

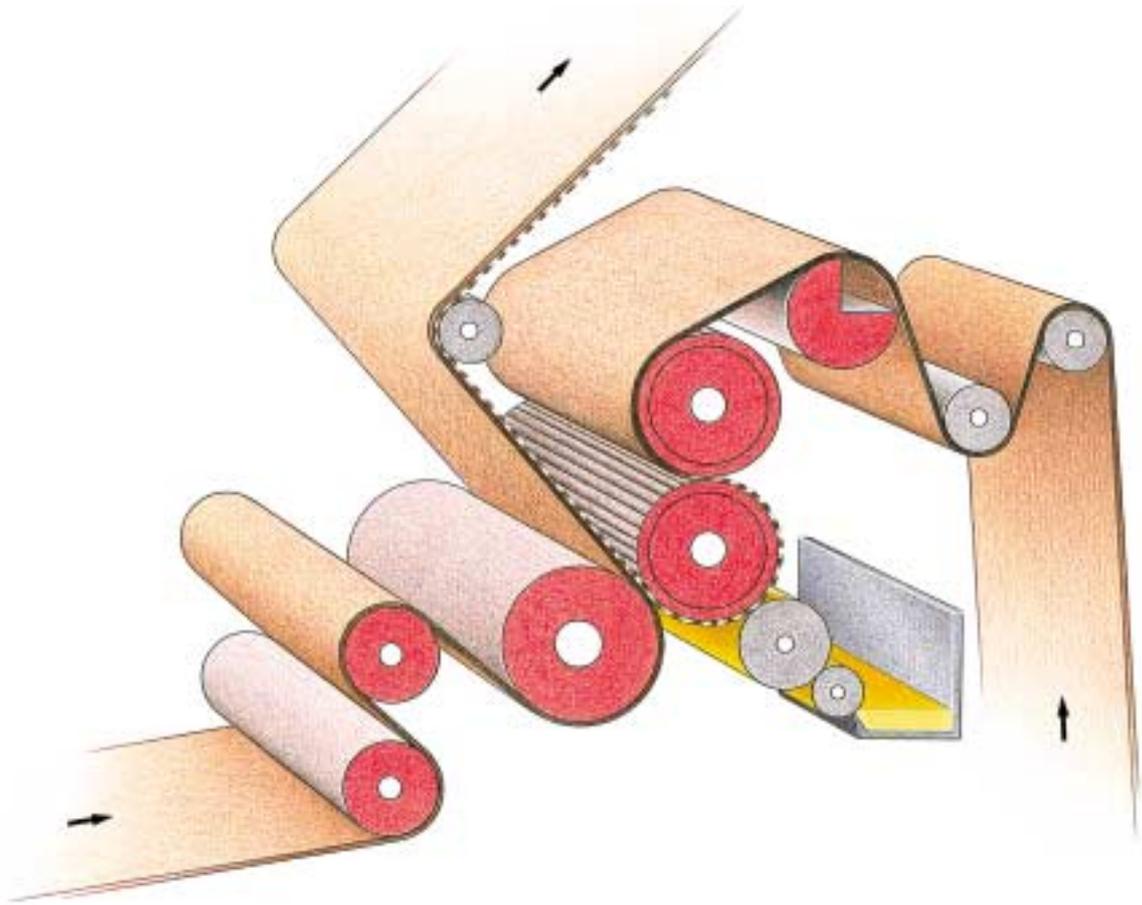
The corrugating industry

Steam and condensate systems



spirax
/sarco

The well managed use of high quality steam is a major factor in producing premium quality board at optimum machine speeds



What is steam used for

Corrugated fibreboard is produced by glueing a liner to a fluting. The fluting, sometimes referred to as the corrugating medium, is formed by a pair of steam heated corrugating rolls.

Steam is used for conditioning and to provide the heat necessary in the forming and bonding processes carried out by the machine.

The need for high quality steam

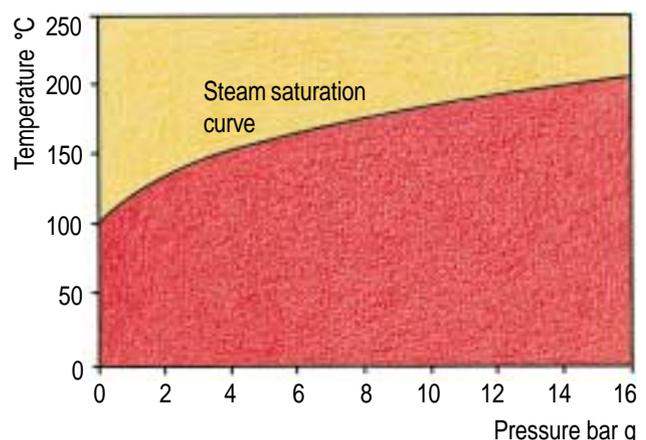
Steam is used because it is an efficient carrier of heat.

It is produced in the boiler and carried to the corrugator by a pipework distribution system. At the corrugator it gives up heat to the various processes and condenses.

A very important property of saturated steam is that its temperature is directly related to its pressure. Therefore the temperature of the heated cylinders and hot plates on a corrugator can be accurately controlled by controlling the pressure of the steam.

Modern high speed corrugators operate at temperatures up to 190°C, requiring a steam supply between 14 and 16 bar.

To enable temperatures to be controlled accurately it is essential that high quality dry saturated steam is delivered to the machine at the correct pressure. Any entrained moisture or incondensable gases in the steam will lower its temperature and 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 temperatures.

