GESTRA®

Conductivity Transmitter

LRGT 16-3
LRGT 16-4
LRGT 17-3

EN (USA)
English

Original Installation &
Operating Manual
850689-00

Contents

Contents

Content of this Manual

Product:

- Conductivity Transmitter LRGT 16-3
- Conductivity Transmitter LRGT 16-4
- Conductivity Transmitter LRGT 17-3

First edition:

BAN 850689/08-2021cm

Scope of supply, product package

- 1 x Conductivity transmitter LRGT 1x-x
- 1 x Installation & Operating Manual

Required accessories for LRGT 16-3, LRGT 17-3 and LRGT 16-4 when installing for the first time

- 1 cable jack Binder series 713 99-0436-58-05

How to use this Manual

This Installation & Operating Manual describes the correct use of LRGT 16-3, LRGT 16-4 and LRGT 17-3 conductivity transmitters, abbreviated below as LRGT 1x-x. 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

Ⓐ 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.

LRGT .. / LRR .. / 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

LRGT 16-3, LRGT 16-4 and LRGT 17-3 conductivity transmitters can be used as conductivity limiters and blowdown controllers to continually measure conductivity in steam boilers and hot water installations. They present a linear profile of conductivity in a preset measuring range via a 4 - 20 mA current output. The LRGT 1x-x is classified as operating control in accordance with UL 60730-1.

- The transmitter's secure 4 - 20 mA actual value output can be used with a suitable conductivity controller, for example as a continuous blowdown controller with MIN/MAX alarm.

Applicable directives and standards

LRGT 16-3, LRGT 16-4 and LRGT 17-3 conductivity transmitters have 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.

Usage for the intended purpose

Admissible system components

According to UL60730-1, the LRGT conductivity electrode can be regarded as part of an operating control, which delivers the measured conductivity via the 4 - 20 mA output. Any diagnostic tester with an input for a 4 - 20 mA unit signal can be connected and used for analysis.

To ensure proper use in all applications, please also read the Installation & Operating Manuals for the system components used.

- You can find the latest Installation & Operating Manuals for other system components on our website:
  http://www.gestra.com

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

Danger to life from scalding! Do not remove the conductivity electrode under pressure. Steam or hot water can spurt forcefully out of the equipment.

- Only remove the conductivity electrode at **0 psi (0 bar) boiler pressure**.

Risk of severe burns! Do not perform work on a conductivity electrode that is still hot. The conductivity electrode gets very hot during operation.

- Always allow the conductivity electrode to cool.
- Only perform installation and maintenance work after the conductivity electrode has been allowed to cool down.

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.

Danger to life! Hot steam or hot water can suddenly escape from a faulty LRGT 1x-x conductivity electrode.

Shocks and impacts during transport or installation can result in damage to or leaks in the conductivity electrode, causing pressurized hot steam or hot water to escape through the pressure relief hole.

- To prevent damage during transport and installation, do not expose the electrode rod to hard impacts.
- Before and after installation, check that the conductivity electrode is undamaged.
- When bringing the conductivity electrode into service, check that it is leak-tight.

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

- LRGT 1x-x conductivity electrodes may only be repaired by the manufacturer, GESTRA AG.
- Only replace faulty equipment with identical equipment from GESTRA AG.

Basic safety information

A lack of proper maintenance and cleaning can result in damage to the conductivity electrode and/or false measurement results and warnings.

- Once a year, check the conductivity electrode by performing reference measurements. If the “CF” (cell constant) value of 003.0 is exceeded after recalibration, the warning code “CF.Hi” will appear.
- Adhere to the maintenance and cleaning intervals, see page 52.

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	Maintenance and refits 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.

Fig. 1

Notes on product liability

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

Function

The equipment measures the conductivity of electrically conductive fluids, and converts the information into a conductivity-dependent 4 - 20 mA current signal.

Measuring process of the LRGT 16-3 and LRGT 17-3

LRGT 16-3 and LRGT 17-3 conductivity transmitters use the conductometric two-electrode measuring process. A measuring current with a suitable frequency for the measuring range is introduced into the fluid. This produces a potential gradient between the electrode and the measuring tube, which is analyzed as a measuring voltage.

Measuring process of the LRGT 16-4

The LRGT 16-4 conductivity transmitter uses the conductometric four-electrode measuring process. It consists of two current and two voltage electrodes. The current electrodes introduce a measuring current with a fixed frequency into the fluid. This gives rise to a potential gradient between these electrodes. This potential gradient is then picked up by the voltage electrodes and analyzed as measuring voltage.

Temperature compensation of readings based on a reference temperature (77 °F (25 °C))

The electrical conductivity changes as a function of the temperature. In order to base the readings on a reference temperature, an integrated resistance thermometer measures the temperature of the fluid. The electrical conductivity is calculated from the measuring current and measuring voltage, and then based on the reference temperature of 77 °F (25 °C) through temperature compensation.

Compensation process

Based on a set temperature coefficient, the conductivity reading is corrected to form a linear characteristic. The coefficient (default 2.1% per °C) is normally used for steam generating units with constant pressure. Conductivity is established for an ambient temperature of 77 °F (25 °C).

The displayed reading is then verified under operating conditions (service pressure and temperature) using a calibrated conductivity meter. If this figure deviates, the electrode must be calibrated. See the section on bringing into service.

Transmitter function

The transmitter function is the ability of the electrode to provide a scalable measuring range on the 4 - 20 mA current output interface and to make this available to one or more recipients for analysis.

These devices do not have any controlling or limiting functions.

Automatic self-test

An automatic self-test periodically monitors the safety and function of the conductivity transmitters and measured value acquisition.

Faults in the electrical connection or electronic measuring equipment trigger an error code on the display, and the current output is set to 0 mA.

Function

Indicators and signals, see page 43 / 47 *

LRGT 1x-x conductivity transmitters feature a green 4-digit, 7-segment display for showing readings, status information and error codes. The operating status is indicated by one red and three green LEDs.

Behavior when switched on *

The display alternately shows the software version, the type and then the measured conductivity.

Behavior in normal operation (no faults) *

The display shows the measured conductivity value (4 digits), e.g., 1550, and converts this value into a current signal from 4 - 20 mA, in accordance with the predefined measuring range (see page 40, Sout parameter).

Behavior in the event of malfunctions *

The error state or malfunction is shown by an error code, e.g., E.005, on the display. For more on error codes, see page 47/47.

Every time there is a malfunction, 0 mA is output via the current output.

Electrode faults cannot be acknowledged.

When the fault is corrected, the error code of the conductivity transmitter also disappears from the display and the LRGT 1x-x conductivity transmitter returns to normal operation.

Behavior when running the test function *

Initiating the test function by pressing the rotary knob on the LRGT 1x-x produces a maximum output current of 20 mA. This enables you to check the effect of limit violation on connected diagnostic testers.

* The tables starting on page 43 clearly show the relationship between the equipment status, the display and the status LEDs.

Setting parameters and changing default factory settings

If necessary, you can adapt the electrode parameters to suit conditions at the plant. Parameters can be set and default settings changed using a rotary knob on the terminal box, see page 36.

Technical data

Design and mechanical connection

■ LRGT 16-3, LRGT 16-4, LRGT 17-3	Thread 1" - 11.5 NPT, see Fig. 7, 8 and 9

Nominal pressure rating, admissible service pressure and temperature

■ LRGT 16-3	464 psi at 460 °F (32 bar at 238 °C)
■ LRGT 16-4	464 psi at 460 °F (32 bar at 238 °C)
■ LRGT 17-3	870 psi at 527 °F (60 bar at 275 °C)

Materials

■ Terminal box	3.2581 G AlSi12, powder-coated
■ Cover tube	1.4301 X5 CrNi 18-10
■ Measuring electrodes	1.4571 X6CrNiMoTi17-12-2
■ Electrode insulation	PTFE
■ Screw-in body:	1.4404 / F316L
◆ Measuring tube/screw of LRGT 16-3, LRGT 17-3	1.4571, X6CrNiMoTi17-12-2
◆ Spacer of LRGT 16-3, LRGT 16-4, LRGT 17-3	PEEK

Available electrode lengths (cannot be cut)

■ LRGT 16-3, LRGT 17-3	7.87/11.81/15.75/19.69/23.62/31.49/39.37 inch (200, 300, 400, 500, 600, 800, 1000 mm)
■ LRGT 16-4	7.08/11.81/14.36/19.59/23.62/31.49/39.37 inch (180, 300, 380, 500, 600, 800, 1000 mm)

