

AQUASTAR® AQC22

Coulometric Titrator



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1 Introduction

Simple and compact

The AQUASTAR® Compact Titrators are modern, titrators for use in a wide variety of application areas. They can be used, for example, in quality control as well as in research and development and satisfy the most demanding of requirements.

The AQUASTAR® titrators perfectly combine simple, easy-to-understand operation with an extremely high level of precision and outstanding reliability. Thanks to automatic titrant recognition (Plug & Play burettes), the titrator independently identifies which titrant is required without intervention from the operator. Settings no longer need to be adjusted manually, even when connecting a printer.

The instruments can either be controlled by Touchscreen or by using LabX PC software. The large color Touchscreen allows intuitive control by the user and flexibility in its adjustment options. All functions can be activated directly from the Homescreen via Shortcuts which can be freely created, making everyday use extremely easier. Controlling the titrator by Touchscreen and all adjustable parameters are described separately and in detail in the operating instructions on the Tutorial CD.

This installation information explains all the steps necessary for installing and commissioning your device. The "Quick Guide" will then guide you through the first titration process using a practical example. If you have any additional questions, EMD is always available to assist you.

2 Measures for your protection

The instruments have been tested for the experiments and intended purposes documented in the appropriate Operating Instructions. However, this does not absolve you from the responsibility of performing your own tests of the products supplied by us regarding their suitability for the methods and purposes you intend to use them for. You should therefore observe the following safety measures.

Measures for your protection



Risk of electric shock

- Only use the power supply unit that was included with the instrument.
- Ensure that you plug the power cable supplied into a receptacle outlet that is grounded. In the absence of grounding, a technical fault could be lethal.



Risk of explosion

- Never work in an environment subject to explosion hazards! The housing of the instrument is not gas tight (explosion hazard due to spark formation, corrosion caused by the ingress of gases).



Risk of corrosion

- Always test the titration vessel for firm seating in the titration head. If it falls off, you could injure yourself if working with toxic titrants and solvents or strong acids or bases.
- When using chemicals and solvents, comply with the instructions of the producer and the general lab safety rules!

All Karl Fischer reagents are readily flammable and toxic.

- In the case of skin contact, immediately wash off with copious amounts of water!
- If eye contact occurs, rinse intensively with copious amounts of water and consult a physician!

Measures for your operational safety

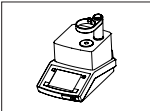
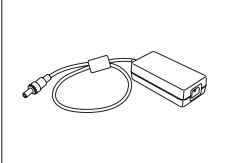
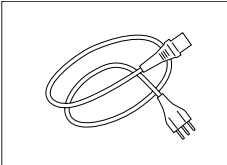
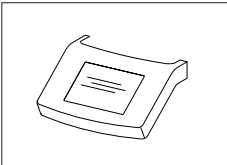
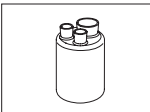
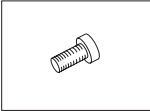

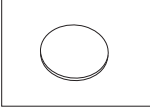
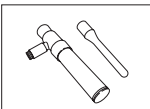


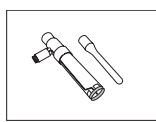
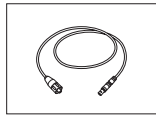
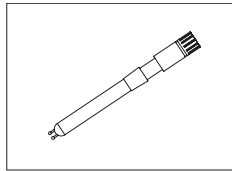
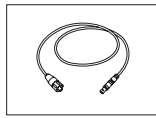
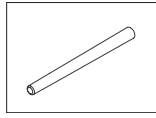
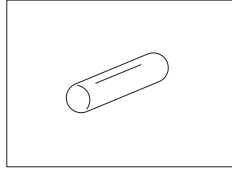
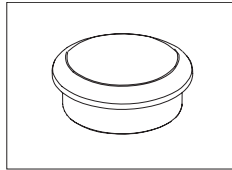
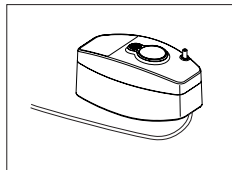
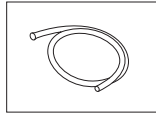

Caution

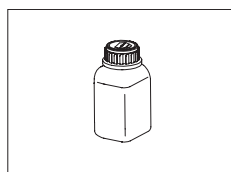
- Have the instrument serviced only by METTLER TOLEDO Service!
- Any spillage should be wiped off immediately! Some solvents might cause corrosion of the housing.
- Exclude the following environmental influences:
 - Powerful vibrations,
 - direct sunlight,
 - atmospheric humidity greater than 80%,
 - temperatures below 5 °C and above 40 °C,
 - powerful electric or magnetic fields!