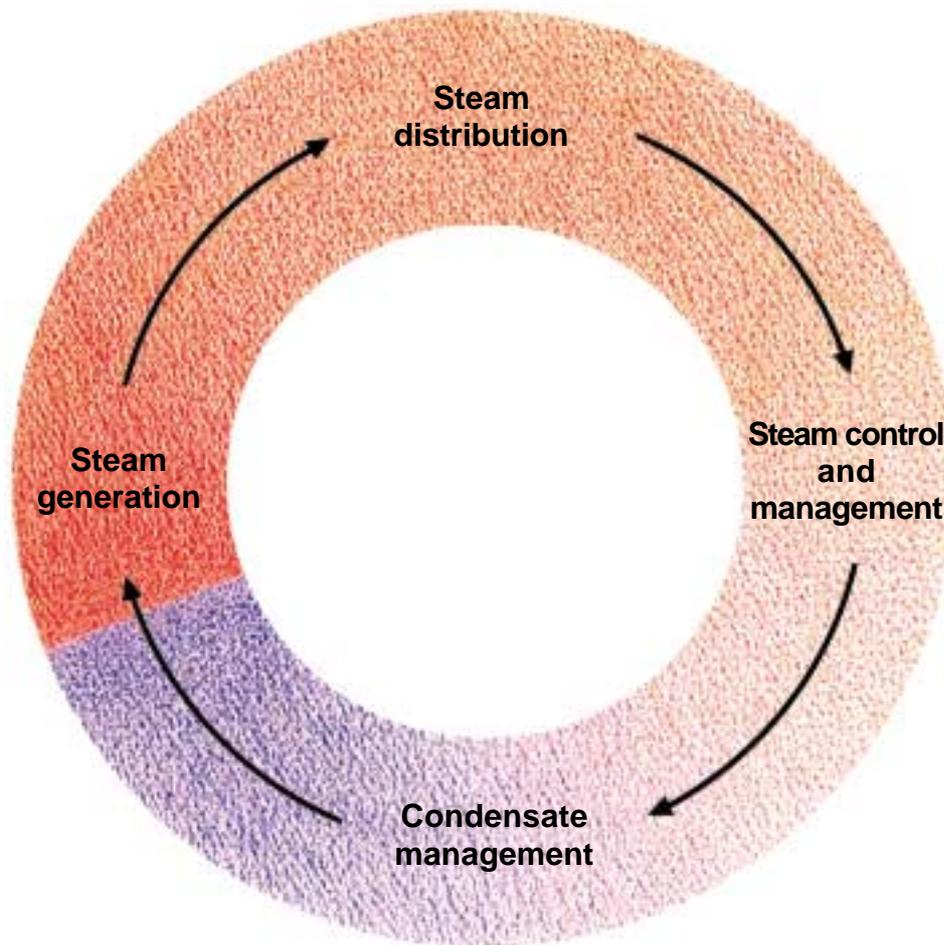


Spirax Sarco in the corrugating industry

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 corrugating industry.

We understand that the corrugating industry has its particular needs and problems, and that each application within the industry should be looked at individually.

We can provide solutions to problems around the complete steam and condensate system in the corrugating industry, anywhere in the world.



The complete system

To produce high quality board while maintaining low production costs it is essential that the corrugator runs at its most efficient speed, and efficiently uses 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 type of corrugator, its speed, the local environment and the different types of board being produced.

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

New machines are manufactured and existing machines are being upgraded to run at higher speeds, producing more board per day. Individual corrugators are now required to be versatile and produce many different types of board, with quick change-over times from one product to another.

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 at the corrugator and minimise the risk of pipeline damage from waterhammer.

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.

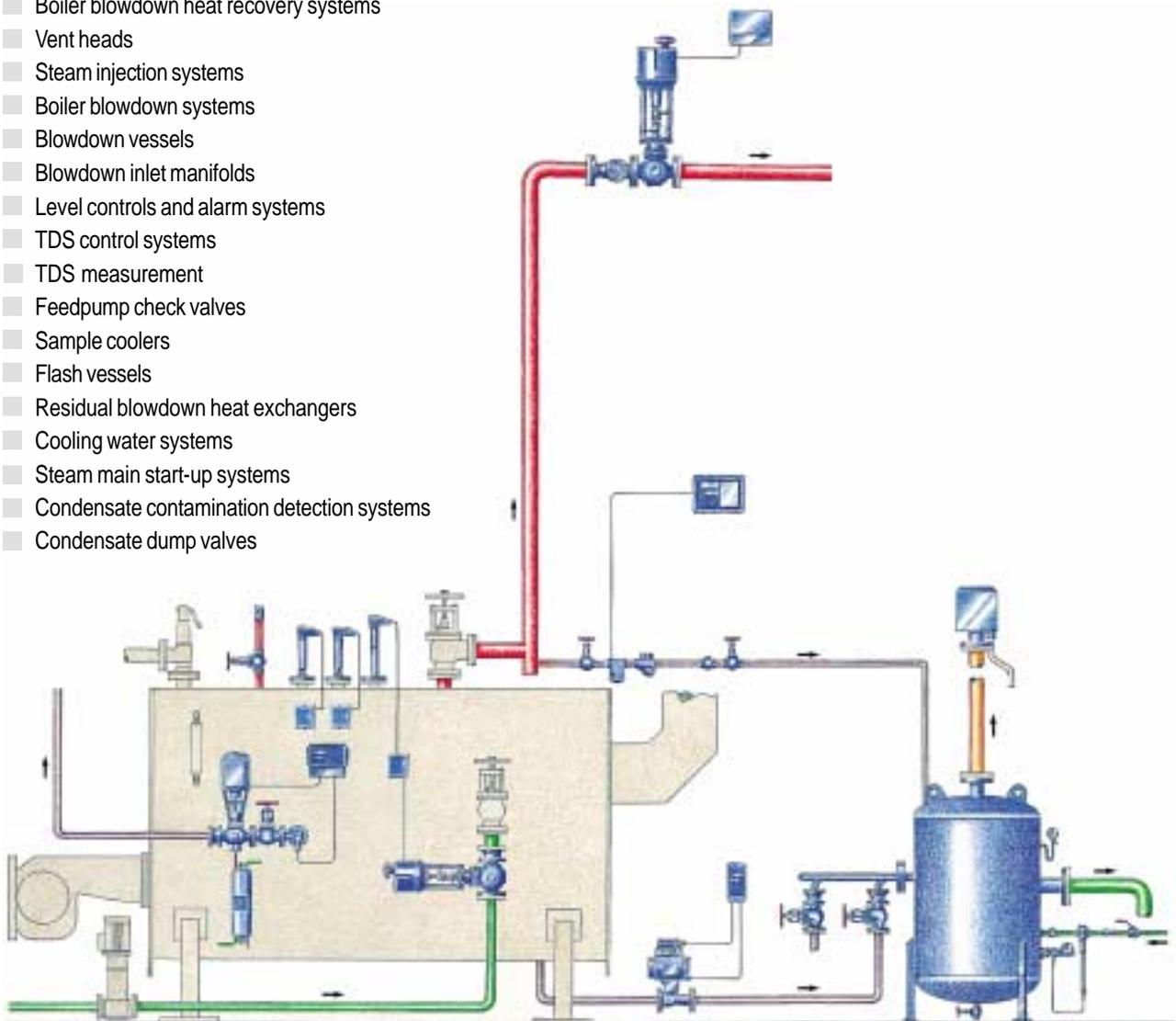
We have technical and sales literature available on the subject of boiler house applications and equipment available upon request.

