



VIRA[®]

STEAM BOILER CONTROL SYSTEMS AND STEAM EQUIPMENTS

- Level Control Systems
- Blowdown Systems
- Condensate Contamination Control Systems
- Level Gauges

- Seperators
- Flash Steam Tanks
- Flow Meters
- Condensate Pump



Vira is an expert, dynamic and experienced company in the design and production of control systems and steam equipments. We offer a variety of products, complete systems, and smart solutions engineered to function with maximum reliability with a combination of our application experience, choosing the right products or systems, ongoing technical support, correct installation, and commissioning ability. Vira provides durable, high-quality control systems and steam equipments that are used in many different industries such as petrochemistry, food and beverage, textile, hotels, hospitals, pulp and paper, and pharmaceutical.

Vira control systems and steam equipments are used wherever steam is generated, distributed, or used. We make flow savings in energy are possible, and be always aware of our important role in environmental protection.

Our goal is to save energy, to help increasing the system efficiency and system reliability. We meet the expectations of our customers with our experience in the sector and focus on customers, we provide permanent value for our company with our talented personnel and expanding product range.

We aim to create a chain of people and institutions that will successfully represent our brand in the world. With this objective, we continue to expand by adding new institutions to our family in different countries.

Vira is intending to always follow the latest standards and meet the highest efficiency and safety in addition to fulfilling legal safety requirements.

As a company, we aim and pledge:

- ✓ To be an experienced and reliable business partner for our stakeholders
- ✓ To improve productivity, production volume and total profitability.
- ✓ To acquire, promote and retain highly qualified and multi-skilled employees
- ✓ To reduce maintenance and total energy costs
- ✓ To supply products, services and solutions that are leaders in the industry
- ✓ To shorten service effort and production time
- ✓ To reduce spare parts and inventory costs
- ✓ Throughout the value-added and supply chain, we insist that our products are manufactured with a desire to preserve resources, and are environmentally friendly and save energy during their subsequent use.
- ✓ We always act in compliance with the general legal conditions and consider these to be the minimum standard.

“Quality means doing it right when no one is looking”.

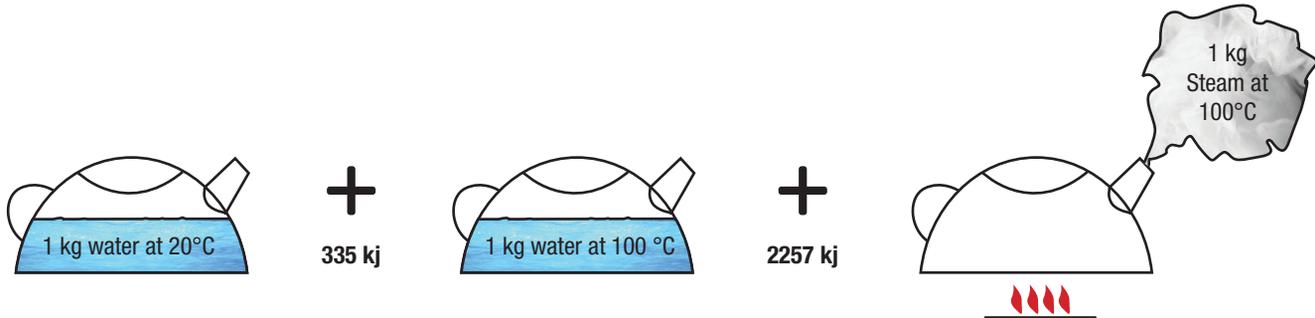
- Henry Ford

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What is Steam?	04
Steam Boiler Types.....	05
Steam Boiler Automation Systems	07
Steam Boiler Level Control	08
Water Level Control Type Selection	09
LEVEL CONTROL AND ALARM SYSTEMS	10
On-Off Level Control System	11
SK 2000 On-Off Level Control and Alarm System	12
SK-T 2400 Compact On-Off Level Control and Alarm System	14
Modulating Level Control System	16
SK 3000 Modulating Level Control and Alarm System	17
SD-AY 420A Capacitive Level Transmitter.....	21
Self Monitoring Level Alarm System	22
SMH-H 1000 and SML-H 1000 High Pressure Self Monitoring Level Alarm Systems	23
SMH 1000 and SML 1000 Self Monitoring Level Alarm Systems	24
SK 1000 Level Alarm Systems	26
VMLG Magnetic Level Gauge.....	28
VRLG Reflex Level Gauge	29
AUTOMATIC BLOWDOWN SYSTEMS	30
Boiler Blowdown	31
Automatic TDS Blowdown System	32
BS4-T and BS4 Automatic TDS Blowdown Systems.....	33
Automatic Continuous Blowdown Valve	34
BS3-T Condensate Contamination Control System	35
NK 20 Sample Cooler	36
Automatic Bottom Blowdown System.....	37
DB2 Automatic Bottom Blowdown System.....	38
STEAM EQUIPMENTS	39
Separator	40
Steam Separator	41
Flash Steam.....	42
VFS Flash Steam Tank	43
VXW Vortex Flow Meter	44
Condensate Pump	46
Vira Float Free Condensate Pump.....	47
72h Operation Without Constant Supervision	48
Steam Pipe Sizing Table	50
Saturated Steam Tablo.....	51

WHAT IS STEAM?

Steam is the gaseous state of water. When water is heated and reaches a certain temperature, it becomes a state where it can no longer remain liquid. This state is called saturation point. The saturation temperature of the water at 1 bar absolute pressure is 100 °C. Giving heat to water at this pressure does not change the temperature of the water. This heat turns water into steam. This steam obtained is called saturated steam. When the saturated steam is raised above its own temperature, superheated steam is obtained.



Steam is an ideal fluid to carry energy. For this reason, it is widely used in many areas. Main usage areas of steam can be specified as industrial facilities such as textile, paper, chemical, pharmaceutical, beverage, tea and milk factories, power plants and heating systems.

Why Steam?

- Access to high temperatures at high pressures.
- Large heat loads can be transported by small volumes.
- Temperature is constant in heat transfer surfaces.
- Temperature control can be done precisely.
- No need for circulation pump. It can reach desired places with its own pressure.
- Steam is more advantageous in terms of heat capacity and heat transfer coefficient compared to other fluids.
- Steam is a clean and hygienic energy carrier. It is environmentally friendly.

Steam Generation

Steam used in the industry is produced in devices called steam boilers. A steam boiler is a pressurized vessel in which solid, liquid or gas is burned and electrical or nuclear energy sources are used in order to obtain steam at the desired temperature and pressure from the water inside.

Boiler Types

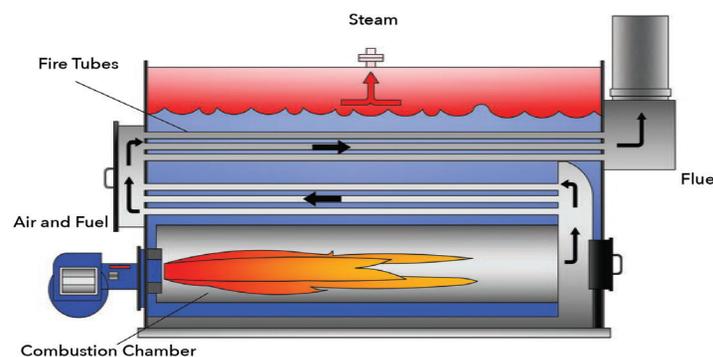
Steam boilers are classified in many different ways according to the place of use, boiler pressure, type of furnace, type of fuel used and construction. However, the two most suitable types in industrial facilities according to their structure; fire tube and water tube boilers.

1- Fire Tube Boilers

Fire tube boilers are typically designed with cylindrical body and horizontal pipes, taking into account the EN 12953 standard. In this type of boiler, the combustion process is carried out in the cell called "combustion chamber". The gases released as a result of burning pass through the smoke pipes in the boiler and transfer the energy to the boiler water.

Fire tube boilers are generally characterized according to the number of passes. The number of passes is taken into account while the combustion gases provide heat transfer to water throughout the boiler. With each pass, it is aimed to transfer the maximum energy from the flue gas to the water until it leaves the boiler by directing the flue gases in opposite directions within the pipes.

Boilers with fire tubes contain large amounts of water, so they need longer time to meet the initial evaporation and steam pressure changes. However, they can easily respond to small pressure and load changes. At the same time, fire tube boilers, which have a large surface area, produce the steam in the body parts, so the amount of pressure they can produce is limited. They are generally produced up to a maximum operating pressure of 25 bar.

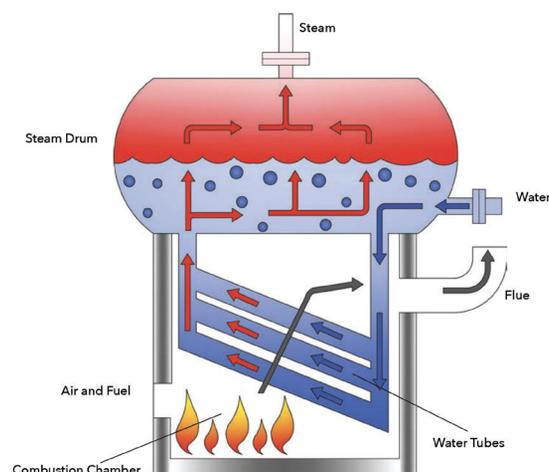


2- Water Tube Boilers

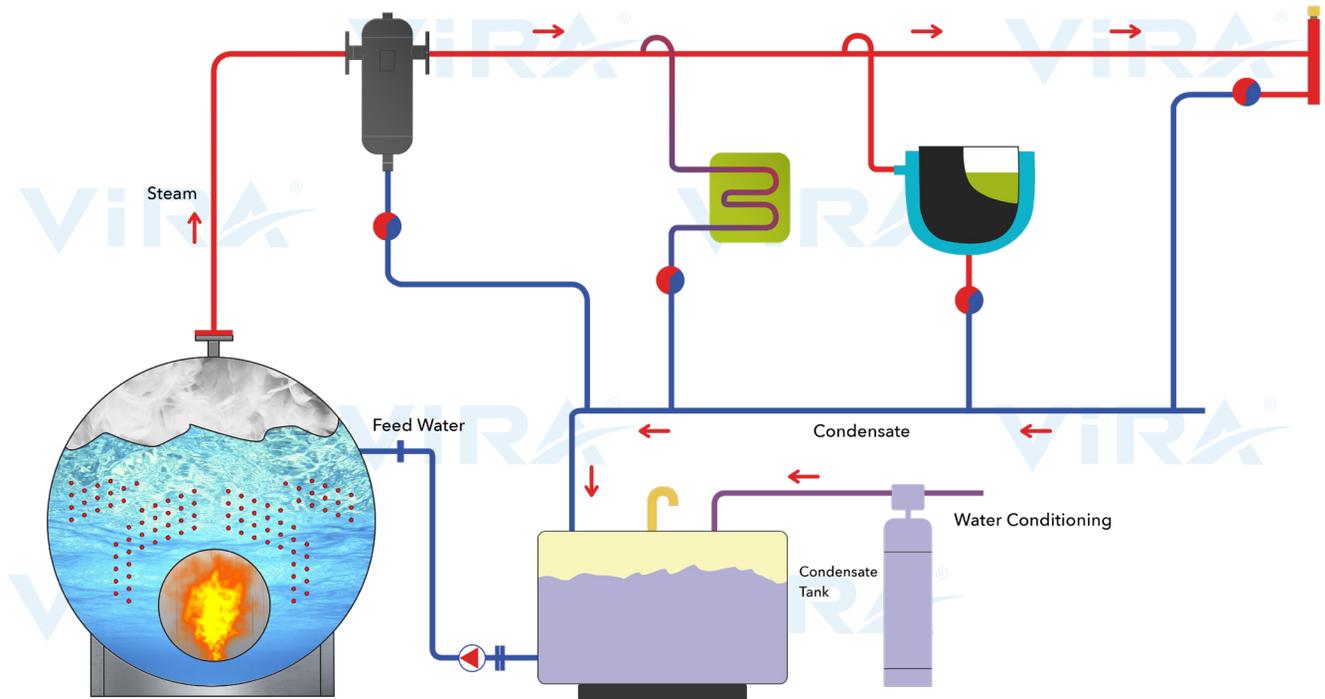
Water tube steam boilers are boilers in which water circulates and evaporates in the pipe. These are steam boilers developed and produced for businesses that need high steam capacity and high pressure. Water tube boilers are designed in accordance with the EN 12952 standard.

Boilers with water pipes are designed as membrane walls that are lined vertically between two drums and are sealed by welding with a plate. In the system, water evaporates in pipe sections and collects in the upper drum. In terms of security, the circulation of water in the pipes makes the system safer. Level controls of the boiler, feed water inlet, surface blowdown system, safety valves and necessary outlet flanges are located on the upper drum.

Since the amount of water contained in water tube boilers is low, they do not need a long time to meet the initial evaporation and vapor pressure changes. The difference of water tube boilers from fire tube boilers is that the boilers with low explosion risk are safer, but it is very important that water conditioning is well done during operation.



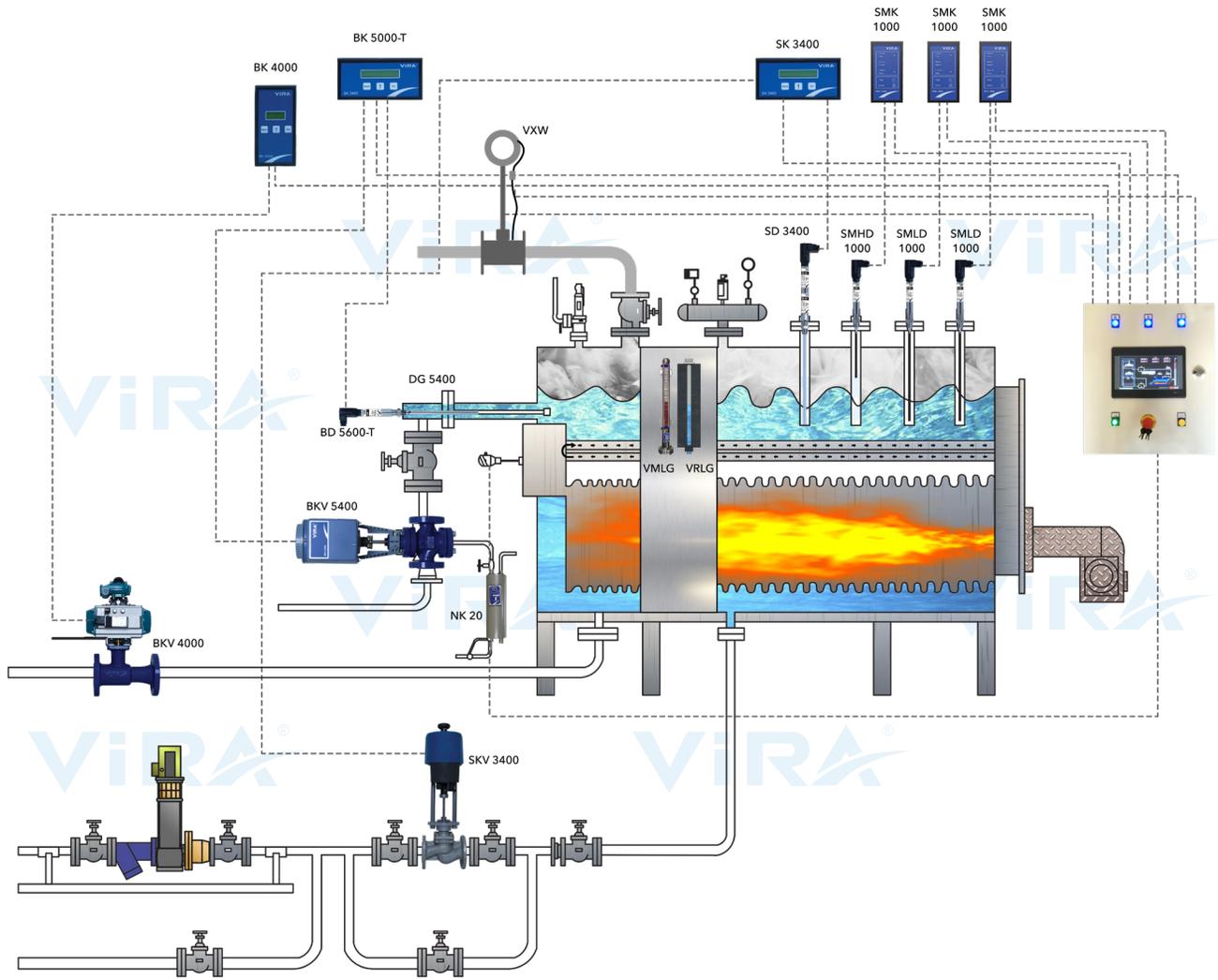
The steam produced in the boiler is transmitted to the places where the heat energy will be used by means of pipes. During this conduction, as soon as the steam leaves the boiler, it begins to give off some of its enthalpy from any low temperature surface. Starting with the main steam lines, heat conduction continues with small branches towards the devices using steam. By opening the valve at the entrance of a device that uses steam, it penetrates into the device through the steam distribution pipes and condenses, leaving the evaporation heat. The condensate is carried in the direction of flow towards the bottom of the pipe and is sent to the condensate tank to be returned by passing through the steam traps.



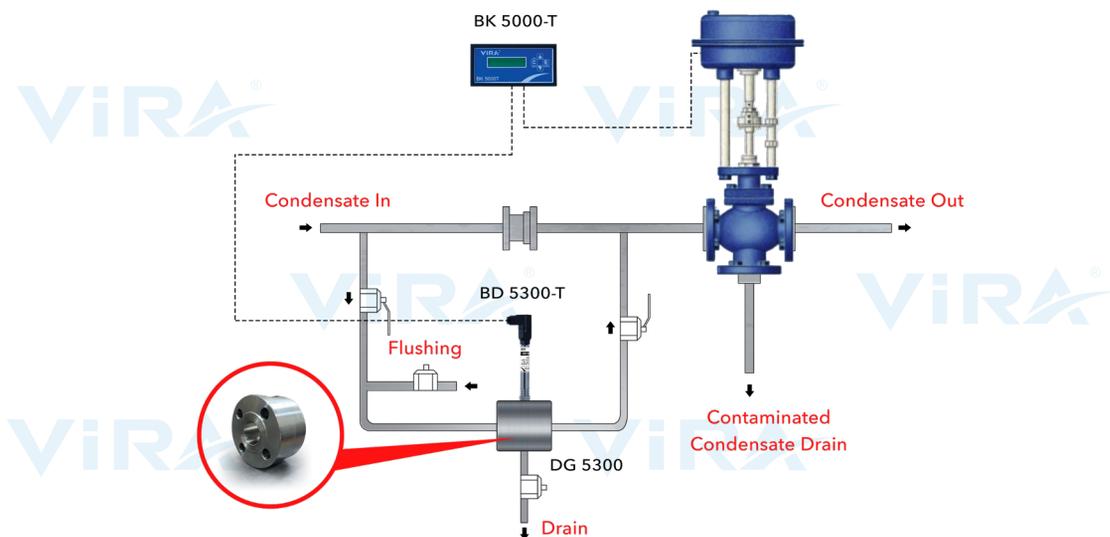
Where possible, the condensate is recycled for reuse and collected in the condensate tank. In addition to the boiler, if heated water is given instead of cold water, the amount of enthalpy required to bring the water to boiling point will decrease. As a result, the amount of fuel to be used for steam generation will be significantly reduced. The condensate formed in the steam lines and devices is a valuable water suitable for use as boiler feed water and should not be wasted.

Steam production must continue as long as processes need steam. For the continuity of this process, it should be added instead of the water that is lost and it is necessary to feed the boiler with fuel.