Temperature sensor

■ Resistance thermometer	Pt1000
■ Fluid temperature measuring range	0 to 536 °F (0 to 280 °C)

Conductivity range at 25 °C

■ LRGT 16-3, LRGT 17-3	0.5 µS/cm to 6000 µS/cm, 0.25 - 3000 ppm *
◆ Preferred measuring range	up to 500 ppm (1000 µS/cm)
■ LRGT 16-4	50 µS/cm to 10,000 µS/cm, 25 - 5000 ppm *
◆ Preferred measuring range	from 250 ppm (500 µS/cm)

** Conversion of µS/cm to ppm (parts per million): 1 µS/cm = 0.5 ppm*

Measuring cycle

■ 1 second

Technical data

Measurement quality (figures for value ranges between the on-site calibration points)

- **LRGT 1x-3**

Resolution for internal processing *	**Measurement error**	**Linearity error**
◆ Range 1: 0.25-5 ppm (0.5-10 µS)	7%	2%
◆ Range 2: 5-125 ppm (10-250 µS)	3%	2%
◆ Range 3: 125-1300 ppm (250-2600 µS)	3%	1%
◆ Range 4: 1300-10500 ppm (2600-21000 µS)	3%	1%

- **LRGT 16-4**

Resolution for internal processing *	**Measurement error**	**Linearity error**
◆ Range 1: 5-50 ppm (10-100 µS)	2%	2%
◆ Range 2: 50-1000 ppm (100-2000 µS)	2%	1.5%
◆ Range 3: 1000-25000 ppm (2000-50000 µS)	2%	1%

** Resolution for internal processing based on 15 bits with plus or minus sign (16 bits).*

The above figures refer to the uncompensated conductivity.

Time constant "T" (measured using the two-bath process)

	Temperature	**Conductivity**
■ LRGT 16-3, LRGT 17-3	9 seconds	14 seconds
■ LRGT 16-4	11 seconds	19 seconds

Temperature compensation

- The temperature compensation process is linear and set via parameter tC, see page 39.

Supply voltage

- 24 V DC +/-20% SELV / PELV / CLASS2

Power consumption

- Max. 7 VA

Current draw

- Max. 0.35 A

Internal fuse

- T2A (slow blow)

Safety cutout at excessive ambient temperature

- The cutout takes place at an excessive ambient temperature of Tamb. = 167 °F (75 °C)

Electrode voltage

- < 500 mV (RMS) at no load

Technical data

Analog output

- 1 x actual value output 4 - 20 mA
- Max. output load 500 Ω
- M12 connector, 5-pole, A-coded

Indicators and controls

- 1 x green 4-digit 7-segment display for showing readings and status information
- 1 x red LED for indicating the error state
- 3 x green LEDs for indicating the unit µS/cm or ppm and OK status
- 1 rotary knob IP65 with button for menu navigation and test function

Protection class

- III Safety Extra Low Voltage (SELV / PELV / CLASS2)

Protection

- NEMA type 3R, 3RX and 5; IP 65 according to NEMA 60529

Admissible ambient conditions

- Service temperature: 32 °F –158 °F (-40 °C – 70 °C)
- Storage temperature: -40 °F – 158 °F (-40 °C – 80 °C)
- Transport temperature: -40 °F – 158 °F (-40 °C – 80 °C)
- Air humidity: 10% – 95%, non-condensing

Weight

- LRGT 16-3, LRGT 16-4, LRGT 17-3 approx. 4.63 lb (2.1 kg)

Other information

- Independently mounted Type 1 action operating control
- Pollution degree 2, impulse voltage 330 V

Rating plate, identification

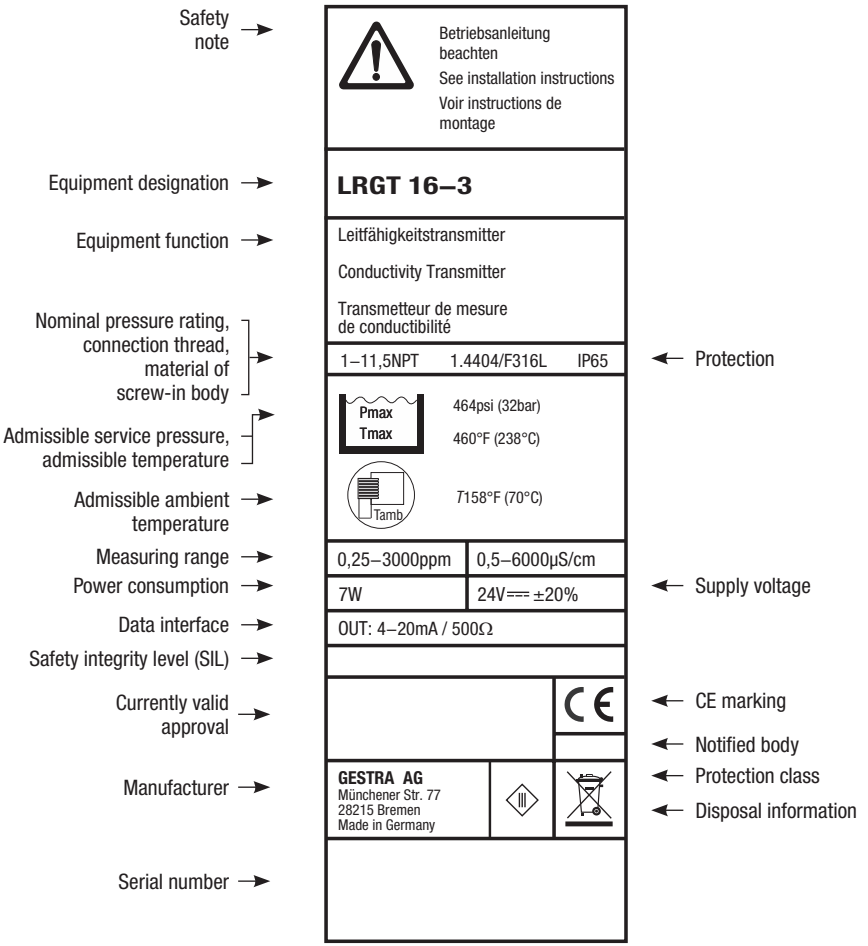
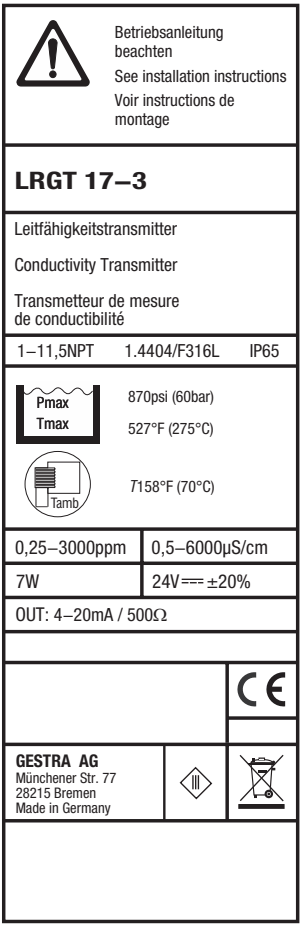
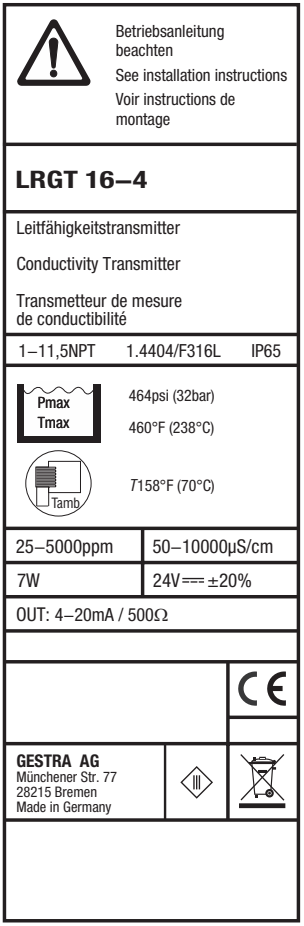


Fig. 3

The date of production (quarter and year) is stamped on the screw-in body of each conductivity transmitter.