An essential part of 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

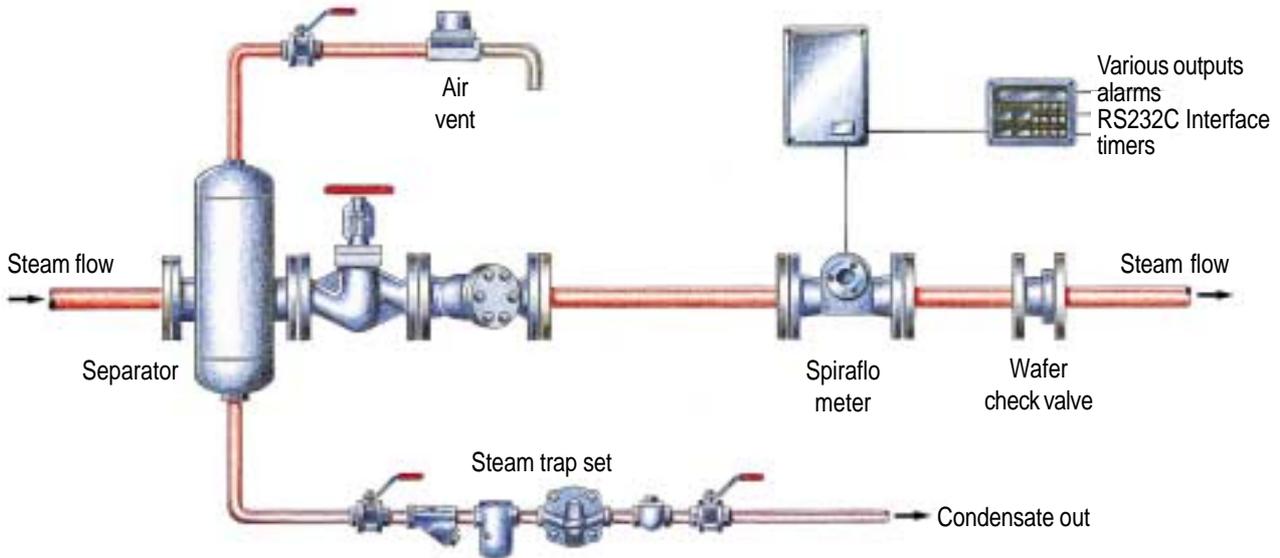
● Supplied by Spirax Sarco



■ boiler feedwater
 ■ steam
 ■ flash steam
 ■ condensate

Spirax Sarco boiler house equipment

Spirax Sarco and steam distribution



Spirax Sarco steam metering station

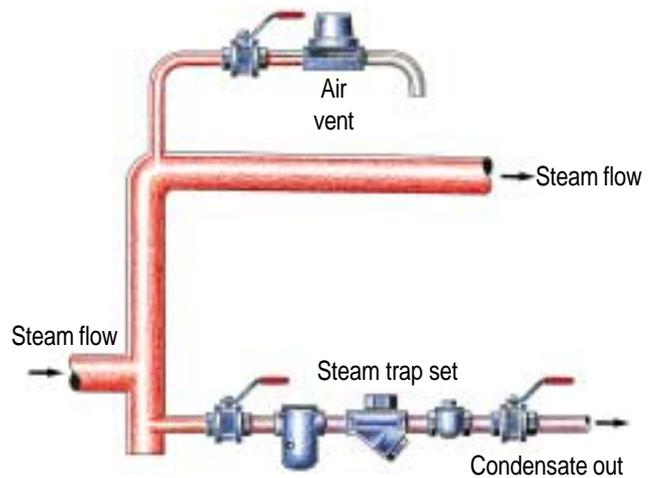
From the boiler house the steam is carried to the corrugating machine by the distribution system. It should be available at the corrugator at the correct pressure, in sufficient quantity and in the best possible condition.

It is important that pipework carrying steam from the boiler house to the corrugator 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 corrugator performance, assist in energy management and provide information that will help in the accurate costing of board production. This can be particularly important when one corrugator makes different types of board.

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 corrugator 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.



Spirax Sarco relay point

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

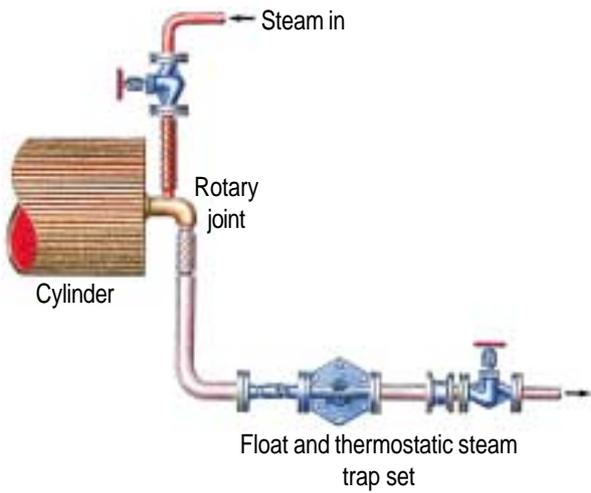


Condensate forms due to radiation losses from the pipe

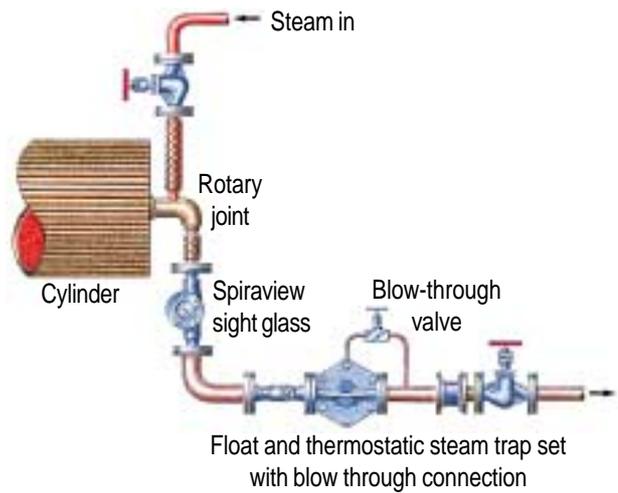


If it is not removed, a slug of condensate can develop and be carried along the pipe at steam velocity.

