FLOWSERVE GESTRA

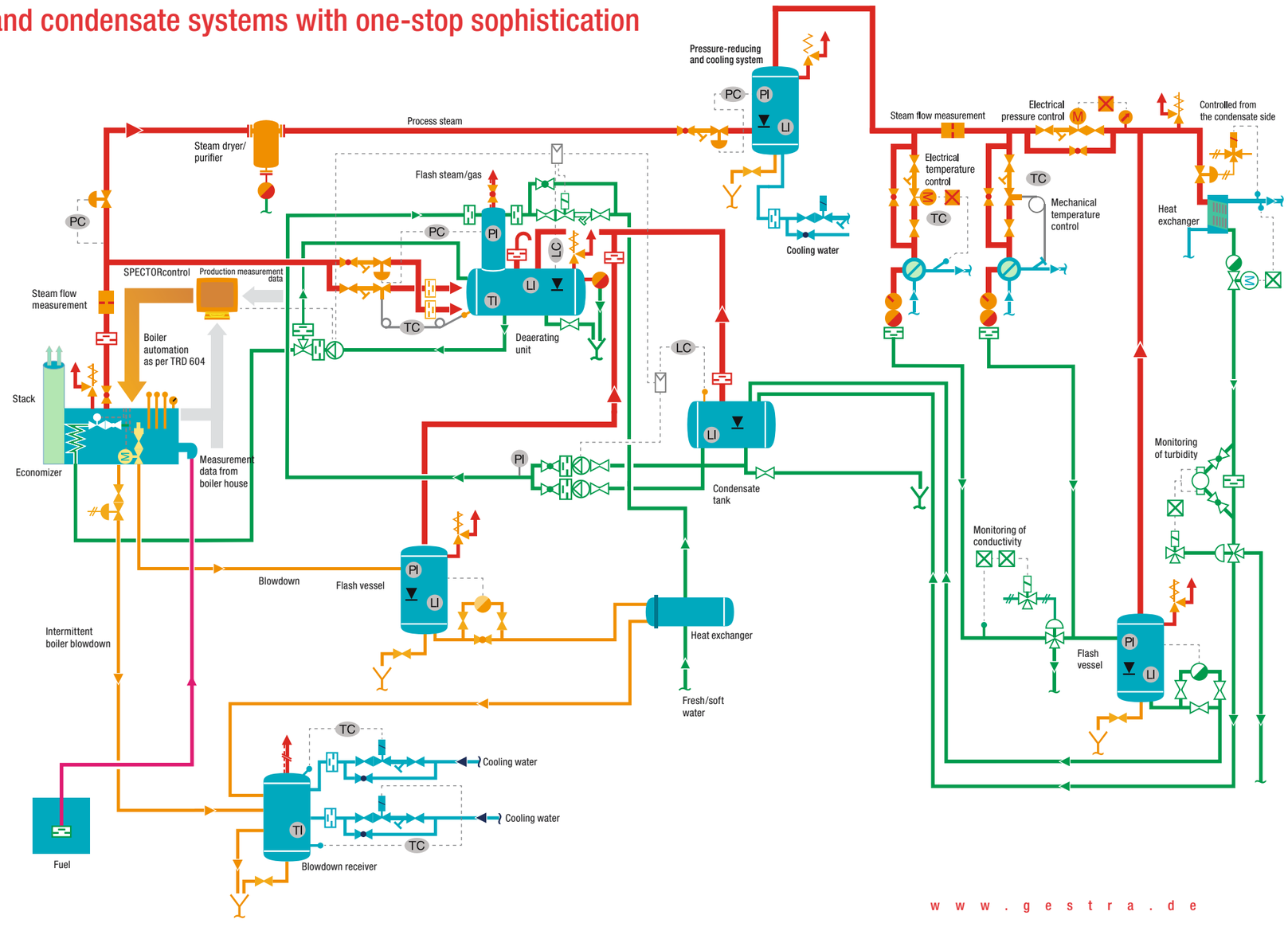
GESTRA

Special Equipment and Vessels for Heat Recovery

For every application the optimally coordinated system

Experience In Motion

Steam and condensate systems with one-stop sophistication



Contents

Preface 4
Quality – Made in Germany 5
Energy Recovery Systems 6
Flash Vessel Systems 7
Feedwater Deaerating Plants 8
Condensate Recovery and Return Systems 10
Steam-Operated Condensate Return Systems 11
Open-Type Condensate Recovery and Return Systems 12
Closed-Type Condensate Recovery and Return Systems 13
Quality Steam – Made by GESTRA 14
Pressure-Reducing Stations 15
Steam Driers 16
Air Driers and Purifiers 17
Desuperheating Plants 18
Water-Bath Desuperheaters 19
Steam Regenerators 20
Heat Exchangers 22
Mixing Coolers VDM 24
Sample Coolers 25
Steam Flow Measurement 26
Compact Systems 27
GESTRA Service 28

Preface

GESTRA is known all over the world as a manufacturer of high-quality steam traps, non-return valves and special equipment for the steam and condensate industry.

In the field of boiler equipment, GESTRA is the largest supplier in Europe. GESTRA has achieved this leading position by focusing on quality and safety as well as on innovative, forward-looking solutions.

Particularly in the German market, GESTRA has been offering complex solutions for steam and condensate systems for many years now – with great success. As a "one-stop shop", we offer special equipment and vessels for heat recovery that are fitted with premium-grade industrial valves and steam traps and augmented by modern control systems. In this booklet, we present and explain a selection of the heat recovery units from our wide range of products.

Quality – Made in Germany

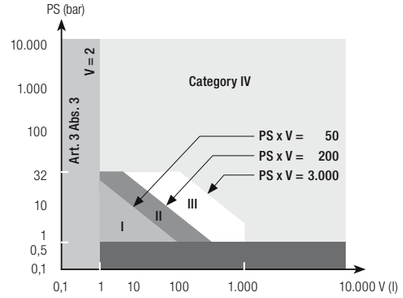
As a manufacturer of top-class heat recovery equipment, GESTRA concerns itself with all aspects of plant safety and reliability. These factors are considered to great degree early on in the design of our components. Safety margin, operational reliability and high availability of the plants form the foundation of our design philosophy.

The QM system at GESTRA was already examined and approved in 1987, the year of publication for the ISO 9000 series, by Lloyd's Register Quality Assurance according to ISO 9001.

Diverse technical codes and standards apply in the various regional markets. For example, these may be the PED, IBR, SQL, ASME or GOST. In most cases, we are able to serve enquiries from these markets and to submit a comprehensive offer.

The Pressure Equipment Directive PED 97/23/EC applies for the European Internal Market.