Rating plate, identification





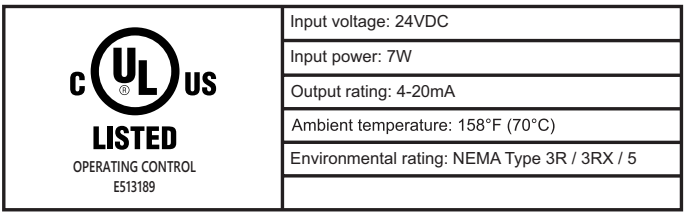


Fig. 4

Default factory settings

LRGT 1x-x conductivity transmitters are delivered ex works with the following settings:

Parameter	Menu display	Unit	Parameter values	
			LRGT 16-3 LRGT 17-3	LRGT 16-4
Cell constant	CF		0.210	
Temperature coefficient	tC	% / °C	002.1	
Filter constant (damping)	FiLt	Seconds	0025	
Scale of current output	Sout	µS	0500	7000
Display unit	Unit		µS	

Fig. 5

Overall view

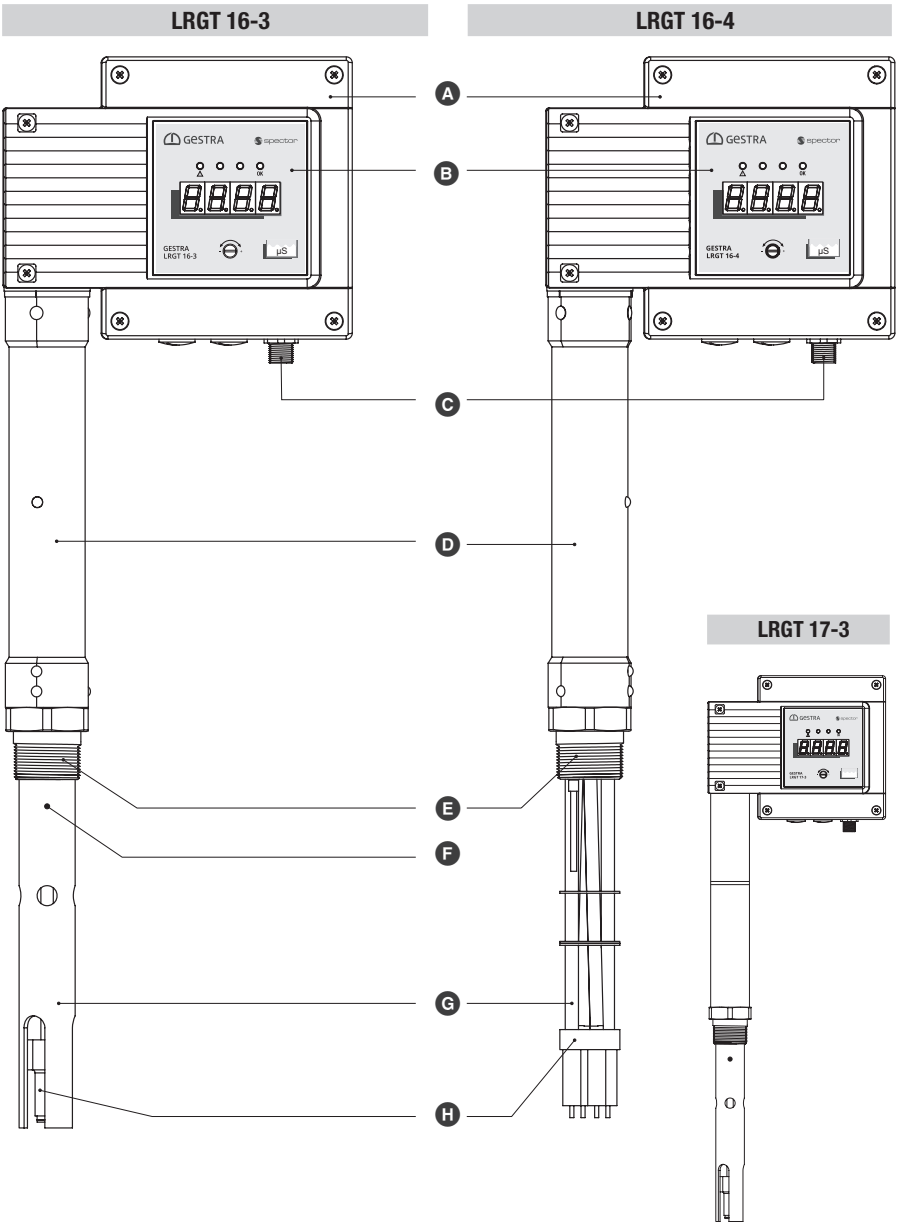


Fig. 6

Overall view

Key to Fig. 6

- **A** Terminal box
- **B** Operating panel with 4-digit LCD, alarm LEDs and rotary knob, see page 43
- **C** M12 connector, 5-pole, A-coded
- **D** Cover tube
- **E** Electrode thread
- **F** Threaded pin M2.5 mm (LRGT 16-3, LRGT 17-3)
- **G** Measuring tube with measuring electrode (LRGT 16-3, LRGT 17-3), measuring electrodes (LRGT 16-4)
- **H** Spacer

Dimensions of the LRGT 16-3

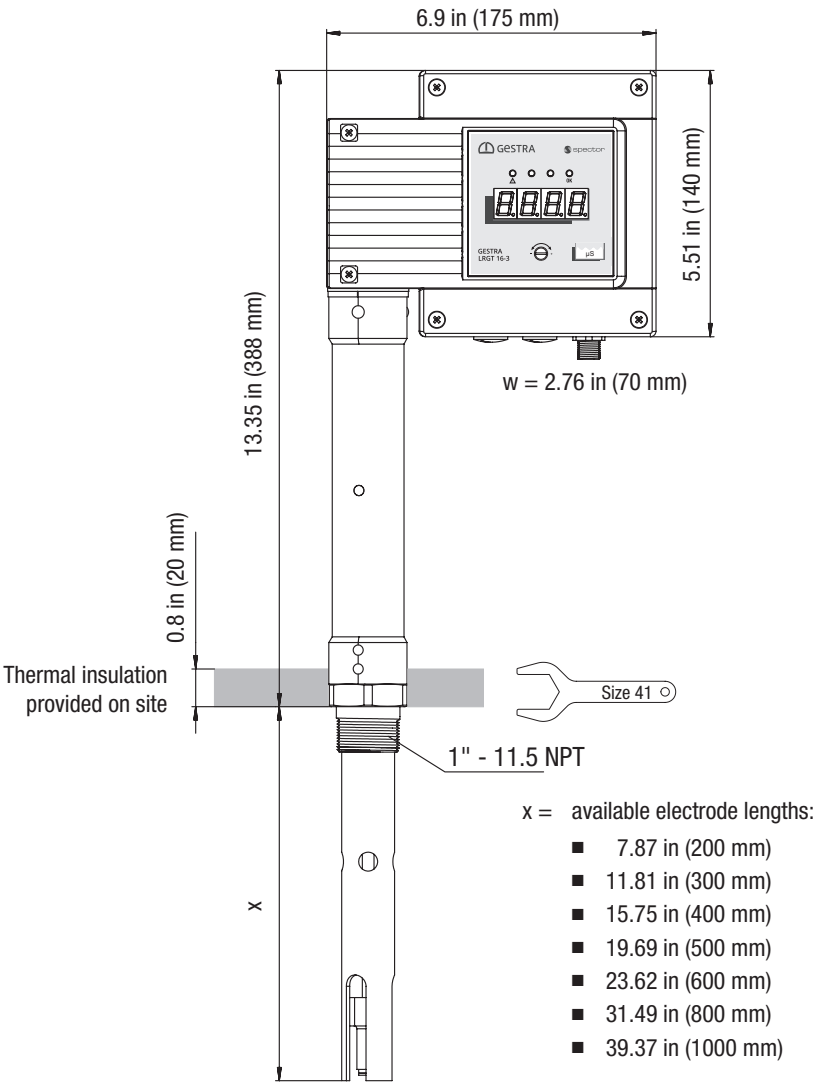


Fig. 7 All lengths and diameters in inches (mm)