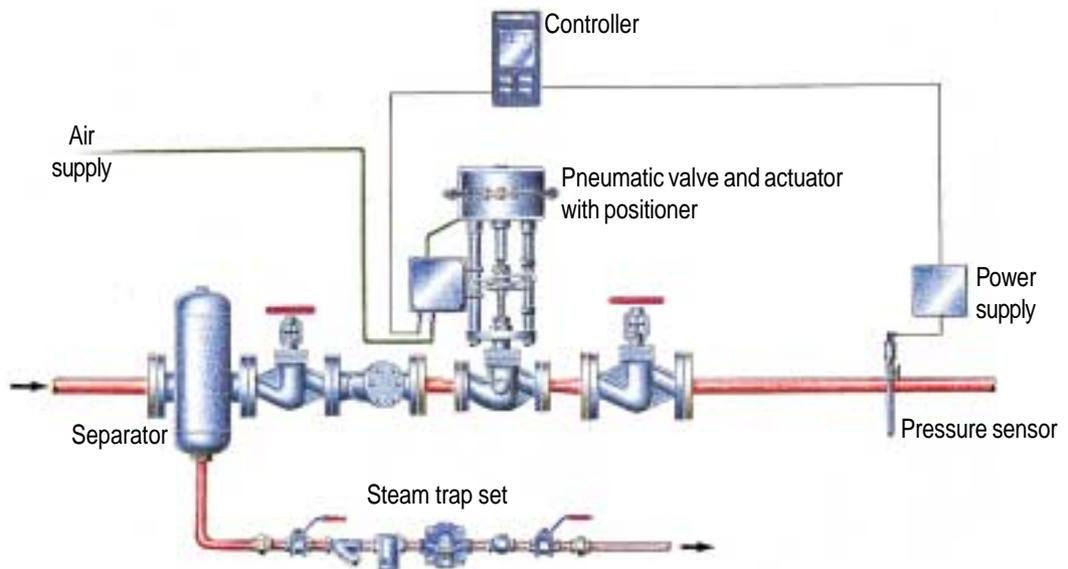
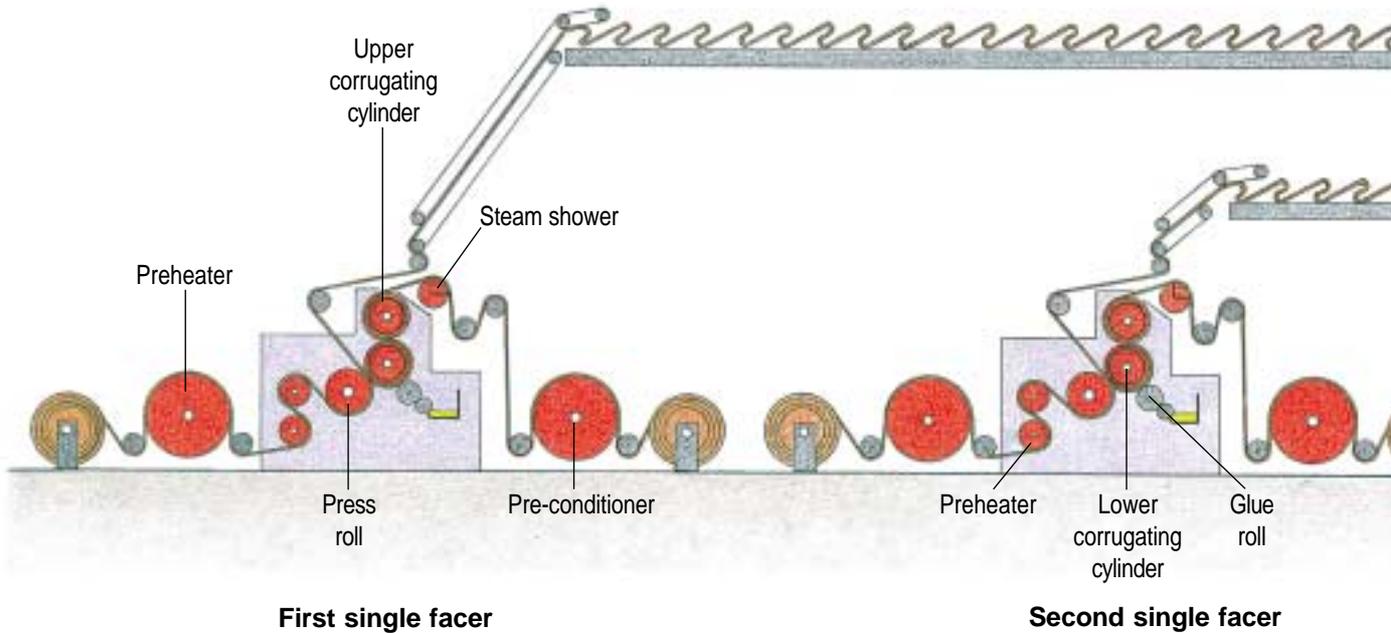
The cause of waterhammer



