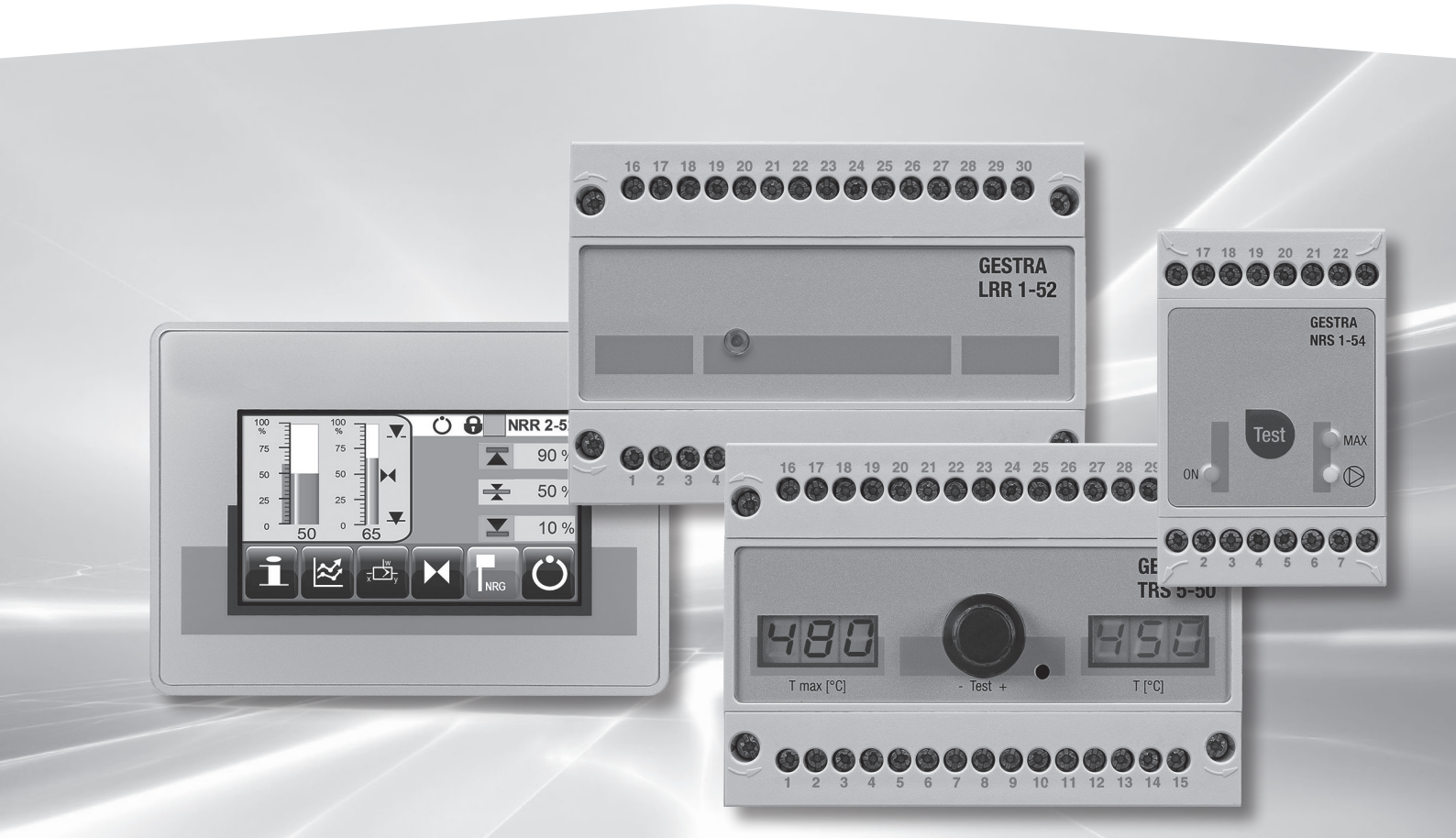
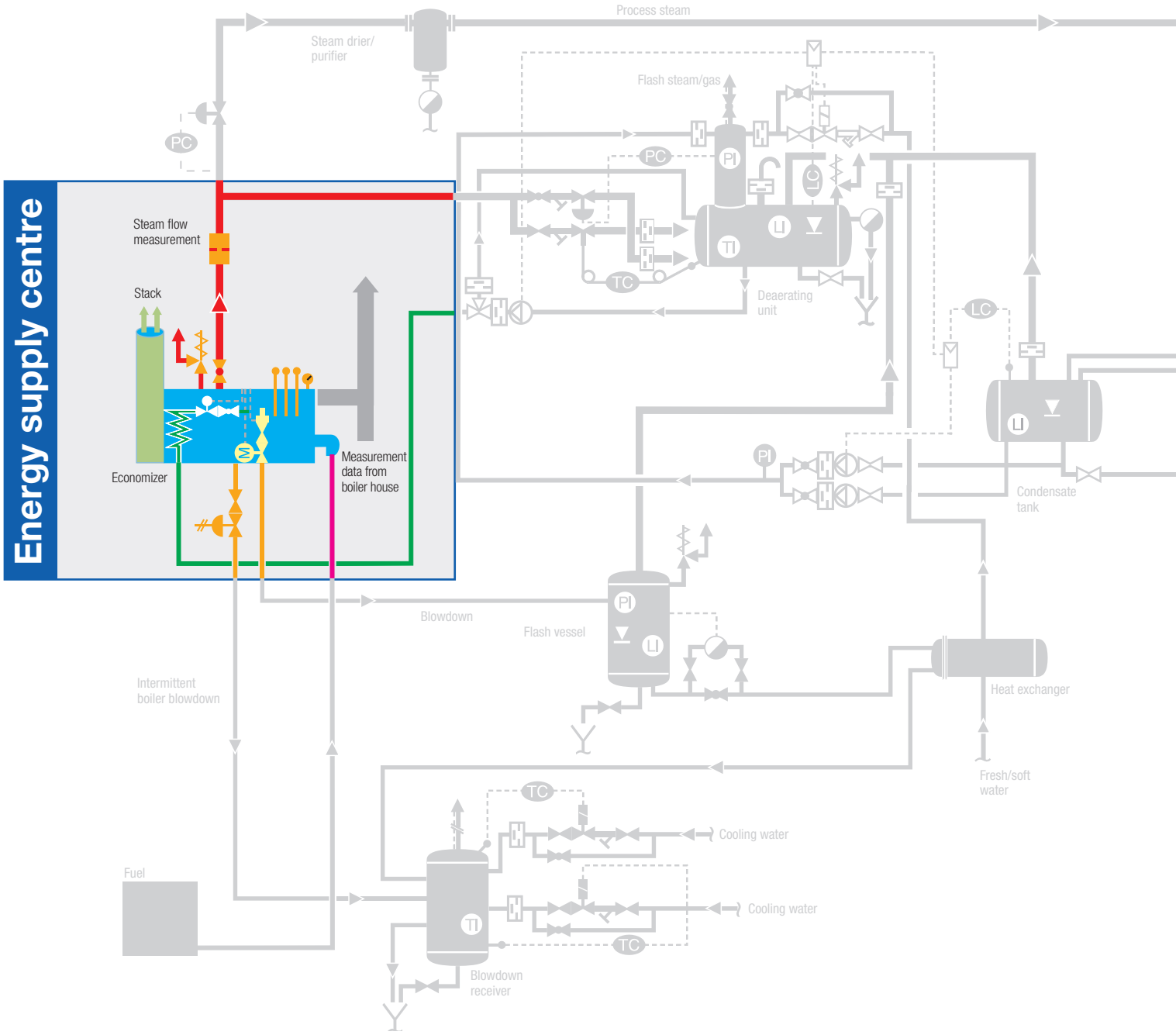
Equipment for Energy Supply Centres

SPECTOR*module for Land and Marine Applications*



Engineering steam performance

Steam and condensate systems with one-stop sophistication



Content

Overview

Safety, reliability, availability and economy have always enjoyed top priority in boiler operation. To an increasing extent, another aspect is being added for the plant operators: process automation and visualization.

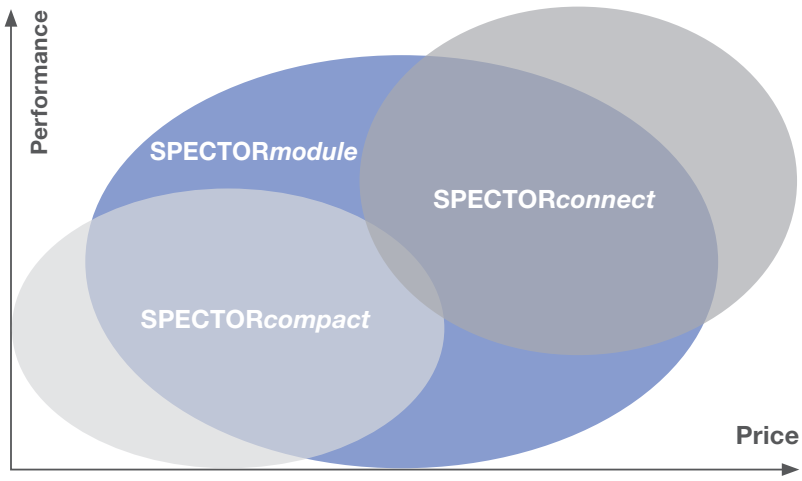
To meet these stringent requirements, GESTRA AG has – for more than five decades now – been working exclusively with electrode systems that are low in maintenance and wear; in contrast to other systems, they function entirely without moving parts, which leads to high service lifetimes and very low failure rates.

By now, these GESTRA electrode systems are being applied in many different areas of the energy supply centre. In addition to the boiler equipment itself, these units are also used in condensate tanks, pump-driven return installations, steam regenerators etc. With a low response sensitivity of > 0.5 µS/cm, even operation with demineralization equipment does not pose a problem. In general, the entire energy supply centre is only as effective as its weakest element. Many plant operators, designers and manufacturers are therefore no longer prepared to enter into any compromises in this area.

Nothing is as cost-intensive as a production outage.
Over and above these aspects, the requirements for the equipment of an energy supply centre tend to differ greatly. The requirements can no longer be met with one and the same system, as was perhaps the case only 10 to 15 years ago. The wishes expressed by the customers have always been the driving force behind GESTRA's innovative developments, and this is still the case today.

There is no longer a "one size fits all" system for customer requirements!
Another step forward was taken for the GESTRA equipment components through the introduction of the SPECTOR family, which focuses on meeting the customer's specific needs. The family now consists of SPECTOR*compact*, SPECTOR*connect* and SPECTOR*module*.

SPECTOR*compact*
SPECTOR*compact* comprises systems that facilitate the easy replacement of existing self-acting systems.



Measurement values are transferred as standard 4–20 mA signals or can be incorporated into existing controllers via integrated volt-free relay contacts without any need for additional electronic control units. If necessary, controllers are of course also available for implementing the entire controlled systems.

SPECTOR*connect*
SPECTOR*connect* offers easy integration into automation concepts by means of remote data transmission and parameter setting. Thanks to many technical innovations, the design, erection and commissioning of plants is simplified considerably. A tried and tested system that meets the requirements made on boiler equipment today and in the future. Now, with SPECTOR*connect*, a large amount of process-relevant data can be transmitted for the first time. Further information is given in the separate brochure "Equipment for Energy Supply Centres – SPECTOR*connect*".