3 Standard equipment

All parts are specified with their ordering code and quantity in cases where more than one part is included. When ordering, some parts are only available in a minimum order quantity. In such cases, the corresponding minimum order quantity is quoted. The standard equipment and optional accessories are listed in the appropriate operating instructions.

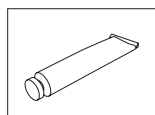
Description	Order number
 Karl Fischer titrator	-
 Separate power supply (100 – 240 Volt)	51105795
 Power cable (country-specific)	-
 Protective cover for touchscreen	51105567
 Coulometer measuring cell	51108732
 Mounting bolt (for titration beakers / measuring cell)	51108752
 Stopper (PTFE) with septum	51108741
 Septum (12 pcs)	51108740
 Generator electrode with diaphragm incorporating straight drying tube only available with C20 D and C30 D standard equipment	51108751

	Generator electrode without diaphragm incorporating straight drying tube only available with C20 X and C30 X standard equipment	51108753
	Cable for generator electrode	51107830
	Dual platinum pin electrode DM143-SC	51109299
	Triaxial SC Lemo cable 72 cm	51109183
	Holder	23960
	Magnetic stirrer bar	51191159
	Seal (titration stand drying tube)	51107492
	Solvent Manager set with: <ul style="list-style-type: none"> • Silicone tube 850 mm (51105581) • Silicone tube 170 mm • Drying tube with cover (23961) • 2 flat seals (23981) (minimum order quantity 5 pcs) 	51105600
	Draining tube	23936
	Brown glass bottle 1 l	71296



