



Level Switch

NRS 1-51

EN (USA)
English

Original Installation &
Operating Manual
850695-00

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Content of this Manual

Product:

- Level Switch NRS 1-51

First edition:

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Scope of supply, product package

NRS 1-51

1 level switch NRS 1-51

1 Installation & Operating Manual

How to use this Manual

This Installation & Operating Manual describes the correct use of the NRS 1-51 level switch. It applies to persons who integrate this equipment in control systems, install, bring into service, operate, maintain and dispose of this equipment. Anyone carrying out the above-mentioned activities must have read this Installation & Operating Manual and understood its contents.

- Read this Manual in full and follow all instructions.
- Please also read the instructions for use of any accessories.
- The Installation & Operating Manual is part of the product package. Keep it in an easily accessible location.

Availability of this Installation & Operating Manual

- Make sure this Installation & Operating Manual is always available to the operator.
- If you pass on or sell the equipment to a third party, please also hand over the Installation & Operating Manual.

Illustrations and symbols used

1. Action to be taken

2.

-
- Lists
 - ◆ Bullet points in lists

A Keys to illustrations



Additional
information



Read the relevant
Installation & Operating Manual

Hazard symbols in this Manual



Danger zone, dangerous situation

Types of warning

DANGER

Warning of a dangerous situation that results in death or serious injury.

WARNING

Warning of a dangerous situation that may possibly result in death or serious injury.

CAUTION

Warning of a situation that may result in minor or moderate injury.

ATTENTION

Warning of a situation that results in damage to property or the environment.

Specialist terms, abbreviations

Here, we explain some abbreviations, specialist terms, etc., which are used in this Manual.

NRGT .. / NRR.. / NRS.. / URS .. / URB .. / SRL .. / etc.

Equipment and type designations of GESTRA AG.

SELV

Safety Extra Low Voltage

Operating point (of the plant)

The operating point describes the operating parameters within which a plant or boiler is operated in its nominal range. In a steam boiler, for example, these parameters would be output, pressure, and temperature.

The design data may be a lot more stringent, however.

A boiler that is operated at 145 psi (10 bar) and 356°F (180°C) may be designed to withstand a pressure of 870 psi (60 bar) and a temperature of 527°F (275°C), for example, which is therefore not necessarily its operating point.

Usage for the intended purpose

The NRS 1-51 level switch is used in conjunction with NRG 1...-51 level electrodes as a high level alarm for steam boilers and hot water installations.

A high level alarm prevents the defined high water (HW) level from being exceeded and switches off the feedwater supply, for example, to achieve this. The NRS 1-51 is classified as protective control Class B (C) in accordance with UL 60730-1.

When used as intended, the NRS 1-51 level switch is combined in a circuit with the level electrodes stipulated by the directives or standards below:

Level electrodes NRG 1...-..			
UL 60730-2-15, CAN/CSA E60730-2-15	NRG 16-51	NRG 17-51	NRG 19-51

Applicable directives and standards

The equipment has been tested and approved for use in the scope governed by the following directives and standards:

Standards:

- UL 60730-1 and CAN/CSA E60730-1
General Requirements for Automatic Electrical Controls
- UL 60730-2-15 and CAN/CSA E60730-2-15
Requirements for Automatic Electrical Water Level Sensing Controls

Improper use



There is a danger of death due to explosion if the equipment is used in potentially explosive atmospheres.

Do not use the equipment in potentially explosive atmospheres.



Do not bring any equipment into service that does not have its own specific rating plate.

The rating plate indicates the technical features of the equipment.

Basic safety information



There is a risk of electric shock during work on electrical systems.

- Always switch off the voltage to the plant before performing connection work.
 - Check that the plant is not carrying live voltage before commencing work.
-



Attempts to repair the equipment will cause the plant to become unsafe.