SPECTOR*module*
The SPECTOR*module* line represents a systematic advancement of the proven GESTRA technology. Using the most modern electronic components and constituting the state of the art, these systems were designed with a focus on ease of handling, reducing the installation expense, and providing cost-effective solutions.

New units were developed as demand-oriented solutions for boiler automation. The scope of the parameterization was limited to the most essential functions to ensure intuitive operating of the controllers.

Depending on the task at hand, the customer can choose between the system variants SPECTOR*module* and SPECTOR*module* Touch.

The Benefits

SPECTOR*module* concentrates on the key functions, and the parameters are set by means of a rotary pushbutton.

SPECTOR*module* Touch
The SPECTOR*module* Touch version focuses on the essentials: the main functions and a clear, intuitive user interface.

With this series, the controller was separated from the operating unit, which means that the laborious wiring for sensors, feedback, limits, valve actuation etc. in the control cabinet door is no longer required.

Universal controllers generally entail a large number of parameter settings, making the operating workflow and the setting of parameters more difficult.

In the development of the SPECTOR*module* Touch series, clear and easily understandable operating was a top priority.

Thanks to the intuitive user interface, the operator can enter the parameters rapidly and reliably. The colour touch display leads directly to the parameterization level. A virtual numerical keypad is shown, so that values can be changed or functions selected.

Care was taken to ensure that the various controllers always have the same clear, uniform operating structure.

To give customers and plant operators greater convenience, we design our systems with a focus on
- optimized system interfaces
- minimized maintenance

GESTRA – always the right solution!

SPECTOR*module*
- Compact design
- Easily accessible connection terminals
- Supply voltage 24 VDC, i.e. independent of national supply voltages
- Supply via reliable networks possible without additional components (inverters)
- Intuitive operating using rotary pushbutton
- Indication by 7-segment digital display

SPECTOR*module* Touch
- Separation of power components and operating level, i.e. no elaborate wiring needed in the control cabinet door
- Use of a colour touch display for intuitive, clear operating that is language-neutral

Level:
- Intuitive operating through touch display incl. visualization of the actual, set and control values
- Trend plot
- PI control response

Optional:
- 3-element control
- Actual-value output 4–20 mA

Conductivity:
- Intuitive operating through touch display incl. visualization of the actual, set and control values
- Type approval as per “WÜ 100” (VdTÜV bulletin on water monitoring facilities)
- Integrated purging pulse
- Integrated program-controlled intermittent blowdown
- Interlocking input to prevent simultaneous operation of two or more intermittent blowdown valves at one blowdown receiver

The 24 VDC version offers the following advantages
- Uniform DC power supply for sensors and electronic control units alike
- Through that, improved EMC control
- Independence from different national mains voltages
- Avoidance of the need for uncommon (and costly) device variants
- Easily adaptable operation with reliable voltage supplies

Only 230 VAC available as the supply voltage? No problem,
we have tailormade power supply units to bridge the gap.

Total connected power:

< 12 W < 60 W < 120 W

The selection of the right power supply unit or the allowable extra load on the existing 24 VDC supply depends on the total consumption of the connected units.

With the sensors LRGT and NRGT in the 24 VDC version, which by now have come into widespread use, we achieve a standardized power supply arrangement.

Sample calculation for a 24 V power supply unit:

Unit	Power	Qty	Total consumption
NRS 1-50, 1E/2E	7 W	1	7 W
NRS 1-51	7 W	1	7 W
NRGT 26-1	5 W	1	5 W
NRR 2-52 mit	5 W	1	5 W
URB 50	8 W	1	8 W
LRGT 16-1	3 W	1	3 W
LRR 1-52 mit	5 W	1	5 W
URB 50	8 W	1	8 W
MV 340c	8 W	1	8 W
		Sum	56 W

At a Glance

Limiter systems with type approval and SIL 3 certification

	NRS 1-50 1E	NRS 1-50 2E	NRS 1-51	TRS 5-50
	Level limiter	Level limiter	High-level alarm	Temperature limiter
Options:				
Supply voltage	230 VAC	230 VAC	230 VAC	
Response sensitivity	> 0.5 µS/cm	> 0.5 µS/cm	> 0.5 µS/cm	
Actual value				4–20 mA

Capacitive level control and signalling of limit levels

SPECTOR*module*

	NRS 2-50	NRS 2-51	NRR 2-50	NRR 2-51
Input switchable – active	NRGT 26-1	NRGT 26-1	NRGT 26-1	NRGT 26-1
Input switchable – passive	NRG 26-21 NRG 21-11 NRG 21-51	NRG 26-21 NRG 21-11 NRG 21-51	NRG 26-21 NRG 21-11 NRG 21-51	NRG 26-21 NRG 21-11 NRG 21-51
Function	Min Max	Max PP on/off Min	Max 3 pos. stepping	Max Modulating 4–20 mA Min
Options:				
Actual value 4–20 mA	Yes	Yes	Yes	
3-element input	–	–	–	–
Marine		Yes	Yes	

Conductivity switch/controller

SPECTOR*module*

	LRS 1-50	LRR 1-50	LRR 1-51	
Input				
- Passive	LRG 16-4 Pt100 LRG 16-9	LRG 16-4 Pt100 LRG 16-9		
- Active			LRGT 1.-.	
Function	Max Min	Max Valve open/ running/closed	Max Valve open/ running/closed	
Actual value		4–20 mA	4–20 mA	

Conductive level control and signalling of limit levels

SPECTOR*module*

	NRS 1-52	NRS 1-53	NRS 1-54	NRS 1-55
Input	NRG 1.-52 NRG 16-4	NRG 1.-52 NRG 16-4	NRG 1.-52 NRG 16-4	NRG 1.-52 NRG 16-4
Function	Min Max	Min, two channels	Fill/discharge PP on/off Max	Discharge/Fill PP on/off Min
Response sensitivity	> 0.5/10 µS/cm	> 0.5/10 µS/cm	> 0.5/10 µS/cm	> 0.5/10 µS/cm

SPECTOR*module*-Touch

	URB 50 NRR 2-52	URB 50 NRR 2-53
	NRGT 26-1	NRGT 26-1
	NRG 26-21 NRG 21-11 NRG 21-51	NRG 26-21 NRG 21-11 NRG 21-51
	Max 3 pos. stepping Min	Max Modulating 4–20 mA Min
	Yes	Yes
	2 × 4–20 mA	2 × 4–20 mA

SPECTOR*module*-Touch

	URB 50 LRR 1-52	URB 50 LRR 1-53
	LRG 16-4 Pt100 LRG 16-9	
		LRGT 1.-.
	Max Valve PI control Min (Intermittent blowdown)	Max Valve PI control Min (Intermittent blowdown)
	4–20 mA	4–20 mA

Temperature monitor

SPECTOR*module*

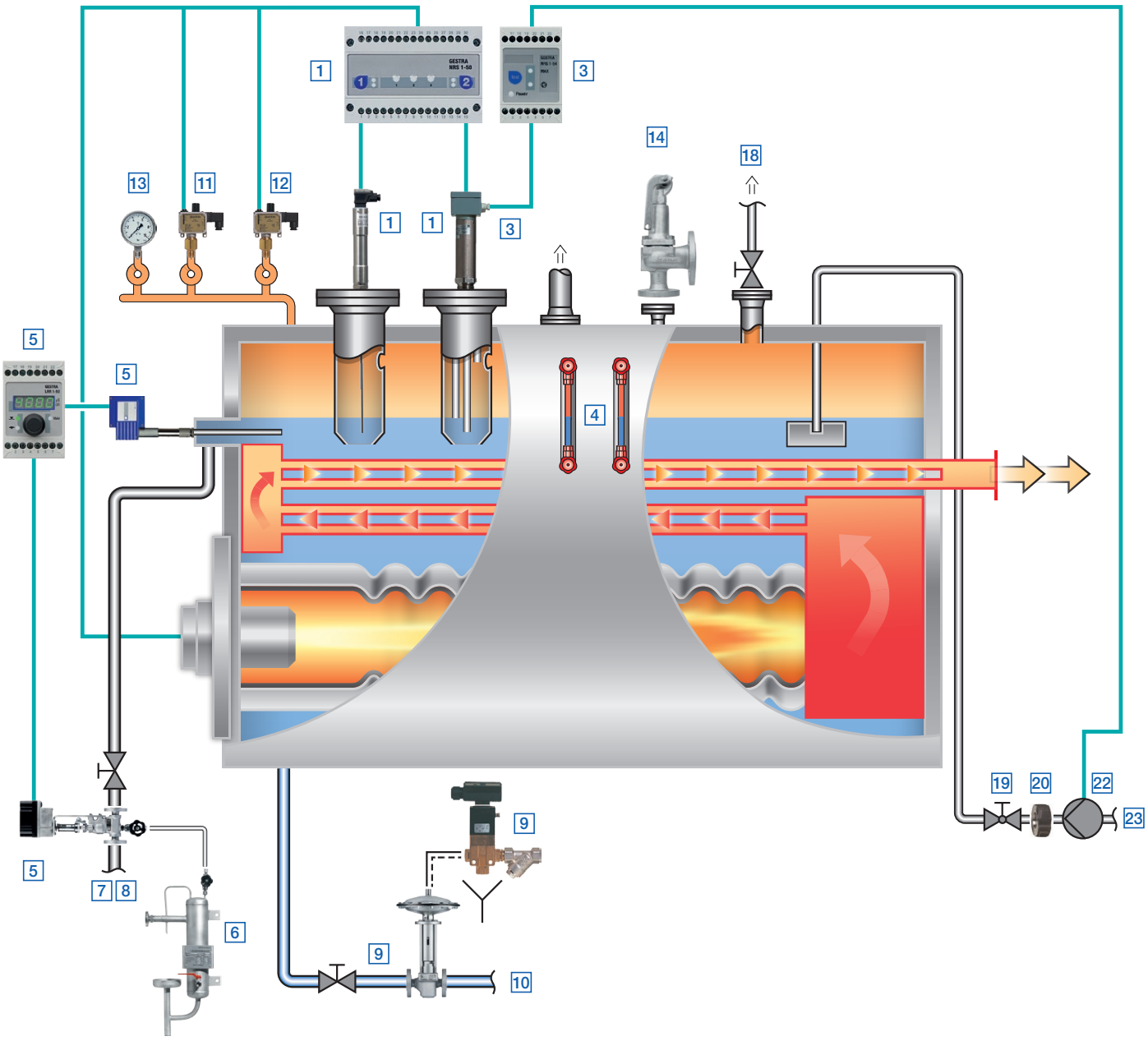
	TRS 5-52
Input	TRG 5-6.
Function	Max Min

Option:

Actual value	4–20 mA

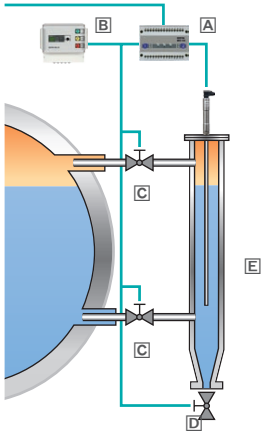
GESTRA Steam Boiler Equipment – SPECTOR*module* –

For operation with limited supervision, e.g. as per TRD 602 (2 h)