PED 1 Conformity assessment diagram



Module assignment

Category	Module
I	A
II	A1, D1, E1
III	B1+D, B1+F, B+E, B+C1, H
IV	B+D, B+F, G+H1

PED 2 Conformity assessment procedures

A Internal production control	**B** EC type examination	**C1** Conformity with type	**D** Quality assurance for production	**G** Unit verification	**H** Full quality assurance
A1 Internal production control with monitoring of final assessment	**B1** EC design examination		**D1** Quality assurance for production (compilation of extensive technical documentation)		**H1** Full quality assurance with design examination and monitoring of final assessment
			E Quality assurance for product		
			F Product verification		

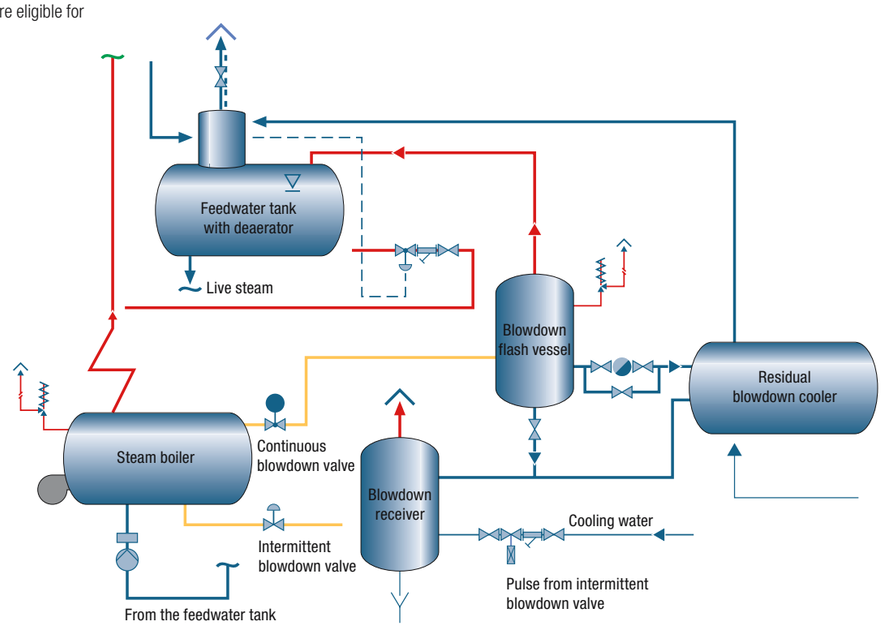
GESTRA Energy Recovery Systems

After continuous blowdown, irrespective of whether automatically controlled or manually set, it is easily possible to utilize the dissipated heat. For example, in a GESTRA blowdown flash vessel, the energy generated by the continuous blowdown is recuperated to a large degree by flashing.In a residual blowdown cooler located downstream, the heat remaining in the flash vessel can also be used to preheat the feedwater. Another possibility for heat recovery is offered by flash steam coolers. Flash steam coolers are, for example, applied in using the flash steam from the feedwater deaerating plant to preheat the make-up water. Our experienced specialists in systems engineering and process technology are available to you for individual advice.

In Germany and many other countries, the heat recovery plants made by GESTRA are eligible for an investment subsidy.

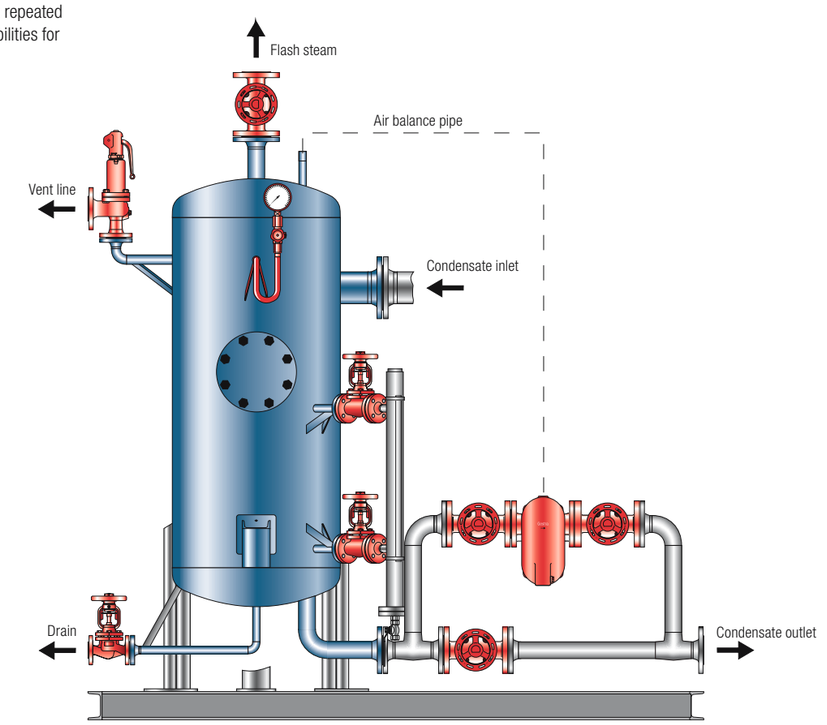
Recovering energy after continuous blowdown

Annual savings for 24 operating hours a day and 250 working days a year	**13,389 EUR ***	**Equipment investment (flash vessel & heat exchanger incl. fittings but without installation costs)**	**6,800 EUR**	**Amortization period: approx. 6 months**
Boiler capacity	10 t/h			
Boiler pressure	10 barg	* Basis for calculation		
Continuous blowdown flowrate approx. 5 %	500 kg/h	Light fuel oil EUR/t	230,– EUR	
Heat recovery	456 x 10^6 W/a	Water treatment EUR/m^3	3,– EUR	



GESTRA Flash Vessel Systems

Flash vessels reduce the operating costs considerably, because the sensible heat of the condensate is utilized very economically. They can be used in all steam systems in which condensate from steam users can be flashed to a lower pressure. During this process, heat is released, which leads to the formation of flash steam. In the flash vessel, this flash steam is separated from the water and fed into a steam system with a lower pressure for further use. Such a process can be repeated several times, depending on the possibilities for operating the steam system with different pressure ratings. The residual condensate in the flash vessel is passed into a condensate tank and reused as boiler feedwater.