Spirax Sarco steam trap set for low speed cylinder

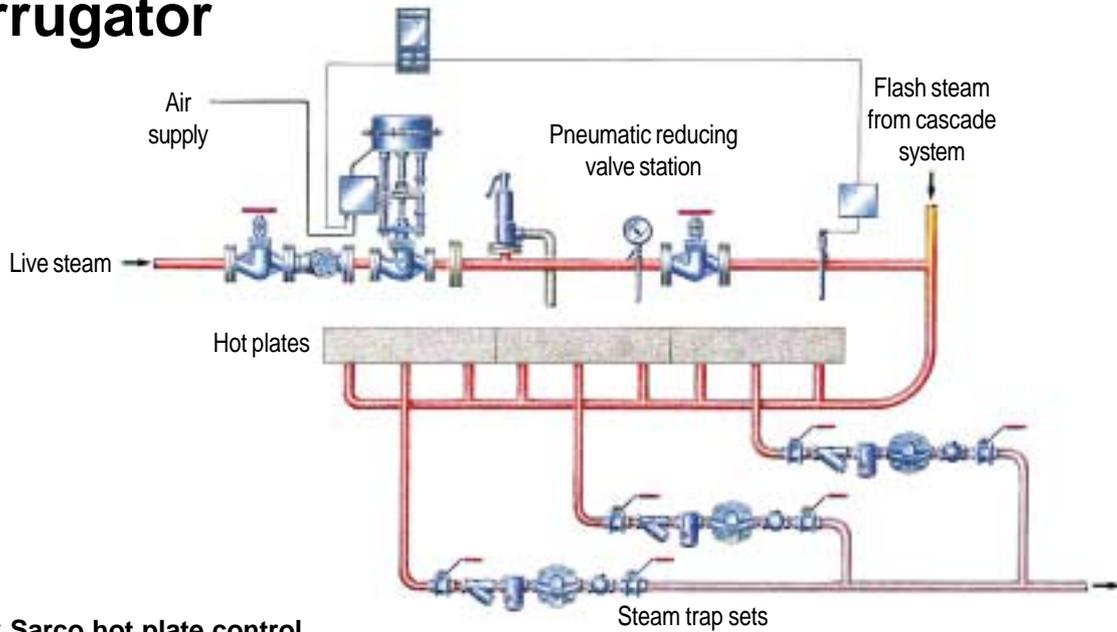


Spirax Sarco steam trap set with provision for blow-through

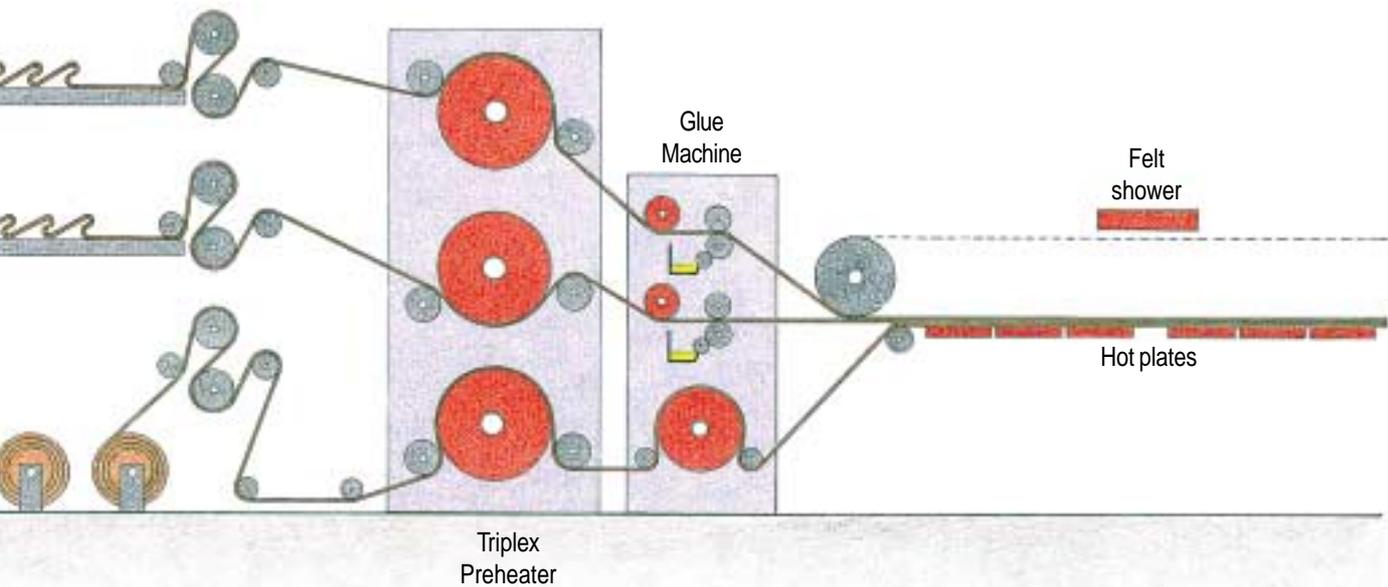


Spirax Sarco reducing valve station

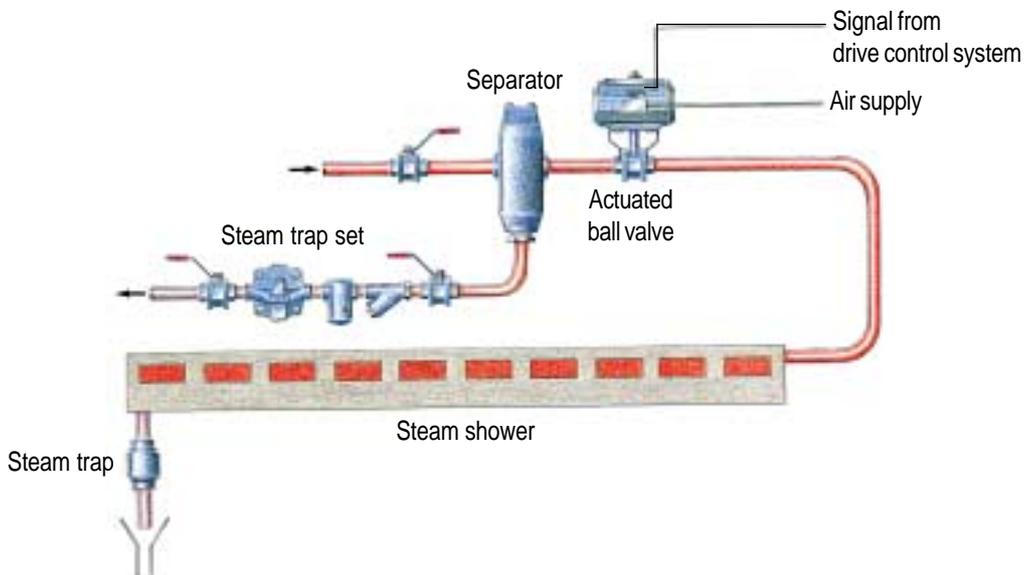
the corrugator



Spirax Sarco hot plate control



Double backer section



Spirax Sarco steam shower control

The steam supply

Corrugators require a primary steam pressure of between 7 bar for older style machines, up to 16 bar for the newer high speed machines.

Whatever type of steam or condensate management system is used, the primary steam pressure onto the corrugator must be correct and stable. The corrugating rolls, small preheaters, press rolls and first section of the double backer usually operate at the highest temperature. They require high pressure steam within ± 0.3 bar ($\pm 2^{\circ}\text{C}$).

Different types of reducing valve are available, from simple direct acting valves to the more flexible pneumatic actuator, valve and electropneumatic positioner combinations.

The choice of main reducing valve type should depend on the needs of the corrugator.

A corrugator that will always require the same pressure at the high temperature rolls with a reasonably stable demand could safely use a correctly sized direct acting reducing valve.