Key	Function	Measuring point	EN 12953	TRD 604	Page
1	Low-level limiter of “high-integrity design”: level electrode NRG 16-50, NRG 16-36, level switch NRS 1-50, SIL 3	LSZA–	■	■	16
3	Level control with high-level alarm: level electrode NRG 16-36 (as controller), level switch NRS 1-54	LCSA+	■	■	18
4	Water level gauge	LI			
5, 9	Conductivity measurement and continuous/intermittent blowdown: conductivity electrode LRGT 16-2, continuous blowdown controller LRR 1-51, continuous blowdown valve BAE; cycling timer TA, intermittent blowdown valve MPA	QISZA+ QC	■	■	34
6	Sample cooler				30
7	Blowdown flash vessel				
8	Residual blowdown cooler				
10	Blowdown receiver				
11	Pressure limiter DSF	PSZA+	■	■	
12	Pressure transmitter DRT	PC	■	■	
13	Pressure gauge	PI	■	■	
14	Safety valve GSV	PSV			
18	Vent valve				
19	Stop valve (also in bypass)				
20	Non-return valve				
22	Feedwater pump				
23	Monitoring of the feedwater/condensate	QSZA+	■	■	32

Externally mounted level limiter

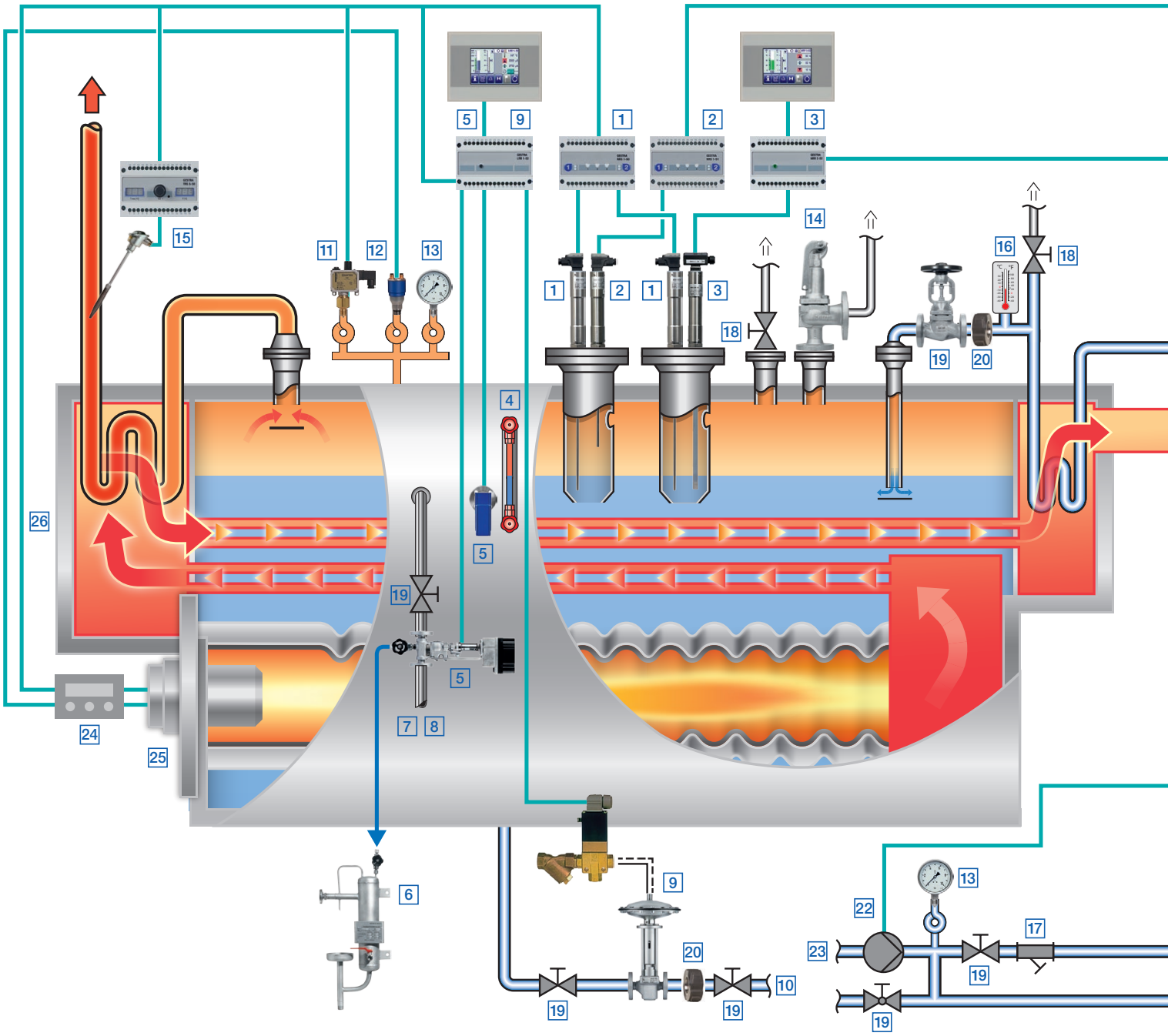


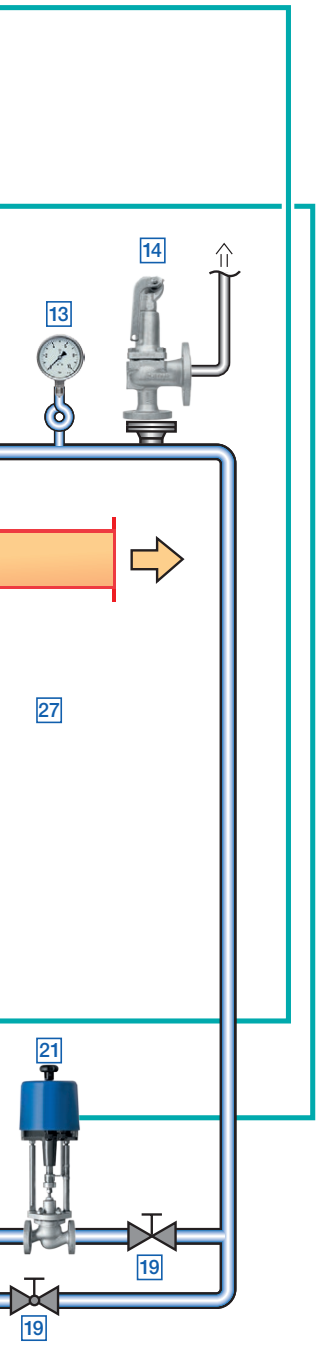
- A Low-level limiter of “high-integrity design”, certified to SIL 3: level electrode NRG 16-50, level switch NRS 1-50
- B Monitoring unit SRL 6-50 (24 h / 72 h)
- C Shut-off valve with two limit switches
- D Drain valve with one limit switch
- E Measuring pot

Required as per TRD 604 (72 h), otherwise depending on the hazard analysis.

GESTRA Steam Boiler Equipment – SPECTOR*module* –

For operation without constant supervision as per EN 12953 (72 h)

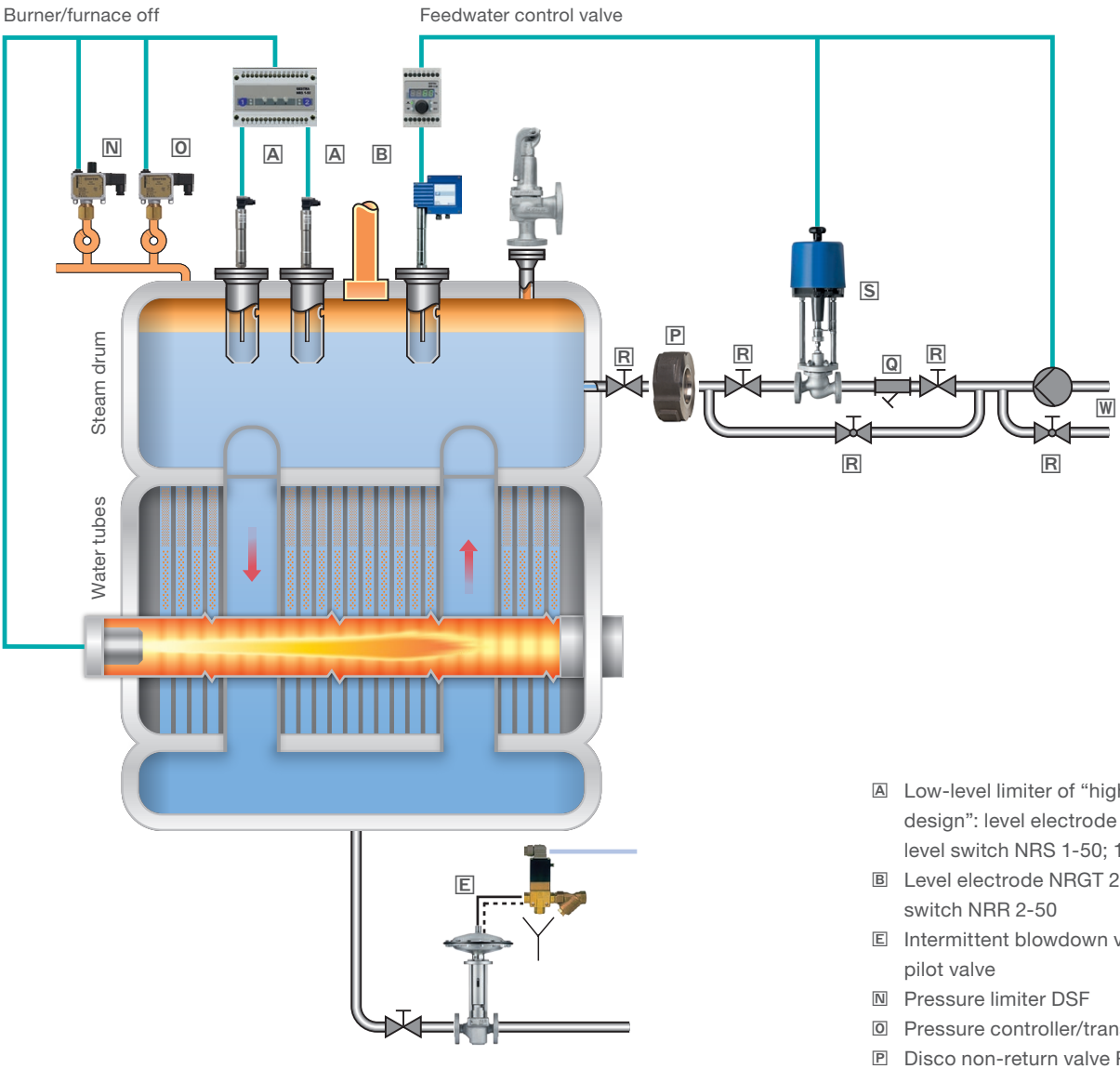




Key	Function	Measuring point	EN 12953	TRD 604	Page
1	Low-level limiter of “high-integrity design”: level electrode NRG 16-50, level switch NRS 1-50, SIL 3	LSZA–	■	■	16
2	Separate high-level alarm of “high-integrity design”: level electrode NRG 16-51, level switch NRS 1-51, SIL 3	LSA+		■	16
3	Level control with high-level alarm and remote water level indicator: level probe NRG 26-21, level controller NRR 2-52, control terminal and display unit URB 50 and control valve	LICSA+	■	■	18
4	Water level gauge	LI			
5	Conductivity measurement with indication, limit switch and ontinuous blowdown control: conductivity electrode LRGT 16-2, ontinuous blowdown control: conductivity electrode LRGT 16-2, down valve BAE, control terminal and display unit URB 50	QICSZA+	■	■	26
6	Sample cooler				30
7	Blowdown flash vessel				
8	Residual blowdown cooler				
9	Automatic intermittent blowdown: intermittent blowdown valve MPA, pilot valve	QC	■	■	26
10	Blowdown receiver				
11	Pressure limiter DSF	PSZA+	■	■	
12	Pressure transmitter DRT	PC	■	■	
13	Pressure gauge	PI	■	■	
14	Safety valve GSV	PSV			
15	Safety temperature monitor/limiter: resistance thermometer TRG, temperature switch TRS 5-50, SIL 3	TSZA+	■	■	28
16	Thermometer	TI			
17	Strainer				
18	Vent valve				
19	Stop valve (also in bypass)				
20	Non-return valve				
21	Electrical or pneumatic control valve				
22	Feedwater pump				
23	Monitoring of the feedwater/condensate	QISZA+	■	■	32
24	Burner control unit				
25	Burner				
26	Superheater				
27	Economizer				