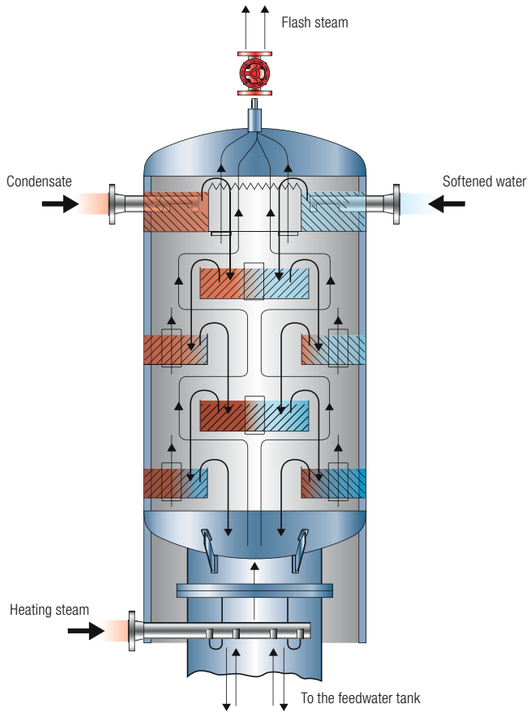


GESTRA Feedwater Deaerating Plants

For the operation of steam boilers with a high thermal load on the heating surfaces, it is necessary to use boiler feedwater is treated and conditioned according to TRD 611, EN 12952 part 12 or EN 12953 part 10. The boiler feedwater must be free of hardening constituents in order to prevent the formation of scale on the boiler heating surfaces.

The aggressive effects of dissolved oxygen and carbon dioxide is likely to cause serious corrosion of metal boiler parts. Aggressive gases are reliably removed in the GESTRA feedwater deaerating plant.

The feedwater deaerating plant, consisting of the feedwater tank SW and the deaerator dome NDR, removes dissolved gases such as oxygen, carbon dioxide and other non-condensable gases from the boiler feedwater and make-up water. The feedwater deaerating plant is custom-designed for each application and meets the essential thermodynamic requirements to achieve optimal performance.



The make-up water and return condensate enter the deaerator dome NDR, which is fitted with a series of welded tray compartments to provide maximum trickling. Heating steam is fed from below into the deaerator dome NDR, which is mounted on top of the feedwater tank SW. The deaerated make-up water and return condensate flow directly from the deaerator dome into the feedwater tank. A steam injector installed in the lower part of the feedwater tank is used to heat up the feedwater to approx. 107 °C.

Oxygen and carbon dioxide are dissolved in water according to Dalton's law of absorption, which states that gas solubility in a solution decreases as the gas partial pressure above the solution decreases. The gas solubility in a solution therefore decreases as the temperature of the solution rises and approaches saturation temperature. The make-up water and return condensate are distributed over the series of trays, coming into direct contact with the heating steam. This counterflow process reduces the solubility of oxygen and carbon dioxide, thus removing these gases. The released gases work their way as flash steam to the top of the vessel where they are vented from the deaerator dome via the vent line.

We recommend a temperature-controlled heating system for warming up a cold feedwater tank. From a feedwater temperature of 70 °C, a pressure-controlled heating steam supply must be used during commissioning. Due to the fact that the feedwater temperature is above 100 °C, enough net positive suction head (NPSH) is required to prevent the formation of steam bubbles in the pump housing.

With the GESTRA feedwater deaerating plant, the oxygen content can be reduced down to 0.02 mg/l.

GESTRA Condensate Recovery and Return Systems

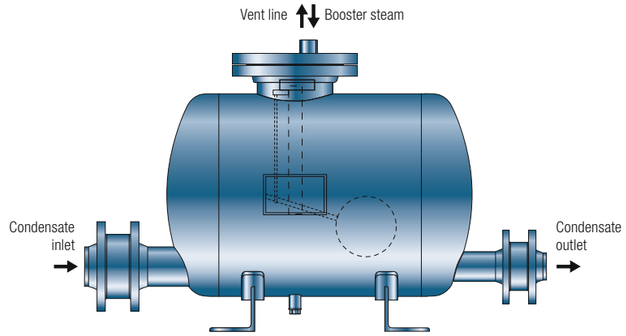
In steam and condensate systems, it is often inevitable that heat exchangers are installed at a lower level than the condensate main, so that the condensate has to be lifted. If the service pressure in the condensate system is high enough, the condensate line to the heat exchangers can also be installed so that it rises constantly, to prevent sudden changes in height.

If there are jumps of more than 7 metres, we recommend the use of condensate dampening pots (type ED) to prevent waterhammer. These provide a cushioning effect to neutralize waterhammer. If the service pressure in the condensate system is not sufficient to transport the condensate back to the boiler house, condensate return systems are needed.

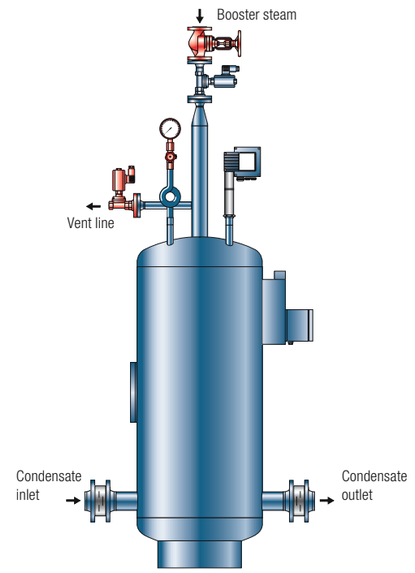
GESTRA condensate tanks collect the condensate flowing into them from the steam users or a flash vessel. Booster steam is used for level-dependent transport of the condensate from the condensate tank to the feedwater tank, either via a steam-powered condensate return unit (type FPS or KH) or by means of condensate pumps.

GESTRA Steam-Operated Condensate Return Systems

Condensate return units of the type FPS do not require electrically-driven pumps to push the condensate to the main condensate tank, because they are powered by booster steam. The FPS units are designed for condensate flowrates up to 6 t/h and a max. service pressure of 13 bar. They are fitted with the corresponding non-return valves and supplied completely mounted and interconnected with counter-flanges, bolts and gaskets.



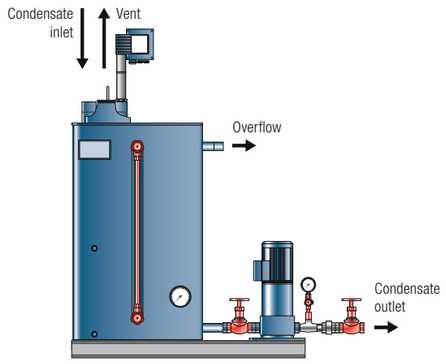
Steam-powered condensate return systems of the type KH are designed for condensate flowrates up to 10 t/h and a max. service pressure of 13 bar. These condensate return systems are fitted with the corresponding valves, pressure gauge assembly, solenoid valves for vent line and booster-steam feed, level probe for automatic control of the return system and non-return valves, and are supplied completely mounted and interconnected with counter-flanges, bolts and gaskets.



GESTRA Open-Type Condensate Recovery and Return Systems

Rectangular condensate tanks of the standard type SDR are designed for condensate flow-rates up to 10 t/h and a max. service pressure of 0.1 bar.

