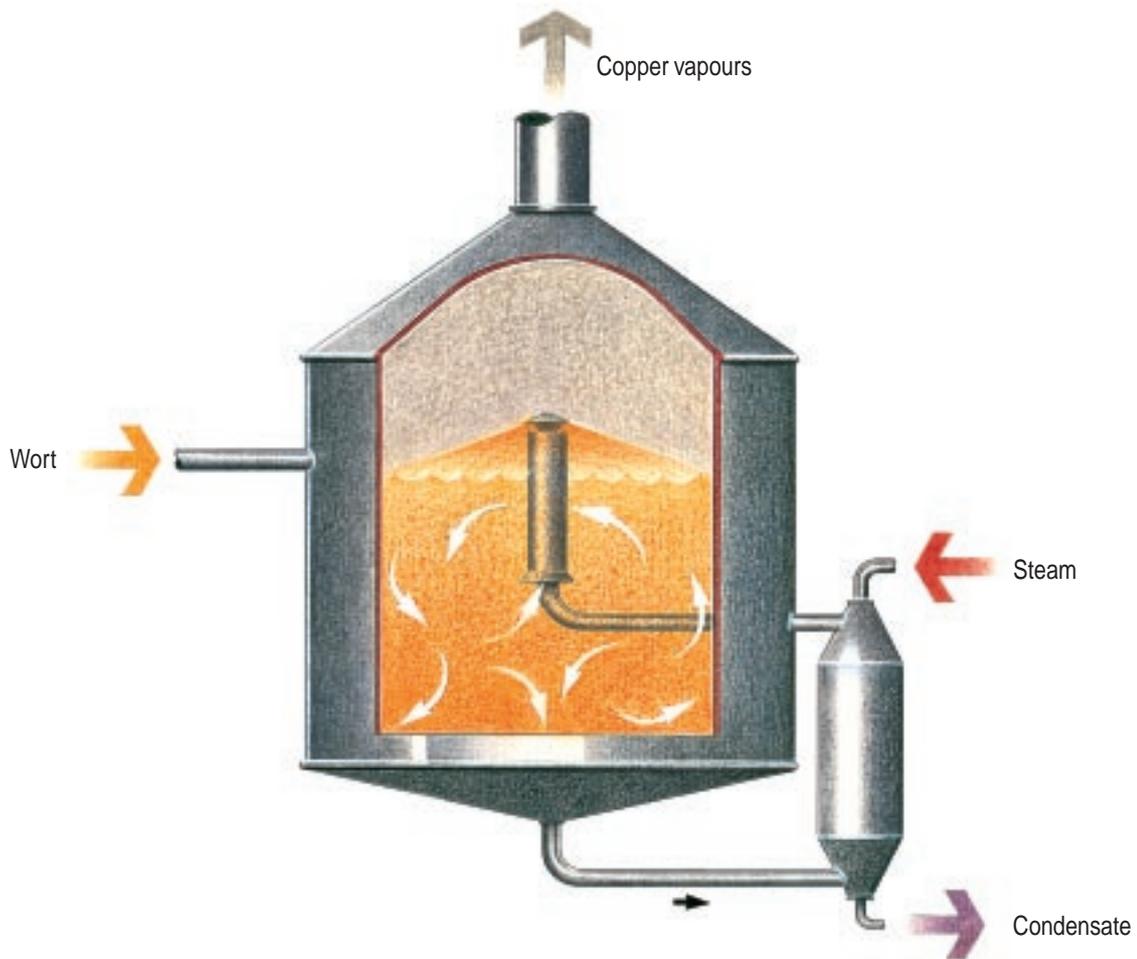


# The brewing industry

## steam and condensate systems



# The well managed use of high quality steam is a major factor in producing premium quality beers efficiently.



## What is steam used for

Brewing is an ancient art where beer is prepared from malt, hops, water and yeast.

During the brewing process complex chemical reactions take place that convert these raw ingredients into beer. Steam is essential in this process for heating, cleaning and pasteurisation.

## The need for high quality steam

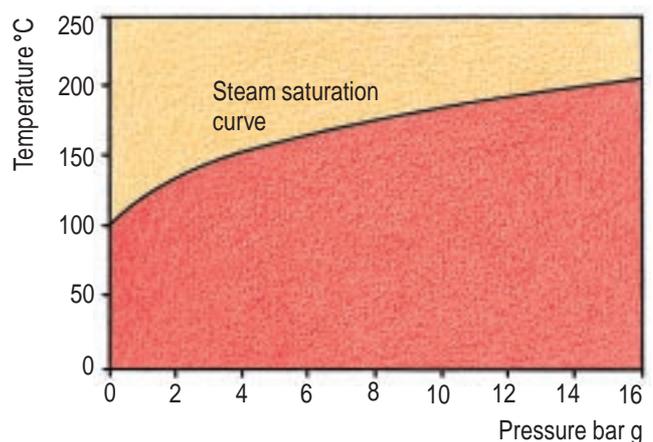
Steam is used because it is an efficient carrier of heat.

It is produced in the boiler and carried to the brewing equipment by a pipework distribution system. At the process it gives up heat and condenses.

A very important property of saturated steam is that its temperature is directly related to its pressure. Therefore, the temperature of the various processes can be accurately controlled by controlling the pressure of the steam.

Most breweries will distribute steam at a pressure between 7 and 10 bar. The pressure will then be reduced at each process to the optimum level.

To enable temperatures to be controlled accurately it is essential that high quality dry saturated steam is delivered to the process at the correct pressure. Any entrained moisture or incondensable gases in the steam could lower its temperature or impair the heat transfer rate. This will make accurate control difficult and in some cases it may not even be possible to achieve the desired production techniques.