A corrugator that requires varying pressures at the high temperature rolls, with the supply pressure adjusted through a single controller or from a central machine control panel, would benefit from a pneumatic based system with its high accuracy and remote adjustment capabilities.

Spirax Sarco can supply many different types of steam pressure control system, and can advise on the best choice for your particular application.

Where is steam used

On a corrugator steam is used in three main areas:

- Rotating and static cylinders which heat the fluting medium, liner and finished board, including the corrugating rolls which form the fluting.
- Steam sprays which moisten and heat the fluting medium prior to corrugation. Steam sprays which heat, moisten and clean the double backer felt.
- Hot plates which dry the board and set the starch before the finishing processes.

A typical corrugator producing double walled board consists of two single facer units with a double backer section, all using steam at various pressures.

In addition, finishing sections will contain slitters, scorers, cutters, on-line printers etc. that do not require steam for their operation, but will require steam for space heating and humidification.

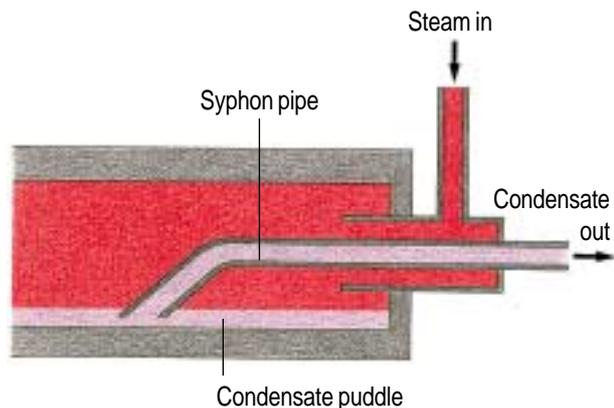
Space heating and humidification requirements must be taken into consideration in order to provide the optimum conditions for board preparation and storage.

Spirax Sarco has extensive experience in this area and can provide advice on your heating and humidification systems.

Static heated cylinders

Some corrugators will have static cylinders used as preheaters. Depending upon the temperature required, these are provided with steam at pressures ranging from 3 bar up to 16 bar. Because they are static, steam inside will condense and form a puddle in the bottom.

Normally a syphon pipe will be fitted inside and the pressure differential between the steam inlet and the condensate outlet will allow condensate to flow up the syphon pipe and out of the cylinder.



Static cylinder section

The correct choice of steam trap for this application will be a ball float (FT) type with integral air vent and steam lock release valve. This will ensure that condensate is drained from the roll as soon as it is formed and allow incondensable gases to pass through the thermostatic air vent, allowing maximum heat transfer across the cylinder wall.

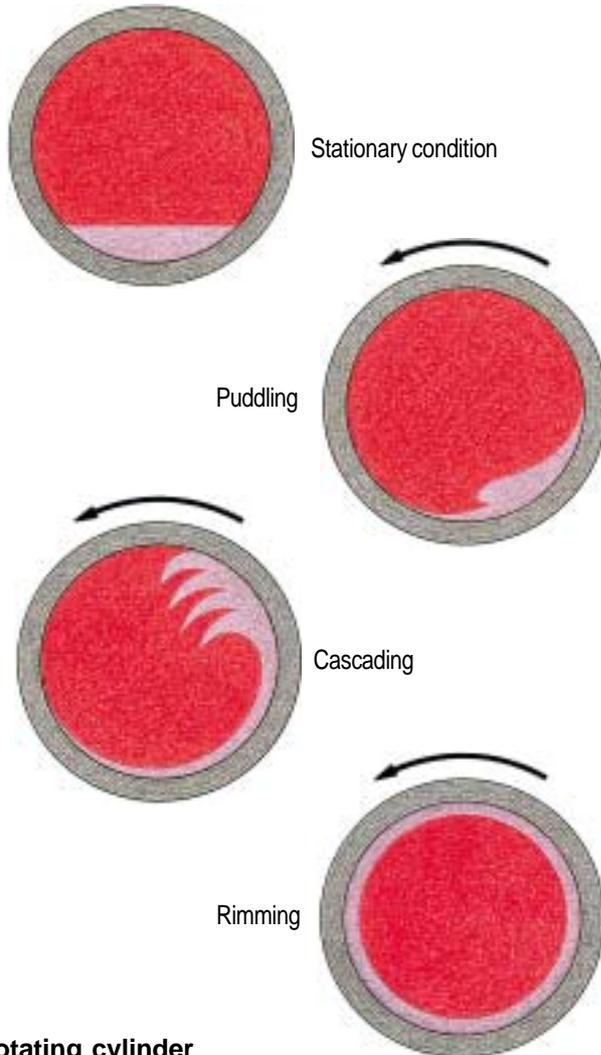
The steam lock release valve will allow any uncondensed steam in the syphon pipe, which may cause the steam trap to shut and condensate to back-up, to bleed away.

Rotating heated cylinders

The majority of steam heated cylinders on a corrugator rotate. Steam enters the roll and condensate exits through a rotary joint. The condensate will normally exit through a stationary syphon.

To maintain the correct cylinder surface temperature, the steam pressure should be accurately controlled and the condensate removed as soon as it forms.

The way that condensate behaves in a rotating cylinder is influenced by many factors, including cylinder diameter, machine speed, condensation rate and the depth of the condensate rim inside the cylinder. Depending upon these various factors it can be either 'puddling', 'cascading' or 'rimming'.



Rotating cylinder

It is necessary to know what is happening to the condensate at actual machine operating speeds to be able to decide upon the most effective and economic method of condensate removal.

The first choice to make will be that of the syphon. Given the necessary data, specialists in this field will be able to advise on the correct type and size.

Different methods can be used to ensure that condensate exits and drains away from a cylinder. There is no single universal choice as individual operating conditions vary from corrugator to corrugator, and even from cylinder to cylinder on an individual corrugator.

On low speed rolls, where rimming does not occur, a ball float (FT) steam trap fitted with a thermostatic air vent and steam lock release valve, to prevent steam locking, should be suitable. Other types of steam trap may also be suitable depending upon the operating conditions.

Where it is known that rimming will occur it may be necessary to provide a steam trap/blow-through combination or even a total blow-through system without a steam trap.

Rimming is caused when a centrifugal force of approximately 3 g or more acts upon the condensate inside a revolving cylinder and holds it against the inner rim. To exit, the condensate must overcome the centrifugal force, travel up the syphon and out through the rotary joint.

