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TitraLab SO₂ content analyzer for wine

USER MANUAL

02/2013, Edition 2

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Section 1 Specifications

These are subject to change without notice!

Performance specifications		
Measuring principle		Potentiometric titration according to the Ripper method for the determination of free SO ₂ and total SO ₂ content in wine
Measuring range		0–640 mg/L SO ₂
Resolution		1 mg/L SO ₂
Programs		3 titration programs
Languages		English, Spanish, French and Italian
Data logger		55 data records
Date/time		DD-MM-YYYY
Display		128 x 64 pt, backlit liquid crystal display
Keypad		7 membrane keys, splash-proof, PET, lifetime of >6 million key-presses
Burette	Resolution	0.001 mL
	Material of syringe	Polypropylene
	Volume	10 mL
Reagent tubes		White PTFE tubes
Peristaltic pump	Volumetric flow	70 mL/min
	Tube	Novoprene, internal diameter 2 mm
Inputs and outputs	Measuring electrode	BNC connector
	Magnetic stirrer	RCA connector (cinch)
	Computer or printer	RJ11 telephone connector
	Power supply, external	24 VAC, 1.25 A, 30 VA
	Mouse	Mini-DIN connector
Dimensions of measuring instrument and environmental conditions		
Enclosure material		ABS and enameled steel
Weight		approximately 4 kg
Dimensions		130 x 160 x 300 mm
Working temperature		+15 to +40 °C (+60 to +104 °F)
Storage temperature		-10 to +50 °C (+14 to +122 °F)
Air humidity		<80% relative humidity, non-condensing
Warranty		
Warranty		1 year

Section 2 General information

2.1 Safety information

Please read the entire user manual carefully before the equipment is unpacked, set up or put into operation. Pay attention to all danger and warning statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To make sure that the protection provided by this instrument is not impaired, do not use or install this instrument in any manner other than that specified in these operating instructions.

DANGER

Indicates a potentially or imminently hazardous situation that, if not avoided, results in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation that, if not avoided, could result in damage to the instrument. Information that requires special emphasis.

Note: Information that supplements points in the main text.

2.1.1 Warning labels

Read all labels and tags attached to the instrument. Failure to do so may result in personal injury or damage to the instrument. For symbols applied to the instrument, corresponding warnings are provided in the user manual.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol may be found on an enclosure or barrier within the product and indicates a risk of electrical shock and/or death by electrocution.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems after 12 August 2005. In conformity with European local and national regulations, European electrical equipment users must now return old or end-of life equipment to the manufacturer for disposal at no charge to the user. Note: For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and all auxiliary items for proper disposal.

2.1.2 Chemical and biological safety

DANGER

Potential danger in the event of contact with chemical/biological materials.
Handling chemical samples, standards and reagents can be dangerous.
Familiarize yourself with the necessary safety procedures and the correct handling of the chemicals before the work and read and follow all relevant safety data sheets.

Normal operation of this instrument may involve the use of hazardous chemicals or biologically harmful samples.

- Observe all cautionary information printed on the original solution containers and safety data sheet prior to their use.
- Dispose of all consumed solutions in accordance with national regulations and laws.
- Select the type of protective equipment suitable to the concentration and quantity of the dangerous material at the respective work place.

2.2 Overview of product

Sulfur dioxide (SO_2) is added to wine for protection and conservation purposes.

Once the SO_2 reaches a concentration depending on local regulations, a label must be added to state that this ingredient may cause an allergic reaction. The label must also state that the product contains sulfites or sulfur dioxide. The terms sulfur dioxide and sulfite are used synonymously in the warning note. Sulfur dioxide (SO_2) is a gas that is frequently referred to as sulfuric acid when dissolved in water. "Sulfites" refers to the salts within the sulfuric acid.

The warning also applies to semi-sparkling and sparkling wine, champagne and all other products governed by wine laws, such as punch or mulled wine.

SO_2 is added to wine for the following reasons:

- To protect against harmful changes caused by oxygen in the air (anti-oxidant)
- To protect against unwanted micro-organisms (preservative)
- To mask (combine with) fermentation by-products with an unpleasant taste (such as acetaldehyde) and thus promote clarity in sensory perception.

Wines contain free SO_2 and bound SO_2 ; only the free SO_2 serves to protect the wine. The permitted total concentration of SO_2 in wine can be restricted by country regulations or directives and depend on the type of wine, the quality and the sugar content.

The TitraLab SO_2 system has three titration programs to determine levels of:

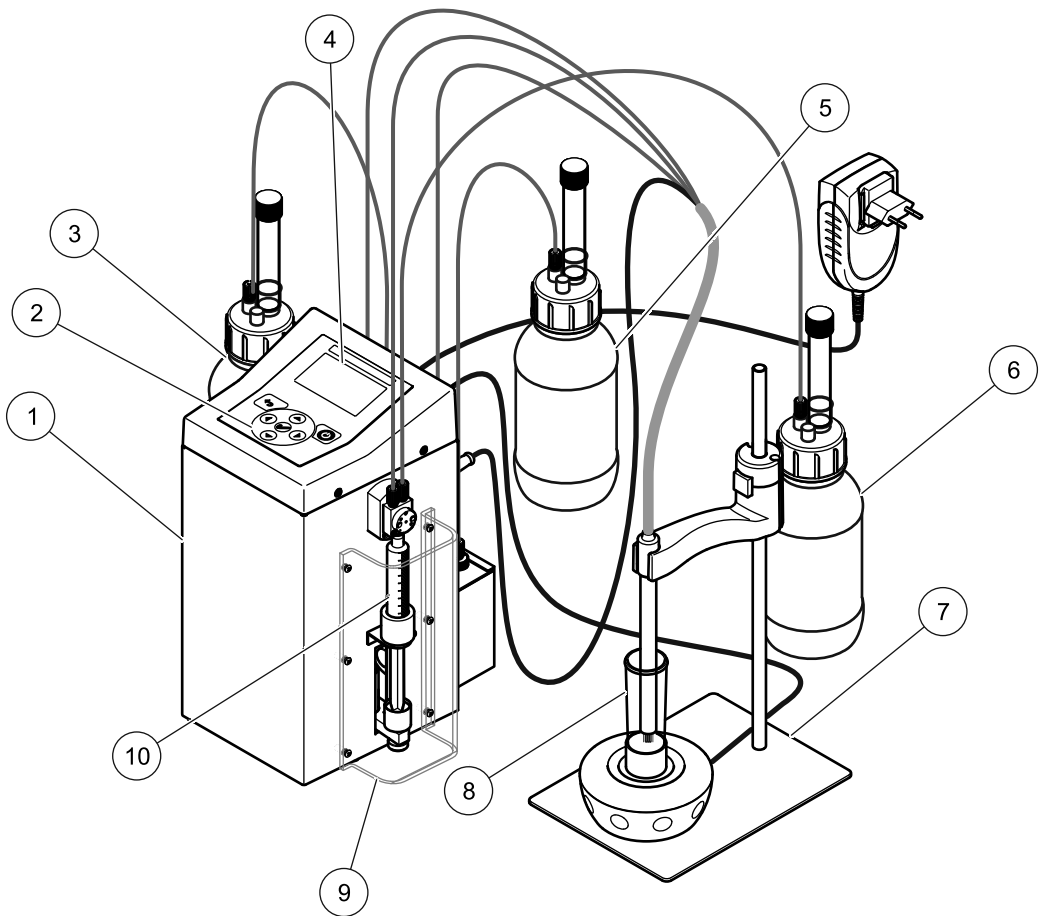
- Free SO_2
- Total SO_2
- Total SO_2 with sample preparation for a series of samples

The programs can be customized.

TitraLab features an RS 232 C interface to enable communication with a computer or printer. Another port enables a mouse to be connected to perform all the functions of "OK". A convenient titration stand is also integrated and equipped with stirrers; pumps integrated with the titrator add reagents automatically as part of the analytical process.