STEAM BOILER AUTOMATION SYSTEMS

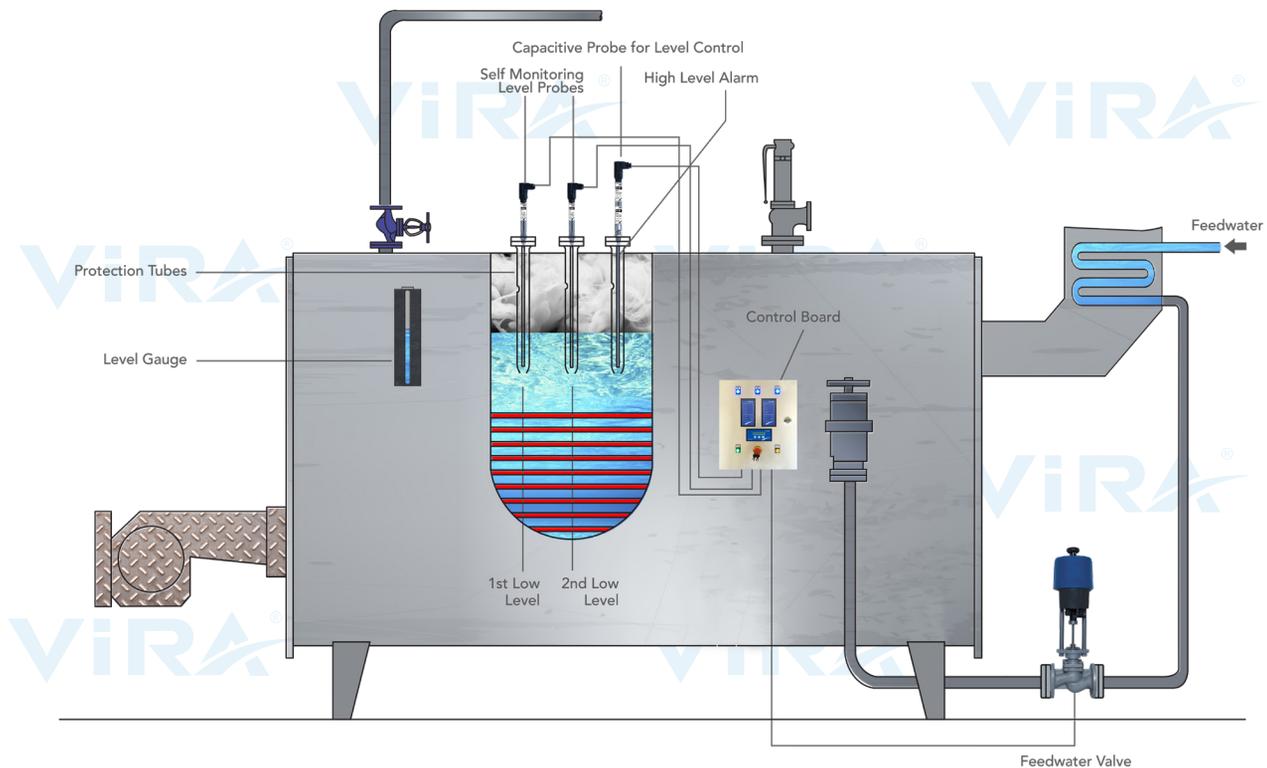


Condensate Monitoring



BOILER WATER LEVEL CONTROL

In steam boilers, the water level decreases with the convert of the water into steam and the decreasing water is completed by the operation of the boiler feedwater pump. Depending on the amount of steam produced in the steam boiler, since the water temperature entering the boiler is lower than the boiler temperature and due to changes in steam pressure, a constant fluctuation in the water level occurs. For the efficient and safe operation of boilers, the water level must always be checked. This check may include a sound or light alarm, shutting down the feedwater supply, and shutting down the burner. It is also essential to provide an outside drum level indicator such as magnetic or reflex level gauges.



High integrity, self-monitoring, modulating control system

Note: Level probes can be both installed in a protection tube or a level tube.

It is undesirable for the water to drop below the desired level in steam boilers. If it does, it can cause costly damage to the boilers and even fatal accidents. In case of low water level, check the following reasons.

Causes of Low Level

- Lack of feedwater
- Sudden load changes
- Feedwater pump failure
- Safety valve leaks
- Control valve malfunction
- Malfunction of boiler water level controller

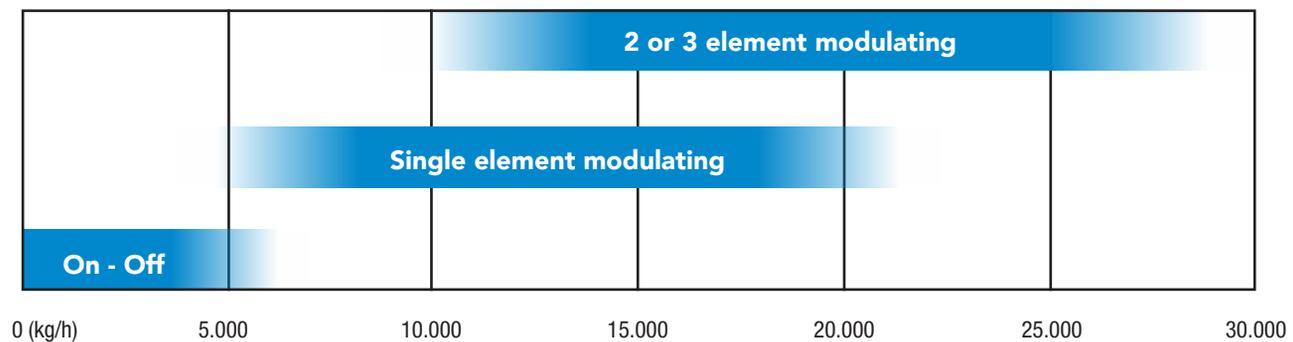
To ensure the safe operation of the boiler, all elements that affect the level control must be monitored and make sure they are working. In case of failure, the boiler operator must understand the cause of the problem and should take action most appropriately.

Boiler Water Level Control Systems

In steam boilers, feed water should be added instead of missing water during steam production. Automatic level control systems are applied in steam boilers produced with modern technology. Automatic feedwater control systems have two different applications: On / Off Level control and modulating level control.

Depending on the boiler capacity; On-Off level control system should be used for the boilers with the capacity up to 5000 kg/h. for the boiler with the capacity up to 15.000 kg/h single element modulating control and higher capacity than 15.000 kg/h 2 or 3 element modulating level control systems should be used.

- **Single Element Modulating** : Modulating level control system only
- **2 Element Modulating** : Modulating level control system, steam production amount measurement with modulating level control system and steam flow meter
- **3 Element Modulating** : Modulating level control system, steam production amount measurement with steam flow meter and feed water amount measurement for the boiler with water flow meter



It will not be correct to decide which level control system to use just by considering the boiler capacity. Knowing the steam consumption behavior of the system that the steam boiler serves is also an important criterion for choosing a level control system. On-off level control system will not be sufficient in a low-capacity system with sudden load changes.

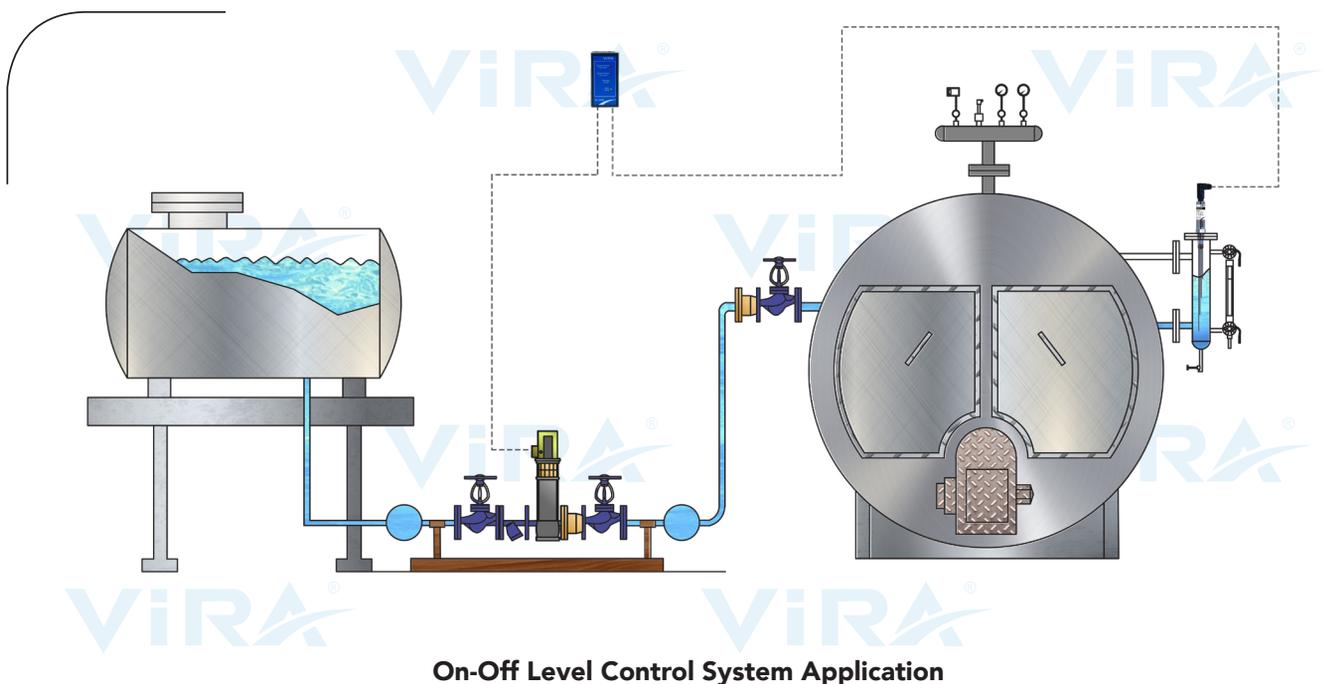
Another reason to use modulating level control system is energy efficiency. At high flow rates, adding cooler water instead of evaporating water will cause both energy loss and thermal stresses.

Therefore, adding water as much as the amount of steam consumption allows us to use steam continuously and efficiently as well as providing energy efficiency.

**LEVEL
CONTROL
AND ALARM
SYSTEMS**

On-Off Level Control System

On-Off Automatic Level control system consists of a conductivity probe and a controller. The feed water pump is started when the water level in the boiler reaches the specified lower level and is stopped when the water reaches the specified upper level. The working principle of the system is conductivity. The pump is allowed to start or stop depending on whether the electrodes are in contact with water.



For a safe operation, all steam boilers should have low and high level alarm systems. Additional high and low level alarms can be received from the On-Off level control system.

On-Off Level control and alarm system is used;

- In boilers with a capacity of 5,000 kg/h and less
- Where constant steam load and pressure are not critical
- In backup boilers
- Feed water tanks
- In condensate tanks

SK 2000

On-Off Level Control and Alarm System

On-Off Level and Alarm Controller

- Type** : SK 2400
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Enclosure** : Panel Mounting
- Function** : Pump On-Off, High Alarm, Low Alarm
- Output** : Pump On-Off Relay, Two Alarm Relay
- Max. Ambient Temp.** : 55 °C

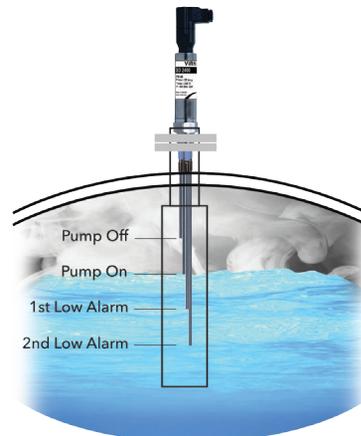
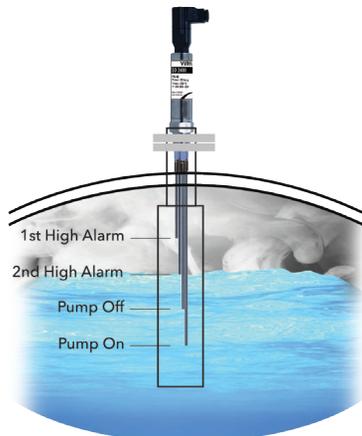
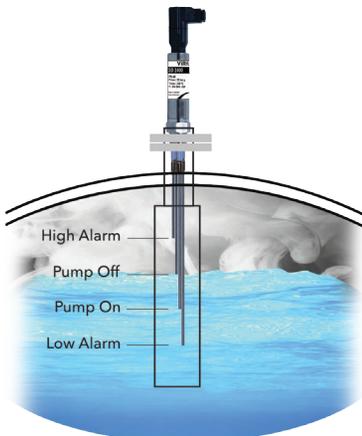


On-Off Level Control and Alarm Probe

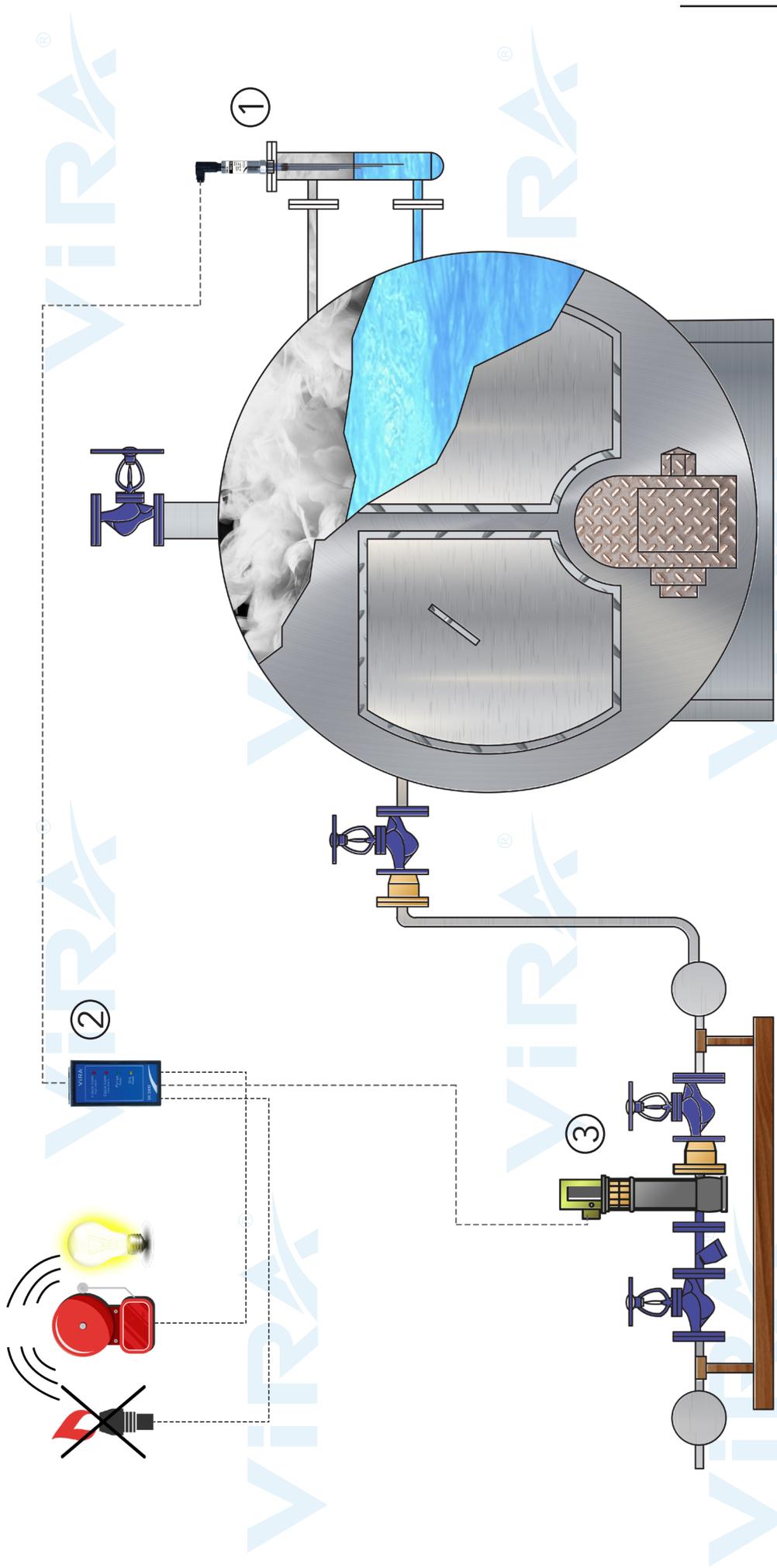
- Type** : SD 2400
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239 °C
- Max. Operat. Press.** : 32 Bar g
- Connection** : 1" BSP Screwed
- Length** : 500 - 1000 - 1500 mm
(Can be cut to desired level)
- Max. Ambient Temp.** : 70 °C



Application Examples



SK 2000 On-Off Level Control and Alarm System



- 1- Level Probe
- 2- Level Controller
- 3- Feed Water Pump

SK-T 2400

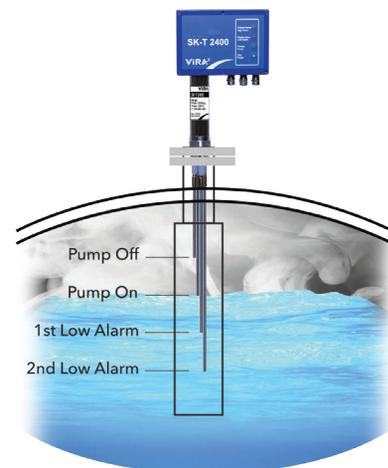
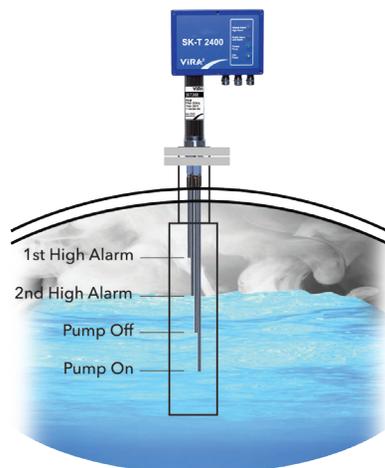
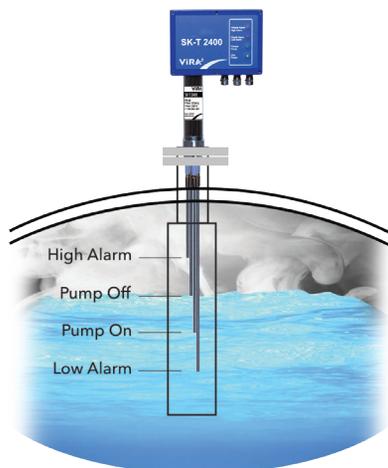
Compact On-Off Level Control and Alarm System