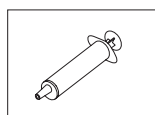
Molecular sieve
250 g

71478



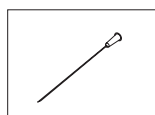
Silicone grease

71300



Syringe
1 mL

-

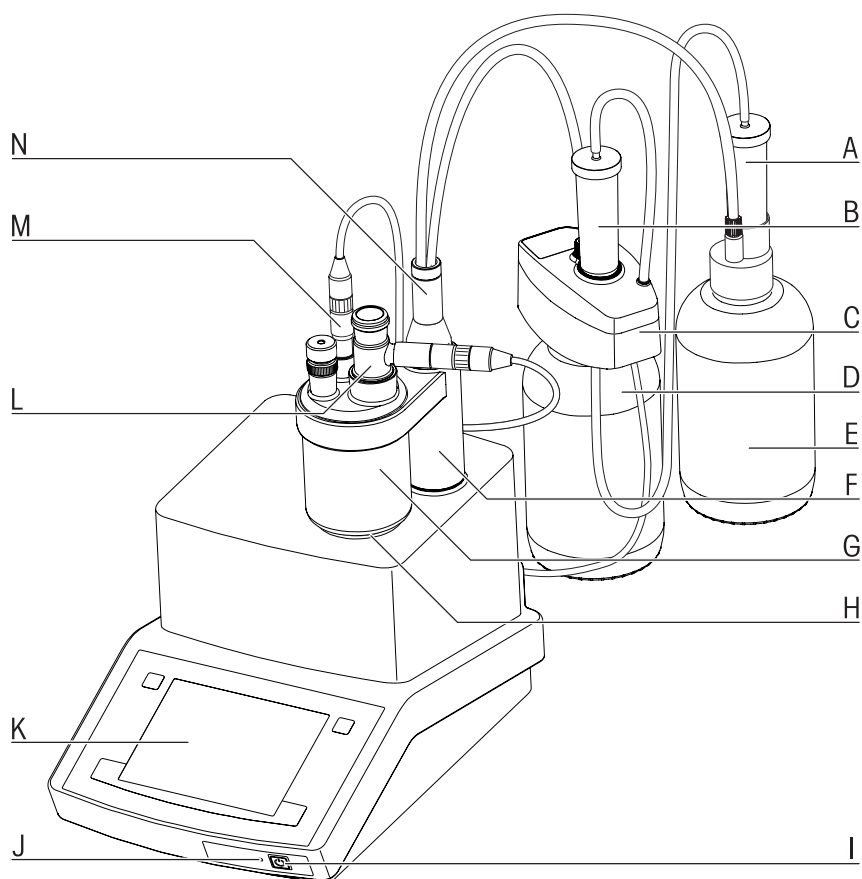


Injection needle
80 x 0.8 mm

-

4 The titrator

4.1 Titrator configuration

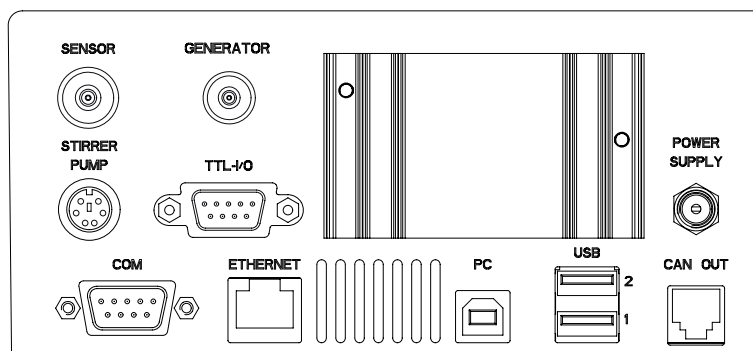


Part	Description
A	Solvent bottle drying tube ¹⁾
B	Waste bottle drying tube
C	Solvent manager
D	Waste bottle
E	Solvent bottle ²⁾
F	Titration arm
G	Measuring cell
H	Internal magnetic stirrer
I	On/Off button
J	Indicator light (LED)
K	Touchscreen
L	Generator electrode
M	Double platinum pin electrode
n	Extraction adapter and park sleeve ¹⁾

¹⁾ Component of the optionally available reagent changing set.

²⁾ Not available with standard equipment.

4.2 Titrator rear panel connections



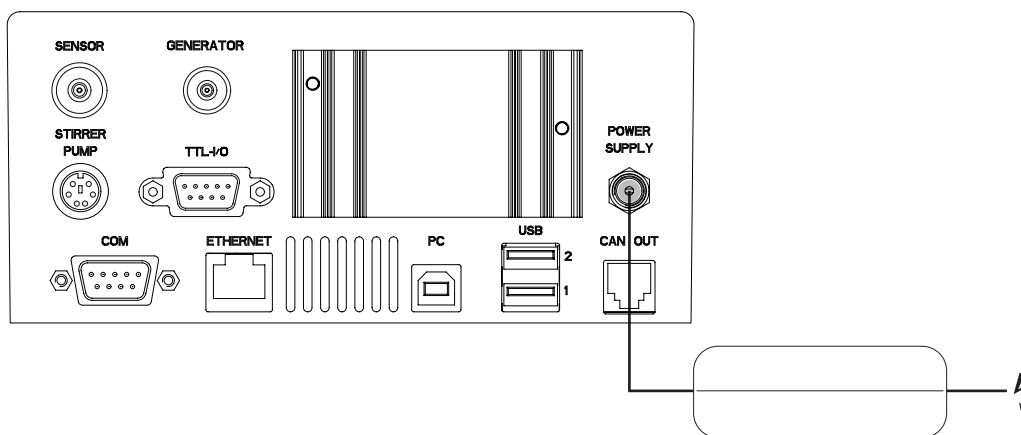
Socket	Use	Example
SENSOR	Measuring electrode	DM143-SC
GENERATOR	Generator electrode	Generator electrode for measuring cell
STIRRER PUMP	Stirrer / pump	Solvent manager
TTL-I/O		
POWER SUPPLY	Power supply	Power supply
COM	Balance	XS analytical balance
ETHERNET	Network	Link to LabX PC software via network
PC	PC connection via USB	Link to LabX PC software via USB interface
USB1	Printer / barcode reader / memory stick / USB hub	USB-P25 compact printer
USB2	Printer / barcode reader / memory stick / USB hub	Barcode reader
CAN OUT	CAN connection	For service use

5 Installation

The installation of the AQC22 titrator is described in this chapter. Standard equipment for the various types of titrators varies and also depends on the optional accessories. For this reason, installation steps may vary.