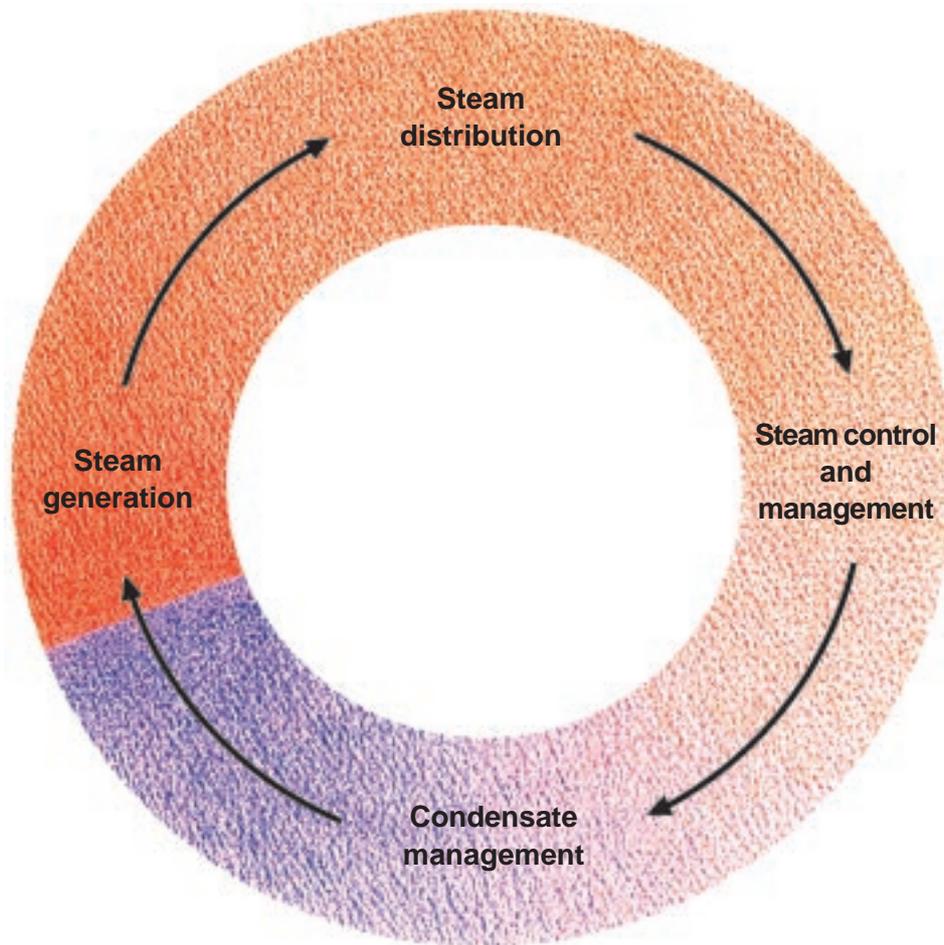


# Spirax Sarco in the brewing industry

For most of the 20th century Spirax Sarco has been the leader in improving steam plant efficiency, providing knowledge and high quality products to all branches of industry, including the brewing industry.

We understand that the brewing industry has its particular needs and problems, and that each application within the industry has its own special requirements.

We provide solutions to problems throughout the complete steam and condensate system in the brewing industry, anywhere in the world.



## The complete system

To produce high quality beer while maintaining low production costs it is essential that the brewing processes are operated as efficiently as possible, effectively using the heat available in the steam.

To achieve this, it is necessary to consider the design and operation of the complete steam and condensate system, taking into account the types of processes, their individual requirements, the local environment and the types of beer being brewed.

Consideration should also be given to future expansion plans and plans to upgrade existing equipment.

# Spirax Sarco and steam generation

Steam leaving the boiler house should contain as little moisture and incondensable gases as possible. This will ensure that the maximum amount of heat is available and minimise the risk of pipeline and equipment damage from water hammer.

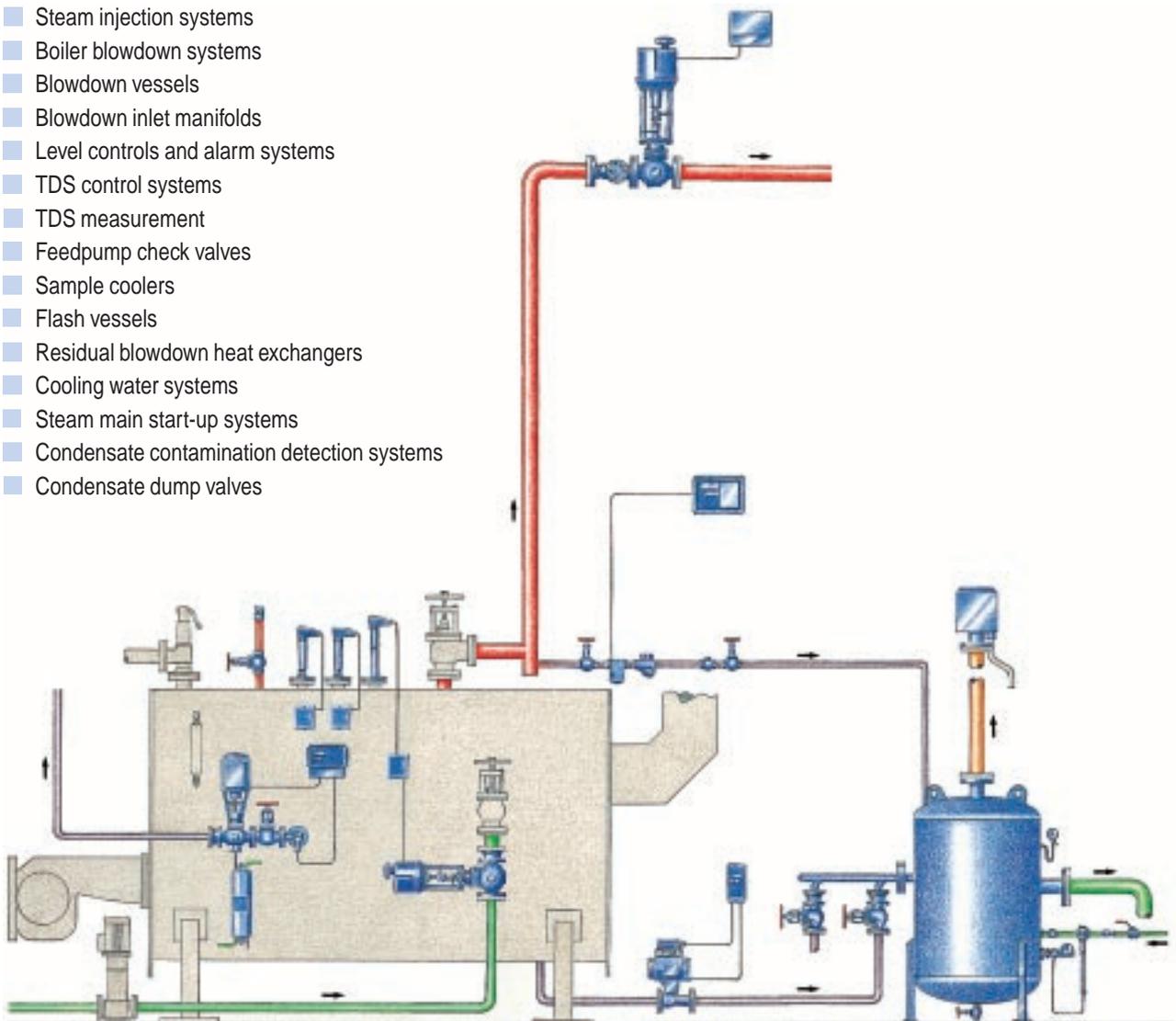
Spirax Sarco has the expertise to help you produce high quality steam from your boilers, at the most economical cost, with a wide range of products specifically designed for the boiler house, all manufactured to the highest standards.

We have literature on boiler house applications and equipment freely available upon request.

An essential part of the boiler house design and operation is ensuring the boiler operates at the highest possible efficiency. Every effort should be made to recover and reuse the heat available from secondary sources such as boiler blowdown. Your local Spirax Sarco engineer will be able to help and offer advice on how this can be achieved.