GESTRA Equipment for Steam Generators – Marine Boilers –

Equipment with maritime approvals



- A Low-level limiter of “high-integrity design”: level electrode NRG 16-50S, level switch NRS 1-50; 15 secs
- B Level electrode NRGT 26-1S, level switch NRR 2-50
- E Intermittent blowdown valve MPA, pilot valve
- N Pressure limiter DSF
- O Pressure controller/transmitter
- P Disco non-return valve RK 86
- Q Strainer GSF
- R Stop valve GAV
- S Electrical/pneumatic control valve
- W Monitoring of the fresh water:
  - Demineralization equipment: using conductivity monitoring
  - Partial demineralization equipment: by monitoring residual hardness (not part of our product range)

Technical Information

GESTRA Equipment for Steam Generators – Marine Boilers –

By making just a few technical modifications, we were able to adapt our well-proven boiler equipment to the special requirements (as regards vibration, air conditioning, EMC etc.) of various classification societies. We can provide our customers with a large number of acceptance inspections – such as GL, LR, See-BG, RINA, NKK, ABS, KR, BV and DNV – which guarantee that the GESTRA equipment range meets the requirements of the international market.

We can offer the following equipment packages:

Steam boilers

Low-level limiter of “high-integrity design”:
- NRG 16-50S/NRS 1-50 see page 16

Level controller, intermittent control:
- NRGS 16-1S (fixed switchpoints)
- NRGT 26-1S/NRS 2-51 (variable switchpoints)
  modulating control:
- NRGT 26-1S/NRR 2-50/..-52

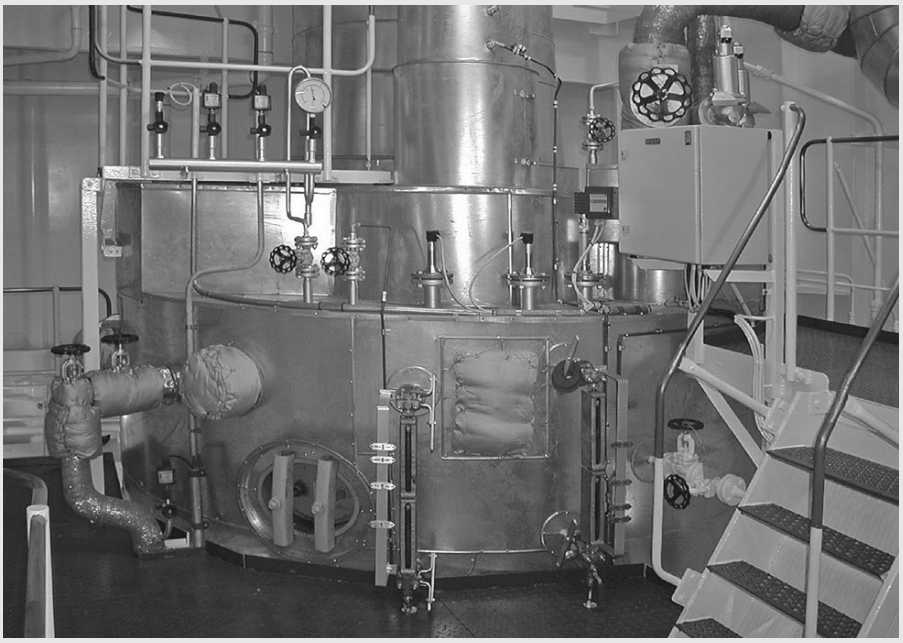
Combination equipment:
- NRG 16-38S/1 × NRS 1-50, 1E (NRG 16-11 + NRGT 26-1)
- NRG 16-39S / 1 x NRS 1-50, 2E (2 × NRG 16-50S + NRGT 26-1S)

Safety temperature limiter (for superheaters) of “high-integrity design”:
- TRG 5-../TRS 5-50 see page 28

Feedwater monitoring:
- LRGT 16-1 see page 24
- LRG 16-9/LRS 1-7

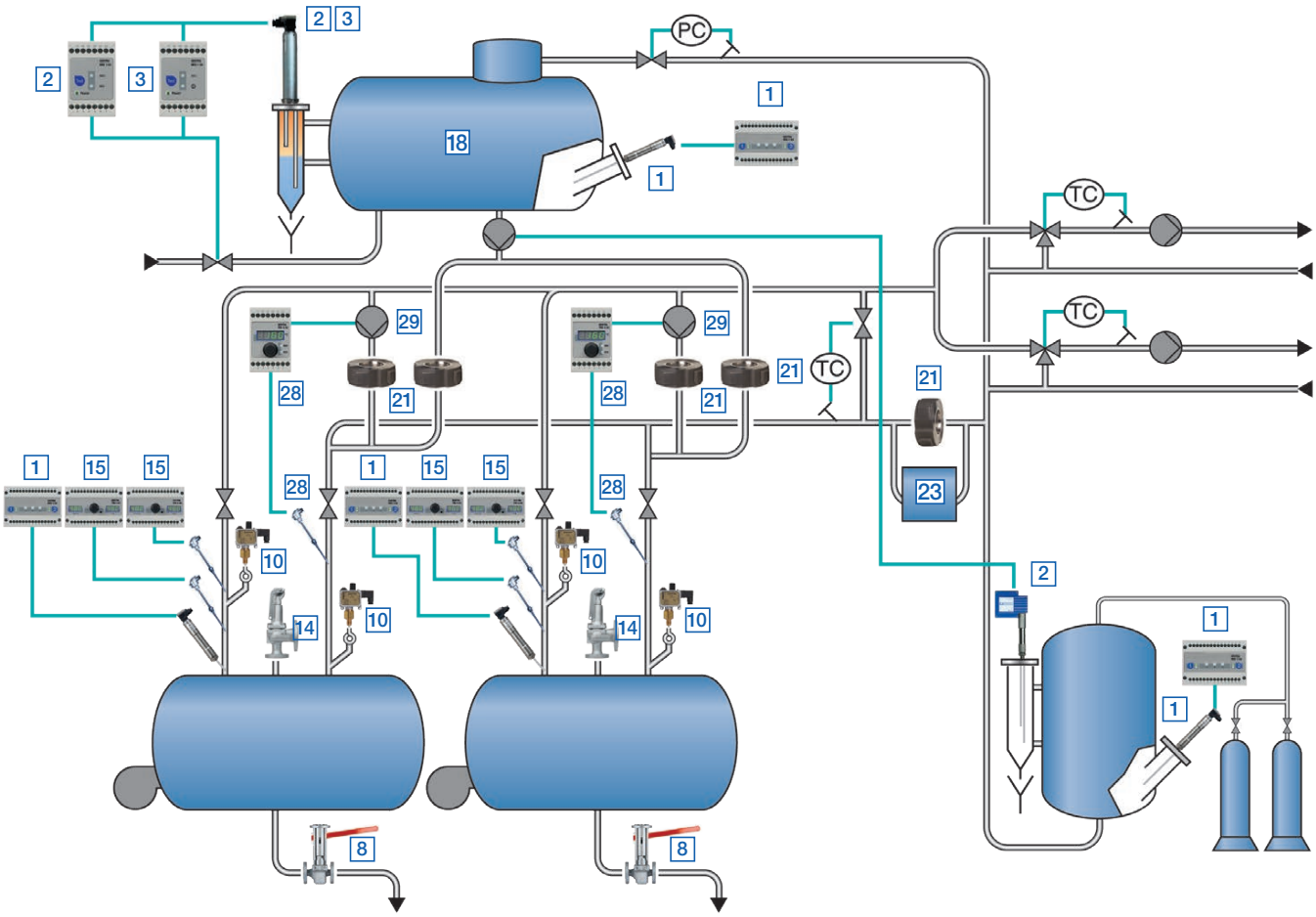
Cooling water monitoring:
- ORGS 11-2

The ORGS 11-2 features a measuring pot that is installed in a bypass and uses gravity to separate oil droplets from water. When approx. 50 ml of oil have accumulated in the “dome” of the measuring pot, the conductivity electrode and the associated electronic control unit will raise an alarm. Due to the qualitative measuring principle, the system is particularly suitable for closed systems, such as cooling water systems for engines etc.



GESTRA Equipment for Pressurized Hot-Water Plants

– Conventional – for high-pressure hot-water generation with separate pressurizing vessel



Key	Function	Measuring point	EN 12953	TRD 604	Seite
1	Low-level limiter of “high-integrity design”: level electrode level switch NRS 1-50, SIL 3	LSZA–	■	■	16
2, 3	Level control with high-level alarm and remote water level indicator: level probe NRG 16-52, switching controller NRS 1-54, NRS 1-52 (HW)	LICSA+	■	■	18
8	Intermittent blowdown valve PA	QC	■	■	
10	Pressure limiter DSH (MAX), DSL (MIN)	PSZA+ (–)	■	■	
14	Safety valve GSV	PSV			
15	Safety temperature monitor/limiter: resistance thermometer TRG, temperature switch TRS 5-50, SIL 3	TSZA+	■	■	28
18	Feedwater tank				
21	Non-return valve				
23	Monitoring of the return flow	QISZA+	■	■	32
28	Return temperature elevation: resistance thermometer TRG, temperature switch TRS 5-52	TC–	■	■	28
29	Admixture pump				

Technical Information

Low-Level Limiters (LW) up to PN 320

The limiters consist of a combination of level electrode and level switch. In general, a distinction must be made between units of “conventional design” and those of “high-integrity design” (i.e. with self-monitoring). The corresponding applications for the units are defined in the technical rules and depend mainly on the hazard potential of the plant. The basis for units of “conventional design” is the maximum operating pressure of the boiler (PED 0.5 bar, TRD 701 1 bar).
The self-monitoring limiters of “high-integrity design” are based on the MR/2VR8 system concept proven over decades, with constant advancements through the systems ER 86/NRS 1-4, NRG 16-11/NRS 1-7 and NRG 16-40 / NRS 1-40. With the system SPECTOR*module* NRG 16-../NRG 17-../ NRG 19-.. and NRG 111-50 / NRS 1-50 and the combination electrode NRG 16-36, we offer equipment that reflects the current state of safety technology.