5.1 Connect power supply

The titrator is operated by a separate power supply. The On/Off button is fitted with an LED and is mounted on the front of the titrator. The LED displays the operating status. The titrator is switched on by pressing the On/Off button. The LED flashes as the system starts up and then remains permanently lit. The titrator is switched off by pressing the On/Off button again. All current tasks are interrupted and the LED starts to flash until the system has shut down, which can take up to 60 seconds. The LED then goes out.



- Connect the power supply unit to the "POWER SUPPLY" socket on the rear of the titrator and to the mains supply.
- Secure the connection at the titrator by screwing the plug connector firmly into place.



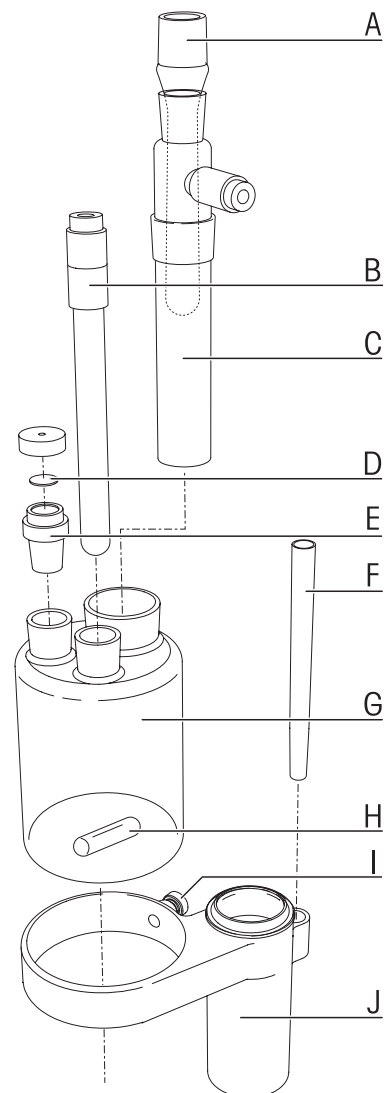
The power supply is suitable for all supply voltages ranging from 100–240 VAC \pm 10% and 50–60 Hz.

5.2 Titration stand

5.2.1 Connecting the titration stand

Once you have set up your KF titrator in a suitable location, mount equipment in the titration stand. The titration arm can be pivoted in both directions.

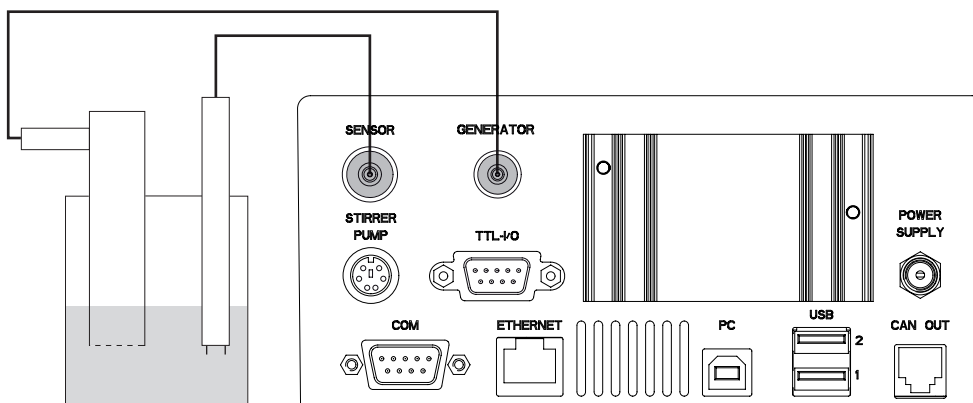
- Slide the magnetic stirring rod carefully into the measuring cell.
- Place the cell in the titration stand and fasten with the mounting bolt.
- Lightly grease microsections with the silicone grease supplied.
- Place stopper with septum in the opening of the cell.
- Place the measuring electrode in the cell openings.
- Place the generator electrode in the cell openings.
- Fill the drying tube with desiccant and place in the generator electrode.
- Use the holder for the tip of the extraction tube.