Dimensions of the LRGT 16-4

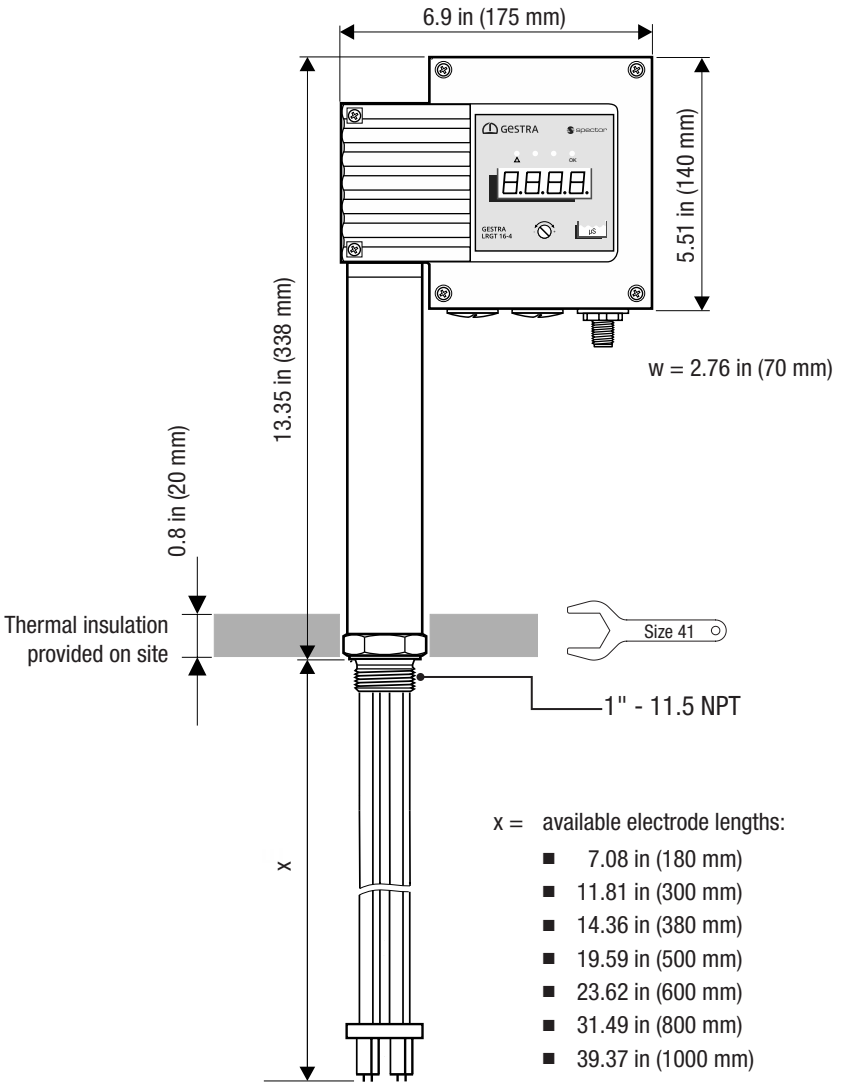


Fig. 8 All lengths and diameters in inches (mm)

Dimensions of the LRGT 17-3

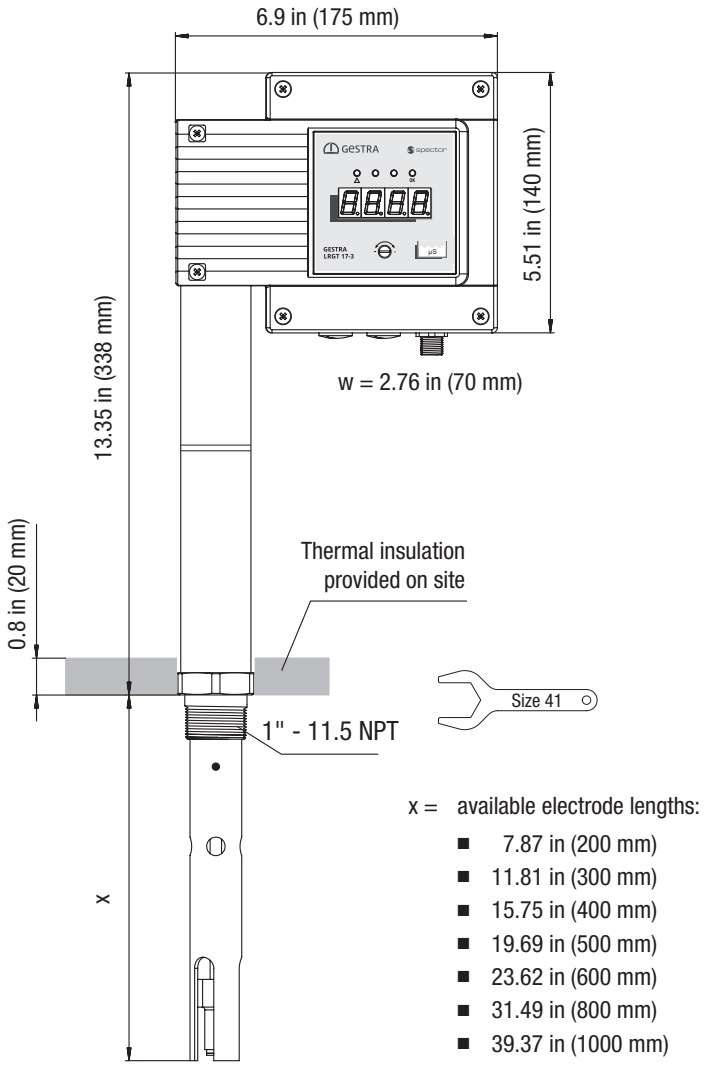


Fig. 9 All lengths and diameters in inches (mm)

Preparing for installation

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

- Pay attention to the permitted ambient conditions in the technical data, see page 16.
- 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 ground point to prevent equalizing currents.
- Use a cover to protect the equipment from direct sunlight, condensation and heavy rain.
- 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:

- Size 41 open-ended wrench, see pages 22 to 24.
- Multimeter

⚠ DANGER

Danger to life from scalding! Hot steam may escape abruptly.

Hot steam or hot water can escape suddenly if the conductivity electrode is unscrewed while under pressure.

- Reduce the boiler pressure to 0 psi (0 bar) and check the pressure before unscrewing the conductivity electrode.
- Only remove the conductivity electrode at 0 psi (0 bar) boiler pressure.

⚠ WARNING

The hot conductivity electrode can cause severe burns.

Conductivity electrodes are extremely hot during operation.

- Always let the conductivity electrode cool down before performing installation and maintenance work.
- Remove the conductivity electrode only after it has cooled down.

⚠ ATTENTION

Incorrect installation can cause irreparable damage to the plant or the conductivity electrode.

- Do not shorten the electrode rods or measuring tube.
- Make sure that both external and internal threads are in good condition.
- Take care not to bend the electrode rods during installation!
- Do not subject measuring electrodes to hard impacts during installation.
- Do **not** install the terminal box Ⓐ or cover tube Ⓓ of the measuring electrode in the boiler's thermal insulation!
- Please note the installation dimensions of the conductivity electrode, see installation examples on pages 29 to 32.
- For internal installation, check the boiler standpipe and flange during the preliminary boiler inspection.

Additional notes for installation

⚠ ATTENTION

If the electrode is not fully immersed in the fluid, measurement results may be false and there is a risk to plant safety.

- Install the conductivity electrode in such a way that the measuring electrodes are always fully immersed in the fluid.
- As far as possible, always install the conductivity electrode below the admissible LW mark.

Ground points (metal objects) between the boiler wall and the electrode have an adverse effect on measurement. False measurement results are a risk to plant safety.

Therefore, always adhere to the distances stated below.

LRGT 16-3, LRGT 17-3

- Leave a distance of approx. 1.18 in (30 mm) between the lower end of the measuring tube and the boiler wall, the smoke tubes, any other metallic fittings, and the low water level (LW).

LRGT 16-4

- Leave a distance of approx. 2.36 in (60 mm) between the lower end of the measuring electrodes and the boiler wall, the smoke tubes, any other metallic fittings, and the low water level (LW).

Montage

Installing the LRGT 1x-x

- Make sure that the internal and external threads are in perfect condition.
- Do not apply more than three windings of PTFE insulating tape around the electrode thread.

⚠ WARNING

Do not use too much tape. Do not use fitting lubricants or pastes.

- Fit the electrode and tighten first with your hand and then with a size 41 open-ended wrench. Do not use a pipe wrench.
- Recommendations for tightening torques cannot be given due to the conical/parallel type of connection.
- Avoid tightening excessively; part of the electrode thread should always remain visible.

The electrode body does not “sit” on the flange, i.e. the underside of the hexagon is not in contact with the flange (also see **Fig. 10**). If it is in contact, the internal thread is outside tolerance. In this case, the flange must be replaced.

After the electrode has been installed with PTFE sealing tape, you must ensure there is adequate electrical contact between the electrode and the boiler wall.

To do this, after installation measure the resistance between the electrode body and the boiler with a multimeter.

The reading must be < 10 ohms.

If the reading is > 10 ohms, connect the electrode to the boiler wall using a band grounding clamp. (The band grounding clamp is available as an optional accessory)

Next, measure the resistance again.

