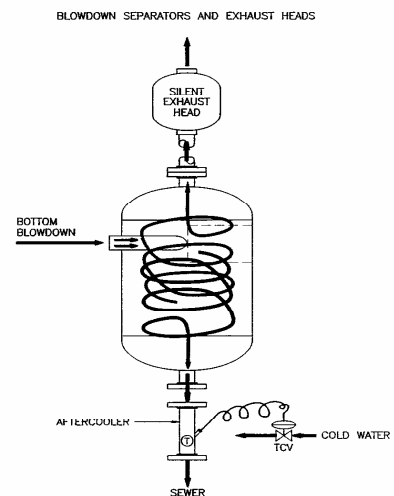
There are three types of blowdown systems available. Their use depends on the conditions.

<u>Type of System</u>	<u>Bottom Blowdown</u>	<u>Surface Intermittant</u>	<u>Surface Continuous</u>
<b>1. Separators</b>	Yes	Yes	?
<b>2. Blowdown Tanks</b>	Yes	Yes	No
<b>3. Continuous Blowdown Heat Recovery System</b>	No	No	Yes

### 1. Blowdown Separators

The Blowdown Separator receives the hot water from the boiler. The separator is sized to operate at 1-2 psig in order to force the blowdown water to the drain. As the water enters the separator, the pressure of the water drops to the operating pressure of the separator. The excess energy in the water is given up as some of the water flashes to steam. The steam leaves the vessel through the vent & is discharge to a safe location outside of the building.

The blowdown separator will reduce the water temperature to approximately 212°F by allowing the steam to flash. The local environmental codes require that the water temperature be lowered further to 140°F before it is discharged to the sewer system. An "aftercooler" is required to mix cooling water with the 212°F water to meet this requirement. If the cooling water available is 60°F, approximately 1 gallon of cooling water will be required to reduce the temperature of the blowdown water to 140°F.



**Sizing the blowdown separator-** The blowdown separator is sized to accommodate a specific flow of water at a given boiler operating pressure. The higher the flow the higher the amount of water which must be cooled and the greater the amount of flash steam which will be released. Increasing the flow will increase the inlet and drain size as well as increasing the vent. Increasing the operating pressure of the boiler, will increase the unit's size for two reasons:

1. Higher pressures will force larger volumes of water through the blowdown line.
2. Higher pressure water contains more energy which results in a greater amount of flash steam release

The sizing and selection information is included in **“Separator Selection Chart A”**.

The separator is sized to accommodate the bottom blowdown requirements. The separator will also accommodate the intermittent surface blowdown with no change in the selection since the intermittent surface blowdown flows are always less than the bottom blowdown flow rates.

Although the blowdown separator will accommodate continuous surface blowdown flow rates, we usually recommend the use of a continuous blowdown heat recovery system in order to recover the energy that would otherwise be lost if it were discharged to a separator. (See **Section III** which follows.)

## 2. Blowdown Tanks

A blowdown tank is a vessel designed to accept boiler blowdown water and safely discharge the flash steam to a vent. The blowdown tank is different from the blowdown separator because it stores the water collected. The water is held in the tank and allowed to cool by convection to the surroundings. The water is discharged from the tank on subsequent blowdown cycles as new water is added above the old water to force it out the drain.

The advantage of a blowdown tank is it will not require any cooling water. The disadvantages of a blowdown tank are it costs more than a separator and it requires more floor space.

**Blowdown Tank Operation -** The blowdown water enters the vessel and the water gives up its excess energy as flash steam. The steam leaves through the vent. The water at 212°F falls to the surface of the water which is already in the tank. As the water level rises, it pushes the water at the bottom of the tank out the drain connection. The water from the most recent blowdown cycle is allowed to remain in the tank to cool down until it is discharged during the next blowdown cycle.

The blowdown tank operates at atmospheric pressure. The vent must be large enough to pass all flash steam generated without increasing the pressure in the tank. If the pressure were to increase, it may force all of the stored water from the vessel before it has a chance to cool off.

The blowdown tank is sized based on the bottom blowdown rate, (see Engineering Information 9.1). If it's sized for bottom blowdown, it should be able to accept intermittent surface blowdown.

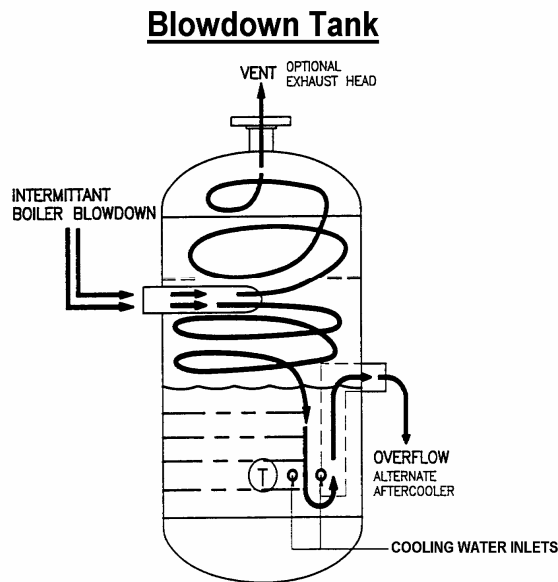
If continuous surface blowdown is required by the boiler, we would recommend using a continuous blowdown heat recovery system to treat the surface blowdown.