On the basis of the applicable EN standards, the units were developed and manufactured according to IEC 61508 “Functional safety” and certified to SIL 3.

Of course, the limiters comply with the PED (Pressure Equipment Directive) and have TÜV and EU type approval. Owing to the requirements for pressurized hot-water plants and to meet the demands for increased availability, one- and two-electrode versions were developed for the level switches.

If particularly high demands are made on the availability of boiler plants, the “2-out-of-3” circuit is often used.

With this arrangement, the safety chain is only interrupted when at least two limiters give the signal for low-water or fault. If the self-monitoring triggers for only one of the limiters, the plant remains available and the malfunctioning unit can be checked during planned downtime.

High-Level Alarm (HW)

For the high-level alarm, there are also various systems available whose areas of application are primarily determined not by the technical literature but by the downstream users of the steam.

Of the diverse standards, only TRD 604 (72 operation) poses the requirement that the high-level alarm must be a unit separate from the controller and limiter. In the other codes, including EN, this requirement is not expressed.

In addition to the demands of the technical codes, the hazards represented by overfilling and entrained boiler water in the downstream sections must also be considered within the scope of the risk assessment. This concerns the danger to the subsequent steam lines, heating surfaces, apparatus etc.

The units of “high-integrity design” which, as with the level limiters, monitor both the electromechanical part of the electrode and the evaluation in the level switch, are used particularly where a high hazard potential must be expected. Units of “conventional design” are applied wherever no direct damage is likely to occur.

Externally mounted level limiters of “high-integrity design”

To safeguard the high safety standard of the level limiters even when they are mounted outside the boiler, it is imperative that the regular, controlled purging of the measuring pot be monitored properly. The logic unit SRL 6-50 is used for monitoring the flushing procedure.

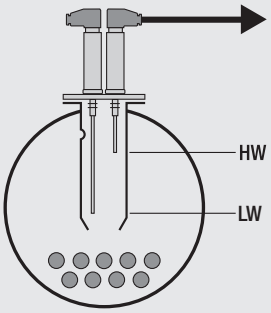
Safe at its best!

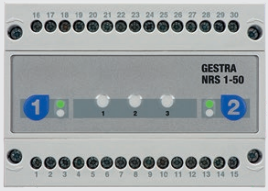
Functional safety is the part of the overall safety that depends on the correct operation of the safety-related systems or subsystems and of external risk reduction facilities.

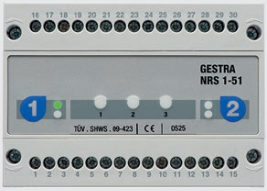
As a consequence, the area of functional safety only covers the overall safety to a limited extent, i.e. it does not include electrical safety, fire protection, radiation protection etc.

Because safety functions are increasingly being implemented in modern systems by electronic components, especially programmable ones, the fundamental challenge relating to functional safety lies in ensuring the correct function of complex programmable systems. Suitable methods must therefore be applied to prevent systemic faults (usually resulting from human error in the specification, implementation etc.) and to control possible failures and malfunctions (usually resulting from phenomena of the operational environment). In this connection, one refers to the “safety integrity” of the protection or safety function.

The relevant aspects of functional safety for electrical or electronic (programmable) systems are described in the







standard IEC 61508 “Functional safety of electrical/electronic/programmable electronic safety-related systems”.

SPECTOR*module* – SIL 3 certified

- One level switch for two electrodes
- Separate undelayed signal contacts for each electrode
- Autonomous functional tests
- Forcibly guided safety relays for the safety chain
- Three LEDs to support the error diagnosis
- Indicators for each electrode:
  - Flashing (red) = switch-off point reached
  - Steady light (red) = switch-off point reached and time delay elapsed => switch-off
  - Steady light (green) = ready indication for each electrode
- Supply voltage 18–36 VDC, i.e. direct supply via reliable networks possible without additional components, such as inverters (optionally 85–240 V 48–62 Hz)
- Standby input for monitoring logic with interlocking (monitoring of the flushing procedure in the case of installation in an external measuring pot)

Type	NRS 1-50 1E	NRS 1-50 2E	NRS 1-51
Number of sensor inputs	1 (NRG 1.-50)	2 (NRG 1.-50)	1 (NRG 1.-51)
Functions	Min level limiter Burner off		Max level limiter Pump off/ burner off
- Time delay 3 seconds	■	■	■
- Response sensitivity 10 µS/cm	■	■	■
- Operating with membrane keyboard	■	■	■
Indicators			
- LED green for power	■	■	■
- LED red for alarm	■	■	■
- LED red for diagnosis	■	■	■
Supply voltage 24 VDC, 7 W	■	■	■

Options:

Single-electrode emergency mode		■	
Time delay 15 seconds	■	■	
Mains supply 100–240 VAC	■	■	■
Response sensitivity > 0.5 µS/cm	■	■	■
	 *NRG 1.-50*		 *NRG 1.-51*

Technical Information

On/Off Level Controllers/Limit Switches with Fixed Switchpoints – Conductive Measurement –

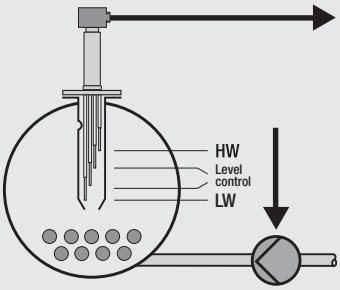
SPECTOR*module*

Depending on the parameters of boiler capacity, required steam quality, plant economy and degree of automation, the make-up arrangement is differentiated into the on/off and modulating control modes. Within the on/off controls, these are subdivided further into those with fixed switchpoints and those with continuously adjustable switchpoints. Besides make-up, these systems are also used for the simple signalling of limits, e.g. protection against pumps running dry, level limiters of “conventional design”, high-level alarms or high-level limiters of “conventional design”.

As with the “high-integrity design”, the switchpoints are determined by the length of the electrode tips, and therefore cannot be changed during operation.

On/off control (pump on/off))

This solution is mainly used in steam boiler plants of low capacity (< 3–5 t/h), in condensate and feedwater tanks, and is frequently also rounded off with the implementation of the entire pump control. The intermittent make-up of relatively cool feedwater (103 °C) naturally leads to strongly modulating operation of the burner and to intense thermal-shock stresses in the boiler. Through the intermittent feedwater flow, integration into a heat recovery concept or exhaust-gas cooling using the economizer principle is not possible. For fulfilling this task and performing the limit signalling, several solutions are available from the SPECTOR*module* system. For more information, see the following pages of this brochure.



Type	NRS 1-52	NRS 1-53	NRS 1-54	NRS 1-55
Electrode input	NRG 16-4, NRG 10-52, NRG 16-52, NRG 16-36 (controller part)			
Compatible with the legacy electrodes	ER 16, ER 50, ER 56			
Functions				
- Max limit	■		■	
- Pump on/off			Fill/discharge	Discharge/fill
- Min limit	■	2 channels		■
Supply voltage 24 VDC, 2 W	■	■	■	■

Options:

> 0.5/10 µS/cm switchable	■	■	■	■

NRG 16-4

NRG 1.-52

NRG 16-36

Technical Information

On/Off Level Controllers with Variable Switchpoints / Limit Switches or Modulating Level Control – Capacitive Measurement –

SPECTOR*module*

Using limit switches with variable switchpoints opens up the possibility of adapting on/off controls or limit values to changing operating conditions while the system is in operation. This is feasible because the capacitive measurement by the probe supplies a signal to the electronic control units that is proportional to the level; the desired switchpoint can therefore be set at the level switches. This measurement also makes it possible to generate a level-proportional 4–20 mA signal and send it to a remote level indicator, to the process control system etc.

Modulating systems (control valves, frequency-controlled pumps)

With modulating control, one thinks first of the economical operation, higher steam quality and the capability of adapting to difficult situations regarding the controlled systems, e.g. those caused by sudden changes in steam consumption, as is the case for process-related reasons in the rubber, foodstuff and building-materials industries.

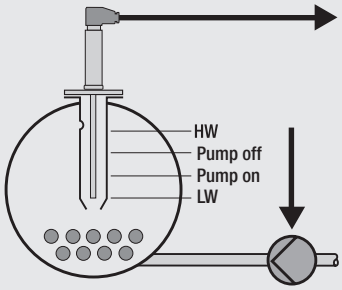
The greater operational economy and the higher steam quality are naturally a welcome aspect of the controlled, demand-oriented make-up of the boiler water. On the one hand, this mode ensures more continuous burner operation and, on the other, the boiler water level is not elevated as high as with the two-position control, which then appreciably reduces the danger of carry-over or of limits being reached.

Diverse solutions from the SPECTOR*module* family are available to us for implementing such systems. Here we distinguish between active and passive probes, and for the electronic control units between the SPECTOR*module* und SPECTOR*module* Touch designs.

In the case of the active probes (NRGT 26-1), the probe itself already delivers a standard 4–20 mA signal to the electronic control units. For this, the probe is given a separate supply voltage. With the passive probes (NRG 26-21), the preamplifier in the probe is supplied by the electronic control unit, returning a level-dependent voltage signal to the electronic control unit. This voltage signal is then normalized in the electronic control unit.

At the electronic control units of the SPECTOR*module* series, the switchpoints are adjusted by means of a rotary pushbutton. Another feature of the user interface is that the functions have been reduced to the minimum necessary.

With the SPECTOR*module* Touch series, we offer a multitude of technical possibilities allowing optimum adaptation to the tasks and requirements.



Type	NRS 2-50	NRS 2-51	NRR 2-50	NRR 2-51
Electrode input selectable				
- Passive - Active	ER 96, NRG 26-11, NRG 26-21, NRG 21-11, NRG 21-51 NRGT 26-21			
Functions				
- Max limit	■	■	■	■
- Pump on/off selectable		Fill/discharge		
- Control			3-pos. stepping	Modulating
- Min limit	■	■		
- 100% calibration value freely selectable from 25% level	■	■	■	■
Display				
- Actual value 0–100%	■	■	■	■
- LED red, Max	■	■		
- LED red, Min	■	■		
- LED yellow		Pump on/off	Valve open/closed	
Operating				
Rotary pushbutton	■	■	■	■
Supply voltage 24 VDC, 4 W	■	■	■	■

Options:

Actual-value output 4–20 mA	■	■	■	
Min instead of Max limit			■	■

NRG 2.-11/-21

NRGT 26-1

Technical Information

Modulating Level Controllers with Variable Switchpoints and Limits – Capacitive Measurement

SPECTOR*module* Touch

In the field covered by the SPECTOR-*module* Touch series, the experience of the last three decades was evaluated and integrated here to optimize the established systems. The level controllers NRR 2-5. permit a number of standard applications and offer further options that allow the designer and operator to use the system that is best for his particular application.

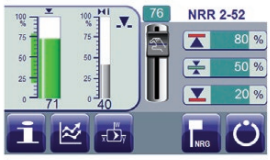
Parameters are set at the SPECTOR-*module* Touch intuitively and quickly by means of a colour touch display with direct access to the relevant parameter value. When an input field is touched, a numeric keyboard appears; after the input has been made, the device returns to the original window.

No complicated programming levels, no cryptic abbreviations!