- Cold water make-up controls
- Boiler feedtanks
- Feedtank controls
- Deaerator heads
- Air vents and vacuum breakers
- Feedtank recirculation systems
- Boiler blowdown heat recovery systems
- Vent heads
- Steam injection systems
- Boiler blowdown systems
- Blowdown vessels
- Blowdown inlet manifolds
- Level controls and alarm systems
- TDS control systems
- TDS measurement
- Feedpump check valves
- Sample coolers
- Flash vessels
- Residual blowdown heat exchangers
- Cooling water systems
- Steam main start-up systems
- Condensate contamination detection systems
- Condensate dump valves

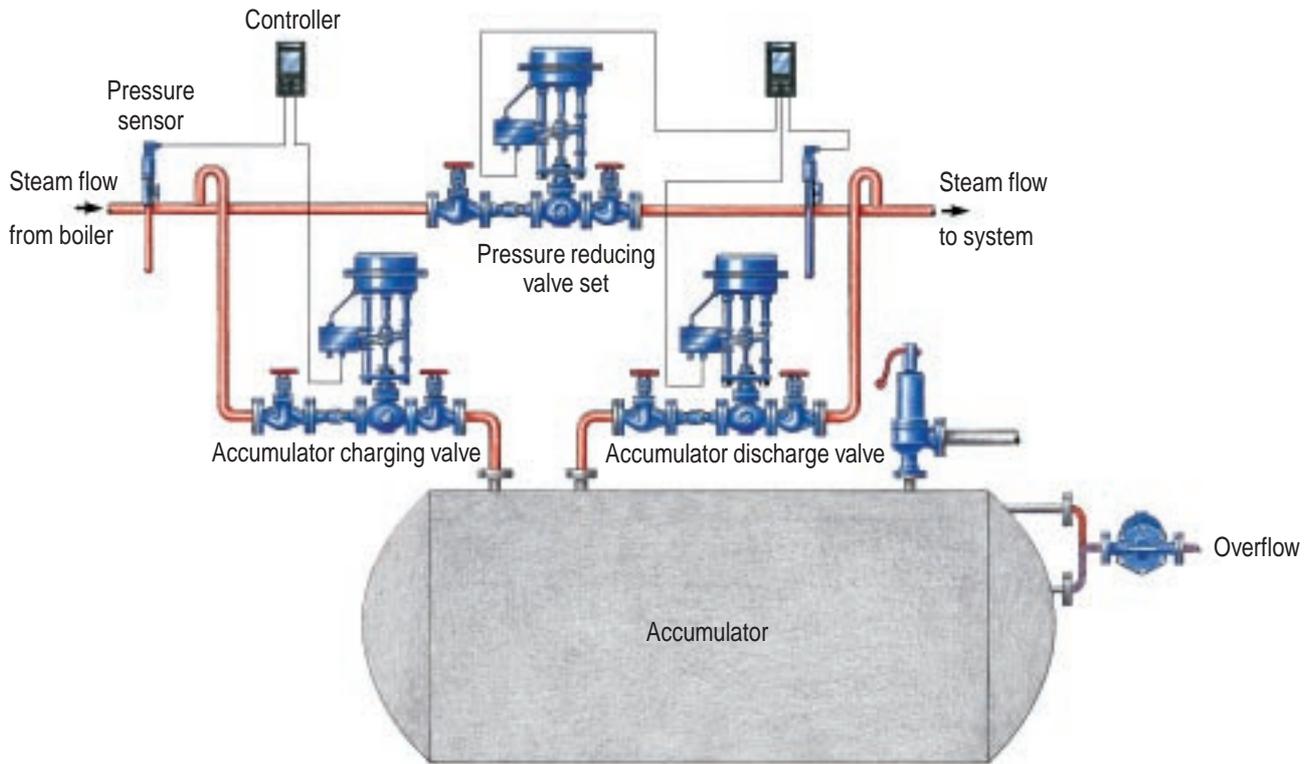
● Supplied by Spirax Sarco



■ steam

■ flash steam

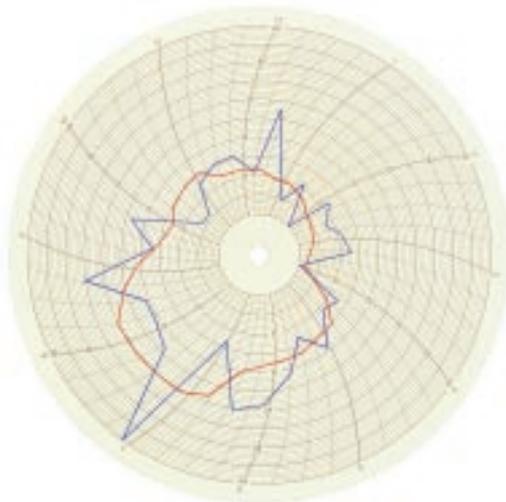
■ condensate



**Spirax Sarco accumulator control**

## Steam quality

High sudden peak demands for steam in a brewery can lead to priming or carryover from the boilers, with very wet steam passing into the distribution system. Various methods are available to minimise the damaging effects these sudden high peak loads can have on brewery operation.



- Boiler loading without accumulator
- Boiler loading with accumulator

The boilers should be operated at the highest possible pressure to provide a degree of thermal storage,

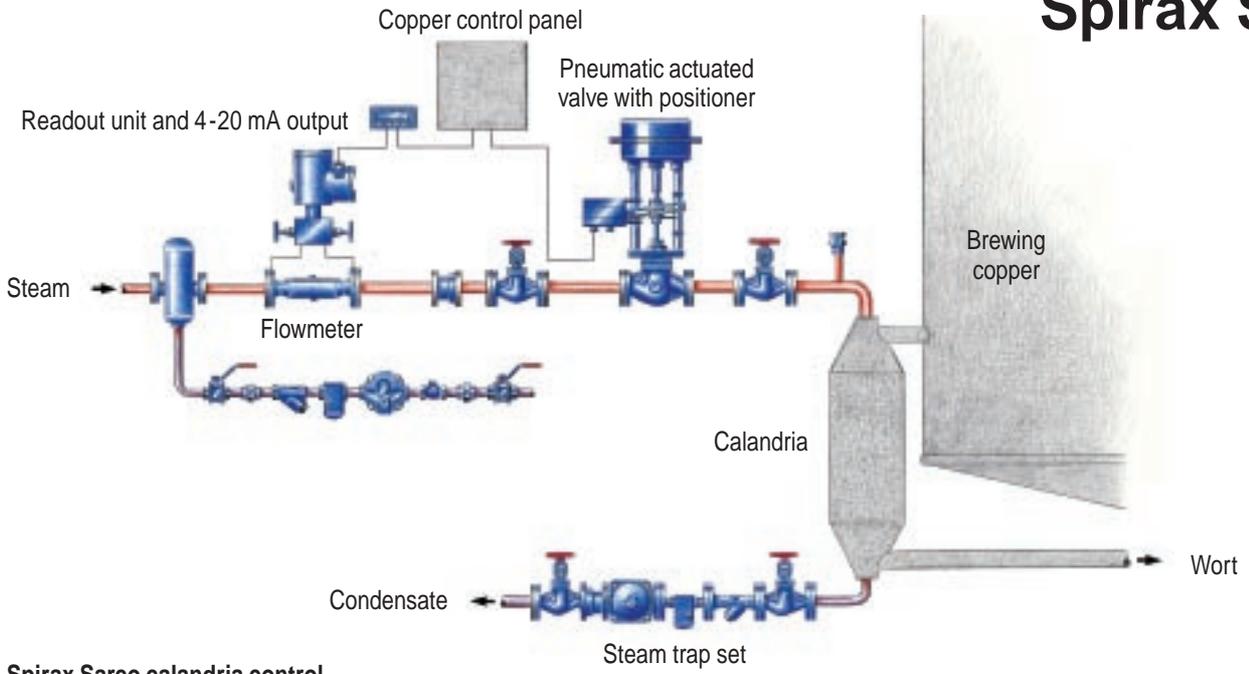
helping to cope with sudden high steam demands. Steam pressure can then be reduced to the required operating pressures.