Compact On-Off Level Control and Alarm System

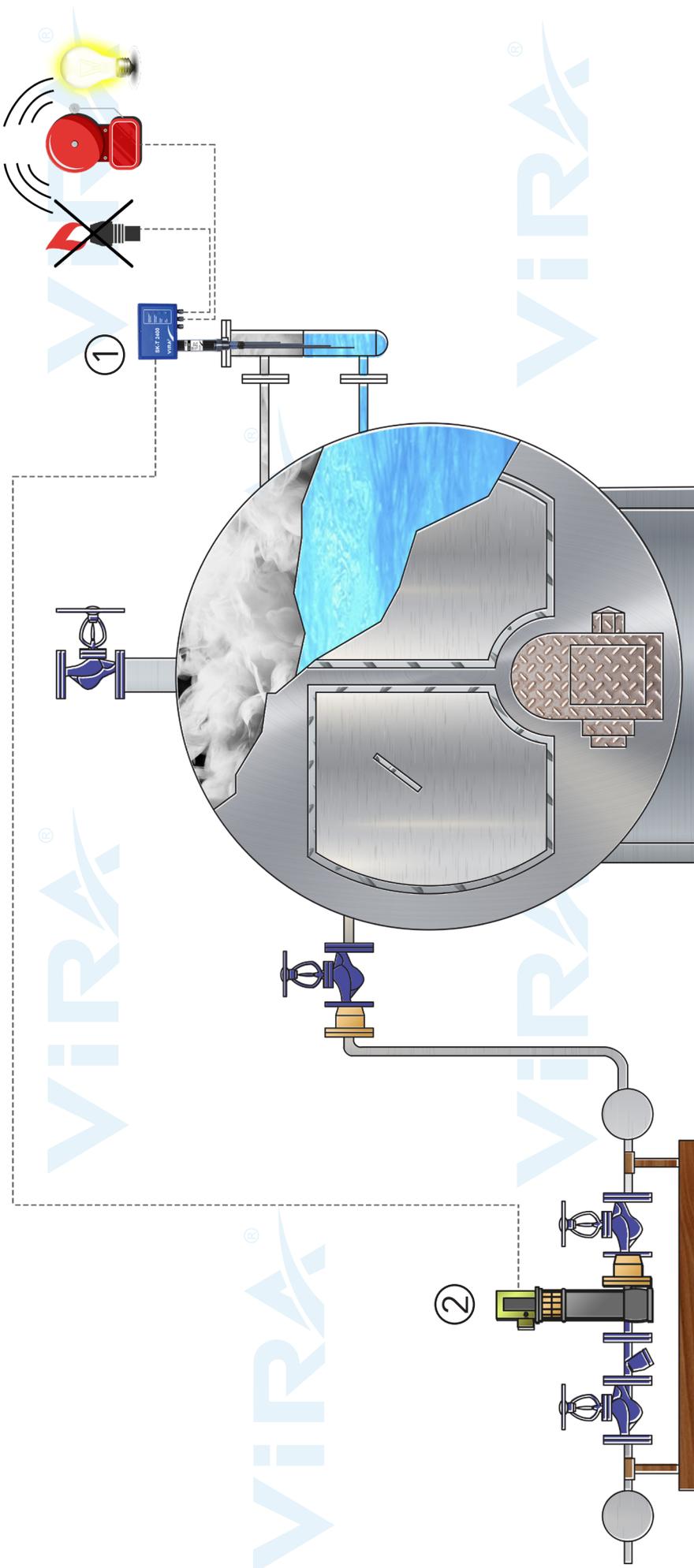
- Type** : SK-T 2400
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Function** : Pump On-Off, High Alarm, Low Alarm
- Output** : Pump On-Off Relay, Two Alarm Relay
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239 °C
- Max. Operat. Press.** : 32 Bar g
- Connection** : 1" BSP Screwed
- Length** : 500 - 1000 - 1500 mm
(Can be cut to desired level)
- Max. Ambient Temp.** : 70 °C



Application Examples



SK-T 2400 Compact On-Off Level Control and Alarm System

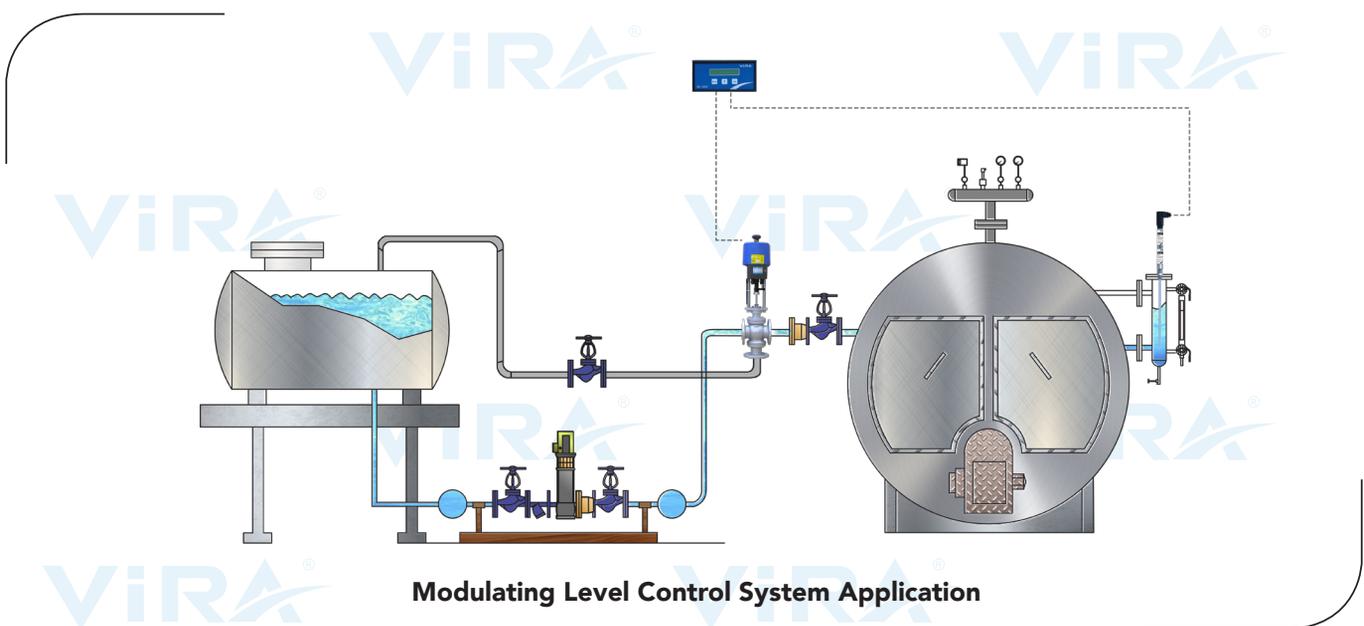


- 1- Compact On-Off Level Control and Alarm System
- 2- Feed Water Pump

MODULATING LEVEL CONTROL SYSTEM

Modulating level control system consists of a capacitive probe, a controller and a 2 or 3-way valve. The water level, which varies with the phase change of the water in the boiler, is determined by the capacitive level probe and is continuously compared with the previously set value by the level controller. In any determined deviation, it sends a signal to the feedwater valve in order to take the required feedwater amount into the boiler.

The probe used in the modulating level control system works according to the capacitance principle. Capacitance value is measured according to the amount of water. The controller opens and closes the proportional control valve through signals from the capacitive probe and the water level is kept at the desired level. Thus, the flow rate and pressure of the steam obtained are constant. It also has a low moisture content.



Note: The control valve may either be a 2-way or 3-way valve according to the user's application.

For a safe operation, all steam boilers should have low and high level alarm systems. Additional high and low level alarms can be received from the modulating level control system.

Modulating level control and alarm system can be used;

- Boilers with a capacity higher than 5.000 kg / h
- Where steam load and pressure are critical

SK 3000

Modulating Level Control System

Modulating Level Control System

- Type** : SK 3400
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Enclosure** : Panel Mounting
- Function** : Modulating Level Control, High Alarm, Low Alarm
- Output** : 4-20 mA Output, Low Alarm Relay, High Alarm Relay, Valve Control Relay
- Max. Ambient Temp.** : 55 °C

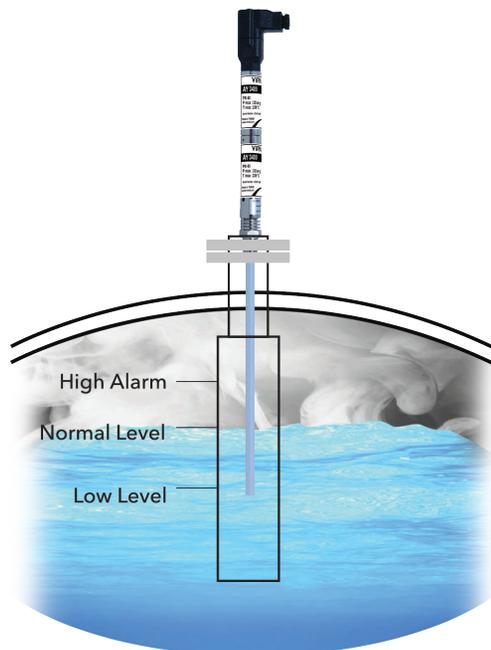


Modulating Level Control Probe

- Type** : SD 3400
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239 °C
- Max. Operat. Press.** : 32 Bar g
- Connection** : 1/2" BSP Screwed
- Length** : 300 - 1500 mm
(The length must be specified in the order.)
- Max. Ambient Temp.** : 70 °C



Application Example



SKV 3400

Modulating Level Control Valves

Modulating Level Control Valve 2-Way

Type	: SKV 3400 - 2
Enclosure	: IP 65
Sizes	: DN 15 to DN 300
Max. Operating Temp.	: 220 - 250 °C
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Max. Ambient Temp.	: 60 °C (Actuator)
Control Mode	: Floating Control
Pressure Class	: PN 16 - 25 - 40 ANSI 150 and ANSI 300



Modulating Level Control Valve 3-Way

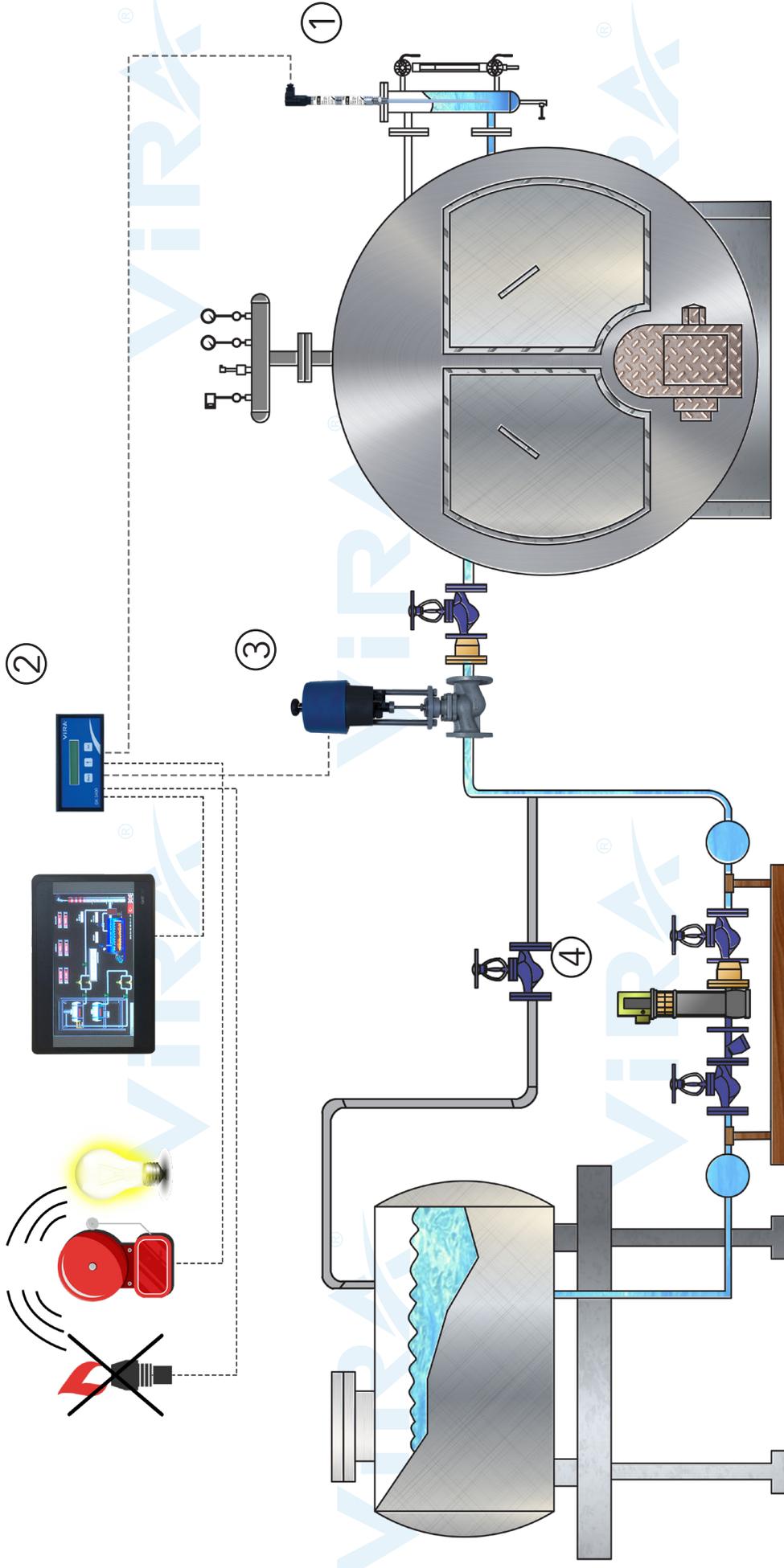
Type	: SKV 3400 - 3
Enclosure	: IP 65
Sizes	: DN 15 to DN 300
Max. Operating Temp.	: 220 - 250 °C
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Max. Ambient Temp.	: 60 °C (Actuator)
Control Mode	: Floating Control
Pressure Class	: PN 16 - 25 - 40 ANSI 150 and ANSI 300



Advantages

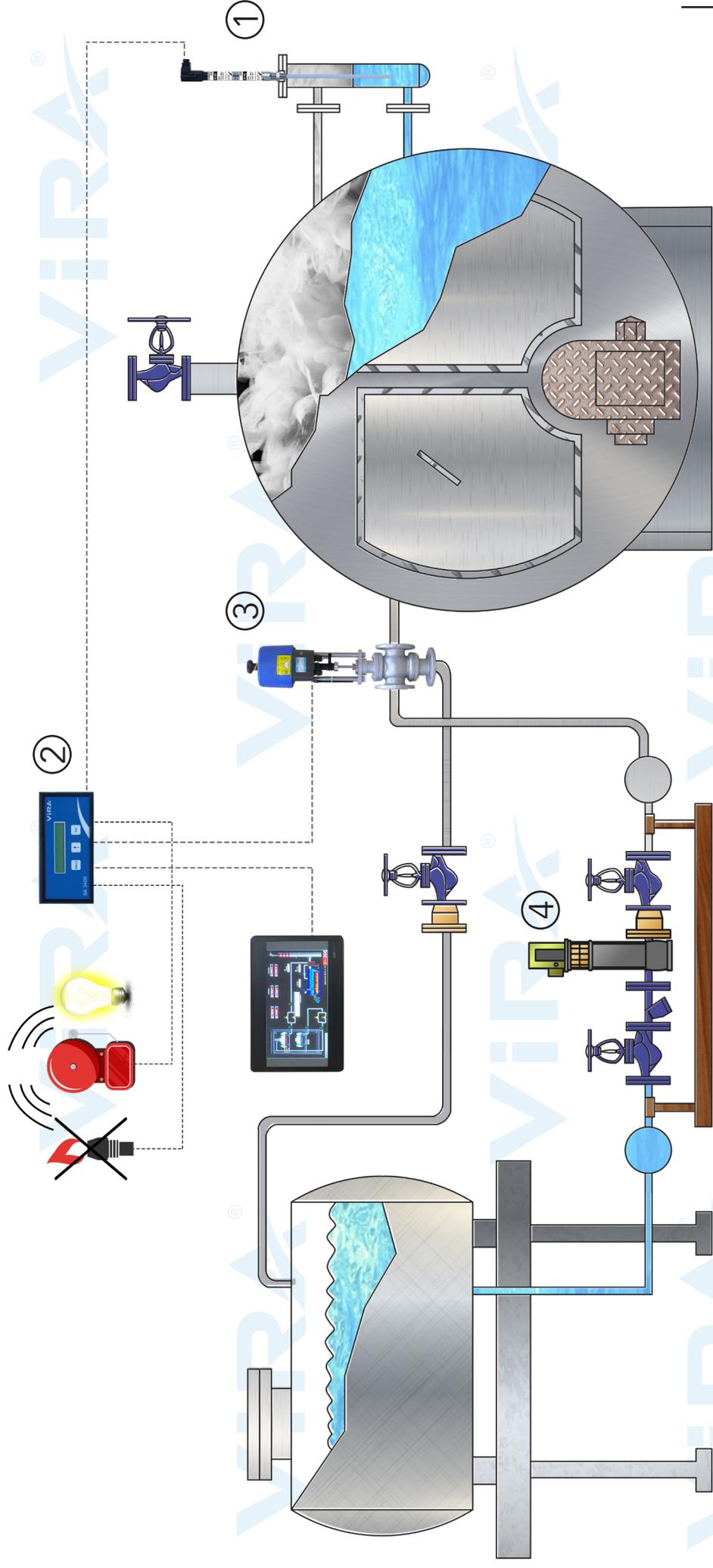
- Constant steam flow and pressure
- Low moisture content steam
- Low thermal stress on boiler surfaces
- Long lifetime for pumps and burners

SK 3000 2-Way Modulating Level Control and Alarm System



- 1- Capacitive Level Probe
- 2- Level Controller
- 3- 2 Way Level Control Valve
- 4- Feedwater Pump

SK 3000 3-Way Modulating Level Control and Alarm System



1- Capacitive Level Probe 2- Level Controller 3- 3 Way Level Control Valve 4- Feedwater Pump

SD-AY 420A

SD-AY 420A Capacitive Level Transmitter

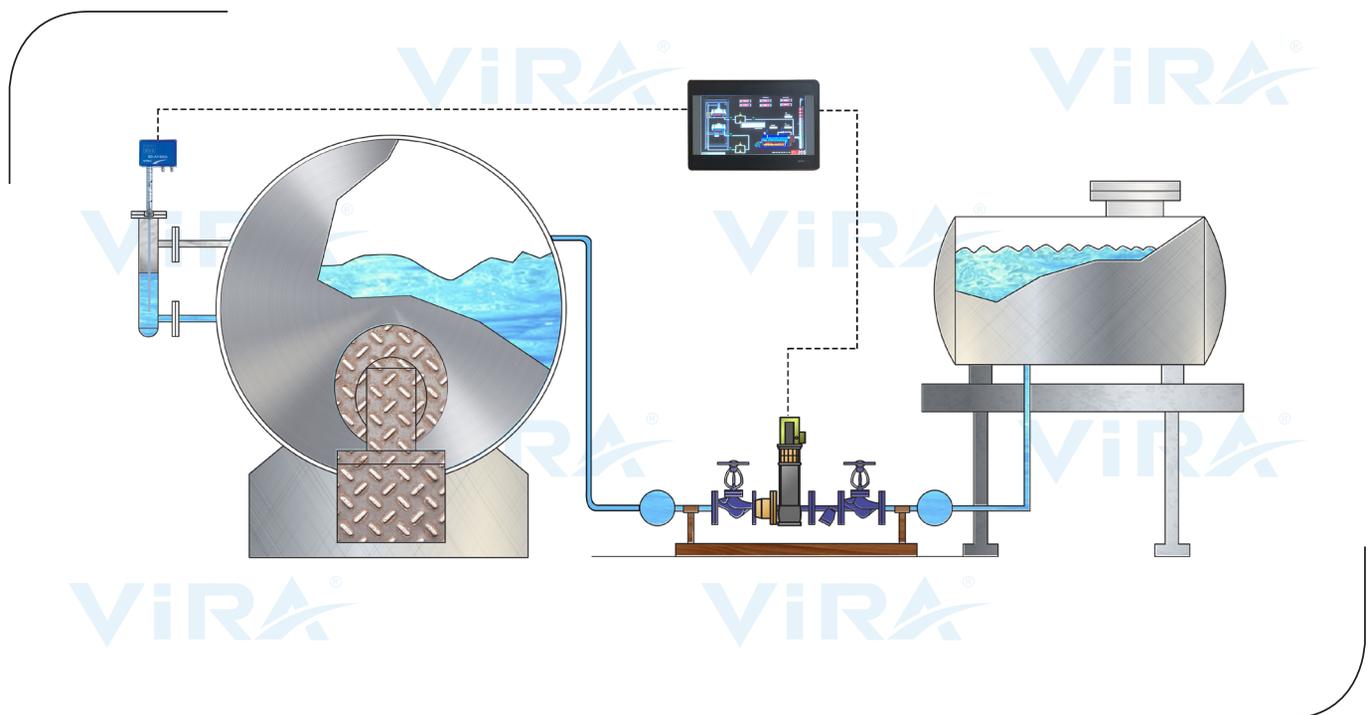
Capacitive Level Transmitter

Type	: SD-AY 420A
Mains Supply	: 230 VAC (+5% / - 10%), 50/60 Hz, 24 Vdc 24 VDC (Optional)
Output	: 4-20 mA Output
Nominal Pressure	: PN 40
Max. Operat. Temp.	: 239 °C
Max. Operat. Press.	: 32 Bar g
Connection	: 1/2" BSP Screwed
Length	: 300 - 1500 mm
Max. Ambient Temp.	: 70 °C

(The length must be specified in the order.)