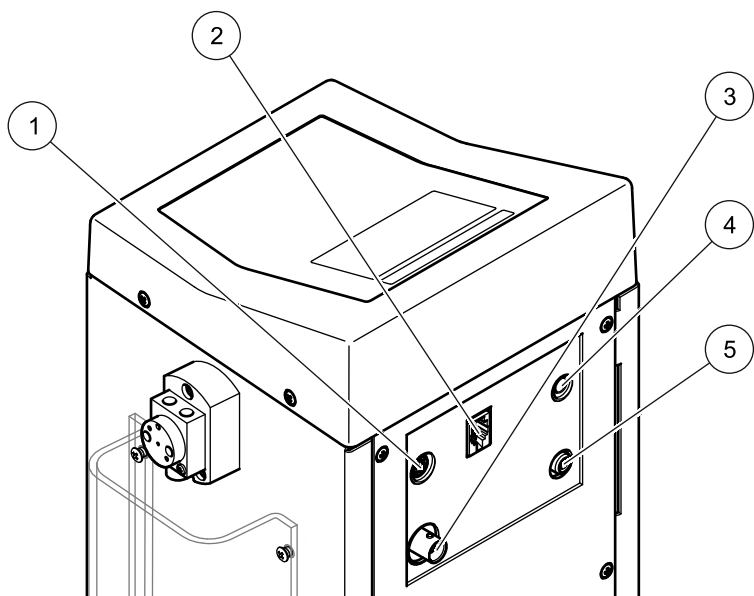
2.3 Front and back view

Figure 1 Front view



1	TitraLab SO ₂ titrator	6	Titrant (Iodine)
2	Keypad	7	Titration stand
3	Bottle for alkali (Sodium or Potassium Hydroxide)	8	Titration cell
4	Display	9	Syringe cover
5	Bottle for acid (Sulfuric Acid)	10	Burette

Figure 2 Back view



1	Connector for mouse	4	Connector for power supply
2	Connector for printer or computer	5	Connector for magnetic stirrer
3	Electrode connector		

WARNING

Risk of injury to eyes, skin and respiratory

When working with chemicals and/or solvents, always observe the relevant accident prevention regulations and wear appropriate personal protective clothing for eye, face, hand, body and/or respiratory protection.

Make sure that the system is only unpacked, assembled, connected and operated by qualified and/or trained personnel.

3.1 Unpack the instrument

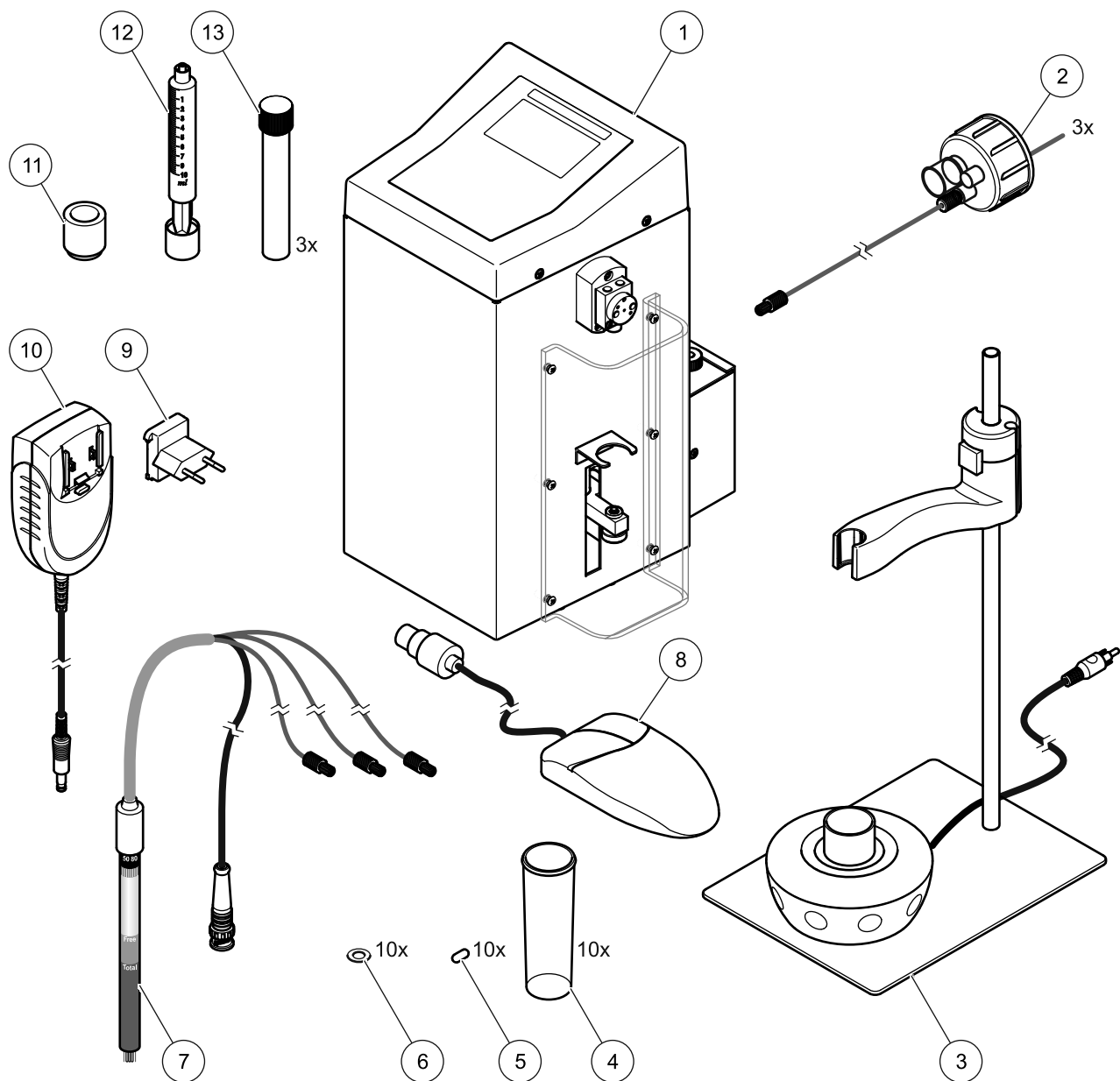
Unpack all supplied parts carefully, as they are highly sensitive in part to shock and impact. Read the user manual prior to installation and proceed exactly as described.

3.2 Scope of delivery

Please check that the order is complete. If anything is missing or damaged, please contact the manufacturer or retailer.

Installation

Figure 3 Scope of delivery



1 TitraLab SO ₂ titrator	8 Mouse
2 3x tube with bottle closure (DIN 45 thread) supplied pre-installed	9 Adapter for power supply
3 Titration stand with magnetic stirrer	10 Power supply, external
4 10x titration cells, 50 mL, Ø 30 mm, polypropylene with lid	11 Hardware sleeve
5 10x Teflon magnetic stirring bars (20 mm x 6 mm)	12 Syringe with plunger
6 10x white O-rings for burette and pump threads	13 3x desiccant cartridge
7 Double-platinum electrode including cable and tubes	

3.3 Operating environment

Note the following points so that the instrument will operate correctly and have a long service life.

- Place the instrument firmly on an even surface. Do not push any objects under the instrument.
- The ambient temperature must be 15 to 40°C (60 to 104°F).
- The relative humidity should be less than 80%; moisture should not condense on the instrument.
- A minimum clearance of 15 cm (5.9 in.) must be ensured above and on all sides of the device; this allows the air to circulate and prevents overheating of the electric parts. The dosage arm of the stepper motor must be able to move freely.
- Do not operate or store the instrument in extremely dusty, humid or wet locations.
- Make sure that no liquids enter the instrument and immediately wipe away any liquids that contact the instrument.
- Protect the instrument against vibrations, direct sunlight, corrosive gases as well as strong magnetic and/or electric fields.
- Only use genuine replacement parts and accessories.

The instrument must be serviced by the manufacturer's service department at the prescribed intervals.

3.4 Installation

3.4.1 Installation of the burette

The burette dispenses the titrant, i.e. the 0.01 M I_3 solution.

The burette comprises the syringe, stepper motor and valve. The stepper motor and valve are already installed in the TitraLab; the syringe must be installed by the user.

⚠ WARNING

Risk of injury to pinch points and cuts

Make sure that the titrator is never used/operated without the syringe cover.

Make sure that the system is only assembled by qualified and trained personnel.

NOTICE

Warning against system damage

Make sure that the syringe is never operated without the attachment sleeve.

Only use genuine replacement parts and accessories.

The instrument must be serviced by the manufacturer's service department at the prescribed intervals.