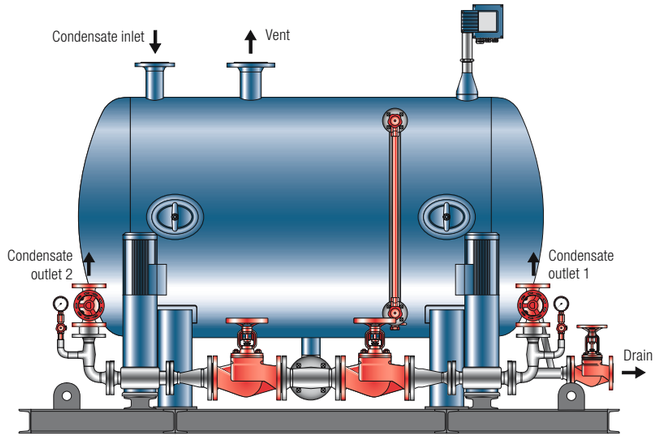
The condensate tanks are equipped with two externally mounted condensate pumps, bimetal dial thermometer, water level indicator, GESTRA level control equipment and level electrodes for automatic pump operation, non-return valves, isolating valves, high-pressure centrifugal pumps and pressure gauge. They are supplied completely mounted and interconnected, together with the control cabinet for pump control.



Open cylindrical condensate tank, type SDL/SDS

Cylindrical main condensate tanks of the standard type are designed for condensate flowrates up to 30 t/h and a max. service pressure of 0.5 bar. Higher flowrates are available on request.

The condensate tank is supplied either as a horizontal or vertical type. It is equipped with two externally mounted condensate pumps, bimetal dial thermometer, water level indicator, GESTRA level control equipment and level electrodes for automatic pump operation, non-return valves, isolating valves, high-pressure centrifugal pumps and pressure gauge. The tanks are supplied completely mounted and interconnected, together with the control cabinet for pump control.

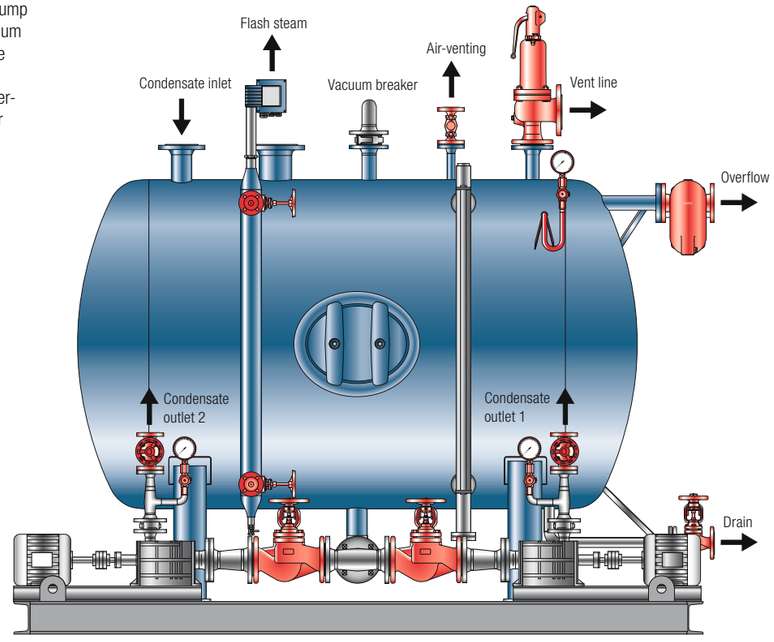


GESTRA Closed-Type Condensate Recovery and Return Systems

Closed cylindrical condensate tank, type SDL/SDS

Cylindrical main condensate tanks of the standard type are designed for condensate flowrates up to 30 t/h and a max. service pressure of 4 bar. Higher pressures and flowrates are available on request.

The tank is supplied either as a horizontal or vertical type. It is equipped with two externally mounted condensate pumps, bimetal dial thermo-meter, water level indicator, GESTRA level control equipment and level electrodes for automatic pump operation, non-return valves, safety valve, vacuum breaker, air vent, isolating valves, high-pressure centrifugal pumps and pressure gauge. The tanks are supplied completely mounted and inter-connected, together with the control cabinet for pump control.



Quality Steam – Made by GESTRA

In modern plants involving process technology, increasingly stringent requirements are being made of the properties of the steam as an energy carrier for the process. In this connection, one speaks of the steam quality.

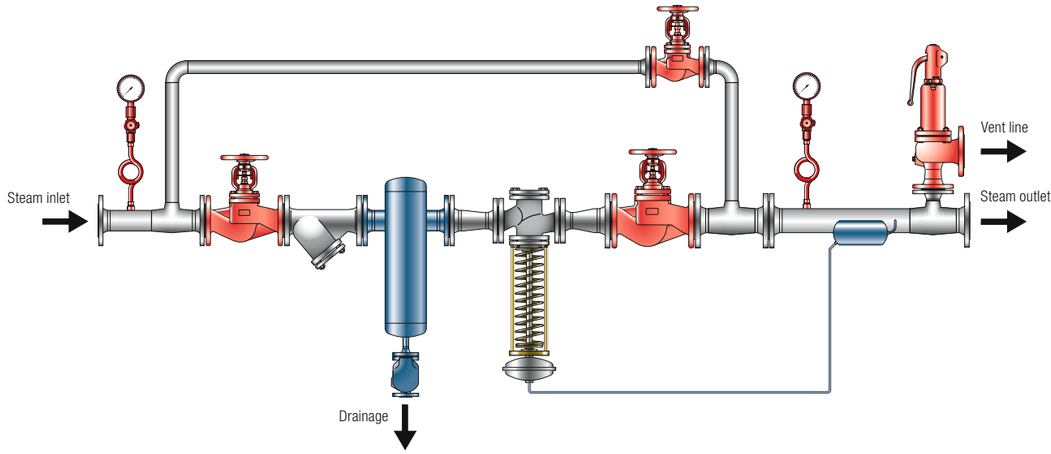
A few examples from practice:

- In hospitals, a control accuracy of ±100 mbar is demanded with sudden consumption by the sterilizers.
- With the operation of steam turbines, a residual moisture for the steam of < 1 % must be gua ranteed.
- In many areas of the textile industry, the steam temperature must be maintained with high pre cision. A deviation of only 1 Kelvin can mean that the colours are no longer clear and the goods must be discarded.

With compact pressure-reducing stations as well as pressure-reducing and cooling units for superheated steam, GESTRA is able to offer an optimum solution to cover most requirements. Depending on the demands, the steam pressure reductions can be achieved through self-acting pressure-reducing valves without auxiliary energy, or through electrical, pneumatic or electro-pneumatic control valves.

GESTRA steam driers ensure that the steam arrives at the user with a residual moisture much lower than 1 %. In GESTRA desuperheaters, the required steam temperature is obtained through the addition of cooling water. Here the diverse requirements decide whether the water-bath desuperheater type KD or injection coolers by the company Haschke & Wendt are used.