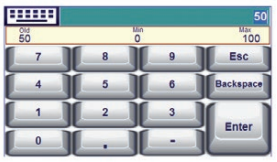
As is already familiar from the bus technology, here we have also placed the highest priority on cost optimization in installation and commissioning. The 100 % calibration of the level probe can take place from any level > 25 %, which leads to considerable savings in commissioning time and feedwater. Another advantage of the bus technology was also adopted: the separation of power components and operating units for the controller. One of the benefits here is that it is no longer necessary to install the costly cable harnesses in the control cabinet between the mounting panel and the cabinet door. Thanks to the numerical and bar graph display of the actual value in the touch display, the controller can at the same time be used as a second water level indicator as per EN 12952-7 section 5.4.1, EN 12953-6 section 5.1.1 and TRD 401 section 8.1. **Only a local water-gauge glass is necessary in this case.**

For the controllers, three-position stepping as well as modulating controllers are available; both can be expanded by the function of 3-element control. Even problematic load conditions can be managed in this way.

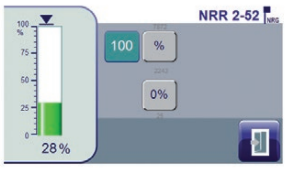
Operating level for manual operation



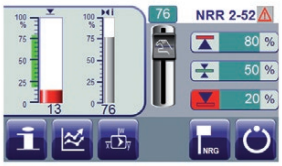
Easy setting of parameters via numeric keyboard



100% calibration possible at levels > 25%!

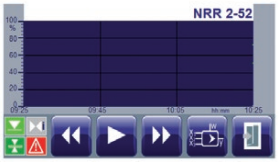


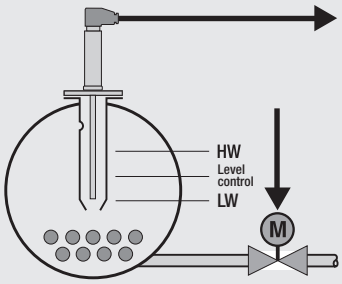
Display of e.g. MIN alarm



Display of the contact; red = Alarm

Trend plots





Type	NRR 2-52	NRR 2-53
Special input selectable		
- Passive - Active - Compatible with the legacy probes	NRG 26-21, NRG 21-11, NRG 21-51 NRGT 26-1 ER 96, NRG 26-11	
Functions		
- Control	3-pos. stepping	Modulating controller
- Control characteristic	P/PI	P/PI
- Limit value	Max, Min	Max, Min
- 100% calibration value freely selectable from 25% level	■	■
Intuitive operating	Colour touch display with direct access	
Indicators in the display	Bar graph for actual value, set point, manipulated variable Numerical display for actual value, set point, manipulated variable Trend plot of alarms (colour change)	

Options:

Actual value 4–20 mA	■	■
Password protection	Can be set on the device	
3-element control	Input of steam flowrate: 4–20 mA Input of water flowrate: 4–20 mA	

NRG 2.-11/-21

NRGT 26-1

Technical Information

Boiler Water Monitoring

Safe operation of steam boilers at high availability necessitates:

1. Modern treatment of the boiler water, designed to meet economic criteria and operational conditions in accordance with EN 12952 part 12, EN 12953 part 10 and TRD 611 (TRD = German Technical Rules for Steam Boilers)

2. The corresponding care and monitoring of the boiler water through constant measurement of the conductivity, monitoring for limit transgressions, continuous top blowdown and periodic bottom blowdown.

Depending on the type of treatment, a certain amount of salts passes into the water cycle all the time. Some of these (mainly calcium and magnesium salts), together with other impurities, remain in the water as hardness constituents.

As a result of the evaporation process, the salt content in the boiler water tends to rise. To prevent deposits or the risk of an excessive dissolved-solids content in the downstream plant components with "foaming and priming" (the result of a salt concentration that is too high), the TDS (total dissolved solids) level must be kept within the admissible limits. This is done in a simple and reliable manner by continuous top blowdown.

Some hardness constituents can contain sediments which pass into the bottom zone of the boiler. Together with the other foreign matter, a sludge layer is produced there which must be discharged with a view to preventing corrosion, poor heat transfer etc. Intermittent bottom blowdown is the proven method.

Continuous (top) and intermittent (bottom) blowdown complement each other. Both processes are usually needed for proper boiler operation. This also applies for boiler types with demineralization plants. Separate monitoring of the boiler water density (TDS level) provides additional safety, and is required by EN 12953 and TRD 604 for 72 h unmanned operation. In plants which are fitted with manually operated continuous and intermittent blowdown valves, it is absolutely necessary for signalling when the limit values have been transgressed.

The aim for modern boiler plants is to achieve not only safe but also economical operation. To optimize the operational economy, energy losses must be kept as low as possible, i.e. by recovering the exhaust heat (for preheating the feedwater or burner air), utilizing the flash steam downstream of the continuous blowdown, saving energy with speed-controlled motors in the feedwater and combustion air control systems etc. An important objective here is, of course, also to reduce the continuous blowdown losses. Optimum continuous blowdown of the boiler plant can be measured on the basis of the "concentration factor", i.e. the relationship between the quality of the feedwater to that of the boiler water. Two main factors play a role in achieving a high concentration factor.

Firstly, the choice of water treatment process and, secondly, optimized continuous blowdown control, with which it is possible to operate the boiler as closely as possible to the limits of the plant, hence reducing the continuous blowdown rates.

As with level control, a distinction is made here between active (LRGT) and passive (LRG 16-4, LRG 16-9) electrodes.

The compact electrodes require a separate supply voltage and, through the integrated Pt1000 sensor, deliver a temperature-compensated output signal of 4–20 mA that is proportional to the conductivity. The passive electrodes are supplied with power from the electronic control unit and deliver a separate conductivity-proportional voltage signal and the temperature-dependent resistance from a Pt100 sensor.

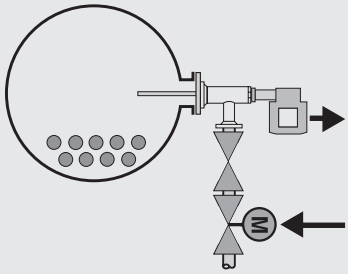
Similarly, a differentiation is also made with this application between the two series SPECTOR*module* and SPECTOR*module* Touch. All systems are type-approved on the basis of the VdTÜV bulletin "Water Monitoring 100" (WÜ 100).

The SPECTOR*module* controllers have the minimum set of functions that are necessary. The intermittent blowdown valves are actuated via a separate cycling timer. The SPECTOR*module* Touch controllers have a large number of technical improvements and can therefore be adapted optimally to all known requirements. The actuation of the intermittent blowdown valves is integrated into these controllers – as are the intermittent blowdown repetition intervals, standby input for preventing simultaneous intermittent blowdown processes at several boilers, as well as standby mode and purging pulse for the continuous blowdown valves.

With these possibilities, boiler water care and monitoring can be designed to suit the operation of the boiler plant in an ideal manner.

Benefits

- Reliable maintenance of the specified boiler water density, and thus a high level of safety with proper boiler care and extended service life
- No manual intervention, relieving the personnel of routine tasks and also cutting energy consumption
- Can be used for all types and designs of boilers
- Robust units proven in thousand of installations



Type	LRS 1-50	LRR 1-50	LRR 1-51
Electrode input			
- Passive LRG 16-4, LRG 16-9, Compatible with legacy electrodes	■	■	
ERL 16	■	■	
- Active LRGT 16-1, LRGT 17-1, LRGT 16-2			■
Functions			
- Measuring range 0.5–10,000 µS/cm	■	■	■
- Unit switchable µS/cm // ppm	■	■	■
- Automatic temperature compensation	With additional Pt100	With additional Pt100	■
- Max limit	■	■	■
- Control		3-pos. control	3-pos. control
- Min limit	■		
- Actual value 4–20 mA		■	■
- Flushing procedure		■	■
Display			
- Actual value 0–9999 µS/cm	■	■	■
- LED red Max	■		
- LED red Min	■	■	■
- LED yellow		Valve open/closed	Valve open/closed
Operating:			
Rotary pushbutton	■	■	■

Options:

Solenoid valve instead of Min limit	■		

LRG 16-4

LRG 16-9

LRGT 1.-.

Technical Information

Boiler Water Care

SPECTOR*module* Touch

With regard to the convenience controllers, the experience gained with the various systems over the last three decades was evaluated and integrated here to optimize the established technologies. The conductivity controllers LRR 1-52/-53 permit a number of standard applications and offer further options that allow the plant designer/operator to use the system that is best for his particular application.

Parameters are set at the convenience controller intuitively and quickly by means of a colour touch display with direct access to the relevant parameter value. When an input field is touched, a numeric keyboard appears; after the input has been made, the device returns to the original window.

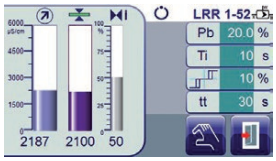
No complicated programming levels, no cryptic abbreviations!

As is already familiar from the bus technology, we have also placed the highest priority on cost optimization in installation and commissioning. Another advantage of the bus technology was also adopted: the separation of power components and operating units for the controller. The benefit is no costly cable harnesses in the control cabinet leading to the cabinet door. Thanks to the numerical and bargraph presentation of the actual value on the touch display, the controller meets the demands of WÜ 100 regarding a permanent, temperature-compensated display of the conductivity, without the need for an additional indicator. With the convenience controllers, a distinction is made between active (LRGT) and passive (LRG 16-4, LRG 16-9) electrode inputs.

Main screen with mini-contact

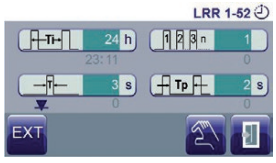
Main screen with intermittent blowdown

Setting the controller parameters

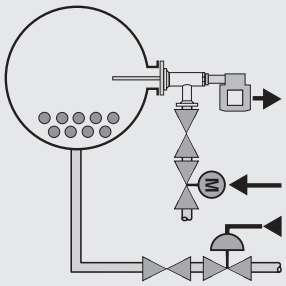


Easy setting of parameters via numeric keyboard

Program-controlled interm. blowdown with pulse rep.



Alarm list



Type	LRR 1-52	LRR 1-53
Electrode input		
- Passive		
LRG 16-4, Compatible with legacy electrodes	■	
ERL 16, LRG 17-1, LRG 19-1	■	
TRG 5-6., Pt100	■	
LRG 16-9 inkl. Pt100	■	
- Active		
LRGT 16-1, LRGT 17-1, LRGT 16-2		■
Functions		
- Measuring range dynamic 0.5–10,000 µS/cm	■	■
- Units switchable µS/cm // ppm; °C // °F	■	■
- Automatic temperature compensation	with Pt100	■
- Control switchable	3-pos. control // 3-pos. stepping control	
- Max, Min limit	■	■
- Standby input	■	■
- Program-controlled intermittent blowdown	■	■
- Interlock for intermittent blowdown	■	■
Supply voltage 24 VDC, 13 W	■	■
Intuitive operating	Color touch display with direct access	
Indicators in the display	Bar graph for actual value, set point, manipulated variable; numerical display for actual value, set point, manipulated variable; trend plot for alarms (colour change)	
LED green	Power	

Options:

Password protection	Can be set on the URB 50	
	 *LRG 16-4*  *LRG 16-9*	 *LRGT 1.-.*

Technical Information

Safety Temperature Monitors (Limiters)/Temperature Monitors

Safety temperature monitors/limiters are used for steam boilers with superheaters and in the inlet flow of pressurized hot-water plants. When used in combination with an external interlock of the safety chain, the safety temperature monitor operates as a safety temperature limiter. Safety temperature limiters are used in the return line of pressurized hot-water plants and serve to elevate the temperature from the inlet flow when the return flow has cooled down too far.