Note: Make sure that you do not misplace the attachment sleeve for the syringe. It is not provided with a new syringe.

1. Push the syringe piston into the syringe body.
Slide the attachment sleeve fully onto the syringe so that the narrow end points toward the piston.
2. Remove the syringe cover by unscrewing it.

Installation

3. Point the syringe tip upward, place the syringe into the bracket such that the attachment sleeve is above the bracket.
4. With the narrow side facing down, carefully press the attachment sleeve into the bracket.
Hold the attachment sleeve in the bracket and screw the syringe onto the valve from below.
5. Withdraw the piston from the syringe and place it onto the screw in the dosage arm.
Hold the syringe piston and turn the attachment screw on the dosage arm into the thread in the piston.
6. Fix the syringe cover with six screws.

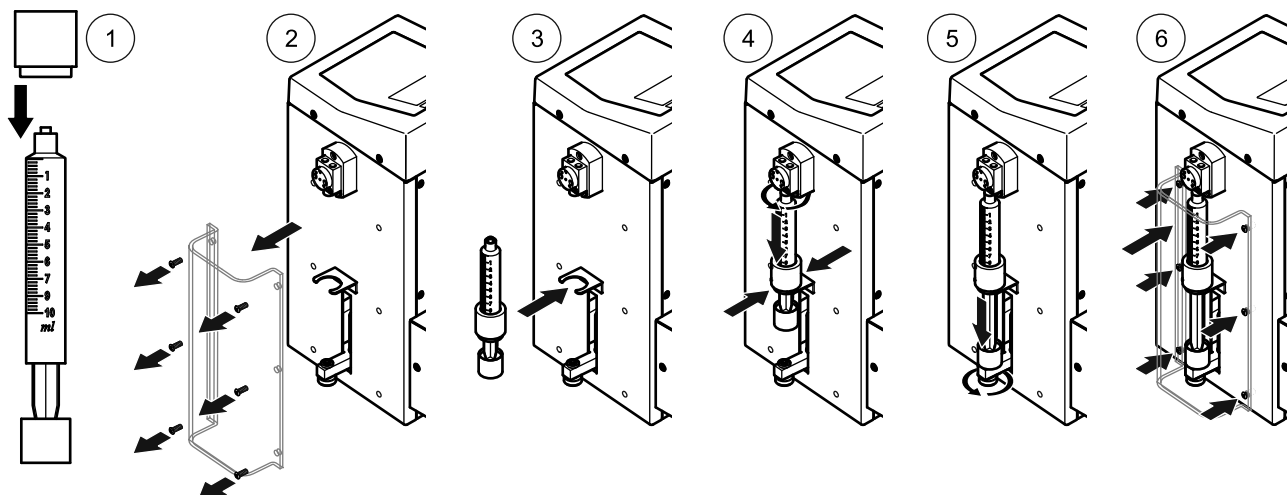
⚠ WARNING

Risk of injury to eyes, skin and respiratory

During the first days of system use, check the screw joint between the syringe and valve to avoid leaks and the potential escape of reagents.

When working with chemicals and/or solvents, always observe the relevant accident prevention regulations and wear appropriate personal protective clothing for eye, face, hand, body and/or respiratory protection.

Figure 4 Installation of the burette



1	Push the piston into the syringe body. Slide the attachment sleeve onto the syringe.	4	Place the attachment sleeve into the bracket. Screw the syringe tip onto the valve.
2	Unscrew the six screws and remove the syringe cover.	5	Screw the piston onto the dosage arm.
3	Insert the syringe into the bracket.	6	Fix the syringe cover with six screws.

3.4.2 Installation of the titration stand

The titration stand consists of a holder onto which the electrode, titration cell and magnetic stirrer are attached. The titration is performed in the titration cell.

1. Place the titration stand on the right side (syringe side) of the titrator (observe the routing of the cable).
2. Place a magnetic stirring bar into a titration cell.
Attach the titration cell to the magnetic stirrer.
3. Place the rubber ring on the stand rod to set the minimum height of the electrode holder.

4. Press the button to lock the electrode holder and place the electrode holder on the stand rod.
The electrode holder is locked upon release of the button.
5. Remove the white cap from the tip of the electrode.
Insert the electrode into the electrode holder.

NOTICE

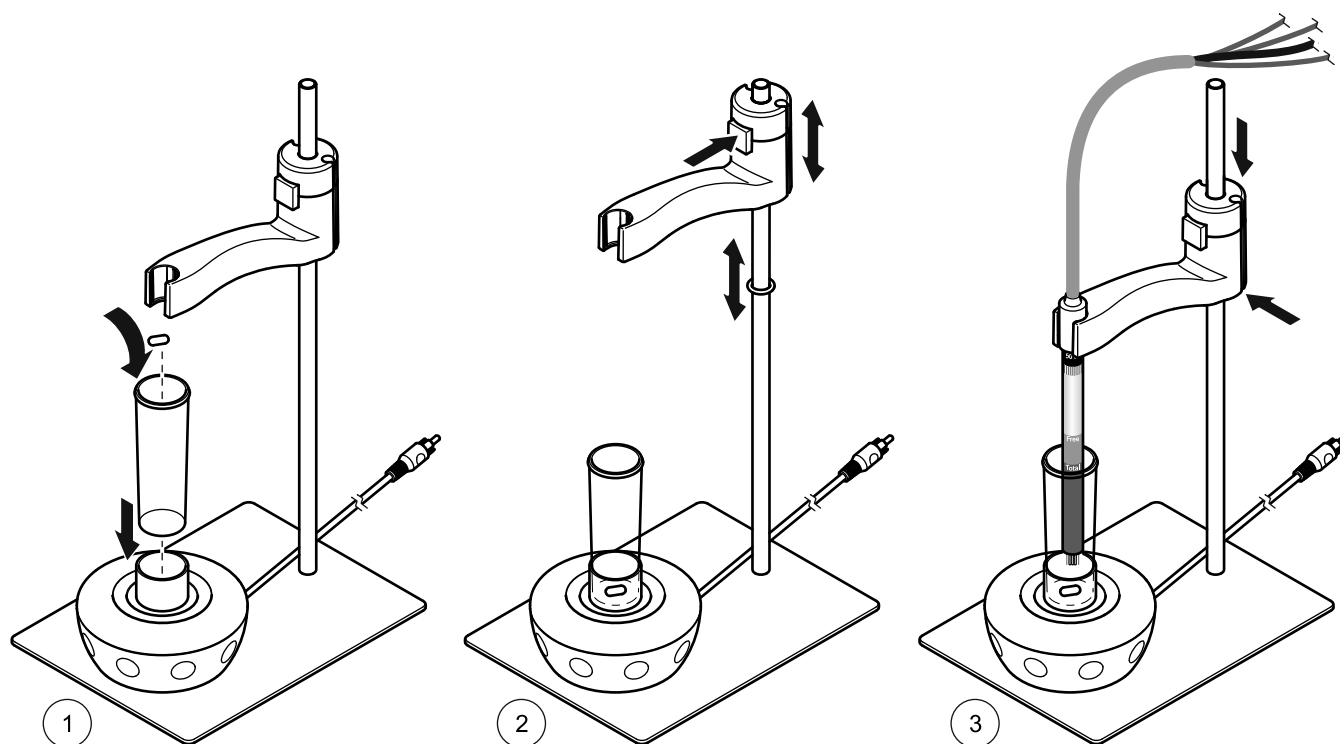
Warning against system damage

Make sure that the height setting of the electrode holder protects the electrode against damage from the stirring bar and against contact with the bottom of the titration cell.

Keep the lock button pressed whenever the electrode holder is being moved.

Note: Whenever the electrode is taken from the titration stand or the titration cell is removed from the titration stand, always place a container beneath the electrode. Otherwise, drips from the sample or chemicals could contaminate the work area.