- The NRS 1-51 level switch may only be repaired by the manufacturer, GESTRA AG.
 - Only replace faulty equipment with identical equipment from GESTRA AG.
-

Required personnel qualifications

Activity	Personnel	
Integration in control system	Specialist staff	Plant designer
Installation/electrical connection/ bringing into service	Specialist staff	The equipment may only be installed, wired and brought into service by qualified and competent staff.
Operation	Boiler service technician	Staff trained by the plant operator.
Maintenance work	Specialist staff	Fitting and maintenance work may only be performed by authorized staff who have undergone specific training.
Refits	Specialist staff	Persons trained by the plant operator to work with pressure and temperature.

Notes on product liability

The manufacturer cannot accept any liability for damages resulting from improper use of the equipment.

Function

The NRS 1-51 level switch is designed for different boiler water conductivities and for the connection of a single level electrode.

When the water exceeds the high water level, the level electrode is immersed and an alarm is triggered in the level switch. This switchpoint is determined by the length of the electrode extension (level electrode NRG 1...-51).

When the off delay has elapsed, the two output contacts of the level switch open the control circuit, e.g., for the feedwater supply. If the feedwater cut-off is interlocked in an external control circuit, this interlock can only be deactivated once more when the level electrode is exposed. In addition, the signal contact for external signaling devices closes without a delay.

An alarm is also triggered if faults occur in the level electrode and/or the electrical connection.

If the level electrode is installed in a level pot outside the boiler, make sure the connection pipes are sufficiently large.

The manufacturer recommends connection pipes of ≥ 1.57 in (40 mm) for steam and ≥ 3.94 in (100 mm) for water. If smaller connection pipes or fittings are used, these shall not be smaller than 1-inch NPS. The level pot must have a suitable flushing device at its lowest point. This device flushes the connection pipes to the boiler.

No shut-off valves of any type shall be placed in the piping between the boiler and the high water cut-off.

An automatic self-test monitors the safety functions in the level switch. In the event of a fault, the control circuit opens without a delay and may switch the heating off, for example.

Alarm and fault indications are displayed by LEDs, and a signal output is also actuated without a delay.

An alarm can be simulated by pressing a button.

Technical data

Supply voltage

24 VDC $\pm$ 20%, 0.3 A; SELV / PELV / CLASS2
100 – 240 VAC $\pm$ 10 / $\pm$ 15%, 47 – 63 Hz, 0.2 A (optional)

Fuse

External 0.5A; UL category JDYX, e.g., RND 170-00012

Power consumption

7 W

Response sensitivity

 [Water conductivity at 77 °F (25 °C)]

$> 5 \dots < 5000$ ppm ($> 10 \dots < 10000$ μ S/cm)

Level electrode connection

1 input for NRG 1...-51 level electrode, 4-pole with shield,
sensitivity 5 ppm (10 μ S/cm) [at 77 °F (25 °C)]

Control circuit

2 volt-free NO contacts, 6 A 250 V AC / 30 V DC $\cos \varphi = 1$.

Off delay 3 seconds.

Inductive loads must have interference suppression (RC combination) as specified by the manufacturer.

Signal output

2 volt-free outputs for external signaling without delay, 24 V DC, max. 100 mA (semiconductor output).

Indicators and controls

2 buttons for testing and
diagnosis, 2 red/green LEDs for indicating operating state and alarm.

3 red LEDs for diagnosis.

Terminal box

Terminal box material: base of black polycarbonate, front of gray polycarbonate

Wire size: 1 x AWG12 (4.0 mm²) solid, or

1 x AWG14 (2.5 mm²) stranded with sleeve acc. to DIN 46228, or

2 x AWG16 (1.4 mm²) stranded with sleeve acc. to DIN 46228

Terminal strips can be removed separately

Terminal box attachment: Mounting clip on support rail TH 35, EN 60715

Electrical safety

Pollution degree 2, overvoltage category II according to UL 60730-1

Protection

Terminal box: IP 40 according to EN 60529

Terminal strip: IP 20 according to EN 60529

As a UL open type, the equipment must be installed in a control cabinet.