The value must be < 10 ohms and entered as followed:

Measured resistance: _____ ohms

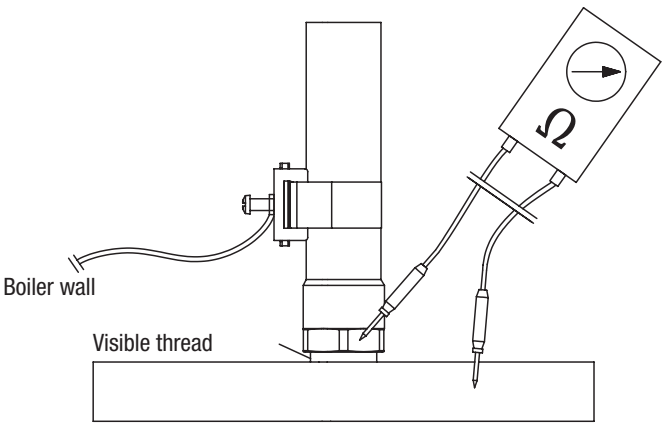


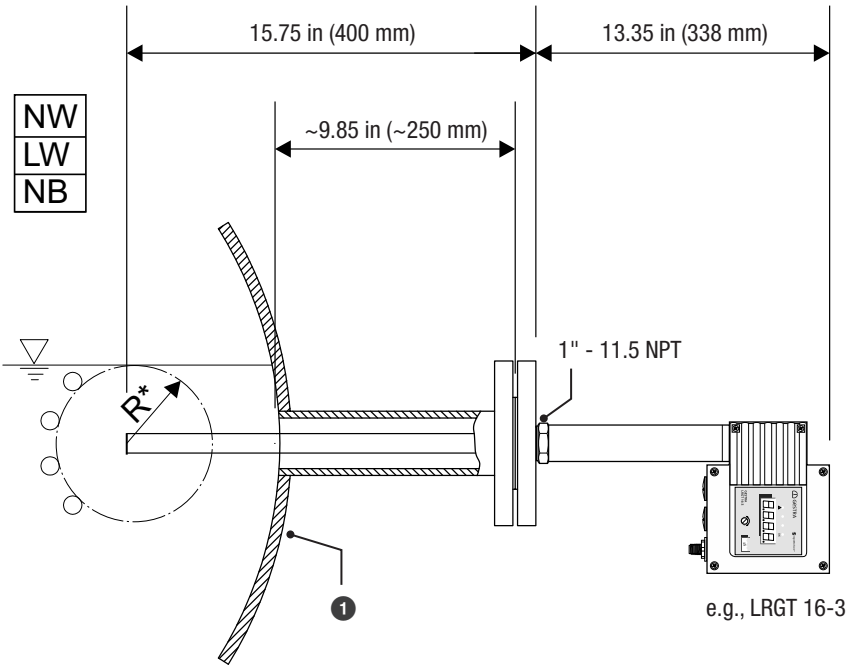
Fig. 10

Installation examples with dimensions

Conductivity measurement

Installing conductivity transmitters via a flange on the side.

Key, see page 32



*** Minimum distances (R)**

- LRGT 16-3 / LRGT 17-3 R = 1.20 in (30 mm)
- LRGT 16-4 R = 2.4 in (60 mm)

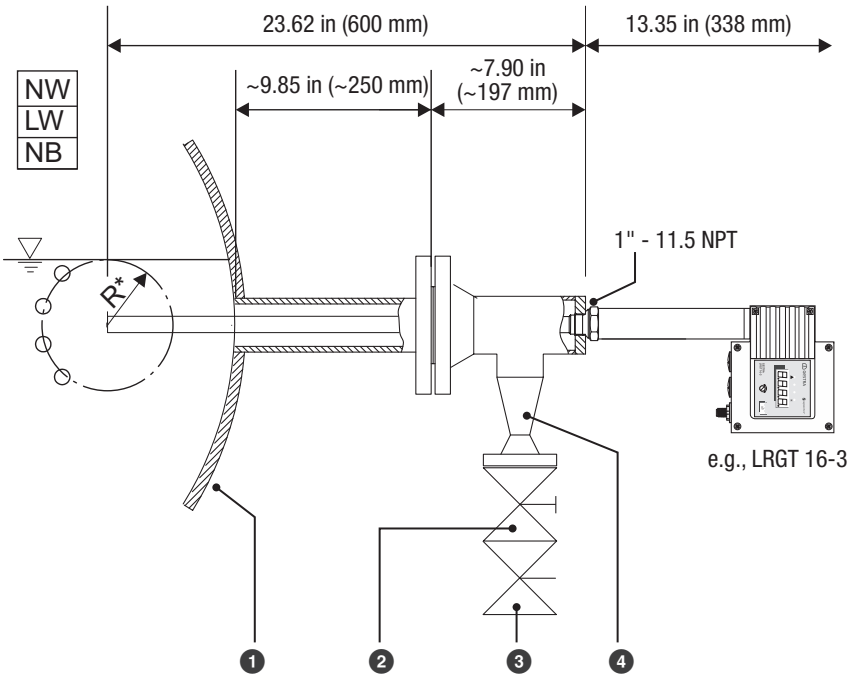
Fig. 12 All lengths and diameters in inches (mm)

Installation examples with dimensions

Conductivity monitoring and continuous blowdown control

Installing conductivity transmitters via a level pot with connected continuous blowdown valve.

Key, see page 32



*** Minimum distances (R):**

- LRGT 16-3 / LRGT 17-3 R = 1.2 in (30 mm)
- LRGT 16-4 R = 2.4 in (60 mm)

Fig. 13 ■ All lengths and diameters in inches (mm)

Installation examples with dimensions

Conductivity monitoring and continuous blowdown control via a separate level pot

Installing conductivity transmitters in the blowdown line via a separate level pot.

Key, see page 32

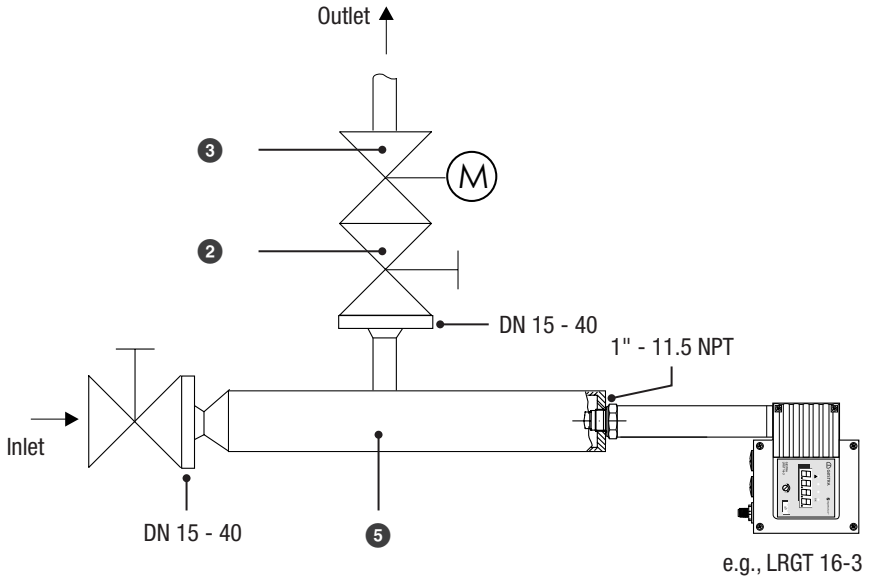


Fig. 14 All lengths and diameters in inches (mm)

Installation examples with dimensions

Key, Fig. 1012 to Fig. 1214

1. Boiler drum
2. Shut-off valve GAV
3. Continuous blowdown valve BAE
4. T-type connector
5. Level pot

Aligning the terminal box

If necessary, you can orientate the display in the desired direction by rotating the terminal box.

⚠ ATTENTION

Rotating the terminal box ≥ 180° will damage the internal wiring of the conductivity electrode.

- Never rotate the terminal box more than 180° in either direction.