Figure 5 Installation of the titration stand

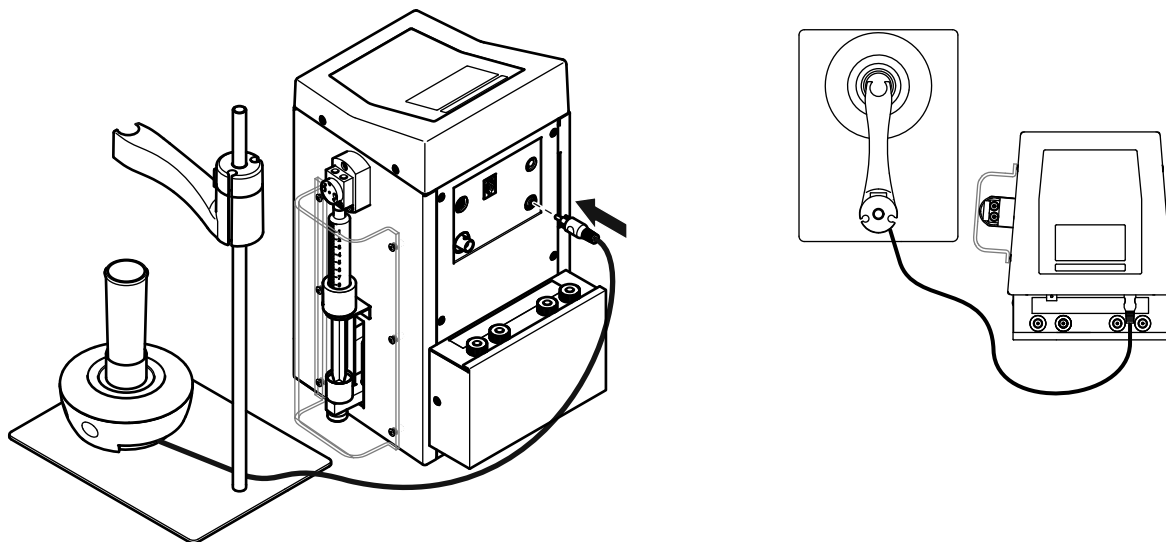


- | | |
|--|---|
| <p>1 Place a magnetic stirring rod in a titration cell. Attach the titration cell to the magnetic stirrer.</p> | <p>3 Insert the electrode and adjust the height of the electrode holder.</p> |
| <p>2 Position a rubber ring on the stand rod to set the minimum height of the electrode holder. Press the electrode holder lock button and place the electrode holder on the stand rod.</p> | |

3.4.2.1 Electrical connection of the magnetic stirrer

1. Connect the cable of the magnetic stirrer to the **STIRRER** port on the back of the TitrLab.
The power is supplied via the TitrLab.

Figure 6 Electrical connection of the magnetic stirrer



- | | |
|---|---|
| 1 | Connect the cable of the magnetic stirrer to the STIRRER port. |
|---|---|

3.4.3 Installation of tubes

⚠ WARNING

Risk of injury to eyes, skin and respiratory

During the first days of system use, check the screw joint between the syringe and valve to avoid leaks and the potential escape of reagents.

When working with chemicals and/or solvents, always observe the relevant accident prevention regulations and wear appropriate personal protective clothing for eye, face, hand, body and/or respiratory protection.

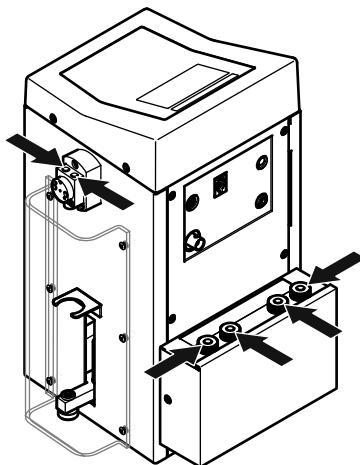
Make sure that the tubes are never kinked.

Regularly check the system as well as all tubes and connections for leaks, condition and cleanliness.

To prevent twisting of the tubes, you should always connect flange tube connections before those with grommets.

3.4.3.1 Removal of protective stickers (Uninstalled tubes configuration)

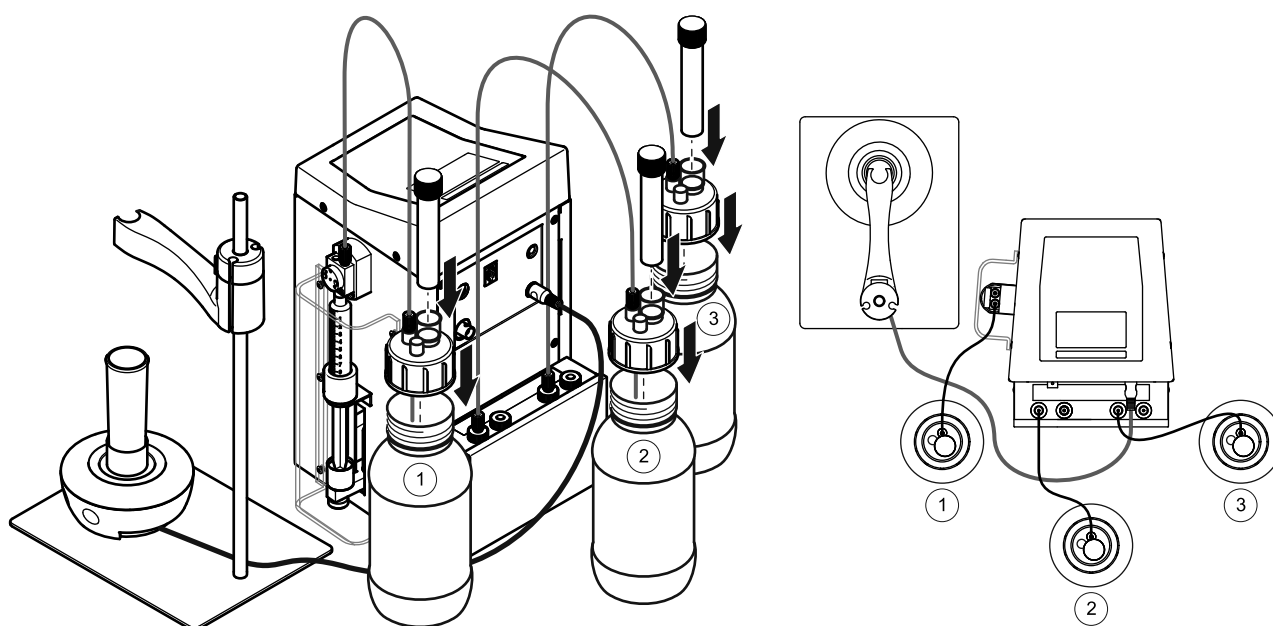
1. Remove the protective stickers on the burette valve and pump connections.
2. Make sure that the pre-installed white O-rings are not removed.
3. Check that the O-rings are in a horizontal position inside the thread.

Figure 7 Position of protective stickers

3.4.3.2 Connection of feed tubes

The system is delivered with three feed tubes with bottle closures (DIN 45 thread). These feed tubes are supplied pre-installed on the TitraLab and only need to be connected to the relevant reagent bottles.

1. Connect the tube from the burette valve to the titrant bottle. Screw onto the bottle closure to do this.
2. Connect the tube from the IN socket of the **ACID** pump to the acid bottle. Screw on the bottle closure to do this.
3. Connect the tube from the IN socket of the **ALKALI** pump to the alkali bottle. Screw on the bottle closure to do this.
4. Place a desiccant cartridge in each bottle closure.