Weight

Approx. 1.1 lb (0.5 kg)

Ambient temperature

at power-on 32 ° ... 131 °F (0 ° ... 55 °C)

in operation 14 ° ... 131 °F (-10 ° ... 55 °C)

Transport temperature

-4 ° ... 176 °F (-20 ° ... +80 °C) (<100 hours), defrosting time of de-energized equipment
before it can be put into operation: 24 hours.

Storage temperature

-4 ° ... 158 °F (-20 ° ... +70 °C), defrosting time of de-energized equipment
before it can be put into operation: 24 hours.

Relative humidity

Max. 95%, non-condensing

Site altitude

Max. 6560 ft (2000 m)

Other information

Incorporated Type 2 action protective control Class B (C)

Pollution degree 2, impulse voltage 2500 V

Rating plate, identification

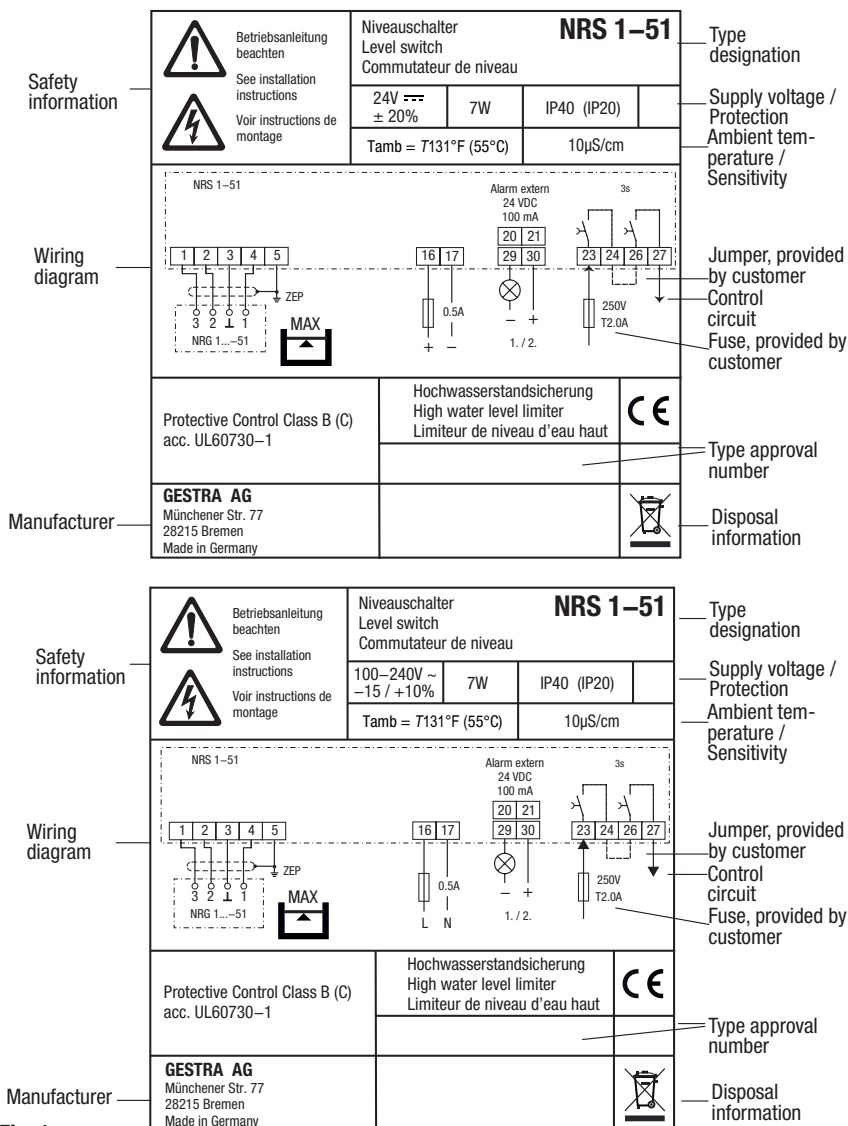


Fig. 1

	Input rating: 24VDC, 7W		Input rating: 100-240VAC, 7W
	Output rating: Pilot duty B300 / R300		Frequency: 50/60Hz Output rating : Pilot duty B300 / R300
	Ambient temperature: 32-131°F (0-55°C)		Ambient temperature: 32-131°F (0-55°C)
	Wiring: Use Copper Conductors Only, Use 60/75°C Conductors. Use No. 18-16 AWG Wire Size Only, Tightening: Torque 0.79Nm or 7lb in.		Wiring: Use Copper Conductors Only, Use 60/75°C Conductors. Use No. 18-16 AWG Wire Size Only, Tightening: Torque 0.79Nm or 7lb in.