Continuous blowdown defeats the primary benefit of the blowdown tank; no cooling water required. If surface blowdown is continually fed to the blowdown tank, the temperature of the water leaving may be high enough to require cooling water.

## 3. Continuous Blowdown Heat Recovery Systems

Many high pressure steam boilers require continuous surface blowdown to maintain acceptable levels of total dissolved solids (TDS) in the boiler. The energy wasted through continuous surface blowdown may be a significant waste of energy, which may make it easy to justify the investment in a heat recovery system.

A continuous blowdown heat recovery system can offer three significant savings in operating costs:



SUGGESTED SIZE PER RECOMMENDATIONS BY THE ASME NATIONAL BOARD:  
VOLUME OF WATER IN 4 INCHES OF LEVEL IN STEAM DRUM  
AT OPERATING LEVEL X  $\frac{TWQ(2)}{2}$

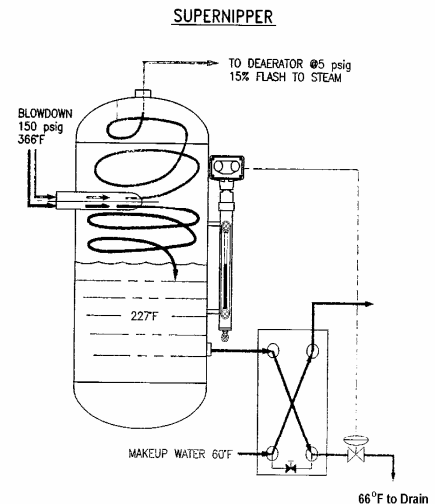
1. eliminate the energy wasted by discharging 300°F or hotter, water to drain
2. eliminate cooling water required for the surface blowdown
3. reduce the sewer charges paid by eliminating the cooling water discharged to drain.

**“Continuous  
blowdown heat  
recovery  
elimiantes**

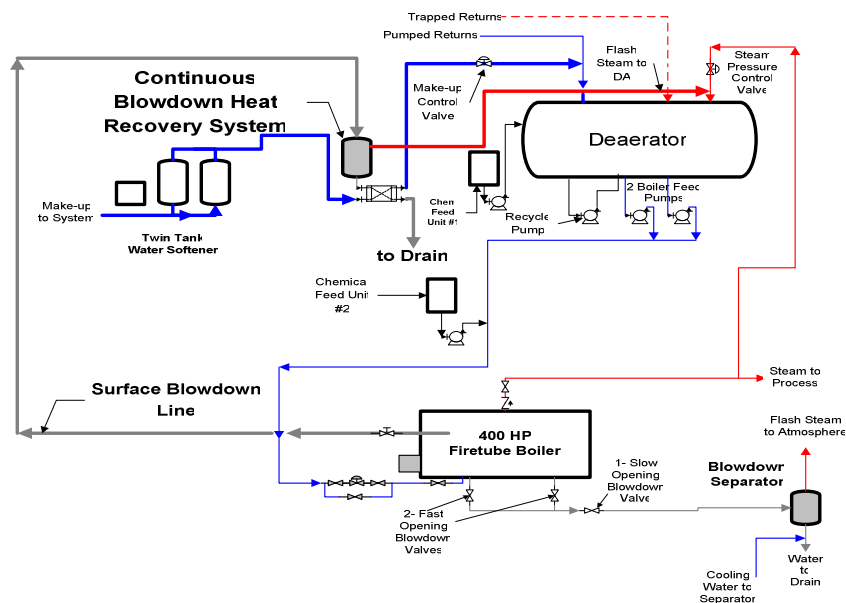
1. *wasted energy lost down the drain*
2. *cooling water for surface blowdown*
3. *sewer charges for the surface*

A continous blowdown heat recovery system is only used for surface blowdown. A separator or blowdown tank will still be required to cool the bottom blowdown.

**Operation of Continuous Blowdown Heat Recovery** - The blowdown heat recovery system operates at the deaerator pressure. the surface blowdown water enters the flash tank. The water temperature is reduced to 227°F (5 psig) and it falls to the storage tank. The flash steam is vented to the deaerator to be used to heat the boiler feedwater. This recovers from 100 to 200 BTU/lbm of blowdown water. The system recovers the balance of the energy available by passing the water through a heat exchanger and transferring heat to the system make-up water.



The investment in this type of system may be paid back in as little as two months in



some systems. See Engineering Guideline 9.3 for an example of the pay back calculations.

We usually suggest using a blowdown separator for bottom

blowdown on all systems. Intermittant surface blowdown would also be handled by the blowdown separator. The separator costs less and requires less space than a blowdown tank. Use a blowdown tank when required by the applicable codes or if the client insists.

If continuous surface blowdown is required, consider using a continuous blowdown heat recovery system if the pay back warrants with a separator for the bottom blowdown.

**Engineering  
Guidelines**

are published by:

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