Thermal storage can be further increased by specifying a larger than normal boiler shell or introducing a steam accumulator. An accumulator stores thermal energy under light load and supplements steam flow to the brewery during sudden high loads. This will protect the boilers from the effects of overload conditions, allow them to fire to the average load and ensure that a high sudden steam demand is met.

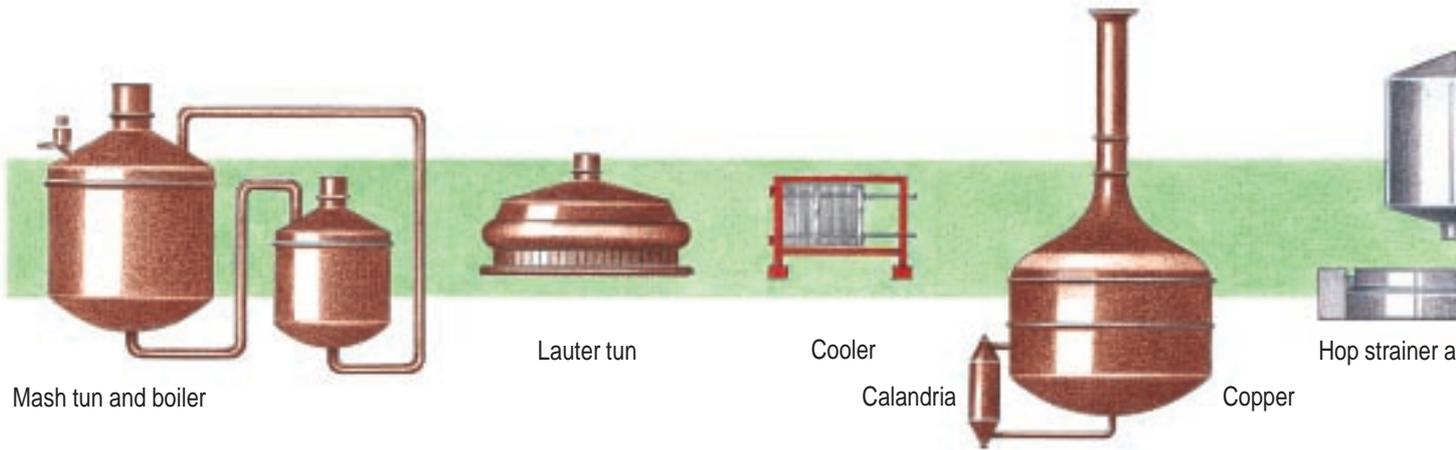
The use of surplussing valves to restrict steam flow to a safe maximum or to shut the supply to low priority users during peak demands can also be an effective way to protect the system.

## Boiler water level controls

Because of the large boilers and variable steam demand found in a brewery, careful consideration should be given to the selection of boiler water level controls. These should be of the modulating type, with two element control preferred for reliable operation under heavy load conditions.