	Use with accessory: NRG 16,17,19,111-12,-51,-51(F)		Use with accessory: NRG16,17,19,111-12,-51,-51(F)

Fig. 2

Factory default settings

Level Switch NRS 1-51

The level switch is delivered with the following factory default settings:

- Off delay: 3 s



DANGER



There is a risk of electric shock during work on electrical systems.

- Switch off the voltage to the plant before you install the equipment.
- Check that the plant is not carrying live voltage before commencing work.

Dimensions of the NRS 1-51

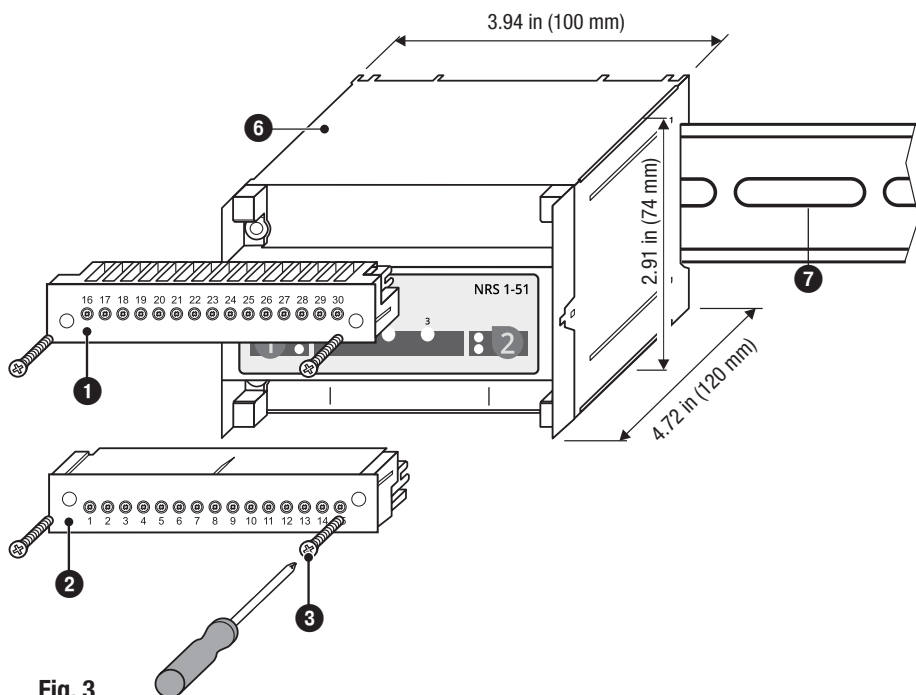


Fig. 3

Key

- 1 Upper terminal strip
- 2 Lower terminal strip
- 3 Fastening screws (cross recess head screw M3)
- 6 Terminal box
- 7 Support rail TH 35, EN 60715

Important notes

Safety information

High level alarms are classed as protective controls according to UL 60730-1 and may only be installed, electrically connected and brought into service by qualified and competent staff.

Fitting and maintenance work may only be performed by authorized staff who have undergone specific training.



Danger

The terminal strips of the NRS 1-51 level switch are live during operation!

There is a risk of serious injury due to electric shock.

Before working on terminal strips (installation, removal, connection of cables), always **cut off power to the equipment**.