SD-AY 420A System Application



Self Monitoring Level Alarm System

Self monitoring level alarm system is presented in two different ways.

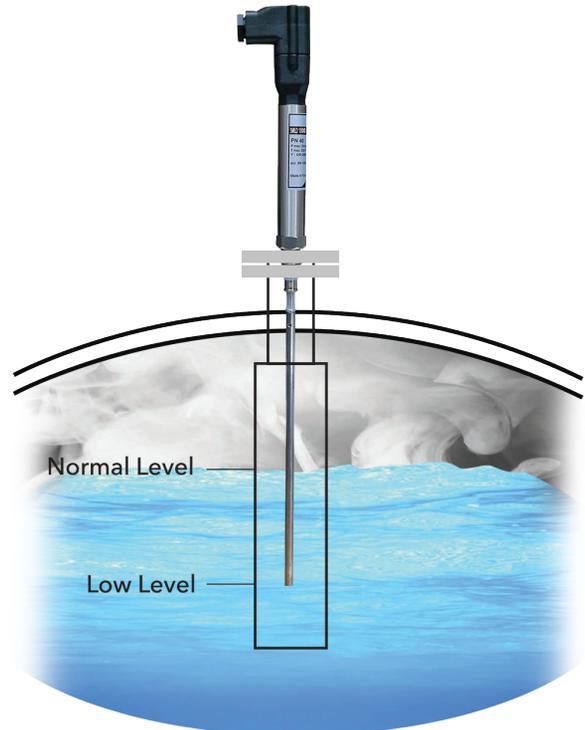
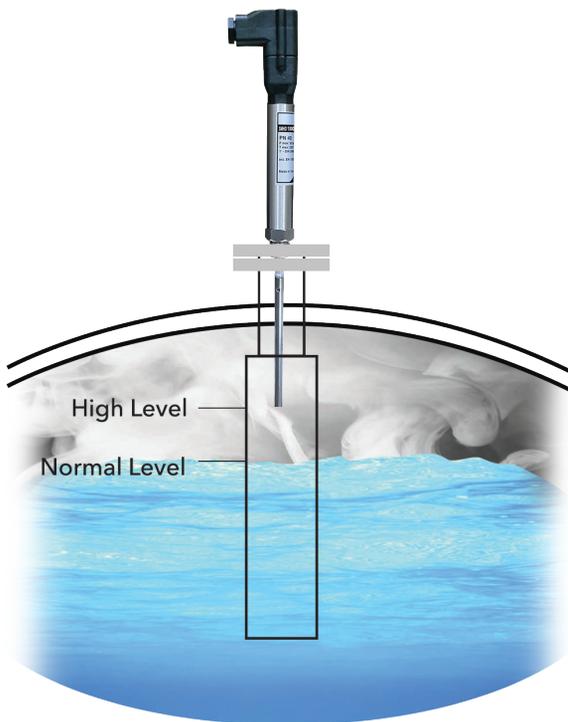
SMH 1000 high level alarm system consisting of SMK 1000 level alarm controller and SMHD 1000 high level alarm probe and SML 1000 low level alarm system consisting of SMK 1000 level alarm controller and SMLD 1000 low level alarm probe.

The features that distinguish the self monitoring level alarm system from normal level alarm systems are as follows;

1. It checks for open circuit (cable break) / short circuit (contact of cables) in the cables between controller and probe.
2. It checks whether the probe level tip touches the boiler body.
3. It checks the leakages that may occur on the probe.
4. It controls the contamination (formation of dirt and scaly layer) at the connection points of the level electrode to the probe body.
5. The controller periodically checks whether the internal circuits are functioning properly.
6. The controller gives the alarm as a result of an error occurring as a result of the above controls.

Note: SMH 1000 and SML 1000 Self monitoring level alarm systems are suitable to be used in unattended operation standards for 72 hours according to EN 12952 and EN 12953 standards.

Application Example



SML-H 1000

High Pressure Self Monitoring Low Level Alarm System

Self Monitoring Level Alarm Controller

Type	: SMK 1000
Enclosure	: Panel Mounting
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Function	: Self-Monitoring High-Low Level Alarm
Output	: Two Alarm Relay, RS 485 Modbus Output
Max Ambient Temperature	: 55 °C

High Pressure Self Monitoring Low Level Alarm Probe

Type	: SMLD-H 1000
Nominal Pressure	: PN 250
Max. Operat. Temp.	: 367 °C
Max. Operat. Press.	: 200 Bar g
Connection	: ½" BSP Screwed
Length	: 500, 1000, 1500 mm



Level Alarm Probe



Controller

SMH-H 1000

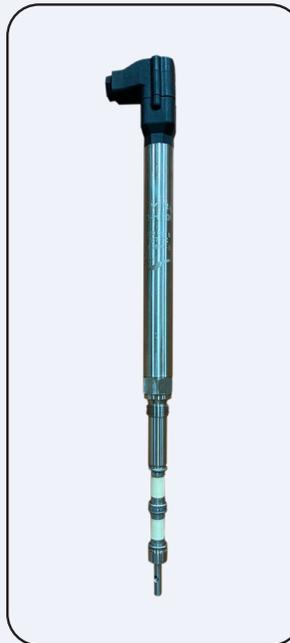
High Pressure Self Monitoring High Level Alarm System

Kendi Kendini Kontrol Edebilen Seviye Alarm Kontrolörü

Type	: SMK 1000
Enclosure	: Panel Mounting
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Function	: Self-Monitoring High-Low Level Alarm
Output	: Two Alarm Relay, RS 485 Modbus Output
Max Ambient Temperature	: 55 °C

High Pressure Self Monitoring High Level Alarm Probe

Type	: SMHD-H 1000
Nominal Pressure	: PN 250
Max. Operat. Temp.	: 367 °C
Max. Operat. Press.	: 200 Bar g
Connection	: ½" BSP Screwed
Length	: 500, 1000, 1500 mm



Level Alarm Probe



Controller

SMH 1000

Self Monitoring High Level Alarm System

Self Monitoring Level Alarm Controller

Type	: SMK 1000
Enclosure	: Panel Mounting
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Function	: Self-Monitoring High-Low Level Alarm
Output	: Two Alarm Relay, RS 485 Modbus Output
Max Ambient Temp.	: 55 °C

Self Monitoring High Level Alarm Probe

Type	: SMHD 1000
Nominal Pressure	: PN40
Max. Operat. Temp.	: 239 °C
Max. Operat. Press.	: 32 Bar g
Connection	: ½" BSP Screwed
Length	: 500, 1000, 1500 mm
Max. Ambient Temp.	: 70 °C



Level Alarm Probe



Controller

SML 1000

Self Monitoring Low Level Alarm System

Self Monitoring Level Alarm Controller

Type	: SMK 1000
Enclosure	: Panel Mounting
Mains Supply	: 230 VAC (+5% / -10%) 50/60Hz
Function	: Self-Monitoring High-Low Level Alarm
Output	: Two Alarm Relay, RS 485 Modbus Output
Max. Ambient Temp.	: 55 °C

Self Monitoring Low Level Alarm Probe

Type	: SMLD 1000
Nominal Pressure	: PN 40
Max. Operat. Temp.	: 239 °C
Max. Operat. Press.	: 32 Bar g
Connection	: ½" BSP Screwed
Length	: 500, 1000, 1500 mm
Max. Ambient Temp.	: 70 °C

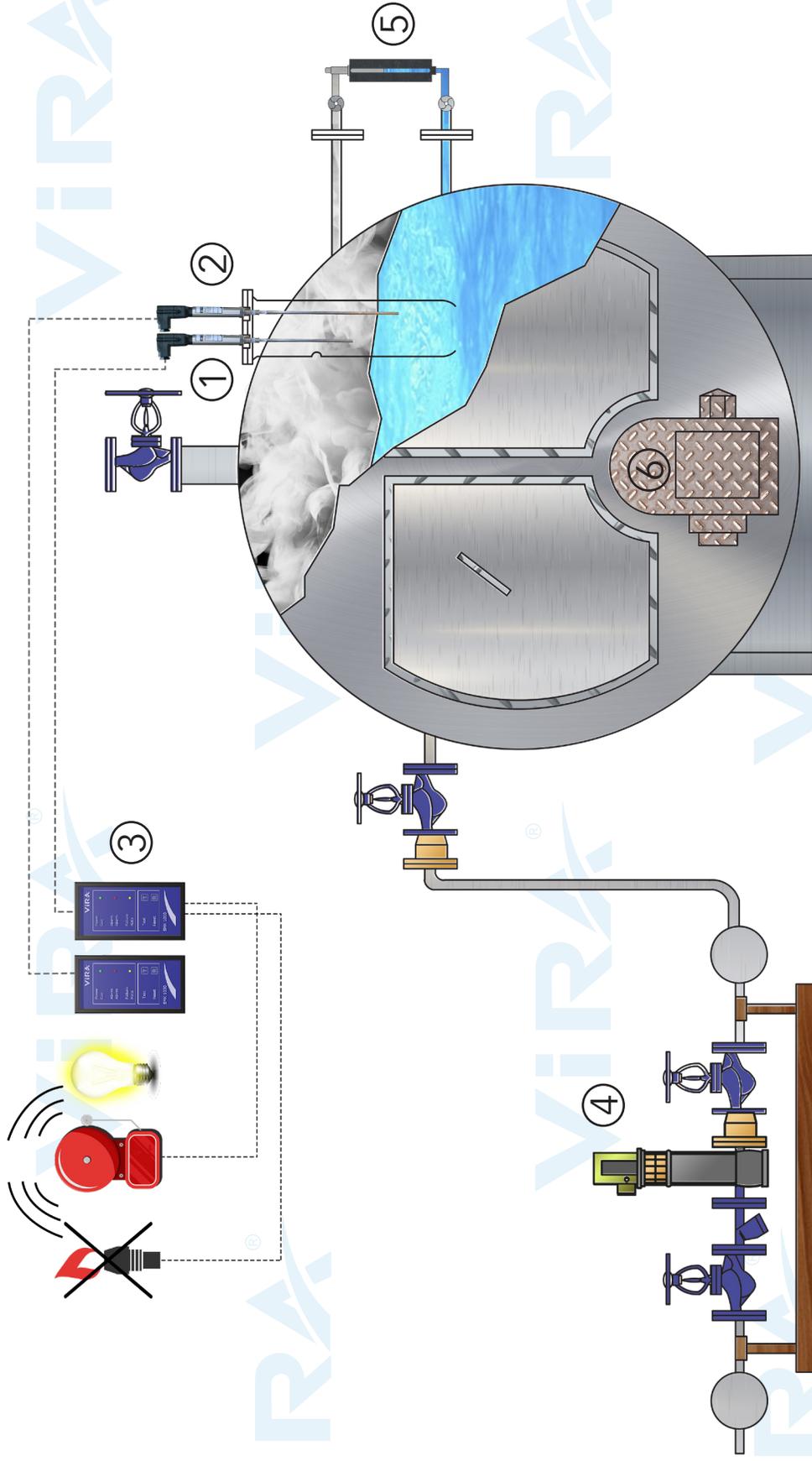


Level Alarm Probe



Controller

High and Low Self Monitoring Level Alarm Systems



1- High Level Alarm Probe **2-** Low Level Alarm Probe **3-** Level Alarm Controller

4- Feedwater Pump **5-** Level Gauge **6-** Burner

SK 1000

Level Alarm System

Level Alarm Controller

- Type** : SK 1200
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Enclosure** : Panel Mounting
- Function** : High Alarm, Low Alarm
- Output** : Two Alarm Relay
- Max. Ambient Temp.** : 55 °C

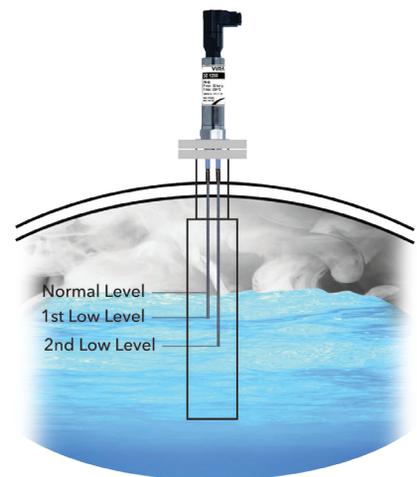
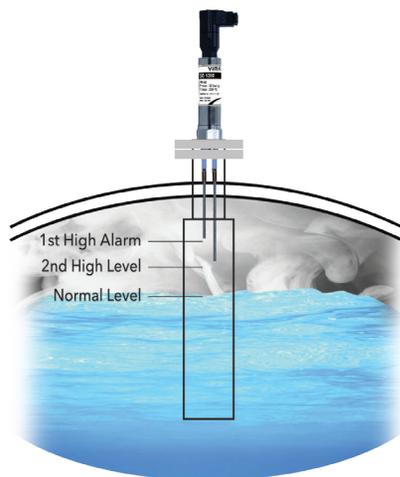
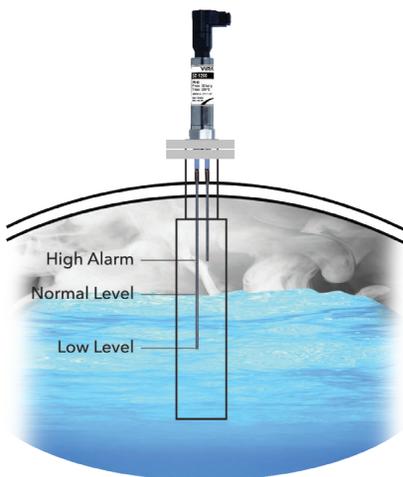


Level Alarm Probe

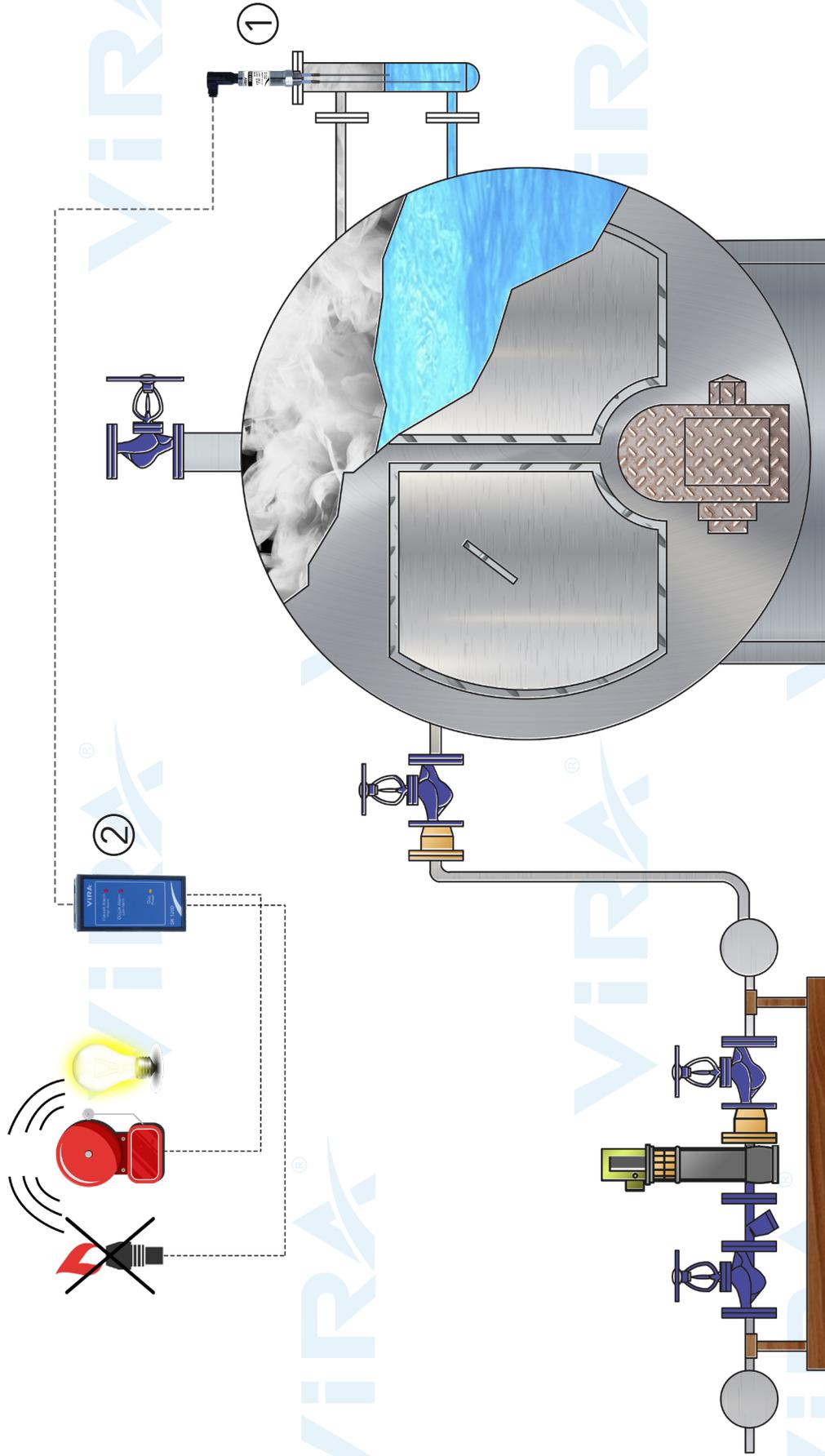
- Type** : SD 1200
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239 °C
- Max. Operat. Press.** : 32 Bar g
- Connection** : 1" BSP Screwed
- Length** : 500 - 1000 - 1500 mm
(Can be cut to desired level)
- Max. Ambient Temp.** : 70 °C



Application Example



SK 1000 Level Alarm System

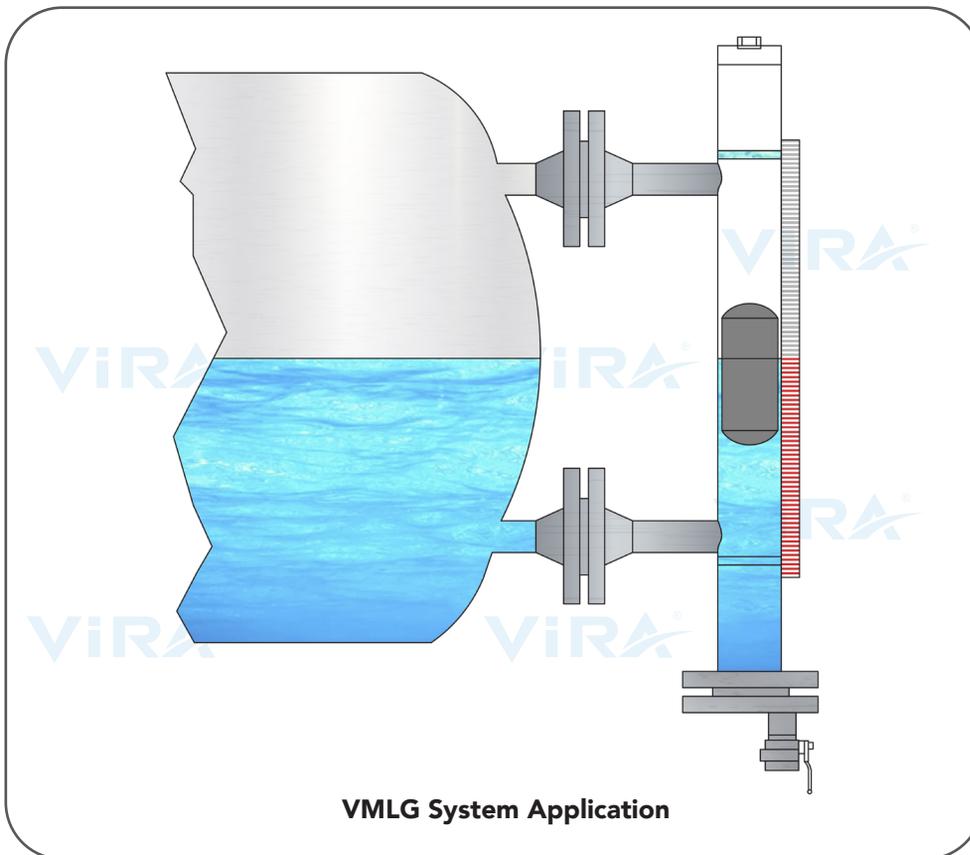


1- Level Alarm Probe 2- Level Alarm Controller

VMLG

Magnetic Level Gauges

A magnetic level gauge is an externally mounted chamber with clear, high clarity indication of liquid level by visual indicators that are completely isolated from the process liquid. Inside the chamber, there is a magnetic float that rises and falls with the level of the liquid. When the magnetic float moves, it causes indicators inside the chamber to turn, and mark the level. Float size and weight are determined by the process fluid, pressure, temperature and the specific gravity of the process fluid. Float chamber is typically constructed with the non-magnetic pipe having process connections that match to the vessel connections.