Figure 8 Connection of feed tubes

3.4.4 Connection of the electrode

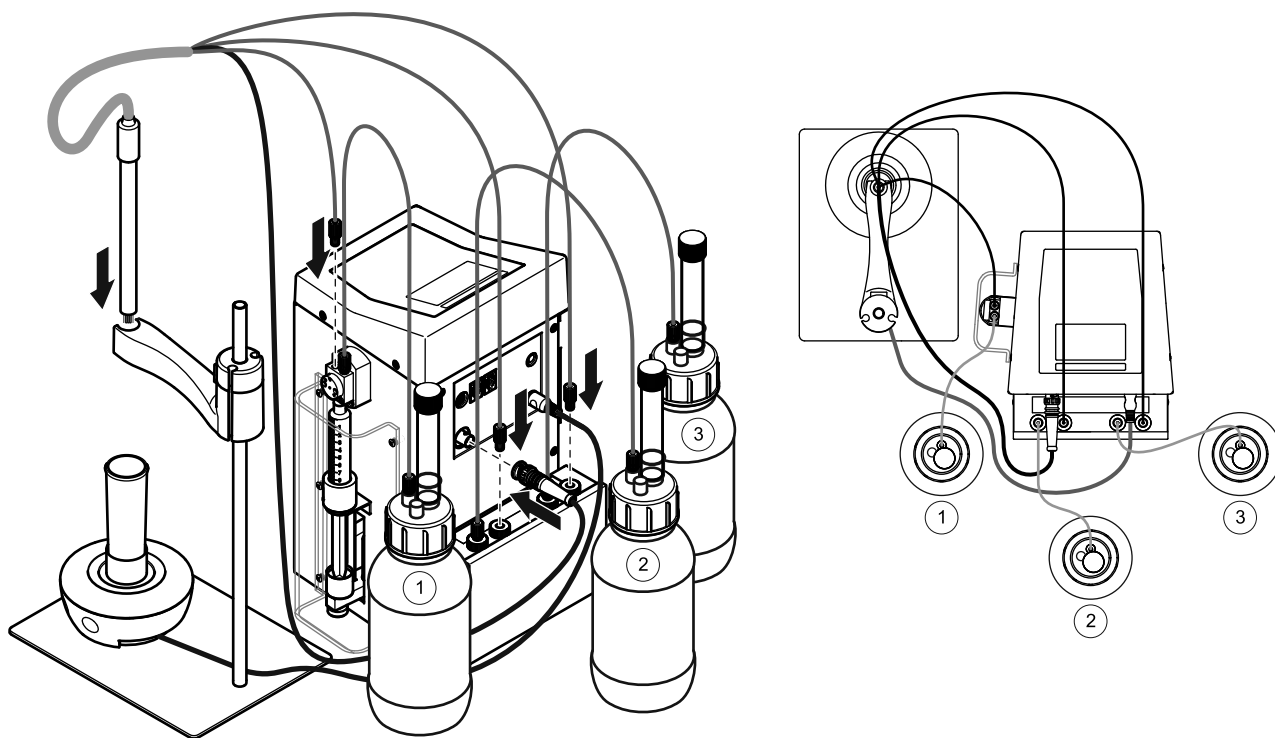
1. Connect the electrode cable to the **SO₂-ELECTRODE** port on the back of the TitrLab. The power is supplied via the TitrLab.

3.4.4.1 Connection of the electrode tubes

The electrode has three tubes with screw connections.

1. Screw one tube onto the burette valve.
2. Screw one tube into the OUT socket of the **ACID** pump.
3. Screw one tube into the OUT socket on the **ALKALI** pump.

Figure 9 Connection of the electrode



3.4.5 Power supply, external

⚠ DANGER

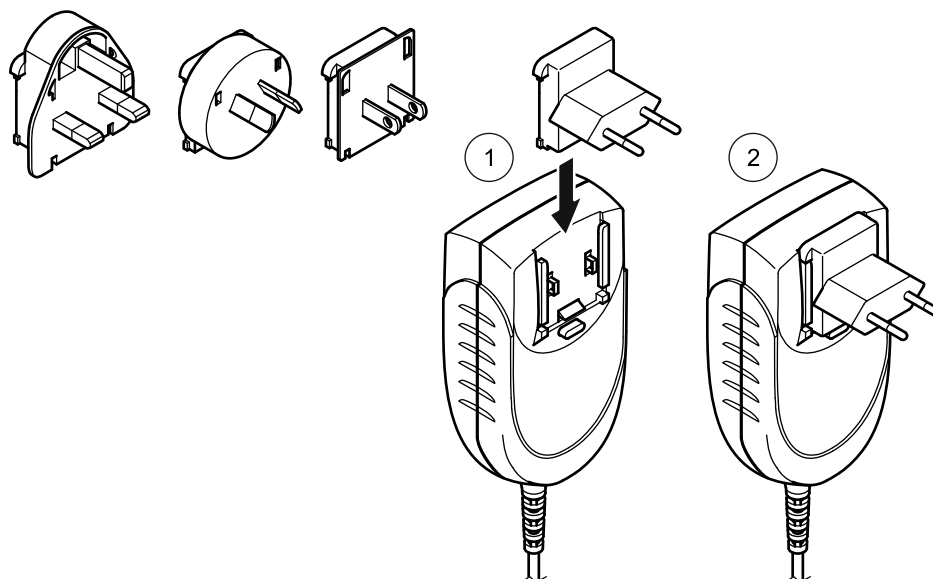
Risk of electric shock

Make sure the AC supply voltage is suitable for the power supply and the mains plug style is suitable for the type of outlet socket.

Only use the original power supply and plug connectors.

The power supply is provided with different plug connectors. The correct plug connector must be attached to the power supply before first use.

Figure 10 Plug connector attachment



1 Slide the plug connector into the power supply

2 Click the plug connector into place

Note: To change the plug connector, press in the catch and slide the plug connector upward.

3.5 Keypad

Navigation key UP

- Used to select between different options on the display.
- Increases numeric values.
- Shows the previous data record in the data log menu.
- Empties the syringe through the discharge tube during manual open loop control.

Navigation key DOWN

- Used to select between different options on the display.
- Reduces numeric values.
- Shows the next data record in the data log menu.
- Fills the syringe through the feed tube during manual open loop control.

ON/OFF key

Navigation key LEFT

- Moves the cursor backward for entry of numeric values.
- Scrolls up in menus.
- Empties the syringe through the feed tube during manual open loop control.

Navigation key RIGHT

- Moves the cursor forward for entry of numeric values.
- Scrolls down in menus.

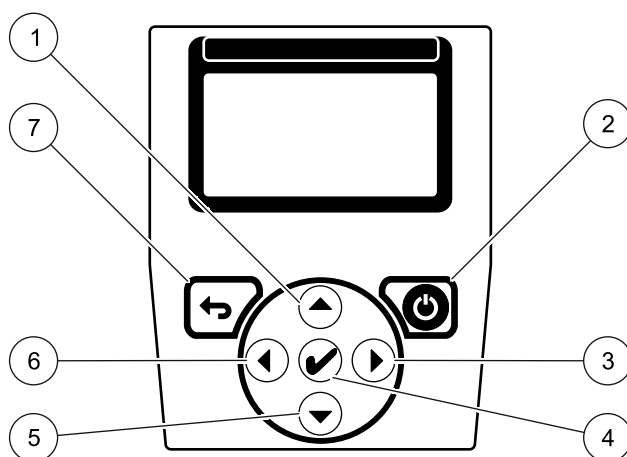
RETURN key

- Scrolls back in menus.
- Cancels a manual control.
- Cancels a titration.

OK key (Check mark)

- Confirms the gray-highlighted menu items and scrolls forward in the menu.
- Shows the first data record in the data log.

Figure 11 Keypad



1	Navigation key UP	5	Navigation key DOWN
2	ON/OFF key	6	Navigation key LEFT
3	Navigation key RIGHT	7	RETURN key
4	OK key (Check mark)		

3.5.1 Optical mouse

All functions executed with OK can also be performed with an optical mouse.

1. Connect the mouse cable to the port labeled **MOUSE** on the back of the TitraLab. The power is supplied via the TitraLab.

3.6 Reagents

- Titrant reagent: Iodine, $I_3 \sim 0.01$ M (standardized reagent)
- Acid reagent: Sulfuric acid, H_2SO_4 25% (4.5 M)
- Alkali reagent: Sodium hydroxide (Potassium hydroxide), NaOH (KOH) 4 M
- Solid Potassium iodide (KI) to suppress interfering substances