Attention

The rating plate indicates the technical features of the equipment. Do not bring into service or operate any equipment that does not bear its own specific rating plate.



Attention

Pay attention to regulations in your country, e.g., NEC, NFPA, CEC, when using this equipment.

Preparing for installation



If the control cabinet is to be installed outdoors, outside the protection of a building, environmental influences may adversely affect function.

- Pay attention to the admissible ambient conditions in the technical data, see page 1612.
- Do not operate the equipment if the temperature is below freezing.
 - ◆ At temperatures below freezing, use a suitable heat source (e.g., control cabinet heater, etc.).
- Connect all parts of the plant to a central grounding point to prevent equalizing currents.
- Use UV-resistant cable ducts for routing the connecting cable.
- Take further measures to protect the equipment from lightning, insects and animals, and salty air.

You will need the following tools:

- Pozidriv screwdriver size PZ1

ATTENTION



Incorrect installation can lead to malfunctions in the plant or the level electrode.

The NRS 1-51 level switch snaps onto a TH 35, EN 60715 support rail in a control cabinet. **Fig. 3** 

Electrical connection

Supply voltage

Please provide the NRS 1-51 level switch with an external 0.5A fuse.

Connecting the level electrode

Please use the following to connect the level electrode:

- For an NRS 1-51 level switch with a response sensitivity of 5 ppm (10 μ S):
Use a shielded, multi-core TC-ER control cable with minimum wire size AWG18, e.g., OELFLEX CONTROL TM CY 5G1. Max. length 328 ft (100 m).

Wire the terminal strip as shown in the wiring diagram. **Fig. 4.** Connect the shields to terminal 5 and to the central grounding point (**CGP**) in the control cabinet.

Connecting the control circuit

Please connect the control circuit for the feedwater supply/heating to terminals 23, 24 and 26, 27. If you are using the equipment as a high level alarm, please connect the output contacts of the two monitoring channels by adding a wire jumper between terminals 24 and 26.

Provide the output contacts with a slow blow T1A fuse.



Note

- A high level alarm prevents the defined high water level from being exceeded. To achieve this, the feedwater supply may be cut, for example. If cutting the feedwater supply poses a danger to heating surfaces in the feedwater pre-heater, the heating must be switched off as well.
- In the event of an alarm, the NRS 1-51 level switch interlock does not take place automatically.
If the installation requires an interlock, this must be implemented in the downstream (control) circuit.
- In order to guarantee Class C function with second fault protection in accordance with UL 60730-1, both signaling outputs must be monitored during interlock deactivation.
- It is important that the interlock is not deactivated when the level switch signals a malfunction to the diagnostic LEDs or the signaling outputs.

Electrical connection

Connecting the signal output

An external signaling device, maximum load 100 mA, is allocated to each monitoring channel in the level switch. For connection, please use a control cable, e.g., 2 x AWG20 (0.5 mm²). In the event of alarm and fault indications, the signal output (terminals 20, 21 / 29, 30) closes without a delay.



Danger

- A safety power supply unit (SELV / PELV / CLASS2) must be used to supply the NRS 1-51 level switch with 24 V DC. This must provide a level of isolation against dangerous contact voltages that at least meets the requirements for double or reinforced insulation in accordance with UL 60730-1 (protective electrical isolation).



Attention

- Provide the NRS 1-51 level switch with an external 0.5A fuse.
- Connect the shields to terminal 5 and to the central grounding point (**CGP**) in the control cabinet.
- Provide the control circuit with a slow blow T1A fuse to protect the switching contacts.
- Switching off inductive loads produces surges that can have a major adverse effect on open and closed-loop control systems. Connected inductive loads must therefore have interference suppression (RC combination) as specified by the manufacturer.
- Connect terminals 24 and 26 with a wire jumper.
- Route the connecting cables to the level electrodes and the logic unit separately from power lines.
- Do not use unused terminals as support terminals
- If, despite the necessary measures being taken, one of the signaling outputs is activated when a relay closes (terminals 23, 24 and 26, 27), there may be a dangerous second fault. Check the equipment and replace if necessary.