GESTRA Pressure-Reducing Stations



In steam systems, a number of different steam pressures are often needed to supply the various users with the steam pressure required in each case. Because it is frequently important to keep the corresponding steam pressure constant, pressure-reducing stations are used.

There are diverse ways of reducing the steam pressure. The simplest possibility is to use a self-acting pressure reducer operating without auxiliary power. The pressure-reducing units are balanced, single-seated valves functioning as proportional controllers that do not need energy from outside. Self-acting pressure reducers can only be used in certain applications: when supercritical pressure gradients have be overcome; when large flowrate fluctuations can occur; when very high demands are made of the accuracy of the secondary pressure; or when the sound pressure level of the valve presents a problem. Electrical, pneumatic or electro-pneumatic pressure reducers are then used to meet these elevated requirements.

The self-acting (mechanical) reduction of steam pressure functions as follows:

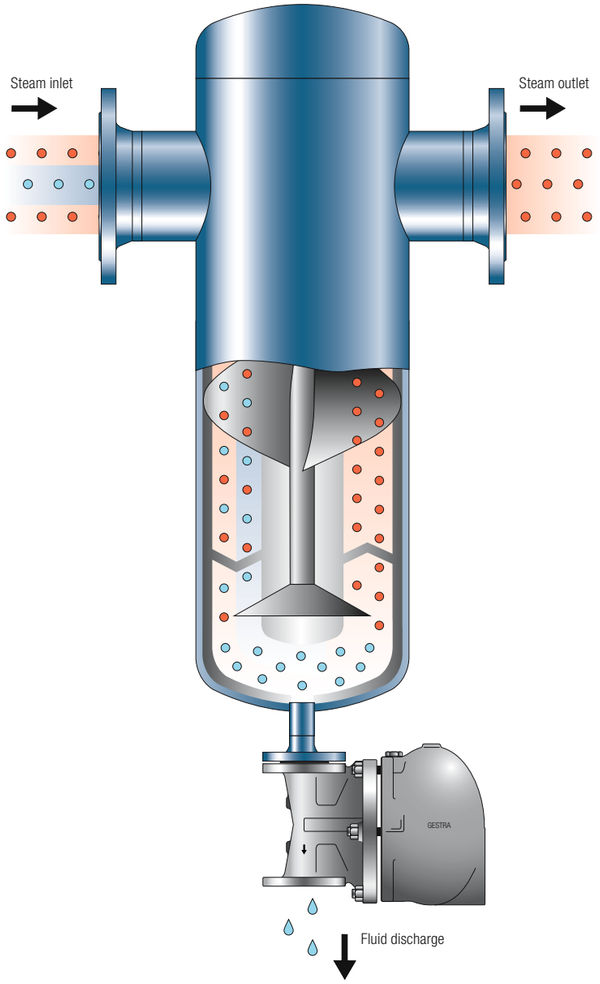
When the fluid flows through the valve, a pressure drop is produced, leading to a reduced pressure downstream of the valve. This pressure level is transmitted into the diaphragm chamber via a pilot line and acts on the actuating membranes. The force produced by the diaphragm opposes the force of the spring. As long as the two forces are balanced, the valve cone remains in position. Deviations in downstream pressure move the cone until the two force are again in equilibrium. The required reduced pressure is set by adjusting a handwheel. The spindle is sealed by a metal bellows which also balances the upstream pressure.

GESTRA Steam Driers

Moisture and impurities in the steam are a cause of increased wear in steam systems. These may consist of water or dirt particles.

GESTRA steam driers remove moisture and impurities from the steam line, thus extending the service life of control valves, heat exchangers and other steam users, and also increasing the reliability of the entire plant.

GESTRA steam driers have no moving parts. The guide element, a two-start helix, is permanently mounted in the body. The wet, unpurified steam enters the drier and flows down the guide element in a spiral motion. The resulting centrifugal forces separate out the particles with a heavier specific gravity. In the lower section of the steam drier, the steam flow is deflected by 180 degrees, which provides an additional separation effect. The dirt particles flow into the lower sump of the steam drier and are discharged via a float trap type UNA.



GESTRA Air Driers and Purifiers

GESTRA air driers and purifiers are used for the drying and cleaning of compressed air and gases by mechanical separation of liquids, mists and dirt particles.

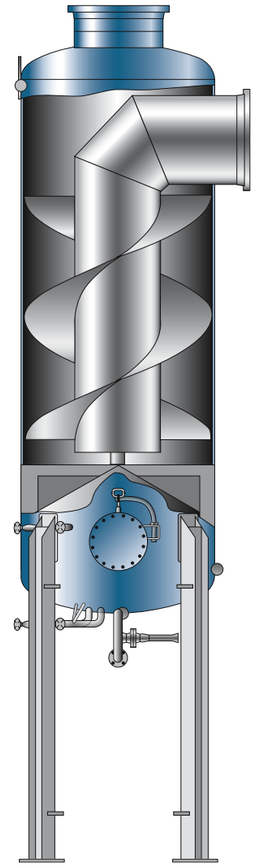
They are installed in pipelines immediately downstream of the aftercoolers of compressors or upstream of the first air distributor, in compressed-air ring lines, in branch lines leading to special separators (such as water adsorbers or oil adsorbers), or immediately upstream of the compressed-air user (compressed-air tool).

The air drier/purifier can either dry and clean the air simultaneously, or act solely as air drier or as air purifier. It has a very high separation effect, requires no maintenance and needs little space.

The wet, unpurified air or gas enters the drier, flows down the guide element in a spiral motion and, after a rotation through 180° above the sump-covering plate, passes to the outlet. The resulting centrifugal forces, as well as the impact and swirling effects, separate the particles with a heavier specific gravity (such as liquids, moisture in suspension, dirt, scale etc.) from the lighter fluid air or gas. The separated particles are deposited in the sump. The abrupt rotation of the gas flow from one passage of the helix to the other prevents the particles from being carried back in the gas flow.

GESTRA steam/air driers are available for a wide range of applications. A practical example:

- Process steam (low-pressure steam) is used in turbines to drive air compressors. The low steam pressures occurring in some cases, also with large quantities of steam, necessitate structures with diameters exceeding 3 m and with heights of more 11 m. Here too, GESTRA employs the highly effective cyclone separation with special internals and proven drainage techniques using float traps or electrically controlled systems.