In most cases the use of stationary syphons and the high differential pressures across the cylinders on a corrugator will be enough to overcome this force. When this is not the case, blow-through steam may need to be introduced to assist in condensate removal.

Blow-through is steam that enters the roll but does not condense. It forms a mixture with the condensate that is less dense and travels at higher velocity. A typical mixture will be 20% blow-through steam by weight.

On a corrugator cylinder the percentage of blow-through is normally controlled by a simple orifice or needle valve.

Hot plates

Groups of steam heated hot plates provide final conditioning to the board before the finishing processes.

A number of individual chests are normally grouped into three sections. Each section will need its own steam control valve and each chest will need its own steam trap set.

The first section normally requires high pressure steam to provide a high temperature. The following sections will require medium or low pressure steam, through steam reducing valve sets.

If a cascade type condensate management system is installed, much of the demand on the medium and low pressure hot plates may be met by flash steam released from the high pressure sections of the corrugator. A reducing valve set will also be required to provide make-up steam in case the flash steam cannot satisfy the whole demand.

Steam showers

Low pressure steam showers are found in two locations on a corrugator.

The first location is the single facer where steam is used to moisten and heat the corrugating medium prior to passing through the corrugating rolls.

The second location is the double backer where steam showers heat, moisten and clean the felt that presses the board onto the hot plates.

The showers are fed with low pressure steam either through a pressure reducing valve set, or with flash steam from the cascade system together with low pressure steam make-up.

It is important that this steam is dry and does not contain any entrained water droplets that could spray onto the board and mark it or cause it to break. Therefore a steam separator should always be fitted before a steam shower to remove any entrained water in the steam.

Provision should also be made to shut the steam supply to the shower when the corrugator stops running, preventing localised wetting. This can be accomplished by fitting an actuated ball valve in the steam supply line to the shower, operated from the drive control system.

Spirax Sarco and condensate management

Heat recovery

Approximately 30% of the heat used to generate steam at 14 bar remains in the condensate when the steam condenses. Therefore in condensate management, consideration should be given to recovering and using as much of this heat as possible.

Another possible source of wasted heat is the blow-through steam introduced to assist in condensate removal from rotating cylinders. If this steam is not recovered and usefully used, the overall efficiency of the corrugator will be lowered.