Areas of Application

- Water Tanks
- Condensate Tanks
- Fuel Tanks
- Steam Boilers
- Chemical Industry
- Liquid and Liquefied Gas
- Degassers
- Underground tanks
- Refineries

Type	: VMLG
Body	: AISI 304 / 316 Stainless Steel
Float	: AISI 316L Stainless Steel
Flaps	: Plastic / Aluminum
Max. Operat Press.	: 16 Bar g
Max. Operat. Temp.	: 160°C
Flange	: Carbon Steel / Stainless Steel

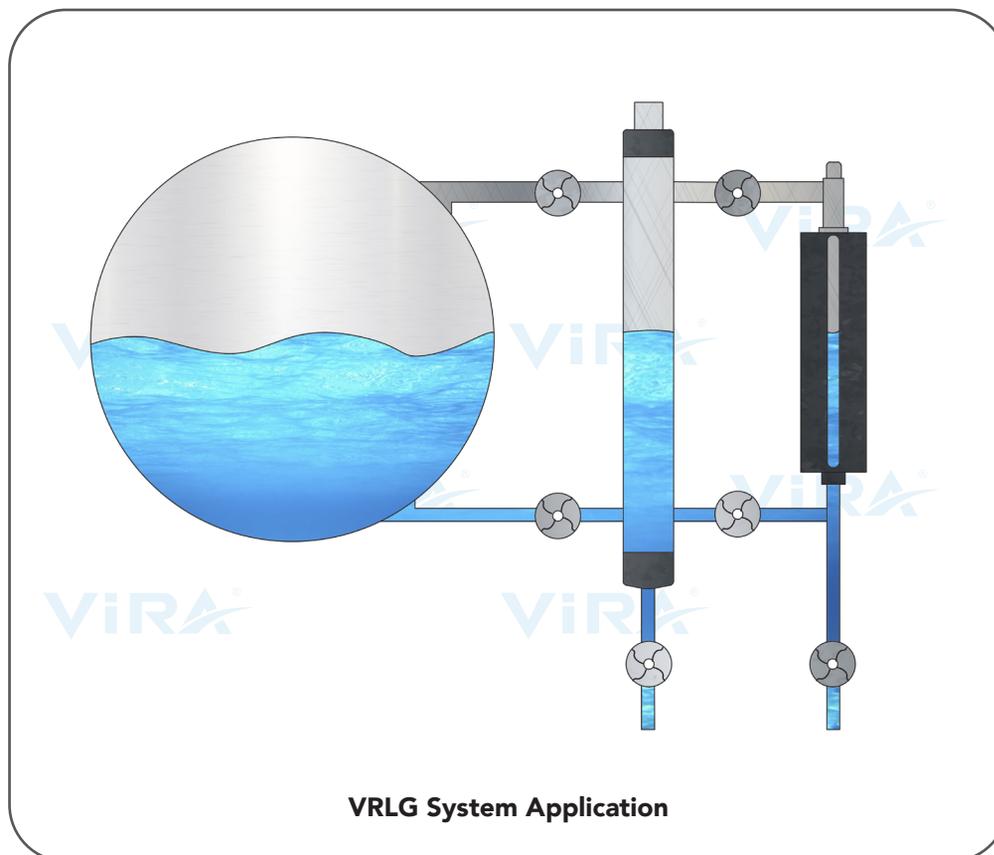


VRLG

Reflex Level Gauge

Reflex level indicators are designed for applications that involve high temperature, high pressure and use of corrosive fluids. The colorless fluid used in this apparatus gives better clarity for level indication. This type of level gauges' working principle is based on the light refraction and reflection laws.

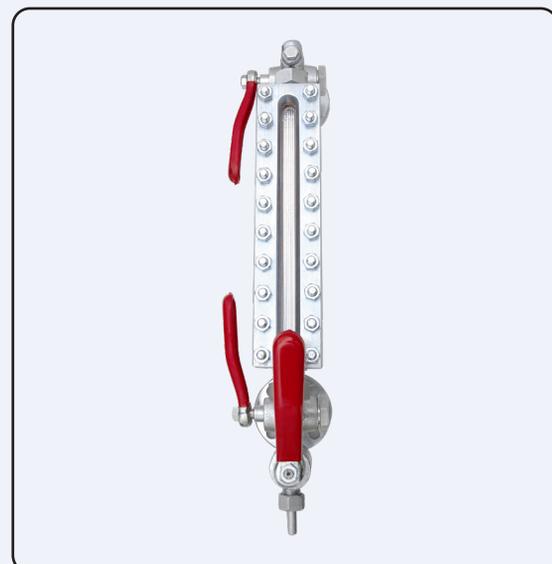
During the operation, the gauge chamber is filled with liquid in the lower zone and vapors in the upper zone. The liquid level is distinguished by different brightness of the glass in the liquid and in the gas/vapor zone.



Areas of Application

- Oil Refinery Plants
- Petrochemical Industry
- Pharmaceutical Plants
- Tank and Boilers
- Chemical Processes
- Textile Industry
- Shipyards
- Paper Industry

Valves	: GGG 42
Reflex Glass	: MAXOS
Shaft	: 304-316 Stainless Steel
Sealing	: Klingerite
Cover	: ST 37 Carbon Steel
Nominal Pressure	: PN 32
Operating Pressure	: PN 16 kg/cm ²
Max. Operating Temp.	: 250°C





AUTOMATIC BLOWDOWN SYSTEMS

BOILER BLOWDOWN

Why is it necessary to blowdown in steam boilers?

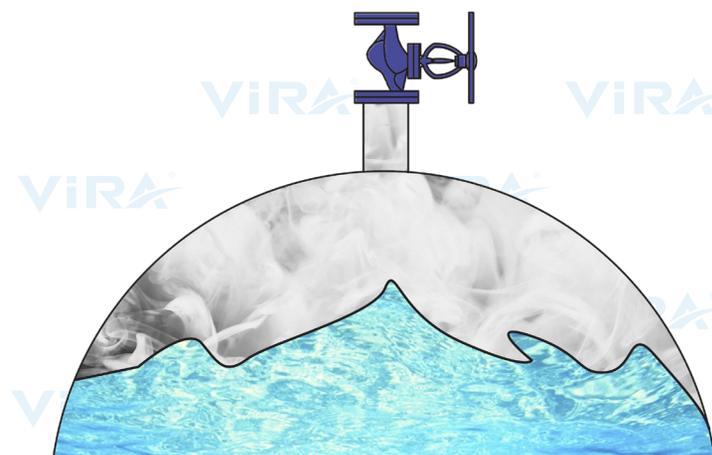
Many industries use boilers to generate steam for their energy needs. The water used to feed the boilers contains varying levels of impurities:

- Dissolved solids - Scale forming substances
- Suspended solids - Sludge forming substances
- Dissolved gasses - Corrosive gasses such as oxygen and carbon dioxide.

Boiler feedwater could contain a high level of dissolved salts and minerals, even if there is a feedwater treatment. When steam evaporates, the concentration of the salt and minerals in the boiler water increases. This causes TDS increase in the boiler water and high TDS may cause;

- Carryover of the boiler water
- Formation of sludge
- Scaling of the boiler tubes

Carryover of the water in steam lines may cause water hammer, corrosion, and deposits. Deposits on the heat transfer surfaces decrease the efficiency and cause control valves and steam traps to malfunction.



Water Carryover

Suspended solids accumulate at the bottom of the boiler and if they are not removed those solids prevent heat transfer from the boiler fire tube which will overheat and may even fail. Sludge formation can lead to malfunction of level control devices.

Scaling on the heating surfaces in the boiler will increase fuel cost, reduce heat transfer, and efficiency. 1 mm calcium carbonate scale increases %3 or 1mm Silicate scale increases %8 in fuel cost.

Why Automatic Blowdown?

The blowdown rate can be controlled manually or automatically.

With manual blowdown control, if the level of TDS is higher than the allowed level, it may cause loss of water, heat and chemicals from the boiler. Boiler blowdown automation helps to reduce fuel, water, chemical and manpower costs.

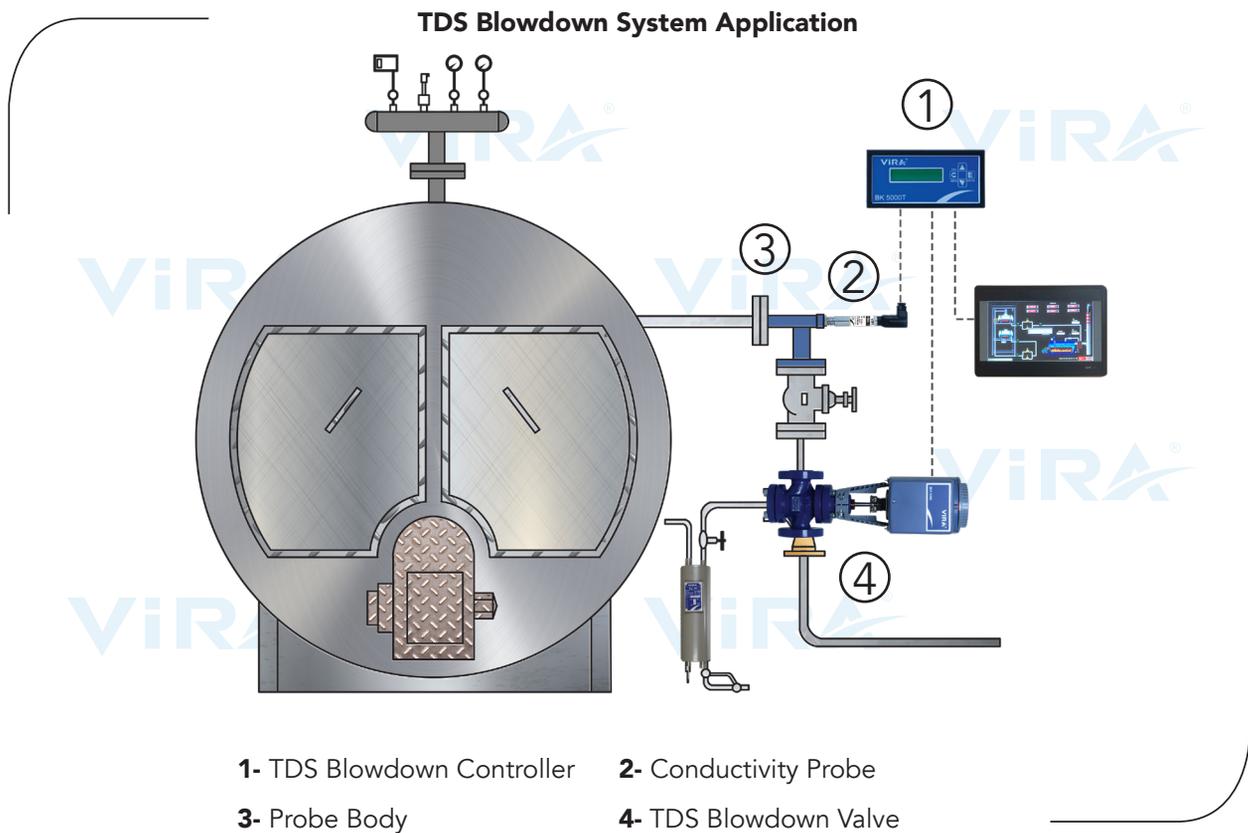
Automatic blowdown system ensures a maximum of dissolved solids and suspended solids are removed with a minimal loss of water and heat from the boiler

BS4-T

Automatic Surface Blowdown (TDS) Control

As the water in the boiler drum turns into steam, the concentration of dissolved solids in the boiler water increases. Dissolved substances are moved to the installation with dragging steam and water cause malfunctions in the system and solid materials accumulate on the heat transfer surfaces causing the heat efficiency to decrease. The blowdown process cannot eliminate scaling by itself. In addition to dosing and degassing of boiler feed water, it helps to keep the water in the boiler at the desired TDS level.

Vira offers two types of surface blowdown systems, BS4 and BS4-T. Unlike BS4 system, BS4-T system has temperature compensation feature. This feature adjusts the system's performance to compensate for the effects caused by changes in temperature. As a result, the BS4-T system is not affected by temperature and pressure changes in the boiler and does not require calibration in every change.



The conductivity probe where located in the boiler shell continuously monitors the conductivity of the boiler water. The measured conductivity value is compared with the Set Point in the controller. If the water conductivity is higher than the set value the blowdown valve will be continuously working until the conductivity value drops below the set value. If it is lower than the Set Point the blowdown valve will remain its closed position.

Advantages of Automatic TDS Blowdown:

- Reduced maintenance and repair costs (minimized carryover and deposits)
- Cleaner and more efficient steam
- Energy Savings
- Reduced operating costs (less feedwater consumption; chemical treatment and higher heating efficiency)
- Potential savings from a blowdown heat recovery system (where installed).
- The labor-saving advantages of automation.

BS4-T

Automatic TDS Blowdown System with Temperature Compensation Feature

Temperature Compensation Type TDS Blowdown Controller



- Type** : BK 5000-T
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Enclosure** : Panel Mounting
- Functions** : Continuous Blowdown Valve Control, High TDS Alarm
- Output** : 4-20 mA Output, High TDS Alarm Relay, Valve Relay, RS 485 Modbus Output
- Features** : Conductivity Set Value, Alarm Set Value, Valve Relay Test, Alarm Relay Test, Temperature Compensation

Temp. Compensation Type TDS Blowdown Probe



- Type** : BD 5600-T
- Nominal Pressure**: PN 40
- Max. Operat. Temp**: 239 °C
- Max. Operat. Press.:** 32 Bar g
- Connection**: 1/2" BSP Screwed
- Length**: 500 mm
- Max. Ambient Temp.** : 70 °C

BS4-T temperature compensated automatic tds blowdown system consists of BK 5000-T tds blowdown controller, BD 5600-T conductivity probe, BKV 5400 continuous blowdown valve and DG 5400 probe body.

Increasing the boiler water temperature means an increase in the conductivity value within the boiler. This increase amount is 2% for every 1 °C. The Vira BD 5600-T probe can perform both conductivity measurement and temperature compensation on the same probe.

BS4

Automatic TDS Blowdown System

TDS Blowdown Controller



- Type** : BK 5000-T
- Mains Supply** : 230 VAC (+5% / -10%) 50/60Hz
- Enclosure** : Panel Mounting
- Functions** : Continuous Blowdown Valve Control, High TDS Alarm
- Output** : 4-20 mA Output, High TDS Alarm Relay, Valve Relay, RS 485 Modbus Output
- Features** : Conductivity Set Value, Alarm Set Value, Valve Relay Test, Alarm Relay Test

TDS Blowdown Probe



- Type** : BD 5400
- Nominal Pressure**: PN 40
- Max. Operat. Temp**: 239°C
- Max. Operat. Press.:** 32 Bar g
- Connection**: 1/2" BSP Screwed
- Length**: 500 mm
- Max. Ambient Temp.** : 70 °C

BS4 automatic tds blowdown system consists of BK 5000-T tds blowdown controller, BD 5400 conductivity probe, BKV 5400 continuous blowdown valve and DG 5400 probe body.

BS4 Tds blowdown system is used in constant pressure boilers that do not require temperature compensation. It is calibrated at maximum pressure. The Vira BD 5400 probe can only measure conductivity.

Automatic TDS Blowdown Valve

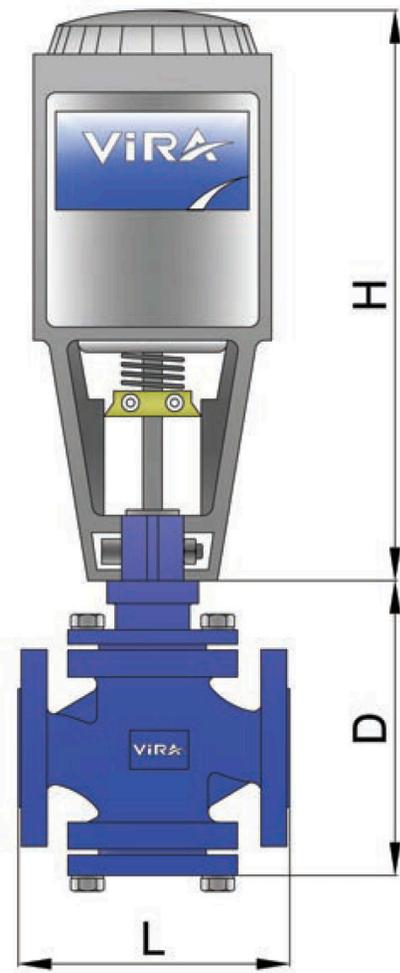
- Type** : BKV 5400
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239°C
- Max. Operat. Press.** : 32 Bar g
- Size** : DN 20
- Body** : GGG 40
- Sample Cooler Outlet** : 1/4" BSP Screwed

Valve Blowdown Capacity (for DN 20)

Pressure bar g	Capacity kg/h
3	525
5	750
7	1200
10	1500
12	1550
15	1650

DIMENSIONS

Type	Size	H mm	D mm	L mm	Weight kg
BKV 5420	DN 20	340	105	150	10 kg

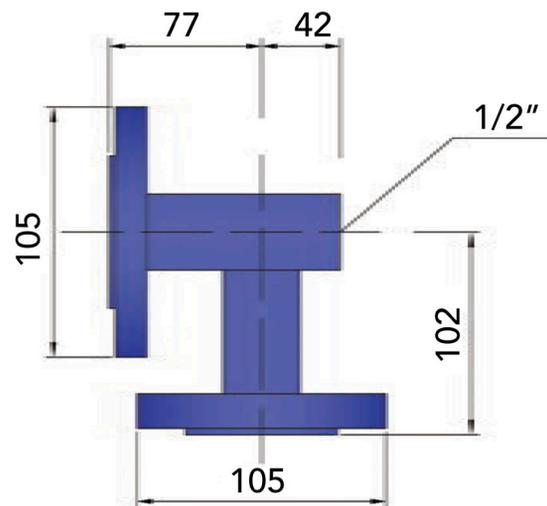


TDS Blowdown Probe Body

- Type** : DG 5400
- Nominal Pressure** : PN 40
- Max. Operat. Temp.** : 239 °C
- Max. Operat. Press.** : 32 Bar g
- Size** : DN 20
- Body** : Carbon Steel

DIMENSIONS

Type	Size	A mm	B mm	C mm	D mm	Weight kg
DG 5420	DN 20	77	42	102	105	3,7 kg



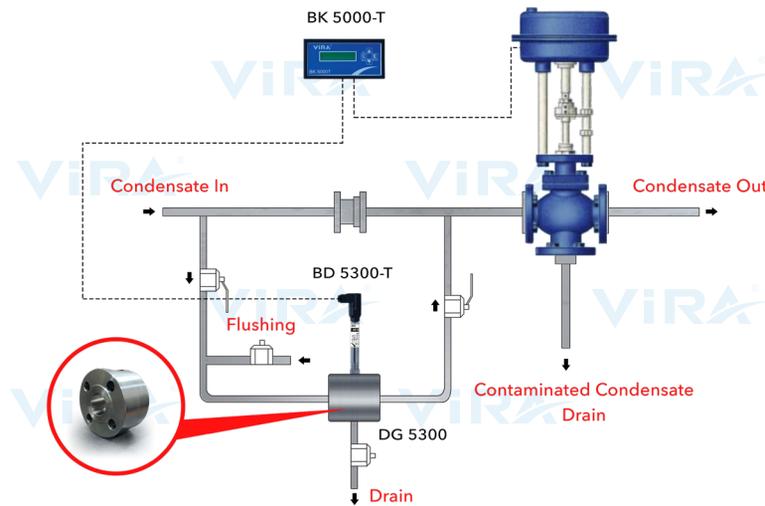
BS3-T

Condensate Contamination Control System

Condensate is very valuable for steam producing plants and needs to be recycled. It must be ensured that the returned condensate is clean. Leakage in one of the devices used for heat transfer may cause the heated fluid to mix into the condensate water.