Electrical connection

Wiring diagram of level switch NRS 1-51

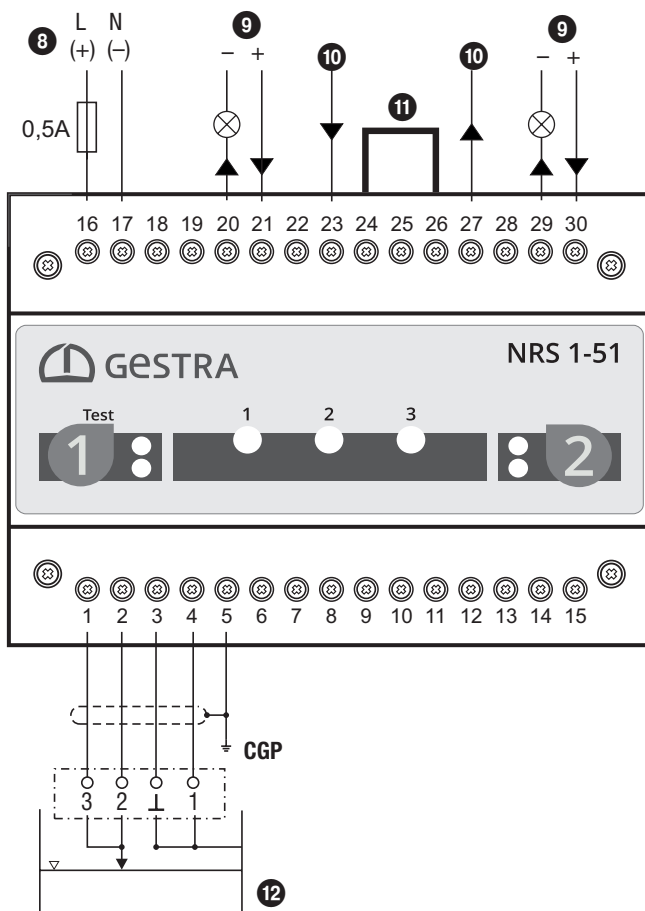


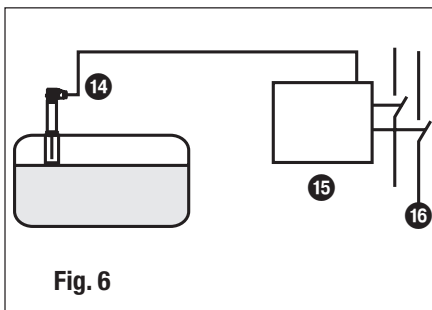
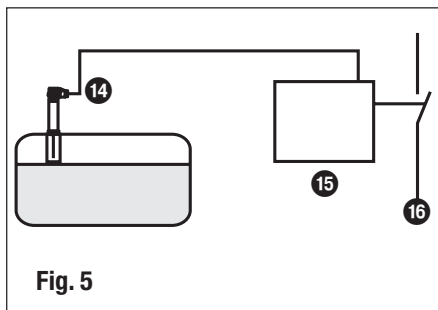
Fig. 4

Key

- 8 Supply voltage
- 9 Signal output 1 / 2 for external alarm 24 V DC, 100 mA (semiconductor output)
- 10 Control circuit, input and output
- 11 Jumper, provided by customer
- 12 Level electrode NRG 1...-51
- CGP Central grounding point in control cabinet

Electrical connection

Example switching combinations



Key

Steam boiler plants

Figure 5

Combination consisting of 1x NRG 1...-51 level electrode plus NRS 1-51 level switch as a high level alarm.

For further uses, please refer to the regulations in your country

Figure 6

Combination consisting of 1x NRG 1...-51 level electrode plus NRS 1-51 level switch as a high level alarm. The level switch opens two separate control circuits.