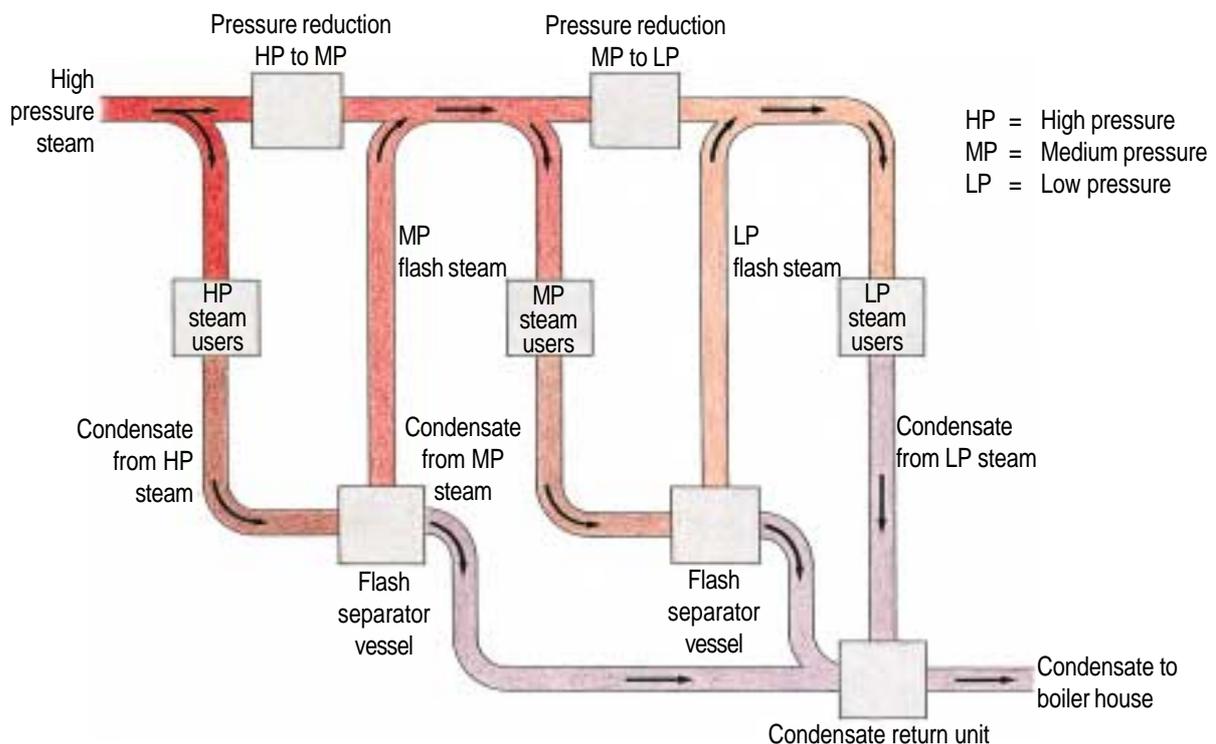
Flash steam

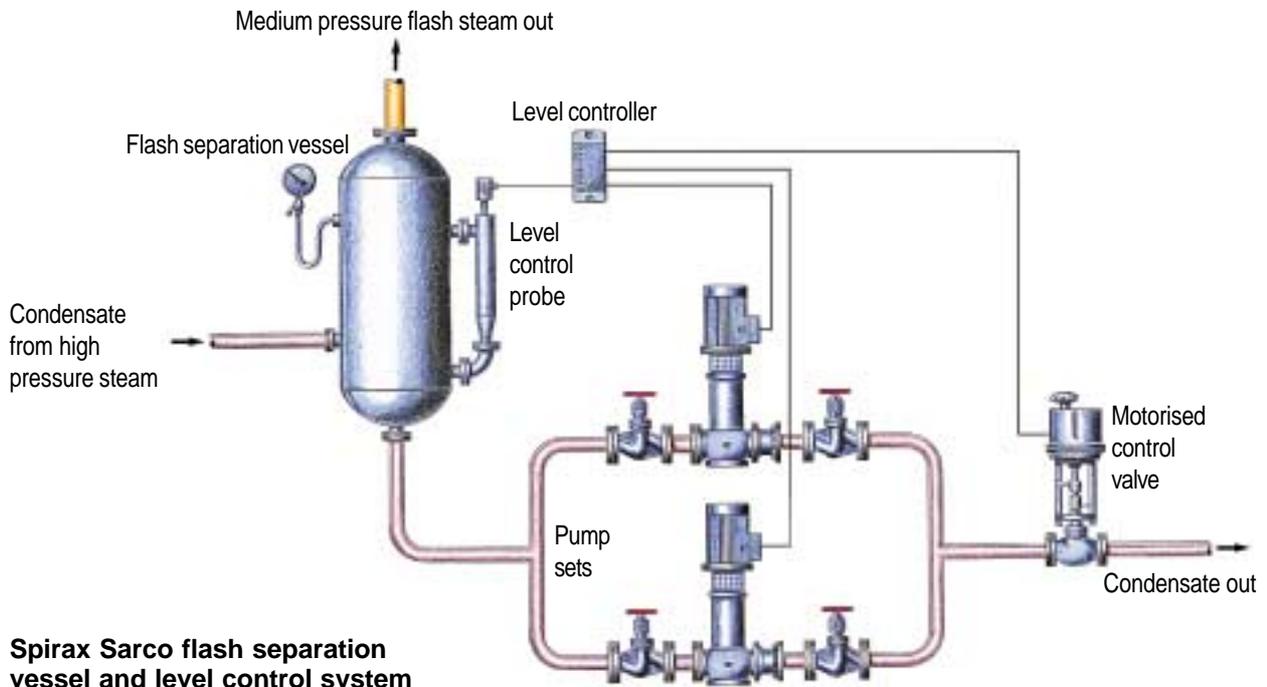
Flash steam will be released from condensate if its pressure decreases. Low pressure condensate has a smaller sensible heat content than high pressure condensate, and this sudden excess heat content will cause some of the condensate to 'flash off' into steam at the lower pressure.

Cascade systems

One method used to recover and use flash and blow-through steam is a cascade type condensate management system.

A corrugating machine requires steam at various pressures, and the release of flash steam from high pressure condensate can be controlled to satisfy part of this steam demand.





Spirax Sarco flash separation vessel and level control system

Flash steam separation

Key components in a cascade system are the flash separation vessels, where flash and blow-through steam are separated from the condensate.

It is important that condensate is effectively drained and not allowed to build-up in the separators. They can be drained either by a steam trap, an electrically driven pump/level control arrangement or a combined steam trap/pressure powered pump system.

The most suitable arrangement will depend on the needs of the individual corrugator.

For condensate to be removed from any process, there needs to be a pressure drop between the steam inlet and the condensate outlet. On a corrugator, a

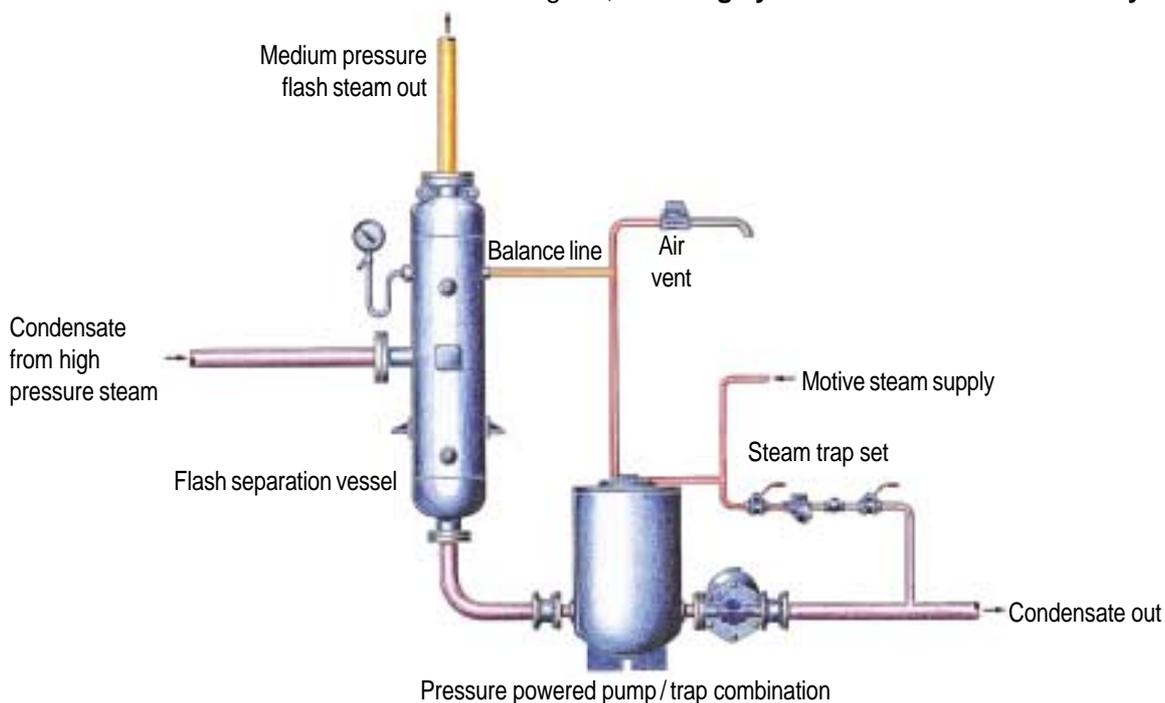
surplussing valve or pressure differential control valve is often fitted to flash separators to ensure that this pressure drop is maintained.

Condensate return

The final stage in condensate management is returning the hot condensate to the boiler house.

Methods of returning the condensate include simple gravity return to a vented boiler feedtank and high pressure pumped return directly into the boiler.

Your local Spirax Sarco engineer will be pleased to advise on the most cost effective means of achieving a highly efficient condensate return system.



Spirax Sarco flash separation vessel and self-acting pump/trap

A partnership with Spirax Sarco provides knowledge, service and products worldwide for the control and efficient use of steam and other industrial fluids.

- Worldwide support from a team of 3 900 dedicated employees.
- Local access to Spirax Sarco's expertise and products through 39 group companies in 32 countries.
- Valuable information, advice and interchange of ideas from customer training courses held in any of our 31 training centres worldwide.
- A comprehensive range of the highest quality products.

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A further 46 agencies operate throughout the world.

If you have difficulty finding a local contact please contact us at the number shown below.

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