**Spirax Sarco calandria control**



**Mash tun and boiler**

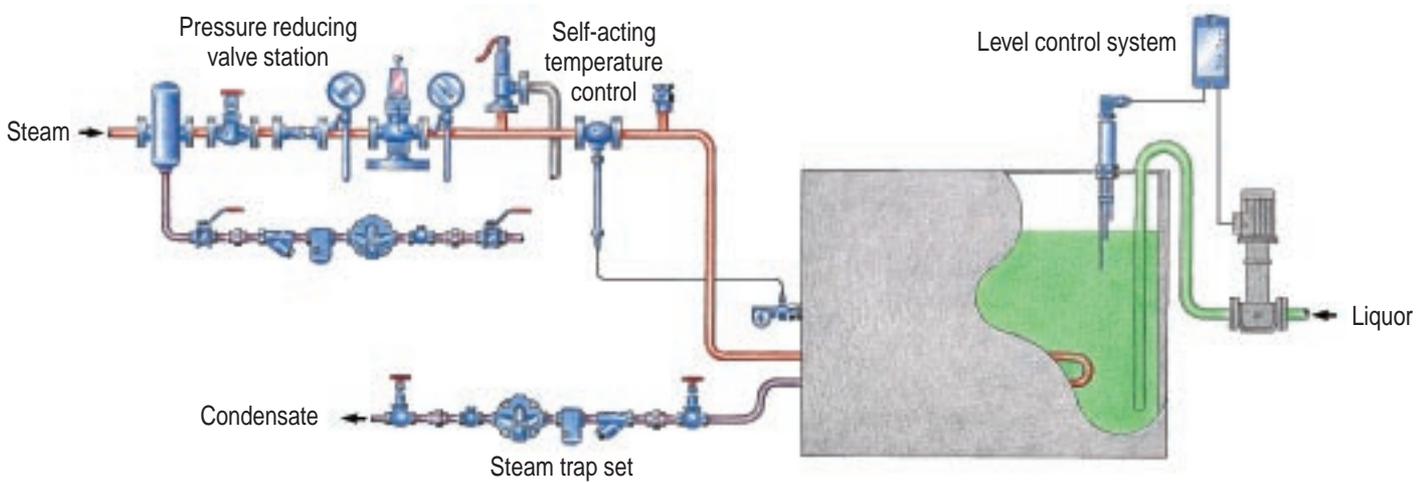
**Lauter tun**

**Cooler**

**Calandria**

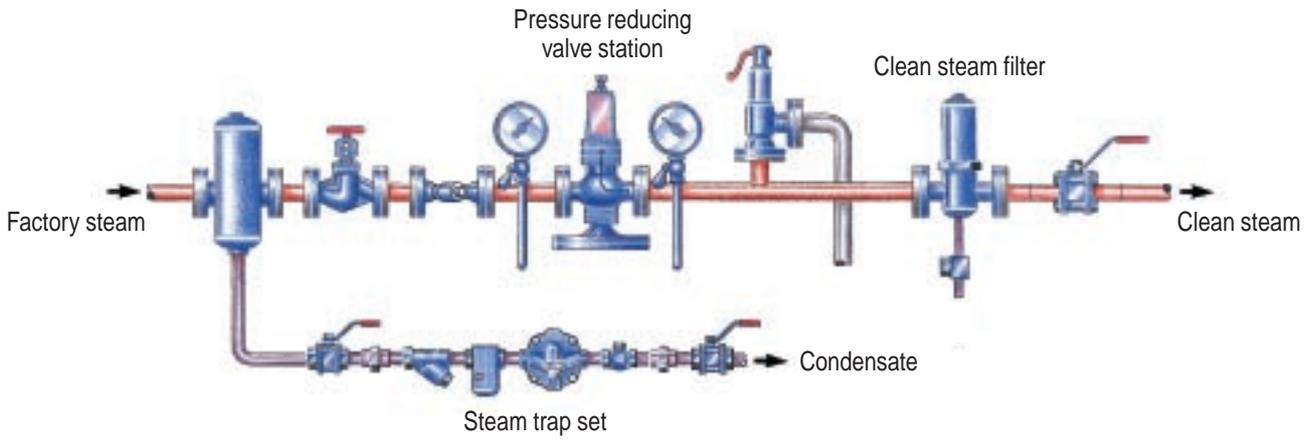
**Copper**

**Hop strainer a**

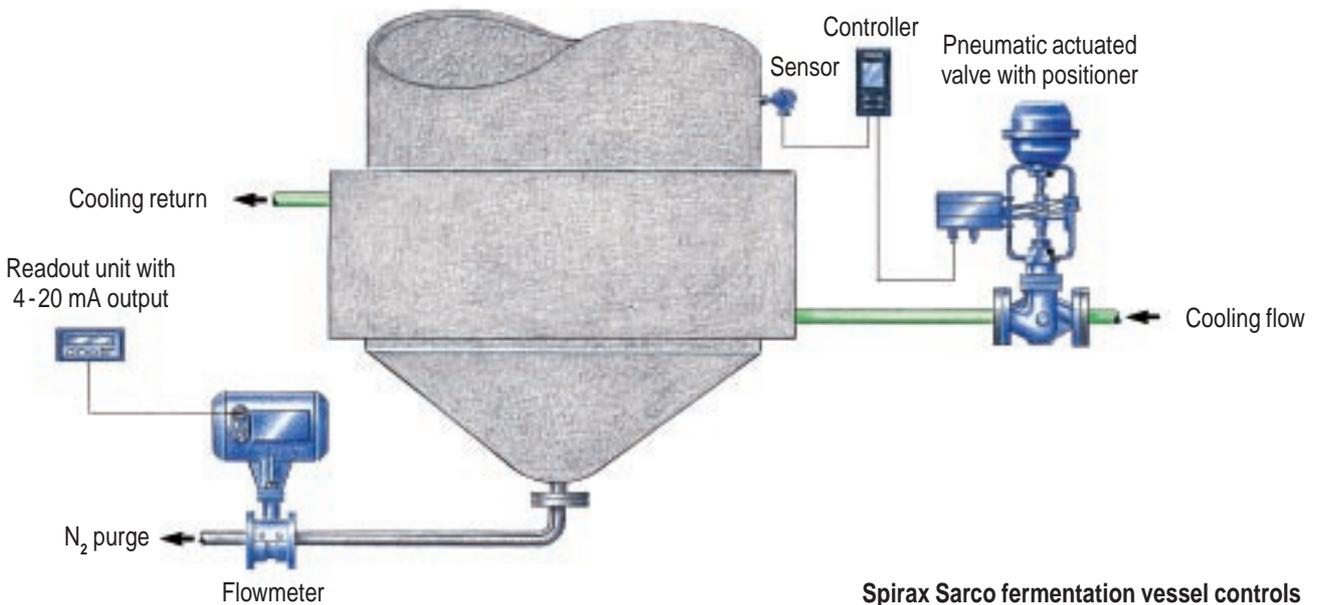
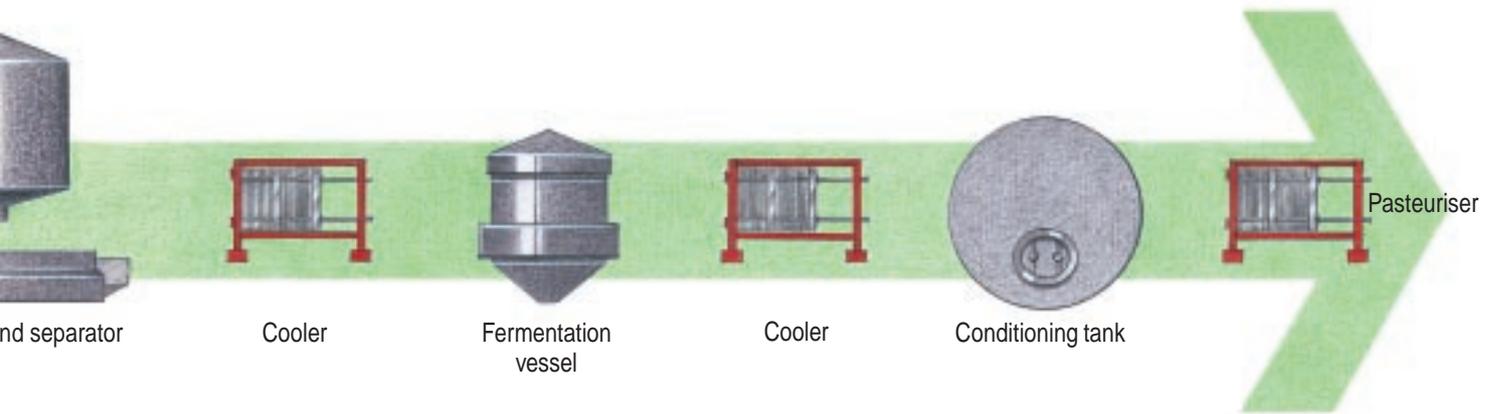