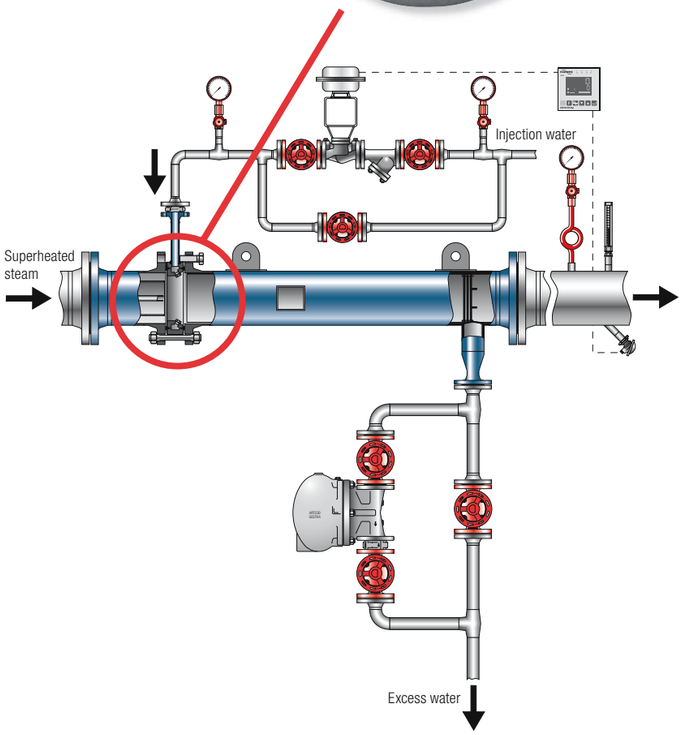
GESTRA Desuperheating Plants

Injection

Coolers (Haschke & Wendt System)
GESTRA injection coolers are used wherever there is a need for desuperheating without having to reach the saturation temperature.

Cooling takes place through direct spraying of water. The desired steam temperature or required quantity of cooling water (condensate) is set by means of a temperature-controlled condensate injection valve, the temperature sensor of which is arranged downstream of the cooler and obliquely to the flow. The atomization process is performed by fine nozzles producing very small droplets.

Depending on the required volume flow of injection water, the cooler is provided with one or two cooling stages. The special arrangement of the nozzles and internal parts of the cooler permit optimum mixing of the nebulized water in the steam, so that the desired steam temperature is obtained within the subsequent tube section. An inner protection pipe in the tube section eliminates the danger of thermal shock and the resulting stress cracks in the steam line. Excess water is discharged through special parts at the end of the tube section through a drainage point. This ensures that dry steam is available at the outlet of the injection cooler.



GESTRA Water-Bath Desuperheaters

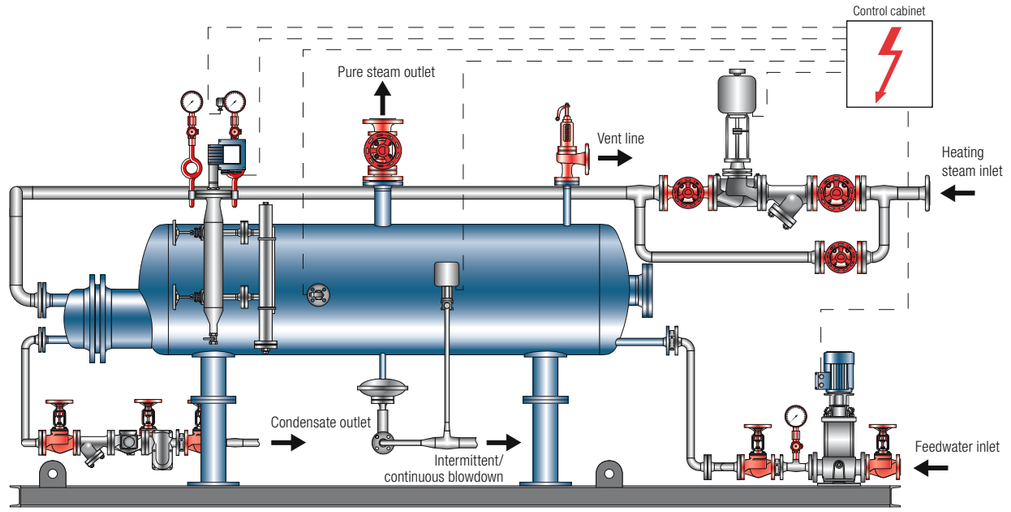
The desuperheater KD 13 consists of a vessel with built-in nozzle arrangement for injecting and cooling superheated steam in a water bath. It is suitable for all applications where an effective conversion of superheated steam into saturated steam is required. The desuperheater is available for various operating loads as the vertical type KDS 13 or horizontal type KDL 13. They are custom-designed for each application and meet the essential thermodynamic requirements to achieve optimal performance.

Superheated steam at a maximum temperature of 400 °C is introduced into a controlled system and injected through a nozzle into a water bath, where it is cooled down to the temperature of the saturated steam. In passing through the water, the superheat energy of the steam is given up to the cooling water, with some of the cooling water being vaporized and entrained as saturated steam. The steam content after the cooling process is 98 %. The desuperheater features an integral water separator that prevents the cooling water from being carried along into the steam line during peak loads. The level electrode NRG or NRGT detects the cooling water level and an electronic control unit ensures that the vaporized cooling water is replaced by make-up water. The cooling water at the required upstream pressure is fed into the lower part of the desuperheater via a control valve or a solenoid valve. If the temperature of the steam is very high, the cooling water must be heated up beforehand. The water-bath desuperheater is the only steam cooling system that supplies saturated steam over a control range of 0 – 100 %.

GESTRA Steam Regenerators

The GESTRA steam regenerators supply process steam as pure steam containing no contaminants that may be detrimental to health, such as hydrazine or ammonia. For technical reasons, such substances must be added to the boiler feedwater during normal boiler operation. They are steam-soluble and will therefore also be present in process steam. Pure steam is necessary for the operation of sterilizing equipment in hospitals, for steaming and drying chambers in the foodstuff industry, and wherever it is important to ensure that the process steam is absolutely free of attendant substances that are noxious, chemically reactive or impair the taste.

GESTRA steam regenerators are available in compact designs as horizontal or vertical units, completely equipped.



The GESTRA steam regenerator as the horizontal version consists of a cylindrical vessel; a heating tube bundle with head is installed in the lower part through a standpipe. The heating medium (steam, pressurized hot-water or thermal oil) flows through a control valve into the tube bundle, where it transfers its thermal energy to the water surrounding the tube bundle. Depending on the quantity of heat applied, the water evaporates and can be extracted via steam-separating internals. If the accuracy of the steam pressure is not a critical factor, then a self-acting pressure regulator may be used.

On the secondary side, the GESTRA steam regenerator is protected by a safety valve. The condensate formed in the tube bundle is discharged by a GESTRA float trap type UNA. The feedwater evaporating during the production of pure steam is made up continuously by a feedwater supply control. For this purpose, GESTRA is able to supply suitable components from its product range for process control.