As with the systems for level detection, here GESTRA also uses exclusively electronic systems that distinguish themselves particularly through high accuracy, low drift and time-saving procedures for commissioning. In keeping with the high demands GESTRA makes of its components in respect of safety, the safety temperature limiter was developed, manufactured and certified to SIL 3, on the basis of the applicable EN standards as per IEC 61508 “Functional safety”.

Of course, the limiters comply with the PED (Pressure Equipment Directive) and have TÜV and EU type approval.

Safety at its best!

Functional safety is the part of the overall safety that depends on the correct operation of the safety-related systems or subsystems and of external risk reduction facilities.

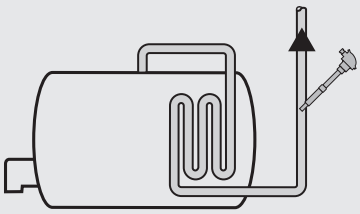
As a consequence, the area of functional safety only covers the overall safety to a limited extent, i.e. it does not include electrical safety, fire protection, radiation protection etc.
Because safety functions are increasingly being implemented in modern systems by electronic components, especially programmable ones, the fundamental challenge relating to functional safety lies in ensuring the correct function of complex programmable systems. Suitable methods must therefore be applied to prevent systemic faults (usually resulting from human error in the specification, implementation etc.) and to control possible failures and malfunctions (usually resulting from phenomena of the operational environment).

In this connection, one refers to the “safety integrity” of the protection or safety function.

The relevant aspects of functional safety for electrical or electronic (programmable) systems are described in the standard IEC 61508 “Functional safety of electrical/electronic/programmable electronic safety-related systems”.

SPECTOR*module* – SIL 3 certified

- Autonomous functional tests
- Forcibly guided safety relays for the safety chain
- Indicators:
  - 3-digit, 7-segment display (red) for the switch-off temperature
  - 3-digit, 7-segment display (green) for the actual temperature
  - Steady light (green) = ready indication for each electrode
- Supply voltage 18–36 VDC, i.e. direct supply via reliable networks possible without additional components, such as inverters (optionally 85–240 V 48–62 Hz)
- Operating by rotary pushbutton



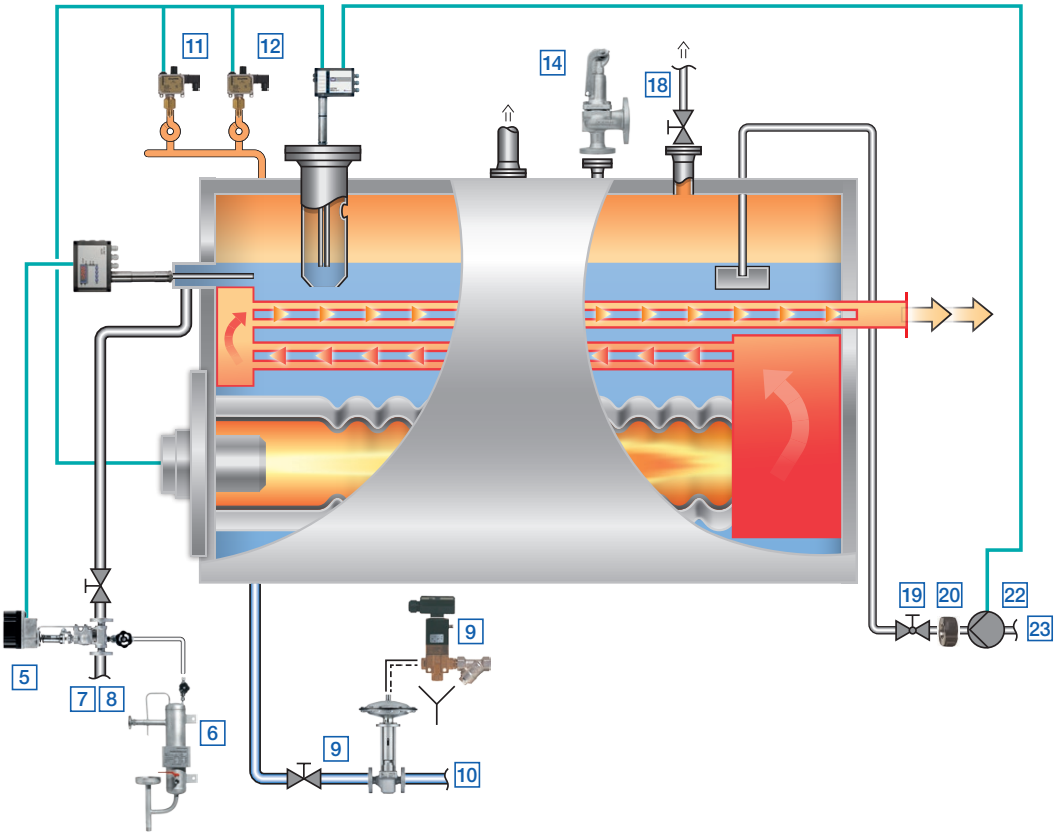
Type	TRS 5-50	TRS 5-52
Sensor input	TRG 5-6.	TRG 5-6.
Functions	Safety temperature monitor/limiter Burner off	Temperature monitor Pump on
Time delay 3 sec	■	
- Max limit - Min limit	2 channels	1 channel ■
Operating Rotary pushbutton	■	■
Indicators - 3-digit, 7-segment (red) - 3-digit, 7-segment (green)	 Switch-off temperature Actual temperature	 Actual/Switch-off temperature
LED red, alarm	■	■
Supply voltage 24 VDC, 7 W	■	■

Options:

Mains supply 100–240 VAC	■	
Current output 4–20 mA	■	■
	 *TRG 5-66*	 *TRG 5-63*

GESTRA Steam Boiler Equipment

SPECTOR*compact* steam boiler plants requiring no supervision, e.g. in non-EU states



Key	Function
X	Low-level limiter of “conventional design” (with test button) incl. on-off level controller: compact system NRGS 15-1 (PN 25) with integrated test and reset buttons
Y, 9	Conductivity measurement and continuous/intermittent blowdown: conductivity electrode LRGT 16-2, continuous blowdown controller LRR 1-51, continuous blowdown valve BAE, cycling timer TA, intermittent blowdown valve MPA
6	Sample cooler
7	Blowdown flashvessel
8	Residual blowdown cooler
10	Blowdown receiver

Key	Function
11	Pressure limiter DSF
12	Pressure transmitter DRT
13	Pressure gauge
14	Safety valve GSV
18	Vent valve
19	Stop and bypass valve
20	Non-return valve
22	Feedwater pump
23	Monitoring of the feedwater/condensate

Technical Information

Sample Cooler PK

Apart from the continuous blowdown, sampling is also of special importance for the smooth operation of steam generating units.

Each GESTRA continuous blowdown valve is fitted with a sample valve, with which boiler water can be removed for analysis.

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; moreover, these samples 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.

The GESTRA sample cooler PK can be fitted downstream of the sample valve, thus enhancing the technical standard of your energy supply centre.

Portable Digital Meter VRM-2/VRM-3

In addition to the chemical reagents needed for analysing the boiler water and condensate, electronic analysis units are indispensable tools for modern steam and hot-water generating plants.

GESTRA has the conductivity testing case VRM-2 to offer. This case contains the conductivity meter and electrode.

The testing case VRM-3 contains, in addition to the conductivity meter and electrode as with the VRM-2, a measuring device for the pH value and temperature, together with accessories such as:
pH probe, Pt100, 5 capsules each for the calibrating solutions pH 4.01; 7.01; 10.01;
1 bottle of 3 mol/L KCl solution, and
1 bottle of Pepsin cleaning solution. The measuring devices operate independently of the mains supply, using a 9 V battery.

VRM-3

VRM-2

Measuring ranges

Conductivity	0	– 200	µS/cm
	0	– 2,000	µS/cm
	0	– 20	mS/cm
	0	– 200	mS/cm
pH-value	0	– 14.0	
Temperature	–50	– +250	°C

Energy Recovery

Energy Recovery after Continuous Blowdown

After the 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. Flash steam coolers offer another way for heat recovery. For example, they can be used for preheating the make-up water by utilizing the flash steam of the feedwater deaerator. 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 investment subsidies.

Technical Information

GESTRA Condensate Monitoring

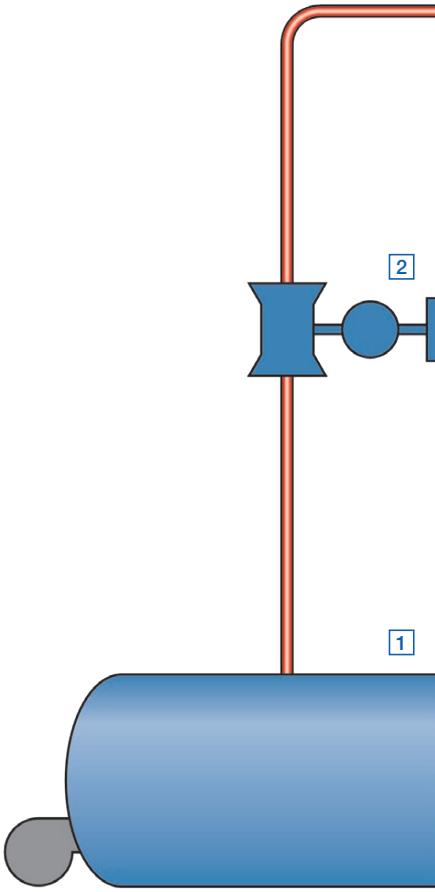
In any heat exchanger that is operated with steam, condensate is produced. Since the condensate contains an appreciable quantity of heat, it would be economically unwise to discharge this condensate unused from the boiler water cycle. Nonetheless, the condensate is often dumped because of fears that it might be contaminated by product ingress. Indeed, the possibility that hydrocarbons, acids, alkalis, dyebaths or other substances may pass through leaky heat-exchanger surfaces into the condensate, thus endangering the boiler operation, cannot be excluded. As a rule, however, the condensate will not be contaminated constantly, i.e. it is generally feasible to include the returning condensate in the boiler water cycle.

If the plants are operated according to TRD 604 or EN 12952/12953, the standard requires constant monitoring of the condensate quality if there is any risk of ingress by the products mentioned above. For this monitoring, a distinction is made between substances which affect the electrical conductivity of the condensate and those which cause turbidity or refraction. The former is sensed by means of conductivity electrodes and evaluated by the associated control units. For the detection of oil, grease and similar substances, oil and turbidity detectors are used.

According to TRD 604, the boiler plant must be shut down on detection of foreign matter ingress if the contaminated condensate can pass into the boiler water cycle. Since the availability of the boiler plant has the highest priority, measures must be taken to prevent such an ingress into the boiler water cycle. In practice, fitting a pneumatic three-way control valve downstream has proven to be effective, i.e. the impure condensate is discharged and then disposed of. This disposal takes place via oil separation systems, for instance, since the contaminated condensate is not allowed to pass into the sewage system.