**Spirax Sarco hot liquor tank controls**

# nd the brewery

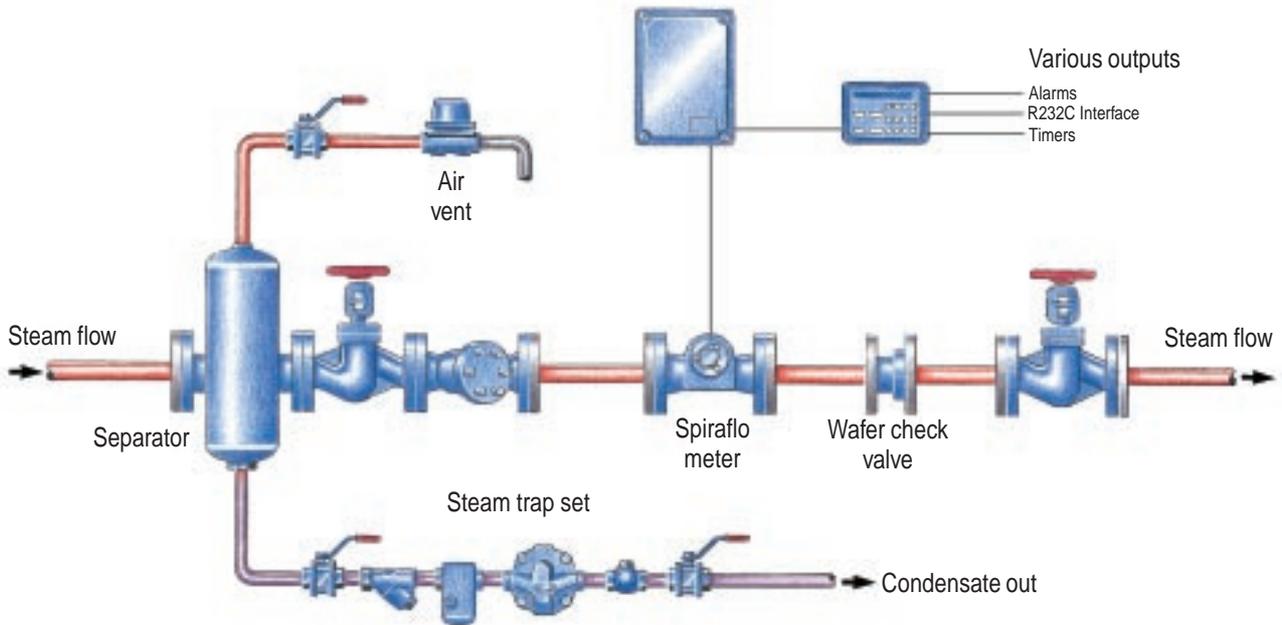


Spirax Sarco clean steam station



Spirax Sarco fermentation vessel controls

# Steam distribution



**Spirax Sarco steam metering station**

From the boiler house the steam is carried to the various processes within the brewery by the distribution system, where it should be available at the correct pressure, in sufficient quantity and in the best possible condition.

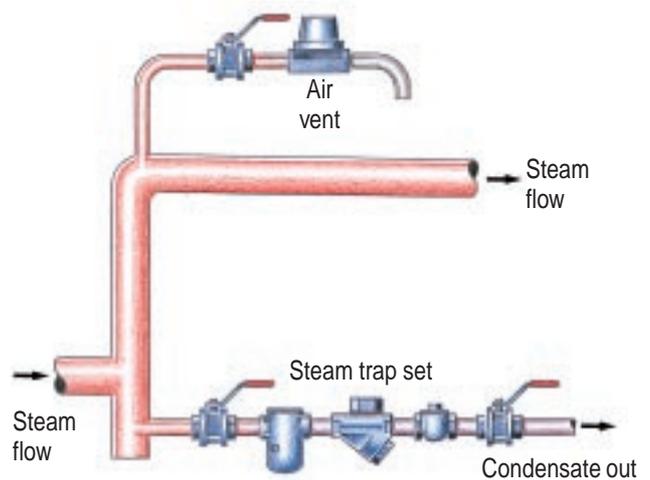
It is important that pipework carrying steam from the boiler house to the equipment is sized correctly. Steam velocity should be at a reasonable level and the pressure drop kept to a minimum. Spirax Sarco will be happy to advise on your distribution pipework sizing.

The installation of accurate steam metering equipment will enable you to monitor performance, assist in energy management and provide information that will help in the accurate costing of beer production.

To ensure that radiation losses are kept to a minimum the steam distribution system should be insulated. Even when insulated some radiation losses will occur, with some steam condensing and forming condensate in the pipework.

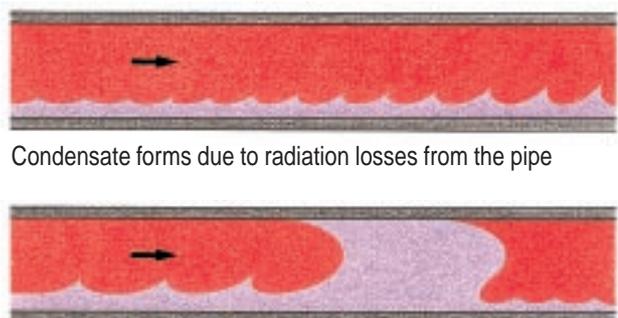
It is important that this condensate is removed so that the steam arriving at the processes is as dry as possible. The removal of condensate from the distribution pipework is also necessary to prevent damage from waterhammer. This occurs when slugs of condensate are propelled along the pipeline at steam velocity.

Condensate can be removed by means of a separator as shown in the illustration of a steam metering station, and in the case of long distribution runs, a relay drain point should be installed. Provision should also be



**Spirax Sarco relay point**

made for removing air and incondensable gases from the steam distribution system through strategically placed thermostatic air vents.



Condensate forms due to radiation losses from the pipe

If it is not removed, a slug of condensate can develop and be carried along the pipe at steam velocity.

## The cause of waterhammer

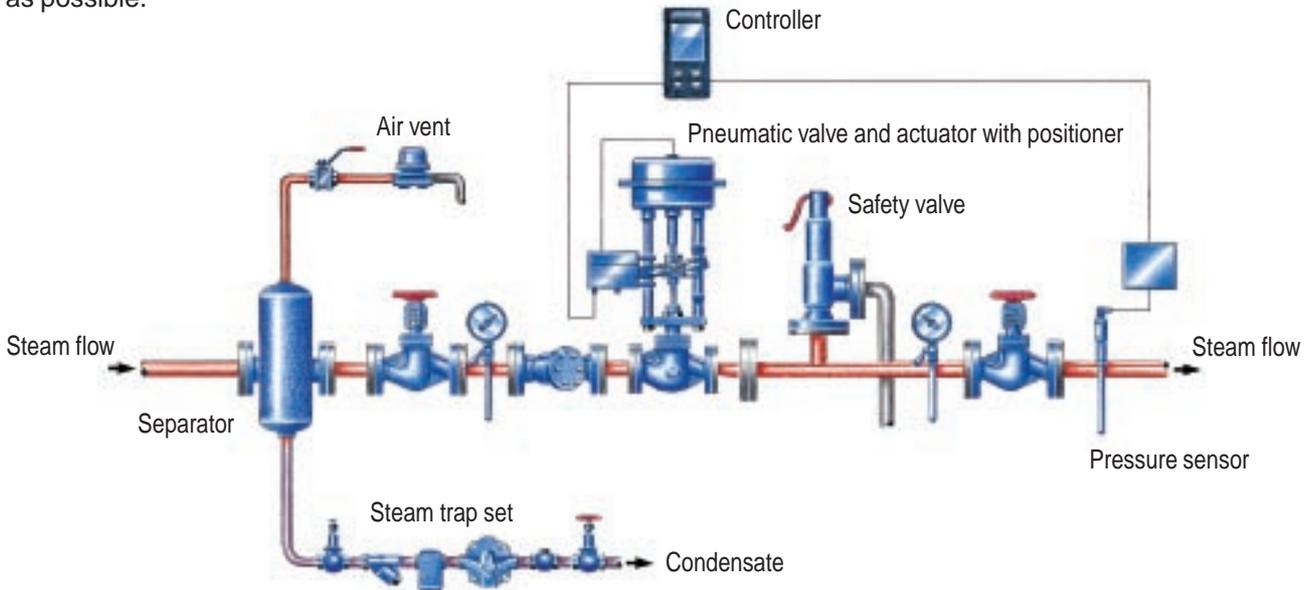
## Steam pressure control

Saturated steam is used in a brewery at various pressures dependent upon the individual requirements of the different processes. The pressure requirements of these processes can range from under 1 bar to over 5 bar.