Functional elements

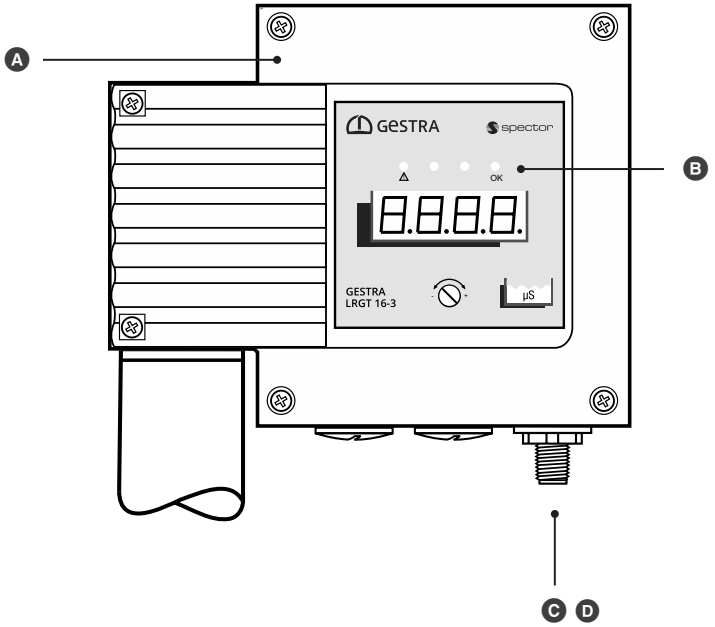


Fig. 15

- **A** Terminal box
- **B** Operating panel with 4-digit LCD, malfunction and status LEDs and rotary knob, see page 43
- **C** M12 connector, 5-pole, A-coded
- **D** Use a shielded, multi-core TC-ER control cable with minimum wire size AWG 18, e.g., ÖLFLEX CONTROL TM CY 5G1.

Electrical connection

Notes on electrical connection

- Use a shielded, multi-core TC-ER control cable with minimum wire size AWG 18, e.g., OELFLEX CONTROL TM CY 5G1.

Connecting the 24 V DC power supply

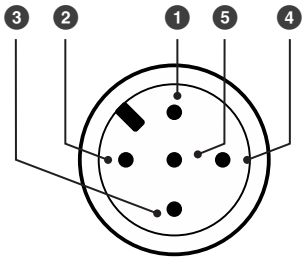
- LRGT 16-3, LRGT 17-3 and LRGT 16-4 conductivity transmitters are supplied with 24 V DC.
- A safety power supply unit that delivers a Safety Extra Low Voltage (SELV / PELV / CLASS2) and is isolated from connected loads must be used to supply the equipment with 24 V DC.

Connecting the actual value output (4 - 20 mA)

- Please note the maximum output load of 500 Ω.
- Maximum cable length = 328 ft (100 m).

Pin assignment of the M12 connector for non pre-wired control cables

If non pre-wired control cables are used, you must wire the cable to match the pin assignment of the M12 connector.



Connector

1	S	Shield
2	+24 V	Power supply
3	– 0 V	Power supply
4	+20 mA	Data line
5	– 20 mA	Data line

Fig. 16

Bringing into service

- Before bringing into service, check that the conductivity transmitter is correctly connected.
- Then switch on the supply voltage.

Change the default settings if necessary

You will need the following tools

- Flat blade screwdriver, size 3/32 in (2.4 mm)

Notes for bringing into service for the first time

When the equipment is brought into service for the first time, the scale of the current output is set to 250 ppm (500 µS) = 20 mA for the LRGT 1x-3 and 3500 ppm (7000 µS) = 20 mA for the LRGT 16-4. After installation, change the scale to suitable values for your specific plant.

Bringing into service

Selecting and setting a parameter:

1. 

Using a screwdriver, turn the rotary knob clockwise or counterclockwise until the desired parameter appears on the display. The set value is displayed after approx. 3 seconds.

The display alternates between the set parameter and its actual value, e.g., Filt. → "Value" → Filt.

When you turn the rotary knob clockwise, the following parameters are shown one after the other:

1234 → °C.in → °C.Pt → CF → tC → CAL → FiLt → Sout → Unit → diSP

Key to parameters, see page 37.

If you do not enter anything for 30 seconds, the display automatically returns to the actual value.

2. 

Once you have selected a parameter, press and hold the rotary knob until the momentary value of this parameter flashes on the display.

3. 

Set the desired value.

- / + Reducing/increasing the value

Each parameter has an individual, admissible value range.

By pressing the knob briefly, you can jump to the next digit. This is a more convenient way of making large changes to values.

If you do not set a parameter within 10 seconds, the process is aborted ("quit") and the old parameter value is retained.

4. 

Save your settings by pressing the rotary knob for approx. 1 second.

The message "donE" is shown and the parameter appears on the display once more.

Key to parameters:

- 1234 = actual value display (normal operating state, example)
- °C.in = display ambient temperature of terminal box
- °C.Pt = display temperature of measured fluid
- CF = cell constant of electrode
- tC = temperature coefficient of measured fluid
- CAL = calibration function for calibrating the display based on a reference value (sample)
- FiLt = filter constant
- Sout = scale of 4 - 20 mA actual value output
- Unit = display unit (µS or ppm)
- diSP = initiate a display test

Parameter display test

An advance display test takes place for parameters CF, tC, CAL, FiLt and Sout. Its aim is to prevent the entry of an incorrect value due to undetected faulty display segments. The user is required to keep an eye on the display segments during the test, to determine whether any segments are faulty.

When the first parameter is selected, the one-off display test opens a 10-minute time window, during which several parameters can be entered without having to repeat the display test when selecting the next parameter.

Replacing faulty equipment

Faulty equipment is a danger to plant safety.

- If numbers or decimal points are displayed incorrectly or not at all, you must replace the conductivity transmitter with an identical one from GESTRA AG.

Manually initiate a display test.

Alternatively, initiate the display test by selecting "**diSP**", see page 41.

Bringing into service

Changing the cell constant

Notes on calibrating the cell constant

The cell constant of LRGT 1x-x conductivity transmitters is precisely set at the factory. If recalibration is necessary at the installation site due to the conditions there, (see page 42, comparing the reading with a reference reading), you can change the cell constant on site.

Requirements for recalibration:

- To calibrate cell constants, there must be sufficient water in the boiler.
- Only perform reference reading comparisons at low boiler capacity, in order to minimize false results due to vapor bubbles.

This parameter can be used to manually adjust the displayed value on site in line with a reference reading from a reliable sample.

Alternatively, you can perform recalibration using the convenient "**CAL**" function, see page 39.

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter "**CF**".
2. Press and hold the rotary knob until the momentary value flashes on the display.
3. Set the desired value (0.050 – 5,000).
4. Save your settings by pressing the rotary knob for approx. 1 second.

Raising the "CF" value increases the display value.

The display value will have become lower due to soiling. You can compensate for this by increasing the "CF" value, as described above in items 1 to 4.

Bringing into service

Changing the temperature coefficient

You can adjust the temperature coefficient manually, as long as an appropriate value has been established.

The factory setting of “2.1” is normally used for steam generating units with constant pressure. For newly installed electrodes, this figure may need to be adapted in line with the temperature coefficient of the boiler water.

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter “**tC**”.
2. Press and hold the rotary knob until the momentary value flashes on the display.
3. Set the desired value (000.0 – 003.0).
4. Save your settings by pressing the rotary knob for approx. 1 second.

Raising the “tC” value reduces the display value.

Using the “CAL” feature

The CAL function enables convenient readjustment of the cell constant “CF” when the electrode gets increasingly soiled during operation. Here, the reference reading from a reliable sample is converted into the display value at the operating point. The internal processor then automatically recalculates and corrects the cell constant “CF”.

⚠ ATTENTION

If the “CF” (cell constant) value of 003.0 is exceeded, the warning code “CF.Hi” will appear.

- You urgently need to clean the electrode, see page 52.
- Continued operation is possible.

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Using a reliable sample, establish a reference reading of the momentary conductivity at the plant’s operating point.
2. Select the parameter “**CAL**”.

   First of all, the momentary cell constant “CF” is displayed.
3. Press and hold the rotary knob until the momentary conductivity value flashes on the display.
4. Set the reference value you previously established (conductivity from the reference sample) as the new display value.
5. Save your settings by pressing the rotary knob for approx. 1 second.

Bringing into service

Using the “FiLt” feature

The aim of this feature is to “smooth” the 4 - 20 mA actual value output of the conductivity transmitter for use on the controller.

- The adjustable time constant (1 - 30 seconds) influences both the current output and the display of the conductivity transmitter.

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter “**FiLt**”.

   First of all, the momentary filter constant is displayed.
2. Press and hold the rotary knob until the momentary value flashes on the display.
3. Set the desired value.
4. Save your settings by pressing the rotary knob for approx. 1 second.

Changing the scale of the 4 - 20 mA actual value output

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter “**Sout**”.
2. Press and hold the rotary knob until the momentary value flashes on the display.
3. Set the desired value.

   Choose from the following measuring ranges:

   - LRGT 1x-3: 0.25 - 10, 50, 100, 250, 500, 1000 or 3000 ppm
     (0.5 - 20, 100, 200, 500, 1000, 2000 or 6000 µS/cm)
   - LRGT 16-4: 25 - 1500, 2500, 3500, 4999.5 ppm
     (50 - 3000, 5000, 7000, 9999 µS/cm)
4. Save your settings by pressing the rotary knob for approx. 1 second.