Section 4 Operation

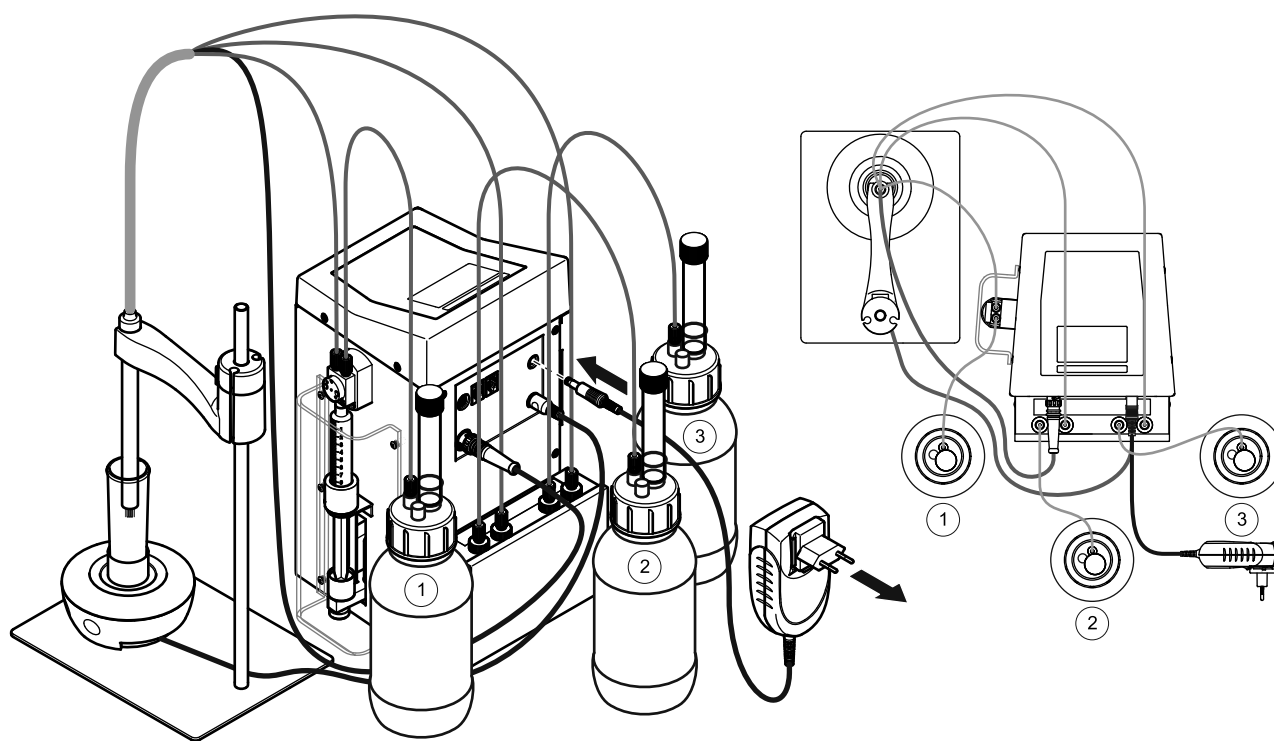
4.1 Switch on the instrument

Become familiar with the instrument functions before operation. Learn how to navigate through the menu and perform the relevant functions.

1. Connect the input connector of the power supply to the **POWER IN** port on the back of the TitraLab.
2. Connect the power supply to a power socket.
3. Press **ON/OFF** below the display to switch on the instrument.
4. The instrument performs a self-test upon each activation.

Note: Wait approximately 20 seconds before switching on again so as not to damage the electronics and mechanics of the instrument

Figure 12 Connection of external power supply



4.2 Startup

4.2.1 Language selection and data output setting

The titrator software supports multiple languages. The first time the instrument is switched on, a language selection list is displayed automatically upon completion of the self-test.

1. Select the required language.
2. Press **OK** to confirm the selection.
3. Select the type of data output (deactivated, printer, computer) and confirm with **OK**.

4.2.1.1 Change the language setting

The instrument functions in the selected language until the option is changed.

1. Turn the instrument on.
2. Select **SYSTEM > LANGUAGE**.
3. Select the required language.
4. Press **OK** to confirm the selection.

4.2.1.2 Change the data output setting

The instrument functions in the selected data output until the option is changed.

1. Turn the instrument on.
2. Select **SYSTEM > DATA OUTPUT**.
3. Select the required setting.
4. Press **OK** to confirm the setting.

4.2.2 First steps after installation

1. Prime the burette with titrant ([section 4.7.1](#)).
2. Prime the pump solvent to add the reagent ([section 4.7.2](#)).
3. Check the stirring speed ([section 4.7.3](#)).
4. Prime the pump waste to dispose the reagent ([section 4.7.2](#)).

4.3 Menu structure

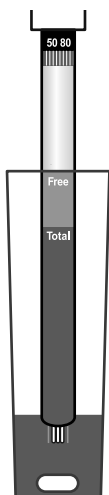
[Section 6 Troubleshooting](#) provides a list of all error and warning messages, and also describes all necessary countermeasures.

MAIN MENU	
ANALYZE FREE SO₂	Titration program to determine the level of free SO ₂ .
Insert Sample: 1	Dispense 10 mL of wine sample.
Start Analysis	Start analysis.
ANALYZE TOTAL SO₂	Titration program to determine the total SO ₂ .
Insert Sample: 1	Dispense 10 mL of wine sample.
Start Analysis	Start analysis.
PREPARE + ANALYZE	Titration program to determine the level of total SO ₂ in a series of samples.
Insert Sample: 1	Dispense 10 mL of wine sample.
Start	Alkali is dispensed.
Next Sample	Additional samples within a series.
Insert Sample: X	Dispense additional wine sample.
Start	Alkali is dispensed.

MAIN MENU

MANUAL ACTIVATION	Select which element is to be controlled manually; refer to section 4.7, page 26 .
Burette	Manual control of burette.
Return	Empties the burette into the titrant bottle (navigation key LEFT)
Empty	Empties the burette into the titration cell (navigation key UP)
Fill	Fills the burette with titrant (navigation key DOWN)
Pumps Activation	Manual pump open loop control.
Pump1 Dispensing	Selects ACID pump 1.
Pump2 Dispensing	Selects ALKALI pump 2.
Continue...	Starts the selected pump.
Stirrer	Sets the stirring speed. Select ON/OFF with OK. Select the stirring speed with UP/DOWN.
SYSTEM	System settings; refer to section 4.8, page 27 .
Free SO ₂ Factor	Change in factor used to calculate free SO ₂ . Default setting: 64.
Total SO ₂ Factor	Change in factor used to calculate total SO ₂ . Default setting: 64.
Data Logger	Data log with up to 55 results; refer to section 4.8.3, page 27 .
Empty Data-Logger	Empties the data log.
Display Data	Display results with search criteria.
By Date:	Display results by date.
By Type:	Display results by type.
All	Display all results.
FREE SO ₂	Display results as free SO ₂ .
TOTAL SO ₂	Display results as total SO ₂ .
Continue...	Display all results.
Data Output	Define the data output; refer to section 4.8.4, page 27 .
DeactiVated	Deactivates the data output.
For Printer	Activates data output on the printer.
For Computer	Activates data output on the computer.
Date / Hour	Entry of date and time.
Display Contrast	Selection of display contrast.
Language	Selection of operating language
SPANISH	
ENGLISH	
ITALIAN	
FRENCH	

4.4 Analysis of free SO₂



1. Dispense 10 mL of the sample into a titration cell.

Note: If the sample is shaken or filtered, the readings will be lower.

Note: Work with a sample and room temperature of (20 °C [70 °F]). Higher temperatures lead to higher readings; lower temperatures lead to lower readings.

2. Obtain just enough solid potassium iodide (KI) to cover the tip of a spoon (approximately 0.2 g) and add to the titration cell.
3. Add a magnetic stirring bar and attach the titration cell to the magnetic stirrer.
4. Lower the electrode into the titration cell until the **"FREE"** mark on the electrode is flush with the top edge of the titration cell.

Note: Make sure that the electrode cannot be damaged by the stirring bar or come into contact with the bottom of the titration cell. Make sure that the electrode wires are covered by sample.

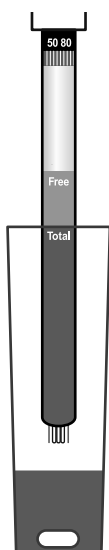
5. Select **ANALYZE FREE SO₂**. **"INSERT SAMPLE: 1"** is shown on the display.
6. Select **START ANALYSIS**.

The following steps are carried out automatically by TitrLab:

- Acid is dispensed into the titration cell for 1 second
- Titration is then started

7. The result is shown on the display and, depending on the setting, sent to a printer or computer.
8. Press **OK** to confirm the result.
9. To begin another analysis, select **OK**. **"NEXT SAMPLE"** is shown on the display.

4.5 Analysis of total SO₂



1. Dispense 10 mL of the sample into a titration cell.

Note: If the sample is shaken or filtered, the readings will be lower.