The condensate contamination control system monitors and displays the conductivity of the condensate. It automatically diverts the condensate to drain by a 3 way valve instead of back to the boiler system.

When the conductivity drops to the desired level, the condensate is allowed to return to the boiler system, thus minimizing heat and water wastage, as well as avoiding the possibility of contaminating the feedwater.



BS3-T System Application

Note: BS3-T Vira Condensate Contamination Control system performs contamination control with electrical conductivity measurement.

BS3-T Condensate Contamination Control System Components



Conductivity Controller

- Type :** BK 5000-T
- Mains Supply :** 230Vac (+5% / -10%) 50/60Hz
- Enclosure :** Panel Mounting
- Functions :** Valve Control, High TDS Alarm
- Output :** 4-20 mA Output, High TDS Alarm Relay, Valve Relay, RS 485 Modbus Output
- Features :** Conductivity Set Value, Alarm Set Value, Valve Relay Test, Alarm Relay Test, Temperature Compensation



Probe Body

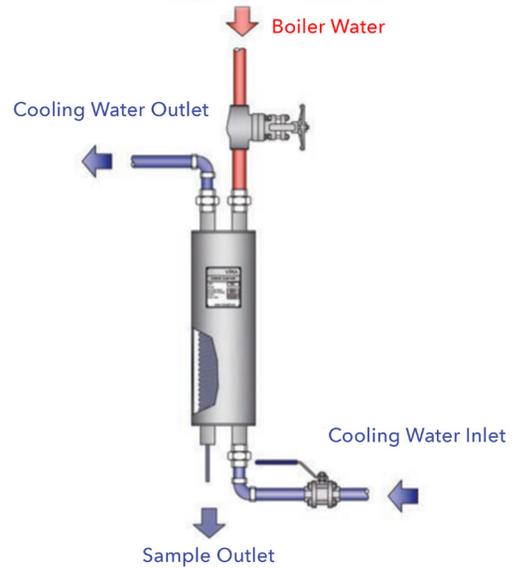
- Type :** DG 5300
- Body :** AISI 304 SS, AISI 316 SS
- Flange Connection :** DN 15 - DN 50
- Probe Connection :** 1/2" , 3/4', 1"
- Drain Size :** 1/4"
- Nominal Pressure :** PN 16, PN 25, PN 32, PN 40, PN 63



Temp. Compensation Type Conductivity Probe

- Type :** BD 5300-T
- Nominal Pressure :** PN 40
- Max. Operat. Temp. :** 239°C
- Max. Operat. Press. :** 32 Bar g
- Connection :** 1/2" BSP Screwed
- Max. Ambient Temp. :** 70 °C

NK 20 Sample Cooler



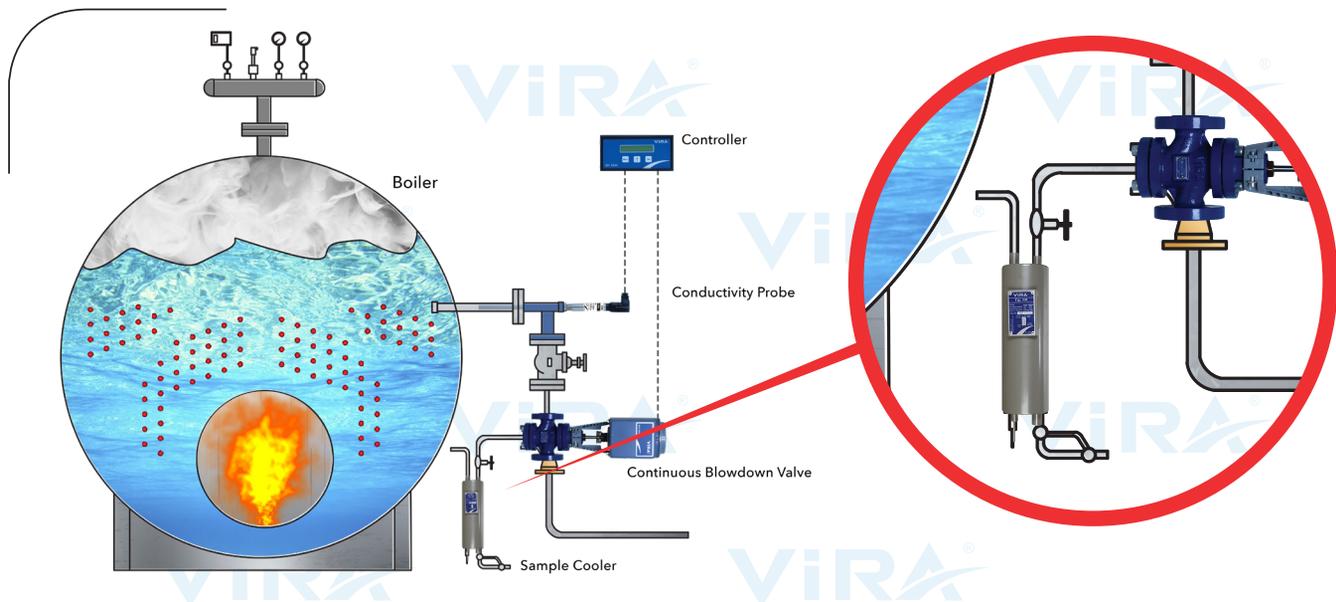
DIMENSIONS				
Type	A mm	B mm	C mm	Weight kg
NK 20	350	100	30	5

Sample Cooler

- Type** : NK 20
- Body** : AISI 304 Stainless Steel
- Coil** : AISI 304 Stainless Steel
- Coil Nominal Pressure** : PN 40
- Max. Operating Pressure** : 32 Bar g
- Max. Operating Temp.** : 239 °C
- Cooling Water Connection** : 1/2" BSP Screwed
- Sample Connection** : 1/4" BSP Screwed

Sample Cooler Montage Set

- Type** : NK 20 - MS
- Needle Valve** : 1/4"
- Street Elbow** : 1/4"
- Pipe** : 1/4", 50 cm, Ø6mm
- Reduction** : 1/2" - 1/4"
- Connector** : 1/4", Ø6mm
- Valve** : 1/2" male-female
DKV-2 Brass

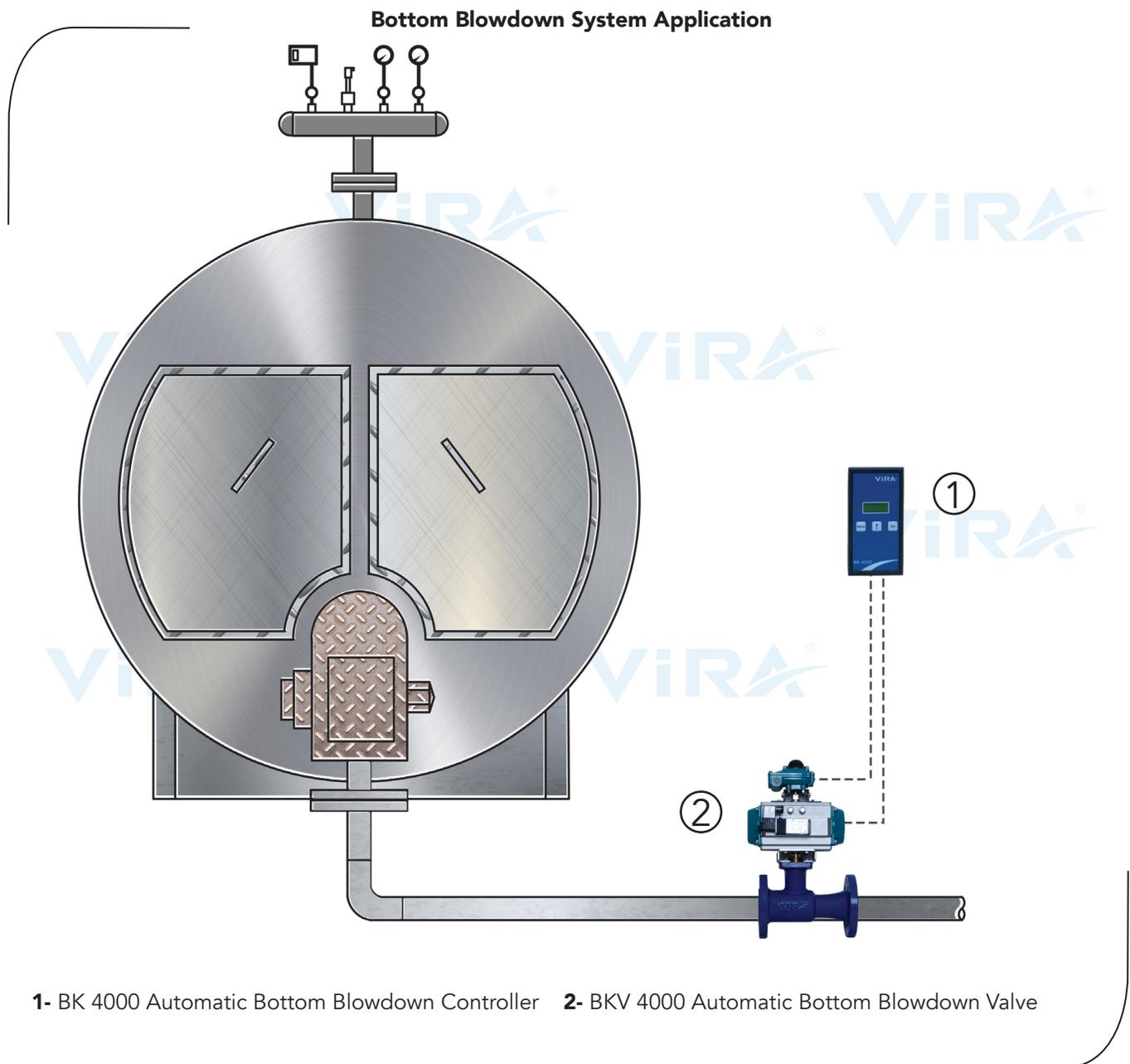


NK 20 System Application

DB2

Automatic Bottom Blowdown System

Some impurities, and salts (rust, oil and dirt that may come from the installation) precipitate to the bottom of the boiler to form a sludge layer. By an actuated valve, at least four-second blowdown is performed in every eight hours (once in a shift). As a result of this process, the sludge and sediment accumulated at the bottom of the boiler are moved out of the boiler. Thus blowdown is made on time and enough by an automatic blowdown valve. By this way, both over blowdown and forgetting of blowdown is avoided.



Difference between Vira BK 4000 Controller and Ordinary Timers

1. It controls the position of the valve. If the valve is in a different position than it should be, it gives an alarm.
2. It prevents simultaneous blowdown in boilers operating side by side and connected to a single blowdown line. Before the blowdown process in a boiler is finished, other boilers are prevented from blowdown.
3. If desired, the blowdown during burner operation is delayed until the burner is switched off.

DB2

Automatic Bottom Blowdown System



Bottom Blowdown Controller

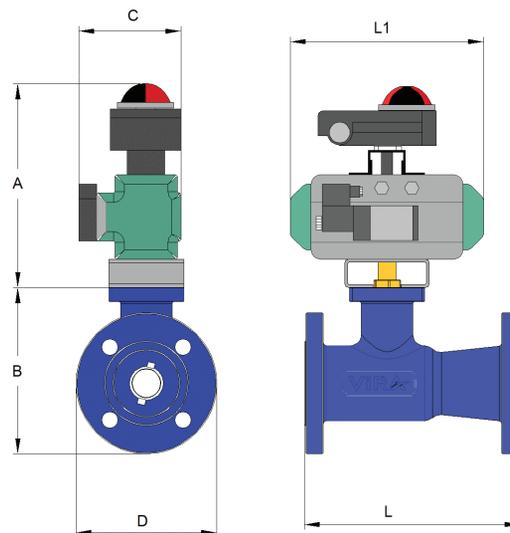
- Type** : BK 4000
- Mains Supply** : 230 VAC (+5% / -10%)
50/60Hz
- Enclosure** : Panel Mounting
- Function** : Valve Open/Close, Valve
Open/Close Failure Alarm
- Output** : Control Relay, Alarm Relay
- Features** : Intercontroller
Communication, Blowdown
Remaining Time, Blowdown
Set Time, Blowdown
Interval, Blowdown Valve
Test, Alarm Test, Blowdown
Counter



Bottom Blowdown Valve

- Type** : BKV 4000
- Nominal Pressure** : PN 25
- Max. Operat. Temp.** : 205 °C
- Max. Operat. Press.** : 16 bar g
- Size** : DN 25 to DN 50
- Body** : GGG 40 , Monoblock

Dimensions



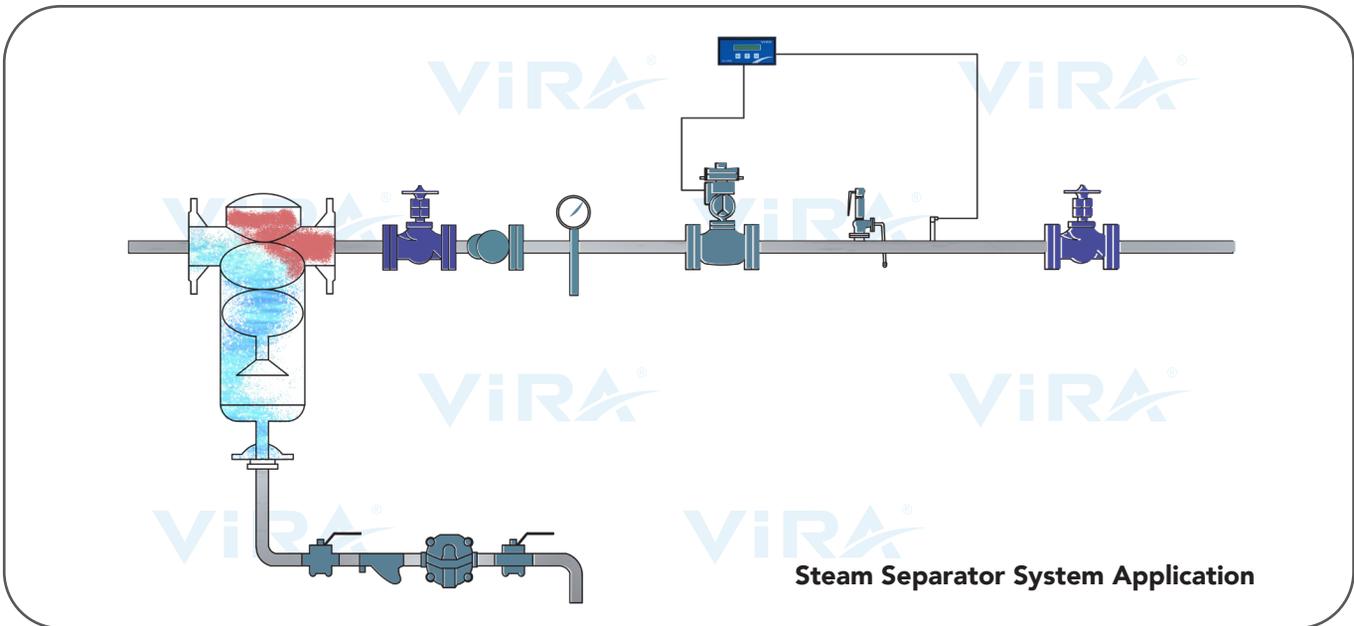
DIMENSIONS								
Type	Size	"A mm"	"B mm"	"C mm"	"D mm"	"L mm"	"L1 mm"	Weight
BKV 4025	DN 25	196	125	122	115	125	240	7
BKV 4032	DN 32	220	145	140	140	130	280	10
BKV 4040	DN 40	243	177	140	150	230	230	15
BKV 4050	DN 50	250	170	160	165	150	350	17
BKV 4065	DN 65	250	190	190	185	170	350	20

STEAM EQUIPMENTS

SEPARATORS

Steam leaving the boiler may contain water particles and cause water to be carried out of the boiler. 'Wet' steam is an important problem in the steam system as it can cause some problems such as maintenance and process problems, lower efficiency, erosion and corrosion. Vira **Vortex and Cyclone** type steam separators are designed to efficiently remove moisture from the steam flow. A correctly selected separator can increase the dryness of the steam up to 98%.

Note: Separator should be chosen considering; the line diameter, velocity and pressure drop.

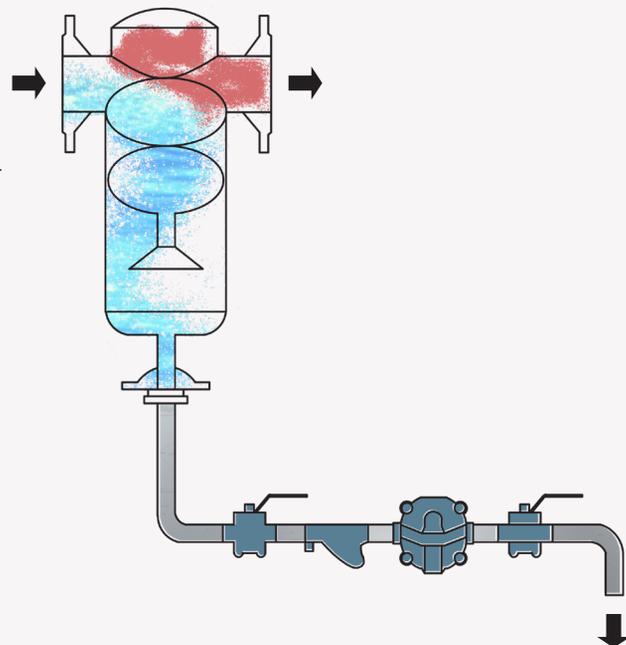


Where to use;

- Outlet of the steam boilers
- Steam flow meter inlets
- Inlet of control valves (temperature, pressure or flow control)

Benefits

- Carbon steel or stainless steel construction
- High efficiency over wide flow range
- No required maintenance
- Economical choice for most applications
- Removes 99% of all water particles
- Gas, steam, or air applications

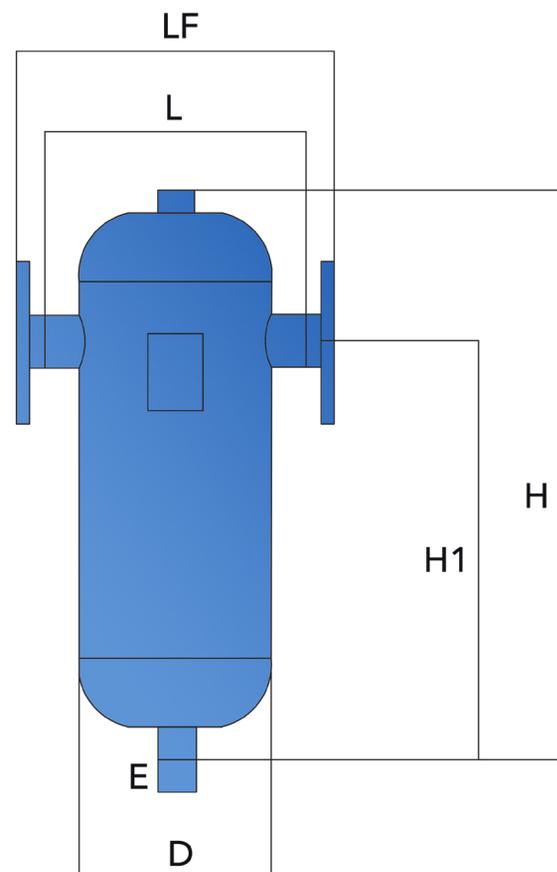


STEAM SEPARATOR

Type: VS-VSF Vortex Steam Separator
Type: SS-SSF Cyclone Steam Separator

Vira steam separators are Vortex and Cyclone type separators. It takes advantage of the difference in specific gravity of liquid and gas by using centrifugal force to separate steam, air and water particles. Steam or compressed air is directed into a spiral flow down the inner wall of the separator. It is then pulled under the separator where a steam trap station is placed to drain the condensate with the help of gravity. Vira steam separators can be produced with different connection types and material options.