Bringing into service

Changing the display unit (µS/cm or ppm)

You can choose between µS/cm and ppm (parts per million) for the unit of the displayed reading.

The formula for converting µS/cm to ppm is: 1 µS/cm = 0.5 ppm

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter "**Unit**".
2. Press and hold the rotary knob until the momentary value flashes on the display.
3. Set the desired display unit (µS or ppm).

   Viewing the set unit via the LEDs (see "Fig. 15" on page 43):

   - **LED 3** (green) = µS/cm
   - **LED 4** (green) = ppm
4. Save your settings by pressing the rotary knob for approx. 1 second.

Manually initiating a display test

Pay attention to the setting instructions on page 36/37 and proceed as follows:

1. Select the parameter "**diSP**".
2. Press and hold the rotary knob until the display test starts and "**....**" is shown.
3. The following numbers and decimal points run across the display from right to left:
   "...., 1, 2, 3, 4, 5, 6, 7, 8, 9, ..."
4. Check that all numbers and decimal points are displayed correctly.
   The display test runs automatically until it has finished, and cannot be interrupted.
5. The display test ends with "**donE**".

Replacing faulty equipment

Faulty equipment is a danger to plant safety.

- If numbers or decimal points are displayed incorrectly or not at all, you must replace the conductivity transmitter with an identical one from GESTRA AG.

Bringing into service

Note for bringing into service:

After a new or cleaned conductivity electrode has been installed, set the parameter "**tC**" in line with the boiler water. Check the value of the cell constant "**CF**", which should be 0.210.

Comparing the reading with the reference reading from a reliable sample

Incorrectly installed or bent conductivity electrodes result in a loss of function that can jeopardize plant safety.

Proceed as follows when bringing into service or whenever the LRGT 1x-x conductivity transmitter has been replaced:

- Establish the momentary conductivity of the boiler water with the aid of a reference reading from a controlled sample at the desired plant operating point.
- Compare the displayed reading with the momentary reference reading.
- Do not bring a plant into service unless this conductivity value check was successful.
- If deviations are discovered in electrodes that have been replaced or cleaned, change parameter "**tC**" until the indicated reading matches the reference measurement. Also see the description of parameter "**tC**" on page 39.
- LRGT 1x-x conductivity transmitters may only be repaired by the manufacturer, GESTRA AG.
- Only replace faulty equipment with identical equipment from GESTRA AG.

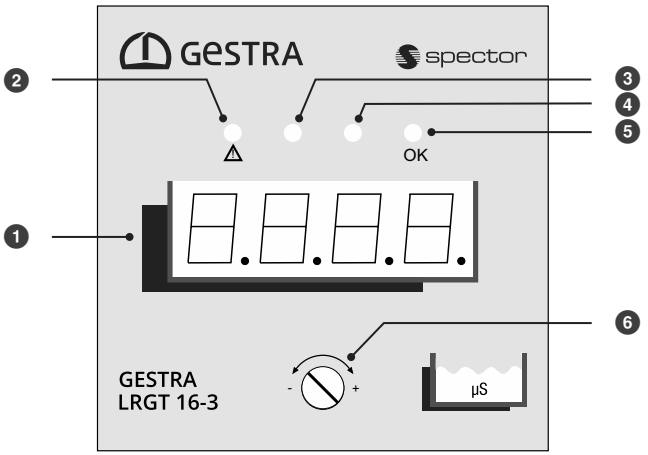


Fig. 17

Operating panel:

1. Display of actual value/error code/limit value - green, 4 digits
2. LED 1, error, red
3. LED 3, µS/cm, green
4. LED 4, ppm, green
5. LED 2, function OK, green
6. Rotary knob/button for operation and settings

Priority of the various error codes

Errors are displayed based on their priority. Codes with higher priority are shown continuously before those with low priority. If several codes require attention, the display does not alternate between them.

Priority of error code display

Higher-priority error codes overwrite lower-priority ones on the display! See page 47 ff. for codes in accordance with the error code table.

Starting, operation and testing

Cross-reference of the display and LEDs and the operating state of the conductivity transmitter:

Starting		
Switch on the supply voltage	All LEDs light up - Test **Display:** S-xx = software version t-09 = equipment type LRGT 1x-3 t-10 = equipment type LRGT 16-4	The system is started and tested. The LEDs and display are tested.

Normal operation		
The measuring electrodes of the conductivity transmitter are immersed	**Display:** 1234 **LED 1:** is Off **LED 3 or 4**: lights up green	Display of momentary, temperature-compensated conductivity Display of set unit
	LED 2: flashes green	The unit is performing a self-test *
	LED 2: lights up green	The self-test is complete - the unit is OK
	* The reading is not updated during the self-test phase.	

Behavior in the event of a malfunction (error code display)		
The measuring electrodes of the conductivity transmitter are immersed or exposed. There is a malfunction.	**Display:** e.g., E005 **LED 1**: alarm LED lights up red	An error code is shown continuously, error code display see page 47 There is an active malfunction
	LED 3 or 4: lights up green	Display of set unit
	LED 2: flashes green	The unit is performing a self-test
	LED 2: is OFF	Malfunction or internal error
■ In the event of a malfunction or error state, an analog value of 0 mA is output.		

Electrode faults cannot be acknowledged.
When a fault is corrected, the message disappears from the display, and the conductivity transmitter returns to normal operation.

See the following page for more information and tables.

<table>
<tr><th colspan="3">Test</th></tr>
<tr><th colspan="3">Checking the safety function via simulation in operating mode</th></tr>
<tr><td rowspan="5">In operating mode:
Press the rotary knob on the LRGT 1x-x and hold until the end of the test.</td><td>Display:
9999
LED 1:
Error LED is OFF</td><td>Test function is active</td></tr>
<tr><td>LED 3 or 4: lights up green</td><td>Display of set unit</td></tr>
<tr><td>LED 2: flashes green</td><td>The unit is performing a self-test</td></tr>
<tr><td>LED 2: lights up green</td><td>Test function is active</td></tr>
<tr><td colspan="2">■ 20 mA is output at the current output of the conductivity electrode. The downstream control can be checked using the MAX alarm, for example.
■ The test ends when the rotary knob is released.</td></tr>
</table>

Faulty equipment is a danger to plant safety.

- If the conductivity transmitter does not behave as described above, the equipment may be faulty.
- Perform failure analysis.
- LRGT 1x-x conductivity transmitters may only be repaired by the manufacturer, GESTRA AG.
- Only replace faulty equipment with identical equipment from GESTRA AG.

System malfunctions

Causes

System malfunctions occur as the result of incorrect installation, overheated equipment, interference in the supply network, or faulty electronic components.

Check the installation and configuration before systematic troubleshooting

Installation:

- Check that the installation location complies with the permitted ambient conditions in terms of temperature, vibration, interference sources, minimum distances, etc.

Wiring:

- Does the wiring conform to the wiring diagrams?
- Does the 4 - 20 mA current loop have the correct polarity and is it closed?
- Is the 4 - 20 mA current loop below the overall output load of 500 ohms?

⚠ ATTENTION

An open circuit in the 4 - 20 mA current loop can cause a plant shutdown and a malfunction is indicated.

- Bring the plant into a safe operating state before commencing work on the installation.
- Switch off the voltage to the plant and secure so that it cannot be switched back on.
- Check that the plant is not carrying live voltage before commencing work.