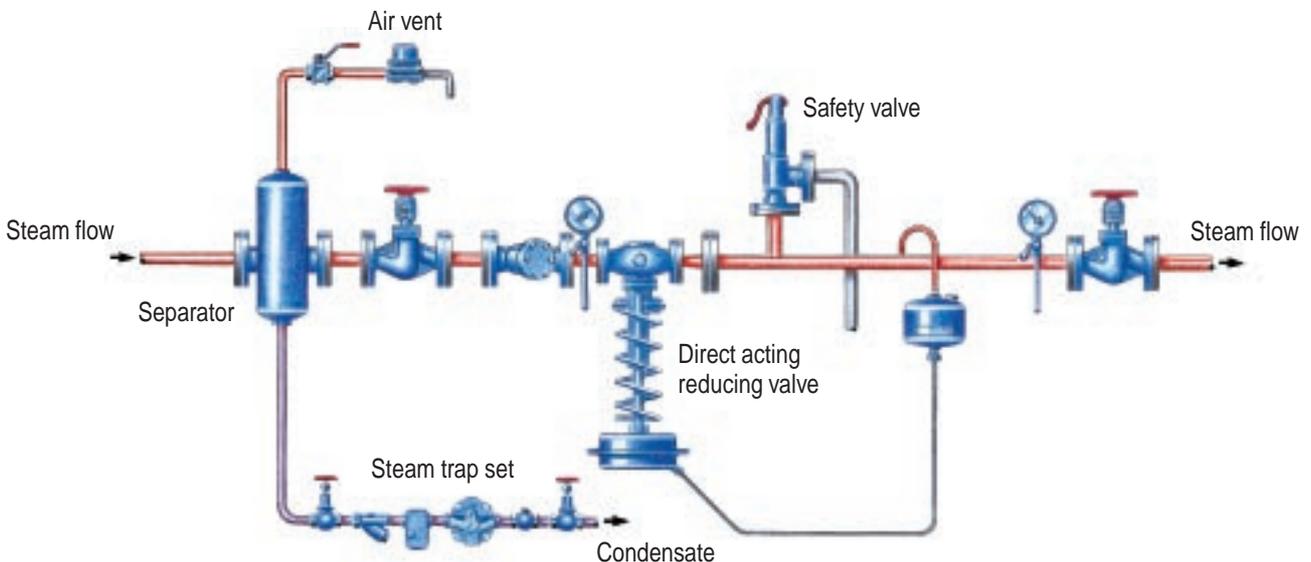
Steam should be generated at the highest possible pressure and then reduced to meet the process requirements. This will help with the problem of peak loads and keep the distribution pipework size as small as possible.

Different types of steam pressure reducing valves are available, from simple direct acting valves to more flexible pneumatic actuator, valve and electro/pneumatic positioner combinations.

The type of system should depend on the needs of the process. Spirax Sarco supply many different types of steam pressure control system and can advise on the best choice for a particular application.



**Spirax Sarco electro/pneumatic reducing valve station**



**Spirax Sarco direct acting reducing valve station**

## Where is steam used

A large proportion of the steam produced in a brewery is used to help in the extraction of sugars and flavours in the mashing process and for wort boiling where the beer is sterilized and stabilised. These two processes alone can account for up to 50% of the connected steam load.

Steam is used to provide the heat for :

- Pasteurisation
- Production of hot liquor

- Bottle washing; in the racking,
- Bottling and canning processes
- The CIP systems.

In addition to the process requirements steam will often be required for the heating and air conditioning system in a brewery. Spirax Sarco has extensive experience in this area and can provide advice on the use of steam in heating and air conditioning applications.

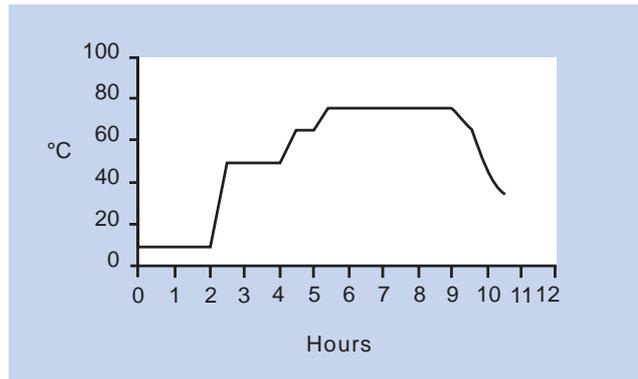
## Temperature control

Most of the steam using processes found in a brewery will require a temperature control system to ensure that the product is heated up to and maintained at the correct temperature.

Spirax Sarco provide many different types of temperature control system and will be able to recommend the most suitable for each of the many different processes.

A simple, robust self-acting control system will often be the most suitable for a hot liquor tank, while a more sophisticated electro/pneumatic system will be required on a mash tun to ensure that all of the

appropriate rests are maintained at the correct temperature for the correct time.



Typical mash tun temperature profile

## Plate heat exchangers

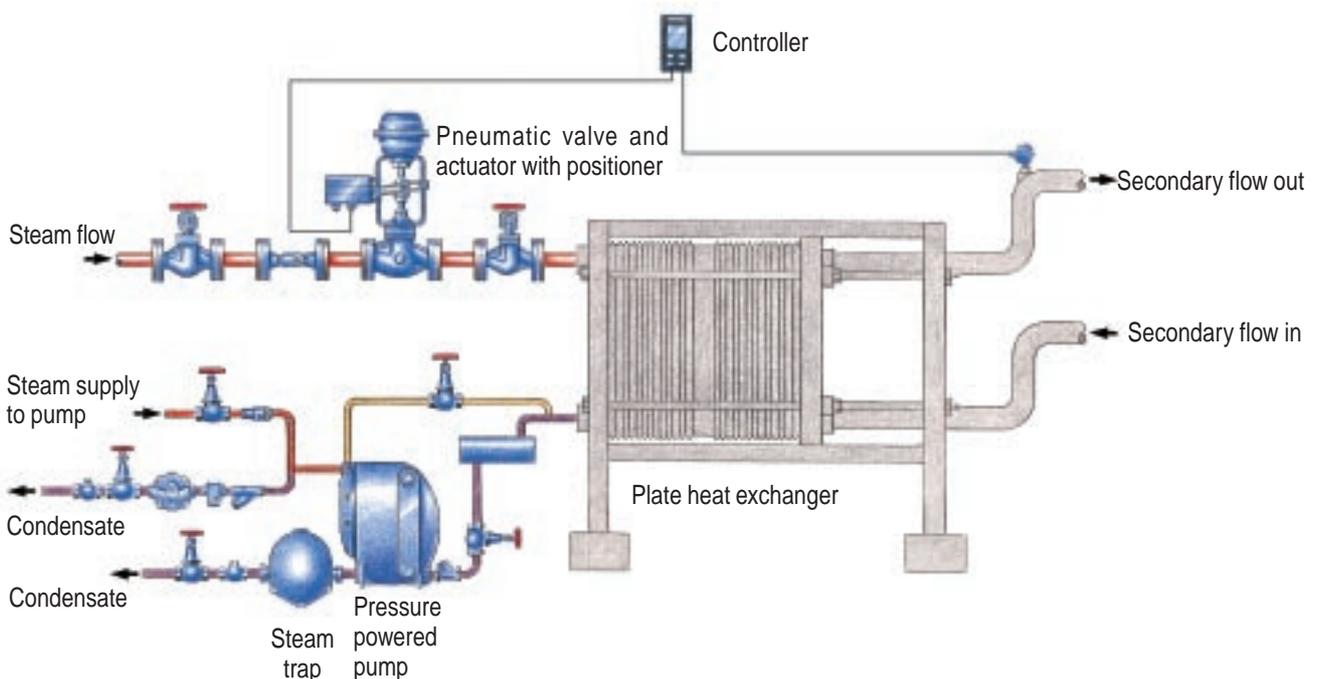
Plate heat exchangers are used throughout a brewery in a variety of heating and cooling applications.