- 14 Level electrode(s) NRG 1...-51
- 15 Level switch NRS 1-51
- 16 Control circuit

Bringing into service

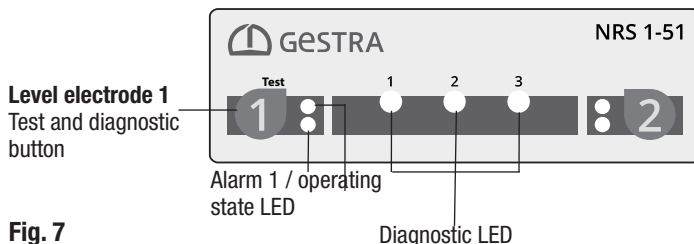


There is a risk of electric shock during work on electrical systems.

- Always switch off the voltage to the plant before performing connection work.
- Check that the plant is not carrying live voltage before commencing work.

Bringing into service

Checking the switchpoint and function



Starting		
Action	Indication	Function
Switch on supply voltage.	All LEDs light up	System is started and tested, approx. duration 10 s. Output contacts open. Signal output 1 closed.
	All LEDs light up for more than 10 s	System error. Possible causes: Supply voltage error, faulty level switch.
Drain water from the boiler until it is below the high water (HW) level. Level electrode is exposed.	Green LED for level electrode 1 lights up	Output contacts closed, signal output 1 open.

Checking the switchpoint and function		
Fill the boiler until water is above the high water (HW) level. Level electrode is immersed.	Red LED for level electrode 1 flashes	Off delay in progress, signal output 1 closes without a delay.
	Red LED for level electrode 1 lights up	Delay has elapsed, output contacts open. Signal output 1 closed.

Possible errors during installation		
Status and indication	Error	Corrective action
Water above high water (HW) switchpoint according to sight glass, but red LED for level electrode 1 is not lit! Control circuit closed.	Electrode rod is too short.	Replace electrode rod and cut a new one in line with HW switchpoint.
	Ground connection to tank is interrupted.	Clean sealing surfaces and screw in level electrode with metal sealing ring. Do not insulate with hemp or PTFE tape.
	Electrical conductivity of boiler water is too low.	Use an enlarged measuring surface for the NRG 1...-51.
	For internal installation: Upper pressure relief hole in protective tube is missing or obstructed.	Check level electrode installation and make sure that the level in the protective tube corresponds to the actual water level.
Water level sufficient. Red LED for level electrode 1 lights up! Control circuit open.	Electrode rod is too long.	Cut electrode rod in line with HW switchpoint.
	Upper pressure relief hole is flooded.	Check level electrode installation and make sure that the level in the protective tube corresponds to the actual water level.

Operation, alarm and testing

Indicators and operation

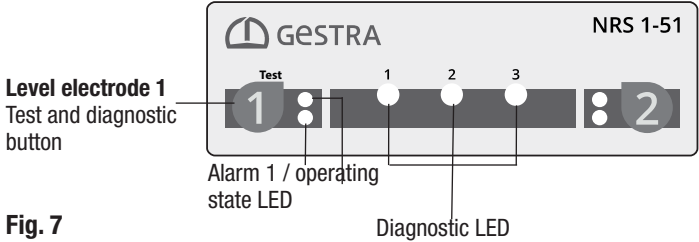


Fig. 7

Operation		
Action	Indication	Function
Level electrode exposed	Green LED for level electrode 1 lights up	Output contacts closed, signal output 1 open.

Alarm		
Level electrode immersed, high water (HW) exceeded	Red LED for level electrode 1 flashes	Off delay in progress, signal output 1 closes without a delay.
	Red LED for level electrode 1 lights up	Delay has elapsed, output contacts open. Signal output 1 closed.

Channel 1 test		
In operating mode: Press button 1 and hold until the end of the test. The level switch must behave as if there were an alarm.	Red LED for level electrode 1 flashes	Alarm simulation in channel 1 or 2. Off delay in progress, signal output 1 closes without a delay.
	Red LED for level electrode 1 lights up	Delay has elapsed, output contacts open. Signal output 1 closed. Test is complete.
If the test is failed, replace the level switch.		