System malfunctions

Display of system malfunctions using error codes

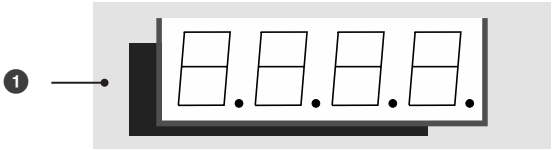


Fig. 18 ❶ Display of actual value/error code/limit value - green, 4 digits

Error code table			
Error code	**Internal designation**	**Possible errors**	**Corrective action**
E.001	LFKurzschlussErr (CondShortCircuitErr)	Short circuit in conductivity measurement (electrode wires)	Replace conductivity transmitter
E.002	LFKabelbruchErr (CondOpenCircuitErr)	Open circuit in cond. measurement (electrode wires)	Check installation location. Is the ground connection less than 10 ohms? Use a band grounding clamp. See page 28. Is the electrode immersed? Replace conductivity transmitter
E.003	Ch1Ch2LFDiffErr	Excessive difference between redundant cond. measurement channels	Replace conductivity transmitter
E.004	PtMinTempErr	Pt1000 below minimum temperature or short circuit	Check installation location. Use a band grounding clamp. Replace conductivity transmitter
E.005	PtMaxtempErr	Pt1000 above maximum temperature or open circuit	Check installation location. Replace conductivity transmitter
E.006	Ch1Ch2PtDiffErr	Excessive difference from redundant Pt1000 measurement	Replace conductivity transmitter
E.007	USIGTSTErr	Test signal measuring voltage outside tolerance	Replace conductivity transmitter
E.008	ISIGTSTErr	Test signal measuring current outside tolerance	Replace conductivity transmitter
E.009	ADCTSTErr	Pt1000 test measuring voltage outside tolerance	Replace conductivity transmitter
E.010	ICONErr	Pt1000 test measuring current outside tolerance	Replace conductivity transmitter
E.011	ADVTSTErr	12-bit/16-bit AD converter comparison outside tolerance	Replace conductivity transmitter
E.012	FREQTSTErr	Test signal frequency outside tolerance	Replace conductivity transmitter
E.013	VMessErr	Control voltage of 4 - 20 mA output (LRGT models only)	Replace conductivity transmitter
Error code	**Internal designation**	**Possible errors**	**Corrective action**

System malfunctions

Error code table			
E.014	ADSReadErr	16-bit AD converter not responding	Replace conductivity transmitter
E.015	UnCalibErr	Calibration invalid	Replace conductivity transmitter
E.017	ENDRVErr	Second shutdown path of 4 - 20 mA analog output faulty	Replace conductivity transmitter
E.018	V12NegErr	System voltage -12 V outside tolerance	Replace conductivity transmitter
E.019	V6Err	System voltage 6 V outside tolerance	Replace conductivity transmitter
E.020	V5Err	System voltage 5 V outside tolerance	Replace conductivity transmitter
E.021	V3Err	System voltage 3 V outside tolerance	Replace conductivity transmitter
E.022	V1Err	System voltage 1 V outside tolerance	Replace conductivity transmitter
E.023	V12Err	System voltage 12 V outside tolerance	Replace conductivity transmitter
E.024	CANErr	Communication error (not LRGT models)	Check baud rate, wiring and terminating resistors
E.025	ESMG1Err	µC error	Replace conductivity transmitter
E.026	BISTErr	µC periphery self-test error	Replace conductivity transmitter
E.027	OvertempErr	PCB/ambient temperature > 167 °F (75 °C)	Check installation location. Reduce ambient temperature of terminal box (cool if necessary)

Error code E.016 is just a reserve and is not documented.

Virtually all of the aforementioned error codes can be caused by electromagnetic interference. This is less likely to be the case with persistent errors, but should be considered for sporadic error codes.

In this case, check that the installation shielding is correctly wired, and check the general EMC conditions before replacing the electrode.

System malfunctions

Faults that do not provoke a shutdown

The indicated conductivity fluctuates, moisture in vicinity of electrode cover tube	
Possible causes if no error codes are shown	**Corrective action**
Moisture is entering the cover tube from the outside.	■ Check the installation location for possible water leaks that could cause water/water vapor to get into the conductivity electrode. ■ Check that the conductivity transmitter is leak-tight. ■ Has the electrode been correctly insulated to prevent leakage? ■ Replace the conductivity transmitter with an identical unit from GESTRA AG.
The inner seals of the electrode rods are damaged.	■ Replace the conductivity transmitter with an identical unit from GESTRA AG.
Ground connection to boiler is poor or greater than 10 ohms	■ Use a band grounding clamp. See page 28.

The indicated conductivity very occasionally but repeatedly displays extreme values.	
Possible causes if no error codes are shown	**Corrective action**
Electrode rods are not continuously immersed.	■ Check that the installation conforms to this manual. ■ Pay attention to the installation examples and stated minimum distances.

Flashing values from t-71 to t-75 appear on the display	
Possible causes	**Corrective action**
The ambient temperature of the electrode terminal box is high, between 159.8 °F and 167 °F (71 °C and 75 °C). If the temperature rises above 167 °F (75 °C), error code E.027 (OvertempErr) appears and the current output delivers 0 mA.	■ Reduce the ambient temperature around the terminal box, e.g., by cooling.

The message “CF.Hi” flashes on the display	
Possible causes	**Corrective action**
The cell constant is excessively high after the “CAL” (calibration) process or manual readjustment LRGT 1x-x CF > 3.0	■ Remove the conductivity transmitter, see page 51. ■ Inspect and clean the electrode, see page 52

System malfunctions

Checking installation and function

When you have corrected system malfunctions, perform a function test as follows.

- Check installation and function.
- Check the indicated reading and perform an equipment test, see page 45, when bringing into service and whenever an LRGT 1x-x conductivity transmitter has been replaced.

System malfunctions in LRGT 1x-x conductivity transmitters produce an output of 0 mA at the analog output.

If you require assistance, please tell us the error code that is indicated.

In the event of malfunctions or errors that cannot be corrected with the aid of this Installation & Operating Manual, please contact our service center or authorized agent.

Taking out of service, removal

⚠ DANGER

Danger to life from scalding! Hot steam may escape abruptly.

Hot steam or hot water can escape suddenly if the conductivity electrode is unscrewed while under pressure.

- Reduce the boiler pressure to 0 psi (0 bar) and check the pressure before unscrewing the conductivity electrode.
- Only remove the conductivity electrode at 0 psi (0 bar) boiler pressure.

⚠ WARNING

The hot conductivity electrode can cause severe burns.

The conductivity electrode gets extremely hot during operation.

- Perform installation and maintenance work only when the conductivity electrode has been allowed to cool.
- Only remove conductivity electrodes that have cooled down.

Proceed as follows:

1. Reduce the boiler pressure to 0 psi (0 bar).
2. Allow the conductivity electrode to cool to room temperature.
3. Switch off the supply voltage.
4. Pull out the connector.
5. Next, remove the conductivity electrode.

Cleaning the measuring electrodes of the conductivity transmitter

Monthly comparison of readings

Every month, an appropriately qualified expert must compare readings with reliable samples.

In the event of discrepancies, the conductivity transmitter must be calibrated using the "**CAL**" function, see page 39.

Cleaning interval

We recommend cleaning the electrode at least once a year, e.g., during maintenance work, or possibly more often depending on operating conditions.

Before cleaning the measuring electrode(s), take the conductivity transmitter out of service and remove it, see page 51.

LRGT 16-3, LRGT 17-3

1. Undo the threaded pin Ⓕ and manually unscrew the measuring tube Ⓖ.
2. Clean the electrode rod and measuring surface.
3. Wipe off loose deposits with a non-greasy cloth.

   Scrub off stubborn deposits using sandpaper (medium grain).
4. Next, screw the measuring tube Ⓖ back on and secure it with the threaded pin Ⓕ *.

LRGT 16-4

1. Clean the measuring electrodes Ⓖ *.
2. Wipe off loose deposits with a non-greasy cloth.

   Scrub off stubborn deposits using sandpaper (medium grain).

   Continue as described below:

   *Ⓕ / Ⓖ *= key to overall view, see page 21*

LRGT 16-3, LRGT 17-3, LRGT 16-4

1. Install the clean conductivity transmitter as described on pages 25 - 28.
2. Switch on the supply voltage.
3. Bring the equipment or plant into service, see page 35.
4. Compare the reading with the conductivity established directly from a reference measurement, see page 42.
5. Check the equipment using the test function of the conductivity transmitter, see page 45.

Disposal

Dispose of the conductivity transmitter in accordance with statutory waste disposal regulations.

Returning decontaminated equipment

If products have come into contact with media that are hazardous to health, they must be drained and decontaminated before being returned to GESTRA AG.

The term 'media' can refer to solid, liquid or gaseous substances or mixtures, as well as radiation.

GESTRA AG can accept returned products only if accompanied by a completed and signed return note and also a completed and signed declaration of decontamination.

The return confirmation and declaration of decontamination must be attached to the outside of the return package, as processing will otherwise be impossible and the products will be returned to the sender at their expense.

Please proceed as follows:

1. Let GESTRA AG know about the return beforehand by e-mail or phone.
2. Wait until you have received the return confirmation from GESTRA.
3. Fill out the return confirmation (including declaration of decontamination) and send it with the products to GESTRA AG.

UL components

LRGT 16-3, LRGT 16-4 and LRGT 17-3 conductivity transmitters are registered under XACN.E513189.

GESTRA®

You can find our authorized agents around the world at: **www.gestra.com**

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