In heating applications steam is frequently used as the primary medium. It is easily controlled and its excellent heat carrying properties allow pipe and exchanger sizes to be kept to a minimum.

A temperature control valve constantly adjusts the primary steam flowrate and pressure to compensate for fluctuations in the secondary fluid's inlet flowrate and temperature. This will ensure the product flow from the exchanger is always at the correct temperature.

When steam gives up its heat it condenses and this condensate must be drained immediately to allow steam to continue to enter the exchanger and carry on the process. If condensate is allowed to remain in the exchanger, poor temperature control will result and there will be an increased possibility of damage from waterhammer.

If the correct type of steam trap is selected and provided the pressure in the steam space of an exchanger is higher than the pressure in the condensate return system, condensate will drain from the exchanger as soon as it has formed.



Spirax Sarco plate heat exchanger temperature control and condensate drainage

The pressure inside the steam space of a plate heat exchanger is never constant, and can even fall into a vacuum condition under light loads. When the pressure within the condensate return system is greater than the pressure within the exchanger steam space, the exchanger is described as being in a 'stall' condition. In this condition condensate will not be able to drain from the exchanger.

A simple and effective solution to this common problem is to install a combination pump/steam trap unit. This will ensure that condensate is drained from the heat exchanger under both normal and 'stall' operating conditions.

Spirax Sarco can advise on whether a 'stall' condition may occur on a heat exchange application and how to ensure its adverse effects are avoided.

## Condensate management

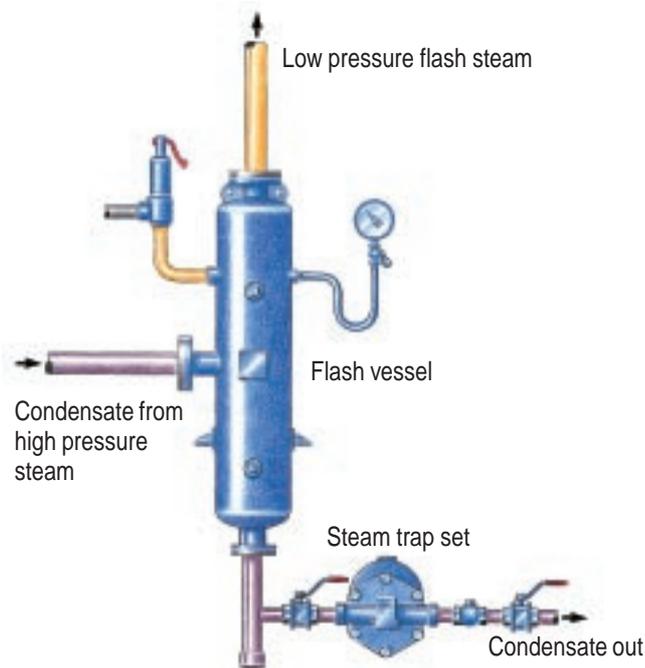
### Heat recovery

Approximately 25% of the heat used to generate saturated steam at 5 bar remains in the condensate when the steam condenses. In effective condensate management, consideration should be given to recovering and using as much of this heat as possible.

### Flash steam recovery

Flash steam is released from the condensate when its pressure falls. Typically this happens when it passes from the process, through a steam trap, to a low pressure condensate system. Low pressure condensate has a smaller sensible heat content than the high pressure condensate and this sudden excess heat content will cause some of the condensate to 'flash off' into steam at the lower pressure.

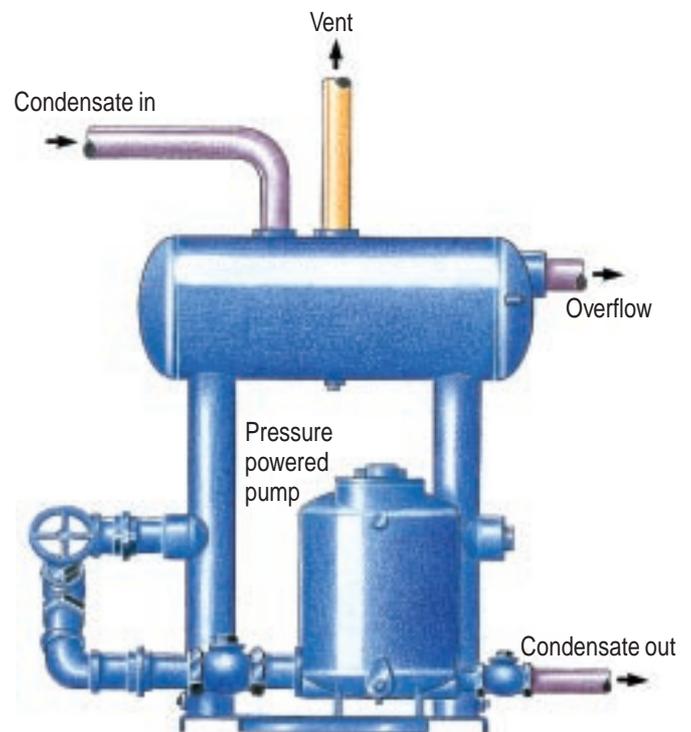
Flash steam recovered in this way can be used to supplement the steam supply to applications that require low pressure steam such as hot liquor tanks.



**Spirax Sarco flash steam recovery set**

### Condensate return

The final stage in condensate management is to return as much condensate back to the boiler house as possible.



**Spirax Sarco pressure powered pump condensate return unit.**

Even after flash steam has been recovered, the low pressure condensate still contains sensible heat - over 400 kJ/kg at atmospheric pressure; and will require no further boiler feed treatment before it re-enters the boiler.

Methods of returning condensate can include simple gravity return systems, electric pumping systems or systems incorporating the versatile Pressure Powered Pump.

**Spirax sarco will be pleased to advise on the most cost effective means of achieving a highly efficient condensate return system.**

# Spirax Sarco provides knowledge, service and products worldwide for the control and efficient use of steam and other industrial fluids in the brewing industry.

As your business partner, Spirax Sarco will provide you with:-

- Worldwide support from a team of 3 500 dedicated employees.
- Local access to Spirax Sarco's expertise and products through 35 group companies in 30 countries.
- Valuable information, advice and interchange of ideas from customer training courses held in any of our 30 training centres worldwide.
- A comprehensive range of the highest quality products.

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A further 46 agencies operate throughout the world.  
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