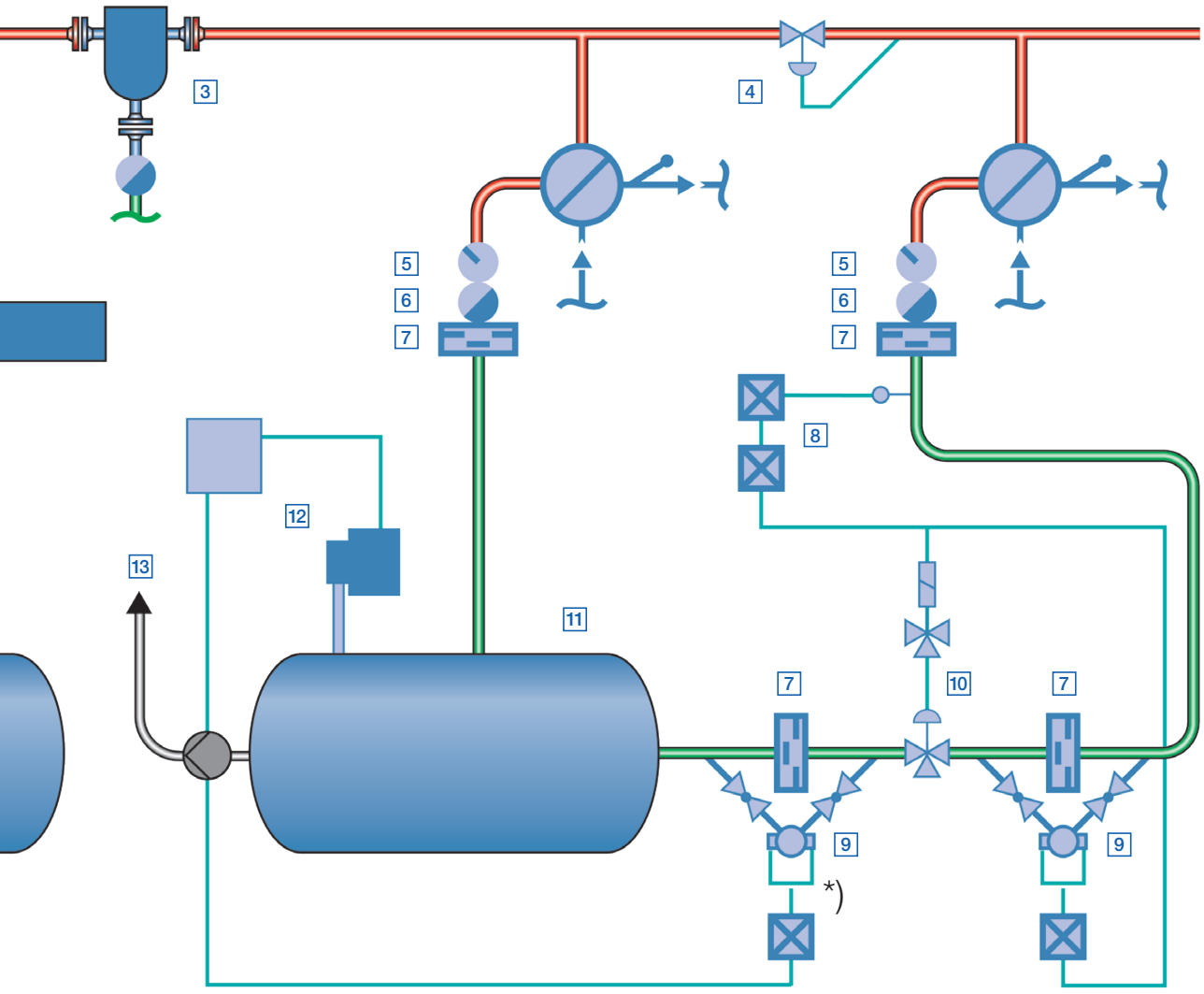
When planning boiler plants according to TRD 604 – 72 h unmanned operation – it is additionally necessary to observe that in this case the oil and turbidity detector is required twofold.

Experience shows that in these cases it is advisable to install the second monitoring unit downstream of the three-way control valve, because only in this way is the function of the valve monitored properly.



GESTRA Condensate Monitoring

According to TRD 604 (72 h) or EN 12953 Part 6 – Steam and Condensate System



1 Steam generator
2 Steam flow measurement
3 Steam drier
4 Pressure-reducing valve
5 Sight glass
6 Steam trap
7 Disco non-return valve RK 86, 20 mbar
8 Monitoring for ingress of foreign substances, such as acids and blowdown: conductivity electrode LRG 16-9, conductivity switch LRS 1-7
9 Monitoring for ingress of foreign substances, such as oil and grease: oil and turbidity detector OR 52-5
10 Pneumatic three-way control valve for discharging the contaminated condensate
11 Condensate tank
12 Condensate discharge control: compact level electrode NRGS 11-1, pump control unit NRSP
13 Feedwater tank

**) only one required by EN*

Technical Information

GESTRA Condensate Monitoring

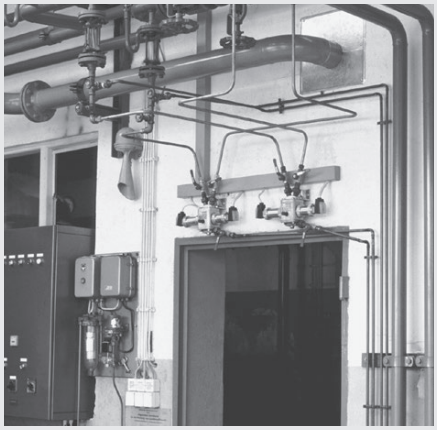
If the downstream oil and turbidity detector senses an impurity, there is the possibility of shutting down the condensate pumps in order to ensure the plant's availability. This step prevents the passage of impure condensate into the boiler water cycle.

In this case, the shutdown should be coupled to an alarm annunciation, so that the operating personnel can intervene appropriately.

Regarding the question as to when monitoring of the return condensate is necessary, a clear rule is given in TRD 604 and EN 12952/12953:

Whenever there is a risk of ingress by foreign substances, but only then!

In the majority of the boiler plants already installed, the condensate is collected in condensate tanks. This is frequently done decentrally in the various production zones, and the condensate is then conveyed to the main condensate tank in the energy supply centre by means of recirculation units working with or without pumps.



Monitoring for grease and oil ingress in two separate condensate return lines

For such extended systems, the most suitable location for the condensate monitoring equipment must of course be considered carefully.

Owing to the increasing pressure of costs with the planning and construction of the plant, the principle frequently applied is to cut the costs as far as possible by reducing the number of units, which often means that the monitoring devices are installed downstream of the condensate tanks. Unfortunately, this approach also signifies that, if there is any ingress of foreign substances, the entire condensate system is contaminated and therefore the entire condensate must be dumped, not to mention the cleaning and disposal costs.

The following rule should be applied:

Mount the monitoring unit as close as possible to the potential source of trouble.

If there are several potential trouble-spots in a facility, it may be necessary to group several condensate lines together before the monitoring point.

But even for this solution, the scope of the grouped lines should be kept within clear limits, so that the source of a fault can be localized quickly.

Conductivity Monitoring

The ingress of conductive substances – such as blowdown, acids, untreated water, dyebaths etc. – is rapidly detected and signalled by the systems LRG 16-9 / LRS 1-7 or the compact system LRGT / URS 2, and the necessary measures are initiated automatically. As explained for boiler water monitoring, these systems function with automatic temperature compensation, i.e. fluctuations in temperature do not lead to a fault indication or initiation of automatic discharge.

Oil and Turbidity Detection

As described above, this monitoring system is used to cover the risk of ingress by hydrocarbons, whey products etc. Because of the various condensates, a system is needed to differentiate, after calibration of the zero point, between soiling and impurities resulting from the condensate system itself and contamination by hydrocarbons, for instance. With the oil and turbidity detector OR, GESTRA has developed a system which can make this distinction through a combination of transmitted and scattered light. False alarms are reduced to a minimum, and system malfunctions are detected automatically.

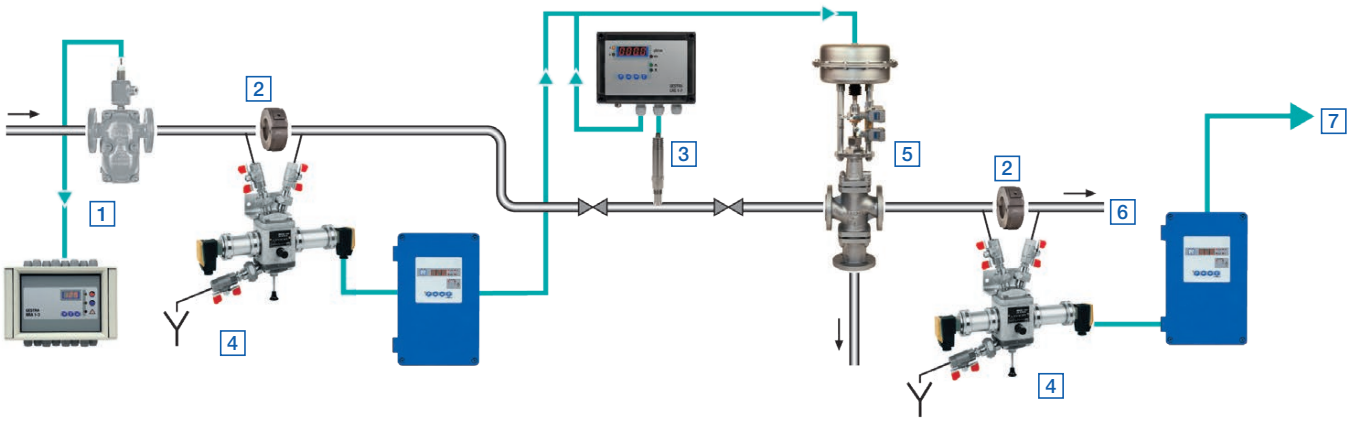
The requirements described for the condensate system must be applied to the same extent for the return flow of pressurized hot-water plants. An essential difference lies in the signal processing, since discharge is not possible or not permissible for hot-water systems.

GESTRA Condensate Monitoring

Please do not disturb!

Since the availability of your boiler plant enjoys highest priority, nothing must be allowed to penetrate the boiler water cycle. With GESTRA oil and turbidity detectors, you obtain automatic compensation of disturbances such as:

- Discolouration
- Lamp ageing
- Soiling of the glasses



Steam and condensate system

1 Steam trap with trap test set: test chamber VKE, electrode NRG 16-19 and test station NRA 1-3 for max. 16 traps

2 Non-return valve RK 86, 20 mbar

Quality control for ingress of foreign matter, using type-approved systems as per VdTÜV bulletin on water monitoring facilities (WÜ 100)

3 Monitoring for ingress of acids, blowdown, raw water etc.: conductivity electrode with integrated resistance thermometer LRG 16-9, conductivity limit switch LRS 1-7

4 Monitoring for ingress of oil, grease etc.: oil and turbidity detector OR

5 Electrical/pneumatic three-way valve for discharging the contaminated condensate

6 Main condensate tank

7 Shutdown of the condensate-return system or interruption of the safety chain

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