Part	Description
A	Drying tube
B	Measuring electrode
C	Generator electrode
D	Septum
E	Stopper
F	Holder
G	Measuring cell
H	Magnetic stirrer bar
I	Fastening screw
J	Titration arm

5.2.2 Connecting the electrodes

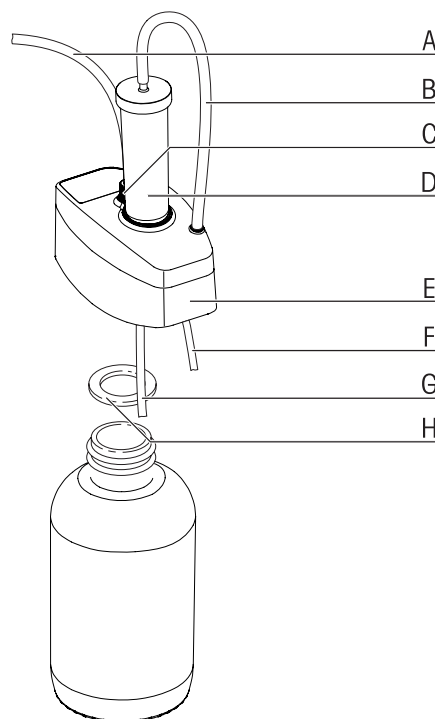
The connection cables for the measuring and generator electrodes have different sized plug connectors on the device side. The cable for the generator electrode has a blue plug for the purposes of differentiation.



- a) Use the triaxial cable with blue plug connector to connect the generator electrode with the "GENERATOR" socket on the rear of the titrator.
- b) Use the triaxial cable with gray plug connector to connect the measuring electrode to the "SENSOR" socket on the rear of the titrator.

5.2.3 Installing the waste bottle

- a) Loosen the threaded sleeve on the solvent manager, push in the extraction tube with the thin end from below through the solvent manager so that it is just below the screw top.
- b) Tighten the threaded sleeve. (An O-ring is located in the bushing to guarantee leaktightness.)
- c) Place the flat seal in position and screw the solvent manager onto the bottle.
- d) Fill a drying tube fitted with a molecular sieve and press into the appropriate opening of the solvent manager.
- e) Using the silicone tube (167 mm), connect the drying tube of the waste bottle to the appropriate adapter of the solvent manager.
- f) Connect the cable of the solvent manager to the "PUMP/STIRRER" socket on the rear of the titrator.



Part	Description
A	Extraction tube
B	Silicone tube (170 mm)
C	Threaded sleeve
D	Drying tube

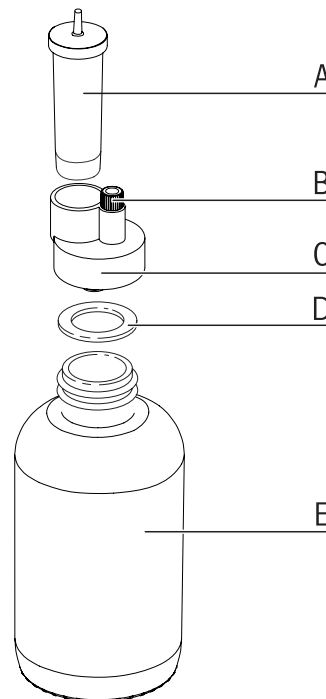
Part	Description
E	Solvent manager
F	Connecting cable
G	Silicone tube (850 mm) only necessary in conjunction with the reagent changing set
H	Flat seal



Check all drying tubes and closing points once again for firm seating in order to ensure that the system is leaktight.

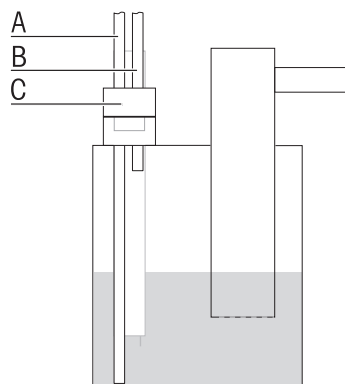
5.2.4 Installing the reagent exchange set (optional)

- Loosen the threaded sleeve on the screw top, push in the dispensing tube with the thin end from below through the threaded sleeve.
- Open the reagent bottle, place the flat seal in position and screw on the screw top (if required, insert adapter, see Optional accessories).
- Push the dispensing tube as far as the bottom of the bottle and tighten the threaded sleeve. (An O-ring is located in the bushing to guarantee leaktightness.)
- Fill a drying tube fitted with a molecular sieve and press into the screw top of the bottle.
- Using the silicone tube (850 mm), connect the drying tube of the solvent bottle to the appropriate connection of the solvent manager. See Installing the waste bottle).
- Press the park sleeve into the opening on the titration arm.