- VS** : Vortex Threaded Carbon Steel
- VSF** : Vortex Flanged Carbon Steel
- VS - S** : Vortex Threaded Stainless Steel
- VSF-S** : Vortex Flanged Stainless Steel
- SS** : Cyclone Threaded Carbon Steel
- SSF** : Cyclone Flanged Carbon Steel
- SS - S** : Cyclone Threaded Stainless Steel
- SSF - S** : Cyclone Flanged Stainless Steel
- Sizes** : 1/2" - 4" / DN 15 - DN 300
- Nominal Press.:** PN 16, PN 25, PN 40
- Max. Operat. Temp. :** 300 °C



DIMENSIONS						
DN	D (mm)	H (mm)	H1 (mm)	E (inch)	LF (mm)	L (mm)
15	114,3	300	210	1/2"	230	180
20	114,3	300	210	1/2"	230	180
25	114,3	350	210	1/2"	230	180
32	139,7	435	300	1"	260	240
40	139,7	435	300	1"	260	240
50	168,3	500	370	1"	300	270
65	219,1	570	410	1 1/2"	380	340
80	219,1	610	460	1 1/2"	400	360
100	273	905	660	1 1/2"	485	450
125	323,9	905	660	2"	550	500
150	350	1000	710	2"	585	535
200	400	1285	1005	2"	650	600

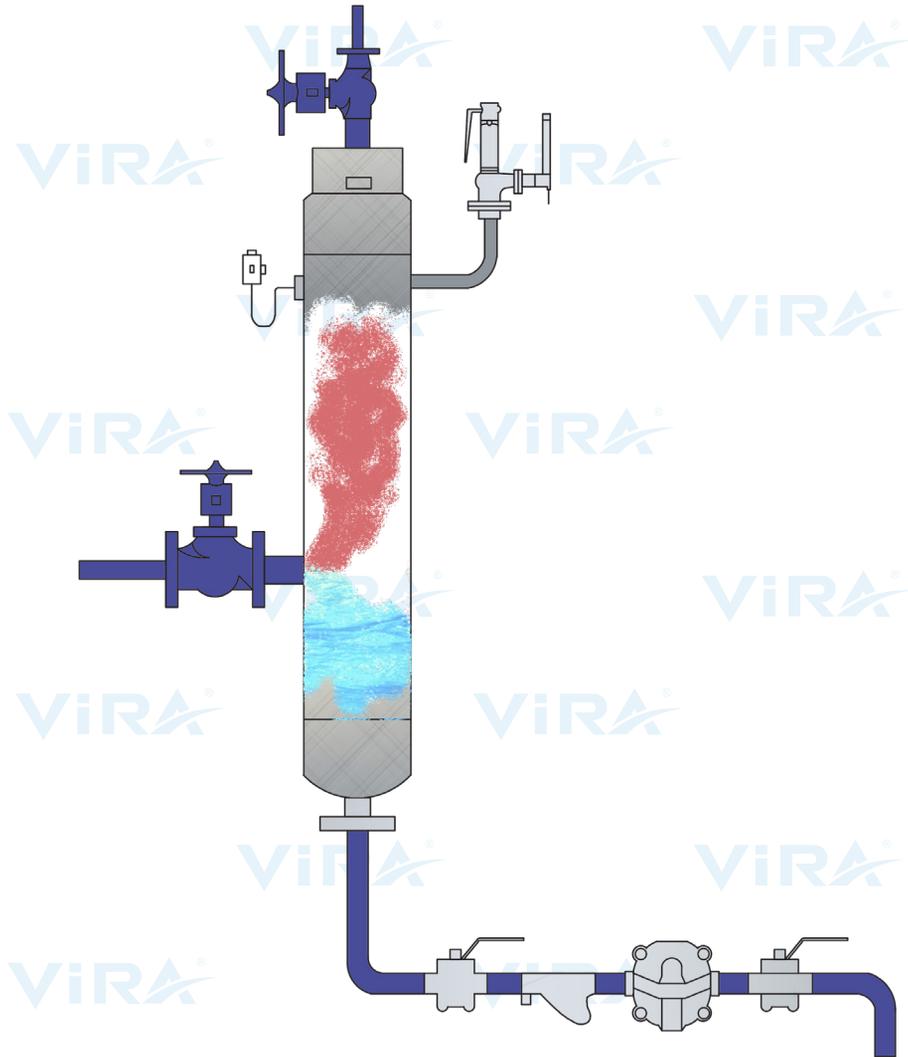
Note: Datas on the table are according to VSF-16 model

FLASH STEAM

Flash steam is produced when high-pressure condensate is discharged to a lower pressure. The word 'flash' describes the way it is formed.

Inside steam piping or any pressurized vessel, steam is generally utilized at a pressure above the atmospheric pressure. When this steam loses its heat either by transferring it to the product being heated or by radiation loss to the environment, condensate is formed. This condensate which is formed is also at the same pressure and temperature as that of steam.

This pressurized condensate is exposed to atmospheric pressure and it has energy more than it can contain at atmospheric pressure. This excess energy is used to convert a portion of this condensate into steam. This phenomenon is called flashing and the steam so generated is referred to as flash steam.



Condensate can be reused in many different ways;

- As heated feedwater, by sending hot condensate back to the boiler's deaerator, for any applicable heating system.
- As hot water, for cleaning equipment or other cleaning applications
- As steam, by reusing flash steam.

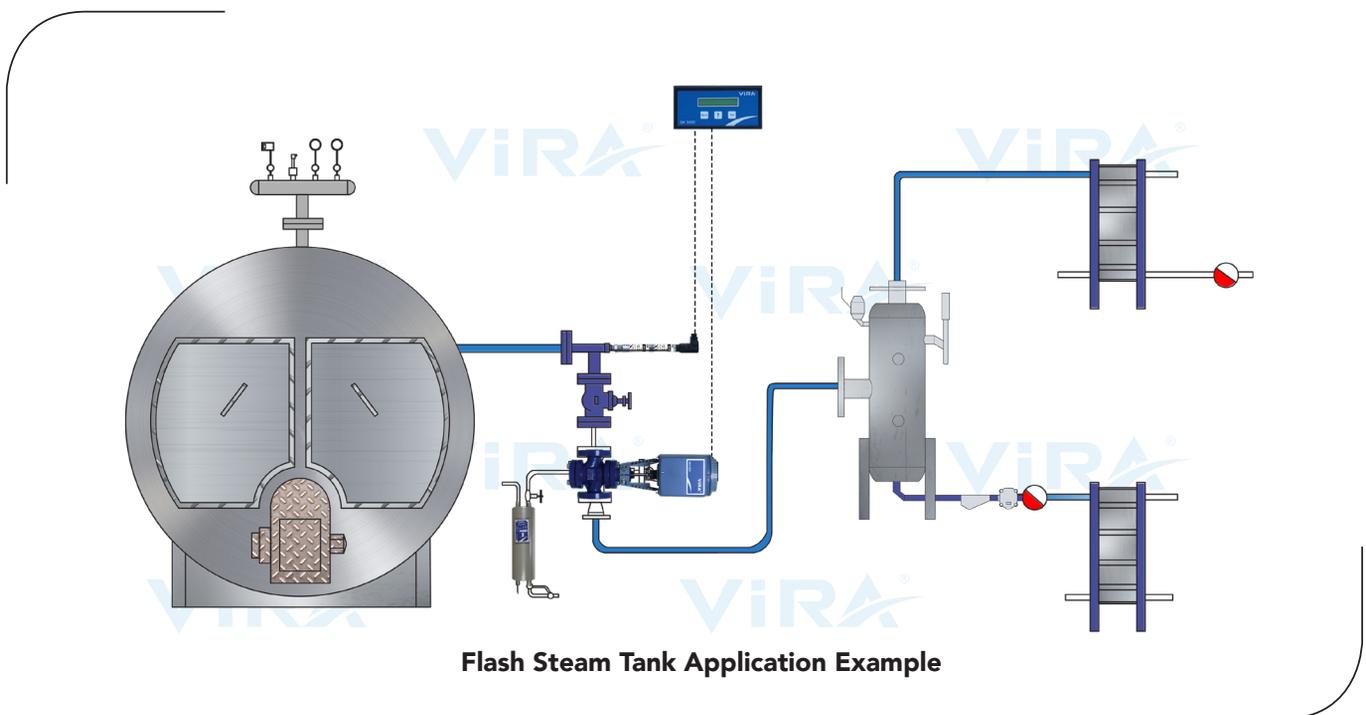
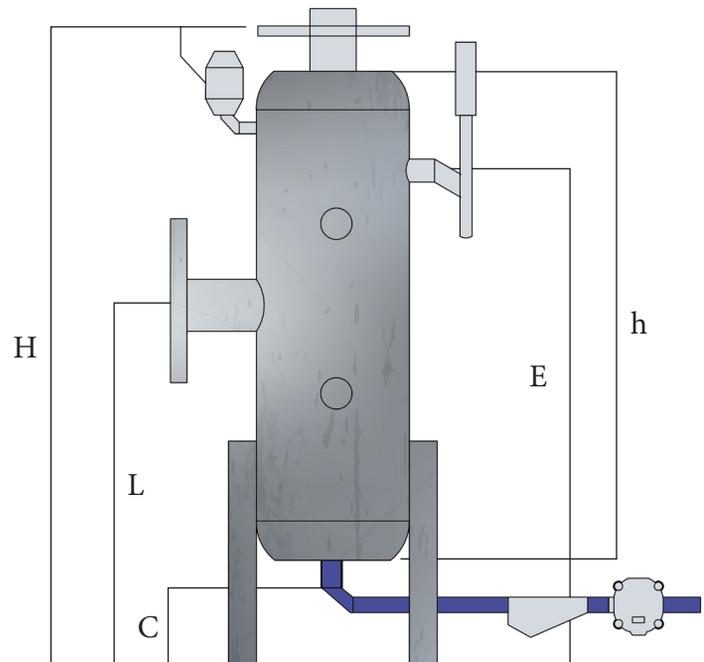
Benefits;

- Reduced fuel costs
- Lower water treatment expenses
- Environmentally safe and friendly

VFS

Flash Steam Tank

DIMENSIONS				
Model No	VFS-6	VFS-8	VFS-12	VFS-16
	mm	mm	mm	mm
h	914	914	1016	1219
L	533	533	584	660
C	241	241	241	241
H	1295	1321	1407	1613
E	914	914	1016	1219



Flash Steam Tank Application Example

To achieve maximum flash steam, the maximum amount of condensate is required. For this reason, the capacity of the steam traps should be carefully selected taking into account the counter-pressure capacity. Also, in systems with temperature control valves, it should be taken into account that the pressure will drop as soon as the valve is closed.

The use of flash steam should be close to the outlet of the high pressure condensate. Transporting low pressure flash steam requires larger diameters and increases the cost of insulation. In addition, the heat losses that will occur in large diameters will reduce the benefits to be obtained from the recovery of flash steam.

There should be a suitable area for flash steam usage. Usage areas should be in capacities equal to or above the flash steam amount. In places where flash steam is missing, steam can be used from a higher pressure steam line by reducing the pressure.

Since the flash steam used in heating is not necessary in the summer, the flash steam recovery system will be ineffective.

VXW

Vortex Flowmeter

VXW Series vortex flowmeter is manufactured according to Karman vortex principle. It is widely used to measure liquid, gas, steam flow in the closed pipeline. The frequency emitted by the Vortex is proportional to the flow rate. From the VXW series, a trepezoidal object is used for vortex creation. This structure ensures that all liquids and gases, even steam, create highly reliable vortexes. The well-designed sharp corner of the upright and wide object that forms the vortex guarantees excellent linearity.

Technical Features

- Compact structure
- No moving parts, long service time
- Long time stability

Display	: Total flow and instant flow
Working Pressure	: 1.6 to 32 Mpa
Ambient Temperature	: - 25 °C to +60 °C
Power	: 24 VDC or 220 VAC
Relative Humidity	: %5 - %95
Atm. Pressure	: 86 - 106 Kpa
Measurable Fluid	: Liquid, Gas, Steam
Accuracy	: %1 (Liquid), 1.5% (Gas and Steam)
Anti Explosion Grade	: Exd Bt4
LCD Digital Display	: L/min, m/h, kg/h, etc.
Output Signal	: 4-20 mA Current (2 Wire System) Standard Pulse Output (3 Wire System) Digital Communication Modbus RTU
Medium Temp.	: 100 - 300°C (High Temp. Type)
Reynolds No. Range	: 2×10^4 - 7×10^6 (DN 25 – DN 100) 4×10^4 - 7×10^6 (DN 150 – DN 300)



Where to use;

- Liquid, Gas and Steam Flow Measurement
- Boiler Efficiency Monitoring

Benefits;

- Calculation of steam costs by measuring the steam consumption of the plant and various units.
- Checking whether steam is supplied to the processes in operation at the correct amount and pressure.
- The efficiency of the plants and processes are monitored with steam flow meters.

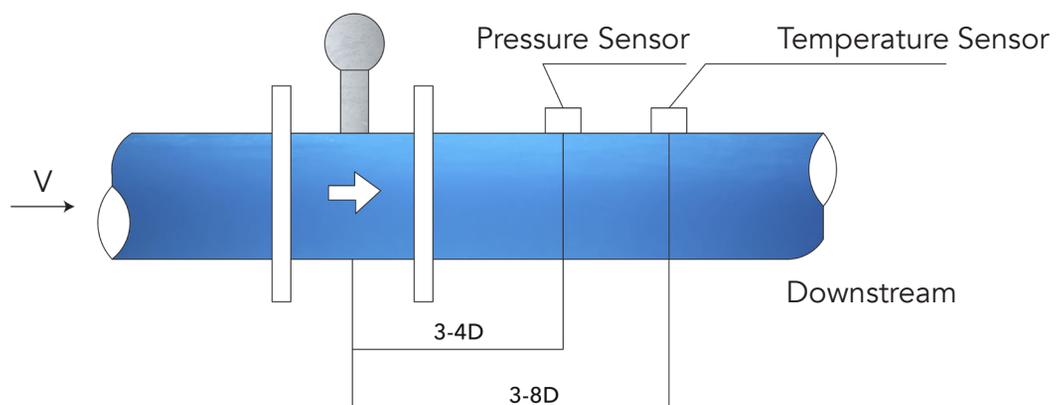
Saturated Steam Flow Range

DN (mm)	Flow Range	Measurable Flow Range							
		1 bar	2 bar	4 bar	6 bar	8 bar	10 bar	15 bar	20 bar
25	Min.	10,2	14,9	24,9	33	41,9	50,8	72,7	94,9
	Maks.	62,2	90,8	146,9	201,9	255,8	310,2	444,4	579,7
40	Min.	24,9	36,3	58,7	80,7	102,3	124,1	177,8	231,9
	Maks.	226	330	534	734	930	1128	1616	2108
50	Min.	40,7	59,4	96,1	132,1	167,4	203	290,9	379,4
	Maks.	361,6	528	854,4	1174,4	1488	1804,8	2585,6	3372,8
80	Min.	84,8	123,8	200,3	275,3	348,8	423	606	790,5
	Maks.	709,6	1036,2	1676,8	2304,8	2920,2	3541,9	5074,2	6619,1
100	Min.	146,9	214,5	347,1	477,1	604,5	733,2	1050,4	1370,2
	Maks.	1243	1815	2937	4037	5115	6204	8888	11594
150	Min.	316,4	462	747,6	1027,6	1302	1579,2	2262,4	2951,2
	Maks.	2531,2	3696	5980,8	8220,8	10416	12633,6	18099,2	23609,6
200	Min.	655,4	957	1548,6	2128,6	2697	3271,2	4686,4	6113,2
	Maks.	4746	6930	11214	15414	19530	23688	33936	44268
250	Min.	1096,1	1600,5	2589,9	3559,9	4510,5	5470,8	7837,6	10223,8
	Maks.	6215	9075	14685	20185	25575	31020	44440	57970
300	Min.	1649,8	2409	3898,2	5358,2	6789	8234,4	11796,8	15388,4
	Maks.	9040	13200	21360	29360	37200	45120	64640	84320

Standard Pipe Length Requirement

Connection Pipe Form	Least Requirement of Straight Pipe	
	Upper Flow	Down Flow
Concentric Shrink Pipe	15D	5D
Concentric Flare Pipe	35D	5D
One 90° Turning	20D	5D
Two 90° Turning in Same Plane	25D	5D
Two 90° Turning in Different Plane	30D	5D
Full Open Valve	20D	5D
Half Open Valve	40D	5D

Note : D means the nominal diameter of flowmeter. If need install temperature sensor and/or pressure sensor in the pipe system, sensor should be installed the down flow of the flowmeter as the below figure shown.

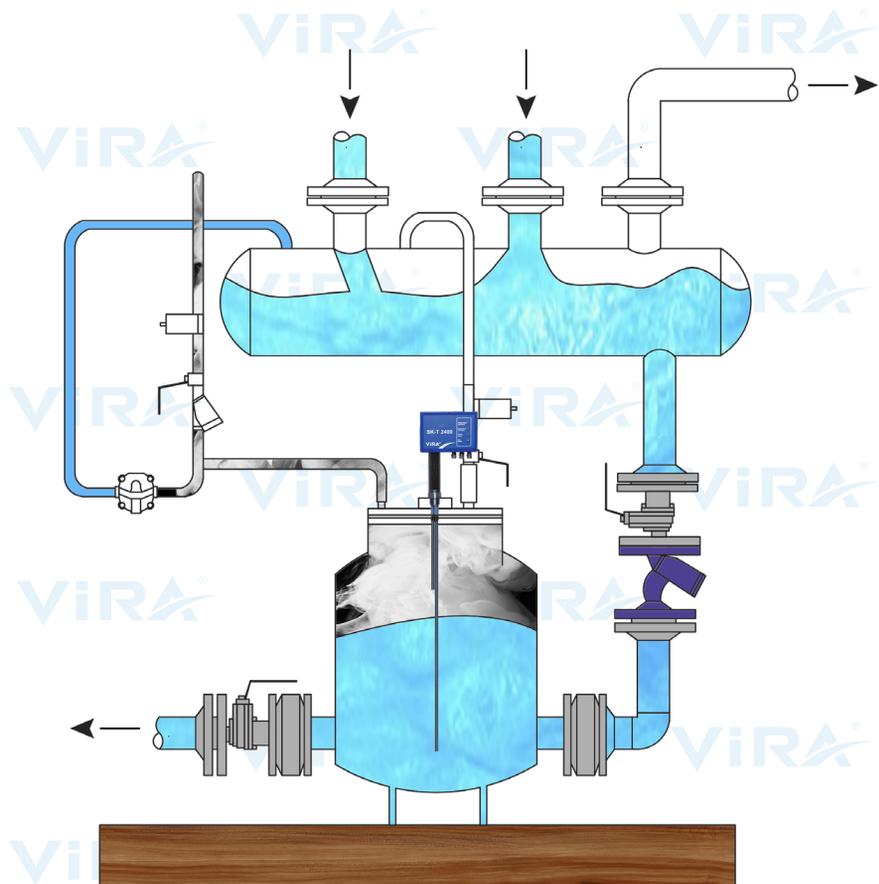


CONDENSATE PUMP

The condensate needs to be recovered considering the energy it contains. Increasing the boiler feed water temperature is essential. Every 6 ° C increase in feedwater can save approximately 1% energy. Besides, at high condensate temperatures, flash steam generated on the suction side of the electric pumps will cause cavitation. Condensate pumps should be used where electrical pumps are not suitable for returning the condensate. Vira float free condensate pumps, pump high-temperature liquids-condensate by using steam or compressed air.