Note: Work with a sample and room temperature of (20 °C [70 °F]). Higher temperatures lead to higher readings; lower temperatures lead to lower readings.

2. Obtain just enough solid potassium iodide (KI) to cover the tip of a spoon (approximately 0.2 g) and add to the titration cell.
3. Add a magnetic stirring bar and attach the titration cell to the magnetic stirrer.
4. Lower the electrode into the titration cell until the **"TOTAL"** mark on the electrode is flush with the top edge of the titration cell.

Note: Make sure that the electrode cannot be damaged by the stirring bar or come into contact with the bottom of the titration cell. Make sure that the electrode wires are covered by sample.

5. Select **ANALYZE TOTAL SO₂**. **"INSERT SAMPLE: 1"** is shown on the display.
6. Select **START ANALYSIS**.

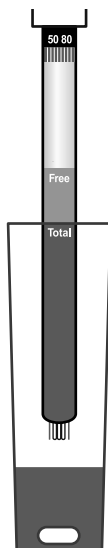
The following steps are carried out automatically by TitrLab:

- Alkali is dispensed into the titration cell for 3 seconds
- The solution is stirred for 3 seconds
- The reaction time is 5 minutes; a countdown on the display indicates the time remaining

- Acid is dispensed into the titration cell for 5 seconds
 - Titration is then started
7. The result is shown on the display and, depending on the setting, sent to a printer or computer.
 8. Press **OK** to confirm the result.
 9. To begin another analysis, select **OK**. "**NEXT SAMPLE**" is shown on the display.

4.6 Analysis of total SO₂ in a series of samples

A reaction time of 5 minutes is required to determine the total SO₂ content. TitraLab is locked and unavailable for other analyses during this time. If the total SO₂ is to be determined in multiple samples, the best program to select is "**PREPARE + ANALYZE**".



1. Dispense 10 mL of each sample into each titration cell of your series.

Note: If the sample is shaken or filtered, the readings will be lower.

Note: Work with a sample and room temperature of (20 °C [70 °F]). Higher temperatures lead to higher readings; lower temperatures lead to lower readings.

2. Obtain just enough solid potassium iodide (KI) to cover the tip of a spoon (approximately 0.2 g) and add to each titration cells.
3. Add a magnetic stirring bar to each one.
4. Attach the titration cell with the first sample to the magnetic stirrer.
5. Lower the electrode into the titration cell until the "**TOTAL**" mark on the electrode is flush with the top edge of the titration cell.

Note: Make sure that the electrode cannot be damaged by the stirring bar or come into contact with the bottom of the titration cell. Make sure that the electrode wires are covered by sample.

6. Select **PREPARE + ANALYZE**. "**INSERT SAMPLE: 1**" is shown on the display.
7. Select **START**.

The following steps are carried out automatically by TitraLab:

- Alkali is dispensed into the titration cell for 3 seconds
 - The solution is stirred for 3 seconds
 - The reaction time is 5 minutes; a countdown on the display indicates the time remaining
8. Remove the titration cell with the first sample and attach the titration cell with the second sample to the magnetic stirrer.
 9. Lower the electrode into the titration cell until the "**TOTAL**" mark on the electrode is flush with the top edge of the titration cell.
 10. Select **NEXT SAMPLE**.
- The following steps are carried out automatically by TitraLab:
- Alkali is dispensed into the titration cell for 3 seconds
 - The solution is stirred for 3 seconds
11. Process all other samples in the series in the same way.
 12. Five signal tones indicate the progression of the reaction time (5 minutes) for the 1st sample in the series.

Decide whether to stop preparing samples and start running analyses of prepared samples or continue preparing sequence.

13. If not all the samples in the series have been prepared, select **NEXT SAMPLE**.
14. Once all samples have been prepared, attach the titration cell with the first sample to the magnetic stirrer.
15. Lower the electrode into the titration cell until the **"TOTAL"** mark on the electrode is flush with the top edge of the titration cell.
16. Select **START ANALYSIS**.
The following steps are carried out automatically by TitraLab:
 - Acid is dispensed into the titration cell for 5 seconds
 - Titration is then started
17. The result is shown on the display and, depending on the setting, sent to a printer or computer.
18. Press **OK** to confirm the result.
19. Remove the titration cell with the first sample and attach the titration cell with the second sample to the magnetic stirrer.
20. Lower the electrode into the titration cell until the **"TOTAL"** mark on the electrode is flush with the top edge of the titration cell.
21. Select **NEXT SAMPLE**. The second sample is titrated. Process all subsequent samples in the series in the same way.

4.7 Manual component activation

4.7.1 Burette

1. Select **MANUAL ACTIVATION > BURETTE** and press **OK** to confirm.
 - Select **FILL** with the **DOWN** navigation key to fill the burette.
 - Select **EMPTY** with the **UP** navigation key to empty the burette into the titration cell.
 - Select **RETURN** with the **LEFT** navigation key to empty the burette back into the titrant bottle.

Note: Repeat this procedure multiple times to make sure that the dispensing process functions correctly.

4.7.2 Pumps

1. Select **MANUAL ACTIVATION > PUMPS ACTIVATION**, and press **OK** to confirm.
2. **PUMP1 DISPENSING** selects the acid pump.
PUMP2 DISPENSING selects the alkali pump.
CONTINUE... activates the selected pump.
3. Press **OK** to switch the pump on or off.

Note: Repeat this procedure multiple times to make sure that the dispensing process functions correctly.

4.7.3 Stirrer

1. Select **MANUAL ACTIVATION > STIRRER** and press **OK** to confirm.
2. Press **OK** to switch the stirrer on or off.
3. Use the navigation keys **UP** and **DOWN** to select the stirring speed.

4.8 System

This function can be used to adapt the titrator to specific requirements.

4.8.1 Free SO₂ Factor

The factor is calculated as follows:

$$F = (C_{\text{Iodine}} * 64000) / V_{\text{Sample}}$$

C_{Iodine} : concentration of iodine in the titrant in mol/L. Recommended concentration 0.01 mol/L.

V_{Sample} : sample volume dispensed. Recommended volume 10 mL.

This results in a factor of $F = 64$, which is the default setting.

The factor can be adjusted individually.

4.8.2 Total SO₂ Factor

The default setting is 64. The factor can be adjusted individually. The calculation formula is the same as for free SO₂.

4.8.3 Data Logger

This section describes the functions of the data log.

- Up to 55 results are stored.
 - The results can be displayed, printed or sent to a computer.
 - When the data log is full, the oldest result is overwritten automatically.
1. Select **SYSTEM > DATA LOGGER > DISPLAY DATA** and press **OK** to confirm. A range of search filters can be used to display the results.
 - BY DATE**: displays the results for a specific date.
 - BY TYPE**: displays the results as either free SO₂ or total SO₂.
 - CONTINUE**: displays all results.
 2. To empty the data log, select **SYSTEM > DATA LOGGER > EMPTY DATA-LOGGER** and press **OK** to confirm.

4.8.3.1 Sample numbers

When a titration program is started, the first sample is assigned the number 1. All subsequent samples receive sequential numbers until the titration program is closed. When the program is launched again, the sequential numbers are reset to 1.

4.8.4 Data Output

This function is only displayed if a printer or computer is connected and activated for data output. Programs, settings and results can be printed or transferred. Following a titration or calibration, the following data is printed or transferred:

- Type of analysis, date and time, titration result, iodine solution end volume, duration of titration and sample number.
1. Select **SYSTEM > DATA OUTPUT**.
 2. Select **FOR PRINTER** followed by the relevant printer model, such as thermal or dot matrix. Confirm with **OK**.

Select **FOR COMPUTER** followed by either **CAPTURE** or **TICOM**. Confirm with **OK**.

Operation

4.8.5 Date/Hour

Entry of date and time.

4.8.6 Display contrast

Increases or decreases the display contrast.

4.8.7 Language

English, Spanish, Italian, French.

WARNING

Risk of injury

Before maintenance or repair work is conducted, thoroughly rinse the instrument with deionized water and make sure that there are no residual chemicals in the tubes and pumps.

Only use genuine replacement parts and accessories.

The instrument must be serviced by the manufacturer's service department at the prescribed intervals.