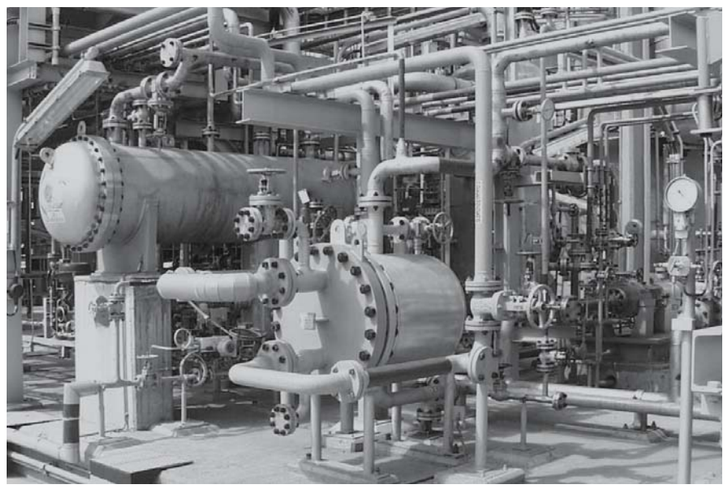
As a result of the continuous evaporation process and feedwater make-up, the concentration of salts dissolved in the boiler water increases steadily, even if the feedwater is partially desalinated. If there is a high steam demand, the permissible limit for the salt content may be exceeded after only a few hours. For this reason, the steam regenerator must be fitted with a continuous and intermittent blowdown unit operating automatically. For this special application, the GESTRA product range for process control offers proven conductivity electrodes, continuous blowdown controllers, automatic continuous blowdown valves, program-controlled intermittent blowdown units, and automatic intermittent blowdown valves. Only in this way can it be ensured that pure steam of the very highest quality can be produced with the use of demineralized feedwater and a continuously controlled continuous blowdown. In this way, it is also possible to prevent the dangerous salt concentration and sludge formation that may lead to corrosion in the steam regenerator.

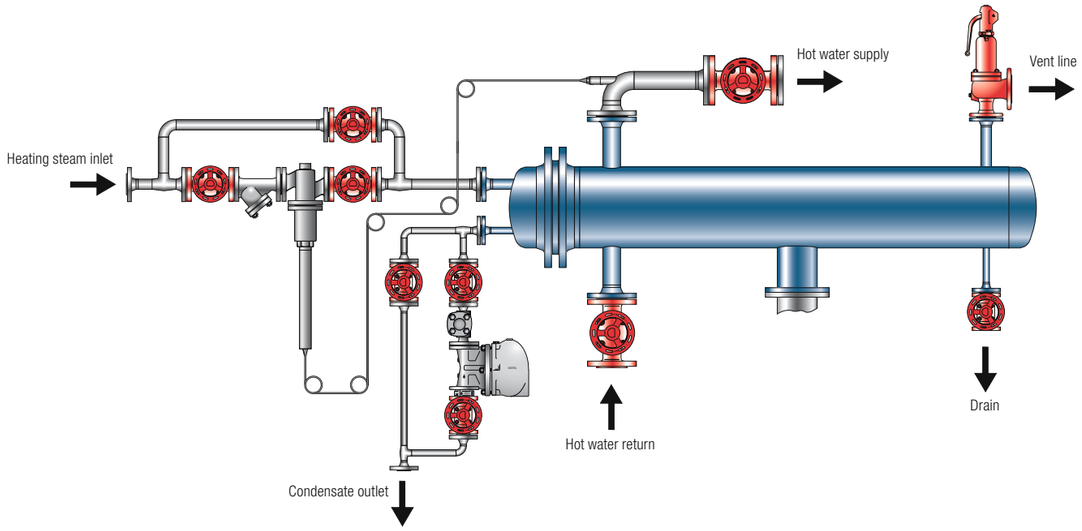
GESTRA Heat Exchangers

Heat exchangers are available in various designs. Apart from the classic tube-bundle heat exchanger as horizontal or vertical versions, plate-type heat exchangers as bolted and welded types are also used in steam and condensate systems.

Heat exchangers can be manufactured from a wide range of materials to suit the requirements.

Applications for heat exchangers include steam-heated heat exchangers for production purposes or for the heating of buildings. Furthermore, a wide variety of applications are to be found in the area of heat recovery. Here heat exchangers can be used as residual blowdown coolers, flash steam coolers or as economizers.





GESTRA offers various system solutions for the control of heat exchangers. Control on the steam side can take place by self-acting temperature regulators (Clorius system), or controllers with electrical, pneumatic or electro-pneumatic actuation. For building-heating systems, heat exchangers with electrical controllers are frequently used on the condensate side.

In addition, diverse requirements are posed by the customer in respect of e.g. control accuracy or speed of the systems, for which GESTRA process control is able to offer customized complete solutions.

The diagram shows a horizontal GESTRA heat exchanger with steam-side control. In this example, the heating steam is controlled by a self-acting temperature regulator of the type Clorius. Depending on the requirements with regard to the safety technology, these temperature regulators can also be fitted with a self-monitoring temperature limiter. During start-up operation or fluctuating operational conditions, it is necessary to prevent waterhammer. For this, it is necessary to discharge the condensate without any banking-up. To ensure that this is possible, GESTRA uses the float trap type UNA. The other valves shown also belong to the GESTRA product range and round off the scope of supply.

GESTRA Mixing Coolers VDM

Mixing coolers (a type of blowdown receiver) serve to cool hot waste water that can no longer be used for heat recovery and is therefore discharged into a pit or drain.

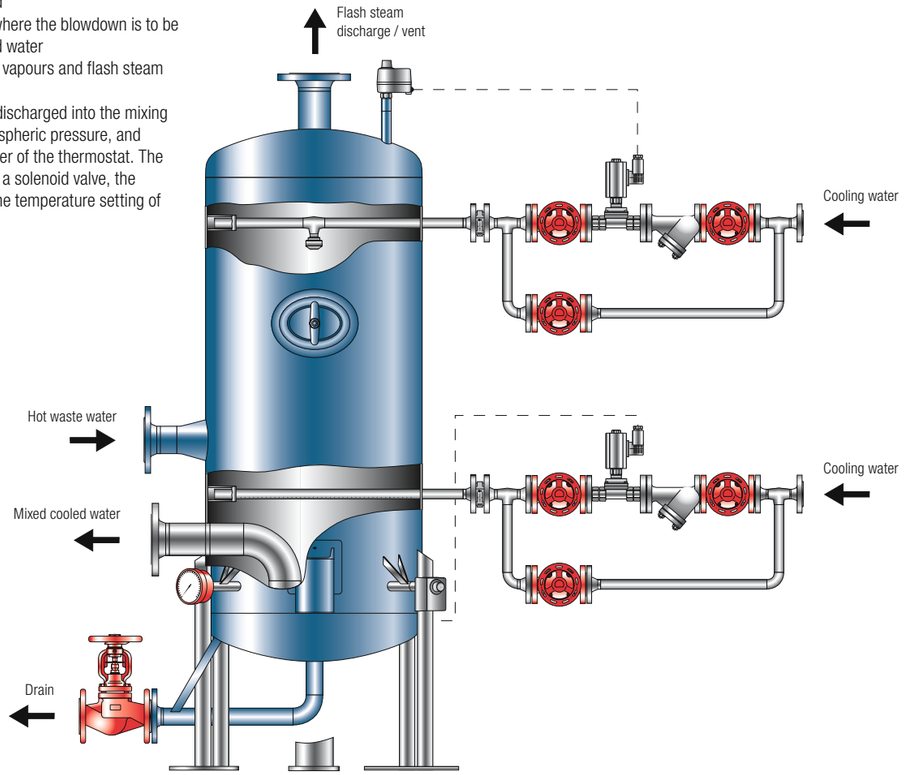
Typical applications for mixing coolers are, for example:

- Process plants where contaminated, hot waste water is being formed
- Steam boiler plants where the blowdown is to be cooled with untreated water
- Mixing condenser for vapours and flash steam

The hot waste water is discharged into the mixing cooler, which is at atmospheric pressure, and passes over the rod feeler of the thermostat. The cooling water enters via a solenoid valve, the amount depending on the temperature setting of the thermostat.

If the waste water is discharged from a system under pressure with a temperature above 100 °C – as is the case for boiler blowdown – flash steam is formed.

If the flash steam can neither be recovered nor discharged to atmosphere (because of the inconvenience caused by the condensing steam), it can be condensed inside the mixing cooler; this is performed by a second cooling-water spray nozzle.

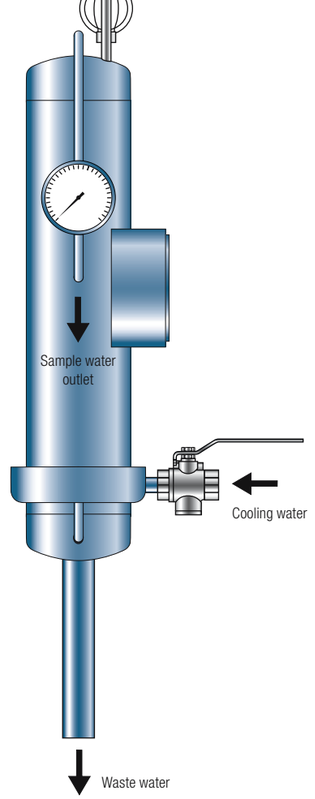


GESTRA Sample Coolers

Sampling is of special importance for the operation of steam boilers. However, proper and uncorrupted analysis values require the right sampling procedure and testing instruments that function correctly.

Direct sampling of hot boiler water from pressurized lines always involves the danger of scalding and inevitably leads to false values for the analysis result. Flashing losses within the sampling line or in the sample container cause an increase in the density of the boiler water sample; the samples therefore do not represent the true TDS content (salinity). Flashing losses within the sampling line or in the sample container cause an increase in the density of the boiler water sample; corruption of the analysis result is thus unavoidable.

The perfect solution is to use the GESTRA sample cooler PK. The boiler water sample is cooled down to the reference temperature of 25 °C and thus fulfils the basic requirements for precise water analysis.

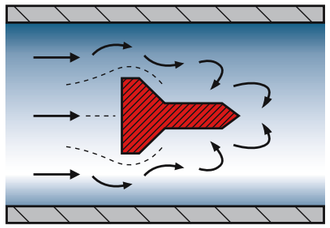


GESTRA Steam Flow Measurement

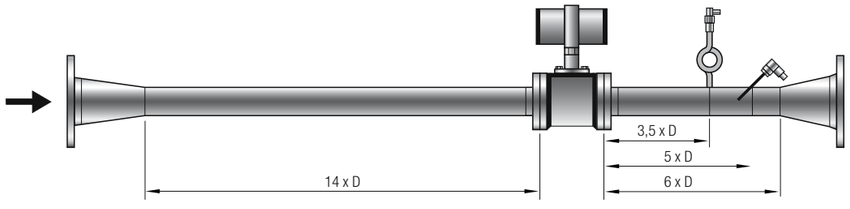
The design is based on the Kármán vortex street principle using a body installed perpendicular to the axis of the pipe. Eddies are shed continuously from either side of the body, forming rows of vortices in its wake. The alternate shedding of vortices creates periodic lateral forces on the body and causes the baffle located in the vortex stream to vibrate. An advantage of the vortex shedder is that it produces a low pressure loss in relation to other measurement principles. The pressure oscillations are transformed into electrical signals by a sensor and converted into a standard output signal, which is then evaluated in the flow computer.

The measurement system is very reliable, since it does not have any moving parts. What is more, the sensor is not in direct contact with the process fluid. At 1 % of the actual measurement value, the measurement accuracy is very high. In addition, the system is very easy to install and put into operation.

The GESTRA steam flow measurement package includes all the components needed for a measuring point. A vortex flow meter is used as the measuring transducer. The measurement signal is evaluated by a microprocessor-controlled flow computer and, in the event of fluctuating steam conditions, compensation can be applied with the aid of a resistance thermometer and a pressure transmitter.



Vortex body with integrated baffle



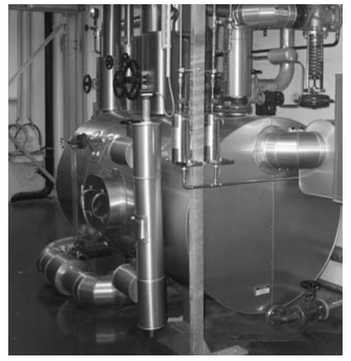
GESTRA Compact Systems

GESTRA equipment and vessels are also available as package solutions with all the necessary accessories.

For further optimization of the heat recovery equipment, GESTRA AG also offers control systems that are already adapted to the corresponding application. With these complete solutions, the customer only needs to connect the supply and discharge lines and to carry out the controller parametrization.

To uphold our high quality standard, we use the same sensors for the heat recovery equipment as for the boiler plants. Here too, we apply only proven technology and make no compromises.

For the controls, we have developed a suite of customized solutions over the years. These are offered with autonomous control units or with complete PLCs (Programmable Logic Controllers) of the type S7300. In plants with a complex structure, it is often very useful to visualize the actual values dynamically in a mimic diagram. The possibility of data transfer (Profibus DP) to the central control room is another benefit. Thanks to this comprehensive concept of heat recovery equipment plus control technology, we unite the wide-ranging know-how of our process and software engineers.



GESTRA Service

As an international leader in the manufacture of valves, traps and control technology for the steam and energy industry, GESTRA offers its customers many decades of experience and the technical service to match – giving you a decisive competitive advantage.

To make the GESTRA support even more direct and customer-specific, the technical service was developed further and subdivided into GESTRA valves and steam traps and GESTRA electronic equipment for steam boilers. This makes it possible for our customers to obtain rapid and effective assistance.

You too can benefit from this competence by calling on GESTRA. We will be happy to advise you.

FLOWSERVE GESTRA

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