Fault indications and troubleshooting

Indications, diagnosis and corrective action



Attention

Please check the following before fault diagnosis:

Supply voltage:

Is the level switch supplied with the voltage specified on the rating plate?

Wiring:

Does the wiring conform to the wiring diagram and your chosen switching combination?

Fault indications and troubleshooting

Indications, diagnosis and corrective action

Level electrode errors		
Status and indication	Error	Corrective action
Water level sufficient. Red LED for level electrode 1 lights up! Control circuit open.	The insulator of the level electrode is dirty or faulty.	Clean level electrode, replace if necessary.

Further fault indications			
Status	Diagnosis	Function	Next action
Error on evaluation of level electrode 1, channel 1	Diagnostic LED 1 and Alarm 1 LED light up	Output contacts open without a delay. Signal output 1 closes without a delay.	Next: Next: Press button 1
Error detected in level switch	Diagnostic LED 3 and Alarm 1 or 2 LED light up	Output contacts open without a delay. Signal outputs 1 + 2 close without a delay.	Next: Press button 1 or button 2

Diagnosis			
Indication 1 and action	Indication 2	Error	Corrective action
Alarm 1 LED and diagnostic LED 1 light up. press and hold button 1	Diagnostic LED 1 flashes	Error in level electrode 1, error in level switch, wiring error, measuring voltage error.	- Check wiring, - replace level switch.
	Diagnostic LED 2 flashes	Error in level electrode 1, error in level switch, wiring error.	
		Diagnostic LED 3 flashes	External voltage error, boiler wall has no PE.
Alarm 1 or 2 LED and diagnostic LED 3 light up, press and hold button 1 or 2	Diagnostic LED 1 flashes	Processor error, standby error.	Pay attention to the operating instructions for the SRL logic unit. Replace level switch.
	Diagnostic LED 2 flashes	Internal voltage error.	Replace level switch.
	Diagnostic LED 3 flashes	Relay error.	
Once the error has been rectified, the level switch reverts to normal operation.			
After troubleshooting, please switch the supply voltage off and on again after approx. 5 s.			

Further information

Action against high-frequency interference

High-frequency interference can be caused by out-of-phase switching operations. If such interference occurs and results in sporadic failure, we recommend taking the following action to suppress interference:

- Provide inductive loads with RC combinations as specified by the manufacturer.
- Route the connecting cable to the level electrode separately from power lines.
- Increase the distance from sources of interference.
- Check the connection of the shield to the central grounding point (CGP) in the control cabinet.
- Suppress HF interference using hinged-shell ferrite rings.

Interlock and interlock deactivation

In the event of an alarm, the NRS 1-51 level switch interlock does not take place automatically. If the installation requires an interlock, this must be implemented in the downstream (control) circuit.

It is important that the interlock is not deactivated when the level switch signals a malfunction to the diagnostic LEDs or the signaling outputs.

In order to guarantee Class C function with second fault protection in accordance with UL 60730-1, both signaling outputs must be monitored during interlock deactivation.

Checking switchpoints

The “High water (HW) exceeded” switchpoint can only be checked by filling the boiler up to the high water level. The level switch must then trigger an alarm and, after the off delay, it must open the control circuit. The heating cut-off is interlocked in the control circuit and this interlock can only be deactivated again when the level electrodes are immersed once more. Please carry out the switchpoint check when bringing the equipment into service, whenever a level electrode is replaced, and at regular intervals, e.g., once a year.

Taking out of service

Proceed as follows:

- Switch off the supply voltage and **cut off power** to the equipment.
- Unscrew the fastening screws on the right and left and detach the upper and lower terminal strips **Fig. 3 ① ② ③**.
- Release the slider holder to detach the level switch and remove it from the support rail.

Disposal

Dispose of the level switch in accordance with statutory waste disposal regulations.

UL components

The NRS 1-51 level switch is registered under XACN.E513189



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