5.1 Maintenance schedule

Maintenance task	Every week	6 months	12 months
Replace dry desiccant cartridges content	x		
Check all tube connections for leaks and damage	x		
Replace burette syringe		x	
Valve block			x
Burette feed tube			x
Burette discharge tube			x
Peristaltic pump, pump cassette			x
Pump feed tube			x
Pump discharge tube			x
Bottle closure set			x

5.2 Power off the instrument

At the end of the working day, deactivate the instrument as follows:

- Empty the contents of the burette into the titrant bottle; refer to [section 4.7.1, page 26](#).
- Empty and clean the used titration cells with deionized water.

When the instrument is to be deactivated for multiple days or extended periods, perform the following steps:

- Clean the burette and pumps with deionized water.
- Seal the reagent bottles with the original bottle closures.
- Empty and clean the used titration cells with deionized water.

5.3 Clean the burette

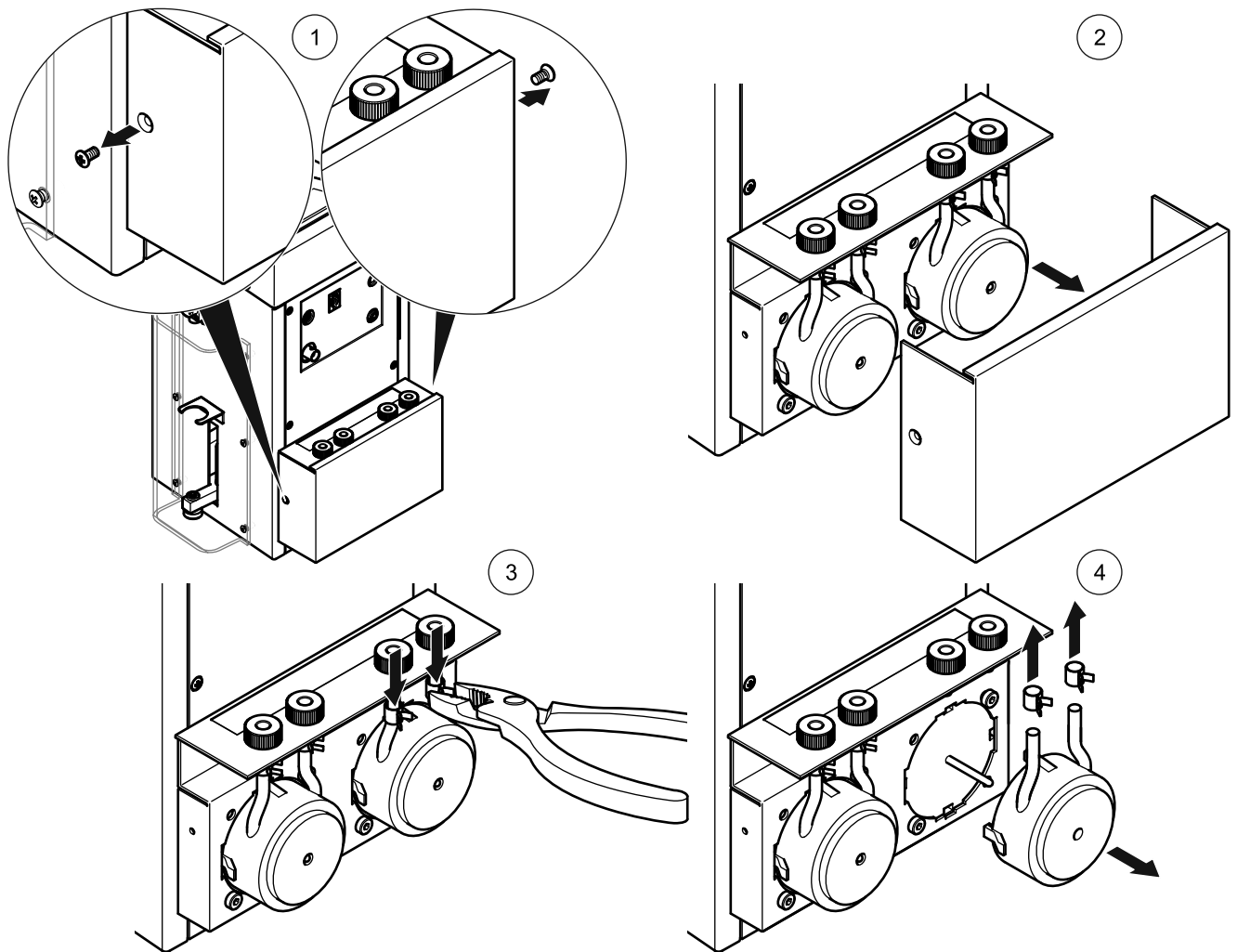
Make sure that there are no crystals or other sediments inside the syringe. If such deposits are discovered, clean the syringe immediately, as this will otherwise damage the plunger.

5.4 Clean the electrode

The double-platinum electrode does not require any special maintenance. Rinse with deionized water if required.

5.5 Replace pump cassette

1. Remove the screws on the right and left of the housing cover (refer to point 1 in [Figure 13](#)).
2. Remove the housing cover.
3. Press the ends of the gripper clamps together (with pliers, for example) and slide the clamps down and off the connectors.
Remove the tubes from the connectors.
4. Press in the catches on the right and left of the pump cassette.
Remove the pump cassette from the shaft.
5. Slide the gripper clamps onto the tubes of a new pump cassette.
6. Slide the new pump cassette onto the shaft until the catches engage.
7. Slide the tubes onto the connectors.
8. Press the ends of the gripper clamps together (with pliers, for example) and slide the clamps up onto the connectors.
9. Put the housing cover back on and tighten the screws.

Figure 13 Replace pump cassette

1 Remove the screws on the right and left of the housing cover.	3 Press the ends of the gripper clamps together (with pliers, for example) and slide the clamps down and off the connectors. Remove the tubes from the connectors.
2 Remove the housing cover.	4 Press in the catches on the right and left of the pump cassette. Remove the pump cassette from the shaft.

Section 6 Troubleshooting

6.1 Error messages

Error displayed	Cause	Resolution
Maximum volume reached.	The maximum volume is reached before the titration is completed. The titration is cancelled automatically.	Empty the titration cell and restart the titration.
Error initial tendency.	The first measurement is incorrect.	When measuring free SO ₂ : The sample might not contain any SO ₂ . When measuring total SO ₂ : Make sure that the acid and alkali pumps are functional.
Data logger empty.	No results are stored or no results match the search filter.	Change the search filter criteria.
All data will be erased.	All data in the data log will be erased.	
Printing error.	Printer is connected but not activated.	Switch on the printer.
PC not connected.	Computer is activated but not connected.	Check the computer connection.

6.2 Incorrect results

Incorrect results	Cause	Resolution
Systematic error	Defective electrode; the electrode is broken/cracked at platinum wire level and need to be replaced.	Replace the electrode.
	Individual reagents	Adjust factor.

Section 7 Replacement parts and accessories

7.1 Replacement parts

Description	Cat. No
TitraLab SO ₂ system, with 1 x 10 mL syringe and 2 pumps. Accessories included: electrode holder with magnetic stirrer, electrode 5080, 10 titration cells and stirring bars, reagent starter set	LLV2300.97.1202
Double-platinum electrode (Pt), 0–80 °C, with built-in tubes	LZW5080.97.0002
Magnetic stirrer with sensors support for TitraLab SO ₂	LZW2320.99
10x Teflon magnetic stirring bars, (20 x 6 mm)	LZW9339.99
10x polypropylene titration cells, 50 mL (Ø 30 mm)	LZW2324.99
Plastic syringe, 10 mL	LZW2323.99
Hardware sleeve for syringe	LZW8743.99
Inlet tube for burette/pump, L = 65 cm, d = 2.5 x 1.5 mm, with R6 record	LZW8705.99
Pump cassette with neoprene tube, internal diameter 2.4 mm, flow rate 100 mL/min.	LZW8691.99
Screw cap DIN 45	LZW8729.99
10x replacement O-rings for tube connections	LZW8734.99
Cotton filter cartridge for reagent bottle cap	LZW9199.99
Electro-valve for Burette	LZW9249.99

7.2 Accessories

Description	Cat. No
3-button mouse	LZW9240.99
Standard PC keyboard, mini-DIN connector.	LZW9013.99
RS 232 C cable for connection between titrator and PC, with 9-pin and USB connectors	LZW9135USB.99

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