Advantages;

- Increasing the feed water temperature every 6 ° C can save approximately 1% energy.
- Water treatment chemicals are saved.
- Water is saved with return.
- Fuel and water savings are achieved by reducing blowdowns
- Energy saving is provided when used instead of an electric pump.
- The condensate pump will not have these malfunctions as electric pumps will often deteriorate the couplings due to high temperature.
- The cavitation in electrical pumps and related failures are prevented.
- There is no need to increase the pipe diameter as it is in the electrical pumps, which brings an additional cost for the condensate to be pumped properly
- In some cases, no additional circulation pump (pressurization pump) is required on the suction side to overcome the counter-pressure.



As the temperature control valve is used in the heat exchanger systems, "condensate lock" or "stall" can be seen when the steam pressure after the control valve is equal to or less than the counter-pressure after the trap. In systems with condensate lock, a Vira float free condensate pump must be used to deliver condensate to the desired tank or back to the condensate line.

To size Vira float free condensate pump the following informations must be known;

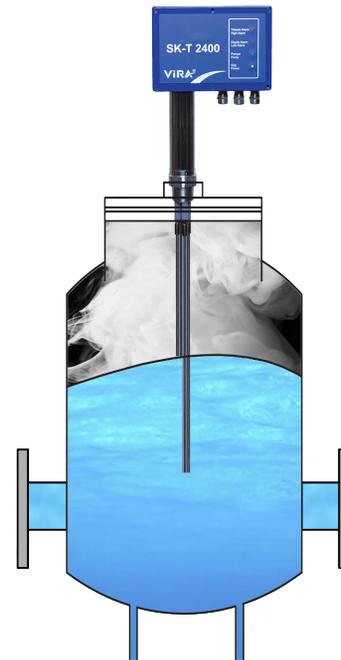
- The maximum condensate flowrate reaching the collector.
- The motive pressure of steam or air available to drive the pump.
- The selection of steam or air will depend on the application and site circumstances.
- The filling head available between the receiver and pump.
- The total delivery head of the condensate system.

Vira Float Free Condensate Pump

Vira float free condensate pumps are designed to remove and recover condensate under all operating conditions and provide opportunity to solve all condensate handling problems.

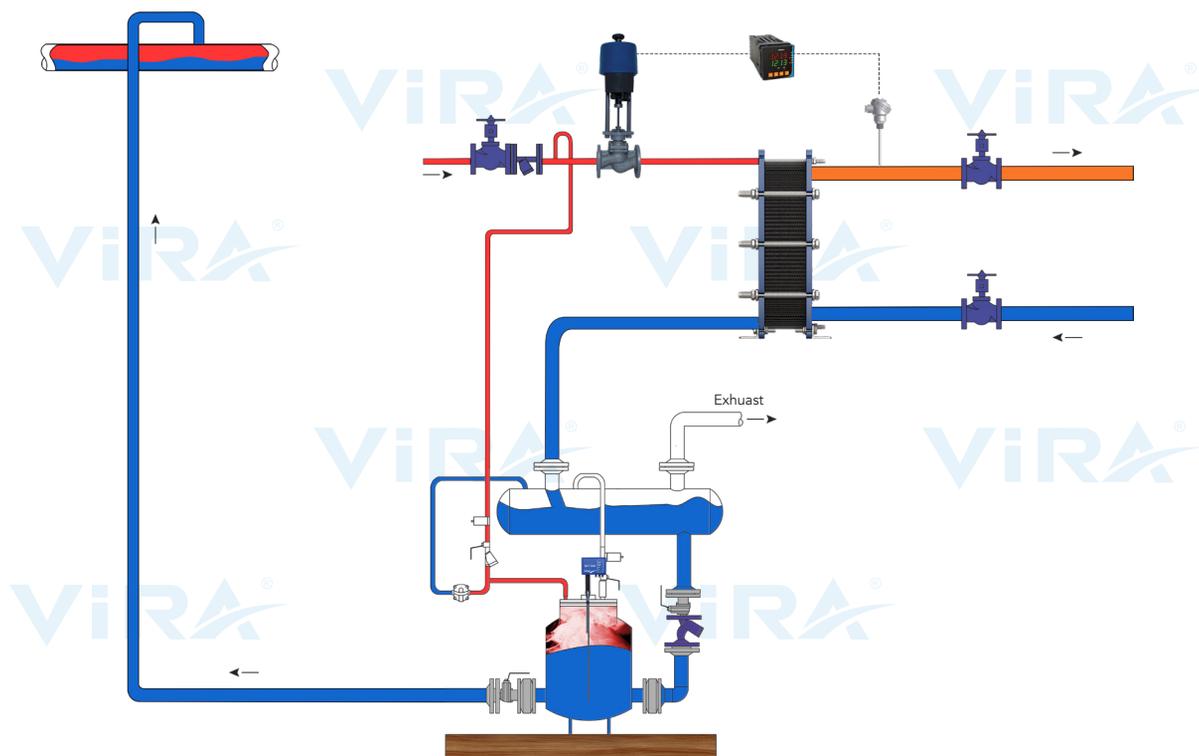
Vira condensate pumps are steam pressure driven pumps that return condensate back to the boiler room; normally using steam pressure as the motive force. Vira float free condensate pumps can be supplied as individual pump units – which include a pump tank and compact level control unit - or as a complete packaged system which also includes the steam valves, steam collector, steam traps, piping, solenoid valves, and ball valves.

There are no moving parts in Vira float free condensate pumps. This helps to reduce plant maintenance problems. It provides no leakage, no cavitation, no spare part need and provides easy installation. The pump can also be monitored, and get alarm remotely by the Compact Level control unit.

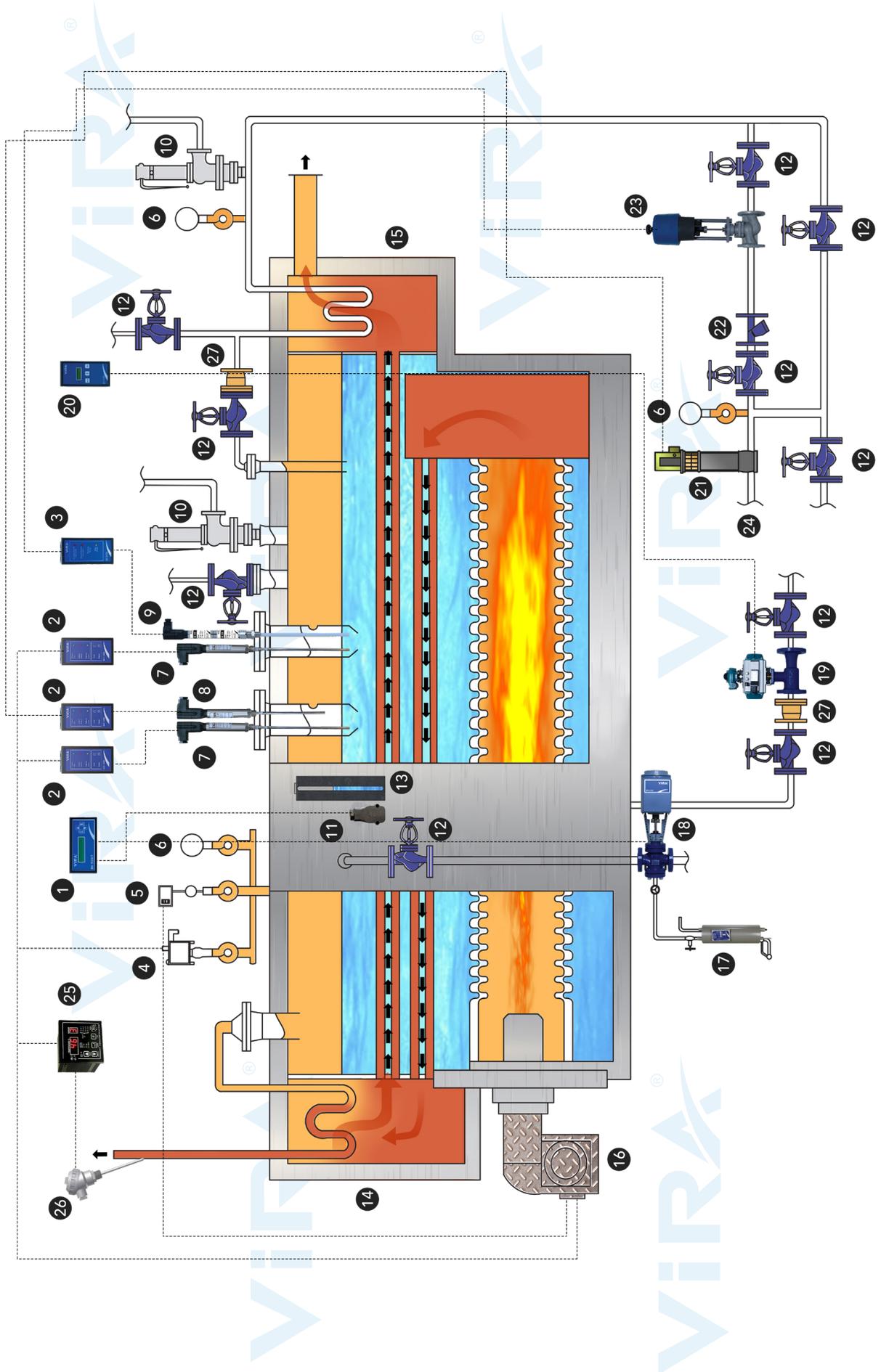


Model	Steam Inlet	Condensate Outlet	Body Material	Collector Inlet	Pressure Class	Collector Vent	Pump Exhaust
KP-14	DN 15	DN 25	ST 37 Carbon Steel	DN 50 x 2	PN 16	DN 50	DN 15
KP-16	DN 15	DN 40		DN 50 x 2		DN 50	DN 15
KP-18	DN 15	DN 50		DN 80 x 2		DN 80	DN 15
KP-20	DN 15	DN 80		DN 80 x 2		DN 80	DN 15

Note: It can be customized according to different system needs.



Condensate Recovery System



72h Operation Without Constant Supervision as per EN 12953

Vira Kodu	No	Fonksiyon
SML 1000	7	SMLD 1000 High Integrity Self Monitoring Low Level Alarm Probe
	2	SMK 1000 High Integrity Self Monitoring Level Alarm Controller
SMH 1000	8	SMHD 1000 High Integrity Self Monitoring High Level Alarm Probe
	2	SMK 1000 High Integrity Self Monitoring Level Alarm Controller
SK 3000	9	SD 3400 Capacitive Level Control Probe with High and Low Level Alarm
	3	SK 3400 Modulating Level Controller with High and Low Level Alarm
	23	SKV 3400 Electrical Control Valve 2/3 Way
	10	Safety Valve
	12	Stop Valve
	4	Pressure Limiter
	5	Pressure Transmitter
	6	Pressure Gauge
BST-4	1	BK 5000-T Conductivity Controller; Conductivity measurement and continuous blowdown
	11	BD 5600-T Conductivity Probe; Conductivity measurement and continuous blowdown
	18	BKV 5400 Conductivity Blowdown Valve; Conductivity measurement and continuous blowdown
NK 20	17	NK 20 Sample Cooler
	13	Water Level Gauge
	16	Burner
DB2	19	BKV 4000 Intermittent Blowdown / Bottom Blowdown Valve
	20	BK 4000 Intermittent Blowdown / Bottom Blowdown Controller
	27	Non-Return Valve
	21	Feedwater Pump
	22	Strainer
BS3-T	24	Feedwater / Condensate Monitoring
	14	Superheater
	25	Safety Temperature Limiter Controller
	26	Resistance Thermometer
	15	Economizer

Steam Pipe Sizing Table

Pressure Bar g	Speed m/s	15 mm	20 mm	25 mm	32 mm	40 mm	50 mm	65 mm	80 mm	100 mm	125 mm	150 mm	200 mm	250 mm	300 mm
0,5	15	7	14	24	37	52	99	145	213	394	648	917	1606	2590	3678
	25	10	25	40	62	92	162	265	384	675	972	1457	2806	4101	5936
	40	17	35	64	102	142	265	403	576	1037	1670	2303	4318	6909	9500
0,7	15	7	16	25	40	59	109	166	250	431	680	1006	1708	2791	3852
	25	12	25	45	72	100	182	287	430	716	1145	1575	2816	4629	6204
	40	18	37	68	106	167	298	428	630	1108	1712	2417	4532	7251	10323
1	15	8	17	29	43	65	112	182	260	470	694	1020	1864	2814	4045
	25	12	26	48	72	100	193	300	445	730	1160	1660	3099	4869	6751
	40	19	39	71	112	172	311	465	640	1150	1800	2500	4815	7333	10370
2	15	12	25	45	70	100	182	280	410	715	1125	1580	2814	4545	6277
	25	19	43	70	112	162	295	428	656	1215	1755	2520	4815	7425	10575
	40	30	64	115	178	275	475	745	1010	1895	2925	4175	7678	11997	16796
3	15	16	37	60	93	127	245	385	535	925	1505	2040	3983	6217	8743
	25	26	56	100	152	225	425	632	910	1580	2480	3440	6779	10269	14316
	40	41	87	157	250	357	595	1025	1460	2540	4050	5940	10476	16470	22950
4	15	19	42	70	108	156	281	432	635	1166	1685	2460	4618	7121	10358
	25	30	63	115	180	270	450	742	1080	1980	2925	4225	7866	12225	17304
	40	49	116	197	295	456	796	1247	1825	3120	4340	7050	12661	19663	27816
5	15	22	49	87	128	187	352	526	770	1295	2105	2835	5548	8586	11947
	25	36	81	135	211	308	548	885	1265	2110	3540	5150	8865	14268	20051
	40	59	131	225	338	495	855	1350	1890	3510	5400	7870	13761	23205	32244
6	15	26	59	105	153	225	425	632	925	1555	2525	3400	6654	10297	14328
	25	43	97	162	253	370	568	1065	1520	2530	4250	6175	10629	17108	24042
	40	71	157	270	405	595	1025	1620	2270	4210	6475	9445	16515	27849	38697
7	15	29	63	110	165	260	445	705	952	1815	2765	3990	7390	12015	16096
	25	49	114	190	288	450	785	1205	1750	3025	4815	6900	12288	19377	27080
	40	76	177	303	455	690	1210	1865	2520	4585	7560	10880	19141	30978	43470
8	15	32	70	126	190	285	475	800	1125	1990	3925	4540	8042	12625	17728
	25	54	122	205	320	465	810	1260	1870	3240	5220	7120	13140	21600	33210
	40	84	192	327	510	730	1370	2065	3120	5135	8395	12470	21247	33669	46858
10	15	41	95	155	250	372	626	1012	1465	2495	3995	5860	9994	16172	22713
	25	66	145	257	405	562	990	1530	2205	3825	6295	8995	15966	25860	35890
	40	104	216	408	615	910	1635	2545	3600	6230	9880	14390	26621	41011	57560
14	15	50	121	205	310	465	810	1270	1870	3220	5215	7390	12921	20538	29016
	25	85	195	331	520	740	1375	2080	3120	5200	8500	12560	21720	34139	47128
	40	126	305	555	825	1210	2195	3425	4735	8510	13050	18630	35548	54883	76534
15	15	85	148	241	417	567	935	1335	2061	3548	5574	8052	13943	21977	31521
	25	141	247	402	695	945	1559	2224	3434	5913	9292	13420	23239	36629	52536
	40	226	395	643	1112	1513	2494	3559	5495	9461	14868	21427	37182	58607	84057
17	15	96	167	271	470	639	1053	1503	2321	3996	6278	9067	15702	24749	35497
	25	159	278	453	783	1064	1756	2505	3864	6659	10464	15113	26170	41249	59162
	40	255	445	724	1252	1704	2809	4008	6188	10654	16743	24180	41872	65999	94659
20	15	112	195	317	549	747	1232	1758	2715	4673	7343	10606	18365	28948	41519
	25	186	325	530	915	1245	2054	2929	4523	7788	12239	17677	30609	48247	69199
	40	298	520	847	1465	1993	3285	4688	7238	12463	19548	28282	48975	77196	110718
24	15	133	232	378	654	889	1466	2094	3232	5565	8744	12629	21868	34468	49437
	25	221	387	631	1090	1482	2445	3488	5386	9274	14573	20048	36448	57448	82396
	40	355	620	1008	1744	2373	3912	5582	8618	14839	23319	33676	58316	91918	131833
28	15	154	269	437	757	1029	1696	2422	3739	6437	10114	14608	25296	39871	57186
	25	256	448	729	1261	1714	2828	4035	6230	10728	16868	23347	42161	66453	95312
	40	410	717	1167	2017	2745	4525	6457	9969	17164	26974	38955	67457	106326	152498
34	15	186	324	528	913	1241	2047	2923	4512	7767	12205	17627	30523	48112	69004
	25	309	541	880	1522	2069	3413	4869	7518	12944	20342	29378	50874	80186	115009
	40	495	865	1408	2434	3312	5460	7791	12029	20712	32548	47005	81397	128299	184013
42	15	231	401	654	1131	1537	2535	3620	5588	9620	15117	21833	37806	59591	85469
	25	382	670	1090	1885	2562	4227	6030	9311	16033	25195	36388	63013	99319	142451
	40	613	1071	1744	3015	4103	6763	9650	14900	25654	40315	58221	100819	158913	227920

SATURATED STEAM TABLE

Gauge Pressure Pg (Bar g)	Absolute Pressure Pa (Bar)	Temperature T (°C)	Specific Volume V (m ³ /kg)	Saturated Water hf (kj/kg)	Evaporation hfg (kj/kg)	Saturated Steam hg (kj/kg)
0	1,013	100	1,673	419,04	2257	2676
0,2	1,213	105,1	1,414	440,8	2243,4	2684,2
0,4	1,413	109,55	1,225	459,7	2231,3	2691
0,6	1,613	113,56	1,088	476,4	2220,4	2696,8
0,8	1,813	117,14	0,971	491,6	2210,6	2702,1
1	2,013	120,42	0,881	505,6	2201,1	2706,7
1,2	2,213	123,46	0,806	518,7	2192,8	2711,5
1,4	2,413	126,28	0,743	530,5	2184,8	2715,3
1,6	2,613	128,89	0,689	541,6	2177,3	2718,9
1,8	2,813	131,37	0,643	552,3	2170,1	2722,4
2	3,013	133,69	0,603	562,2	2163,1	2725,5
3	4,013	143,75	0,461	605,3	2133,4	2738,7
4	5,013	151,96	0,374	640,7	2108,1	2748,8
5	6,013	158,92	0,315	670,9	2086	2756,9
6	7,013	165,04	0,272	697,5	2066	2763,5
7	8,013	170,5	0,24	721,4	2047,7	2769,1
8	9,013	175,43	0,215	743,1	2030,9	2774
9	10,013	179,97	0,194	763	2015,1	2778,1
10	11,013	184,13	0,177	781,6	2000,1	2718,7
11	12,013	188,02	0,163	798,8	1986	2784,8
12	13,013	191,68	0,151	815,1	1972,5	2787,6
13	14,013	195,1	0,141	830,4	1959,6	2790
14	15,013	198,35	0,132	845,1	1947,1	2792,2
15	16,013	201,45	0,124	859	1935	2794
16	17,013	204,38	0,117	872,3	1923,4	2795,7
17	18,013	207,17	0,11	885	1912,1	2797,1
18	19,013	209,9	0,105	897,2	1901,3	2798,5
19	20,013	212,47	0,1	909	1890,5	2799,5
20	21,013	214,96	0,0994	920,3	1880,2	2800,5
22	23,013	219,65	0,0868	941,9	1860,1	2802
24	25,013	224,02	0,0797	962,2	1840,6	2803,1
26	27,013	228,15	0,074	981,6	1822,2	2803,8
28	29,013	232,05	0,0689	999,7	1804,4	2804,4
30	31,013	235,78	0,0645	1017	1787	2804,1
32	33,013	239,28	0,0605	1033,9	1770	2803,9

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