Part	Description
A	Drying tube
B	Threaded sleeve
C	Screw top
D	Flat seal
E	Reagent bottle

- a) Push the draining tube of the waste bottle and the dispensing tube of the reagent bottle through the draining adapter.
 - ⇒ The length of the draining tube is adjusted to approx. 100 mm.
 - ⇒ The length of the dispensing tube is adjusted to approx. 25 mm.
- b) Remove the stopper and place the tubes with the draining adapter in the opening.
- c) Set the height of the waste tube so that it barely touches the bottom of the cell.



Part	Description
A	Draining tube
B	Dispensing tube
C	Draining adapter

To fill or empty the measuring cell, remove the stopper and place the tubes in the opening with the draining adapter. If the equipment is not required, you can place it in the park sleeve and insert the stopper again.



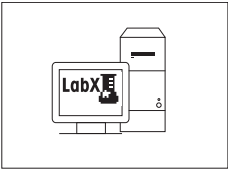
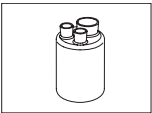
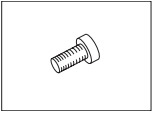

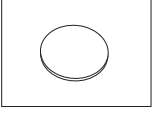
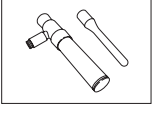
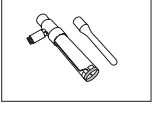
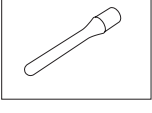


Check all drying tubes and closing points once again for firm seating in order to ensure that the system is leaktight.

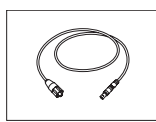
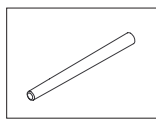
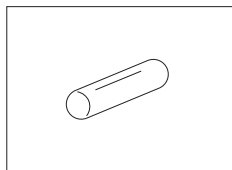
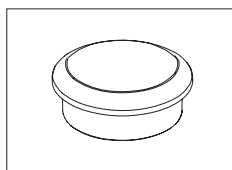
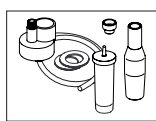
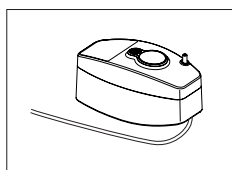
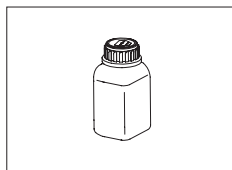
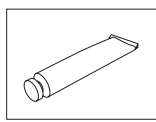
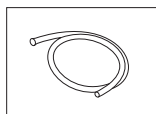
5.3 Internal magnetic stirrer

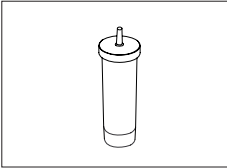
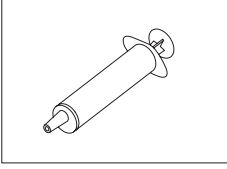
A magnetic stirrer is standard on all models and fitted at the top of the housing, underneath the pivoted titration arm. Both On/Off switching and the stirrer speed are controlled by the software.

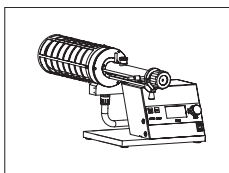
6 Optional accessories

All parts are specified with their ordering code and quantity in cases where more than one part is included. When ordering, some parts are only available in a minimum order quantity. In such cases, the corresponding minimum order quantity is quoted. The standard equipment and optional accessories are listed in the appropriate operating instructions.

	Description	Order number
	Titration software <ul style="list-style-type: none"> • LabX light titration • LabX pro titration • Instrument licenses for titrators 	LabX
	Coulometer measuring cell	51108732
	Mounting bolt (for titration beakers / measuring cell)	51108752
	Stopper (PTFE) with septum	51108741
	Septum (12 pcs)	51108740
	Generator electrode with diaphragm incorporating a straight drying tube	51108751
	Generator electrode without diaphragm incorporating a straight drying tube	51108753
	Drying tube, straight	51108733
	Cable for generator electrode	51107830
	Dual platinum pin electrode DM143-SC	51109299

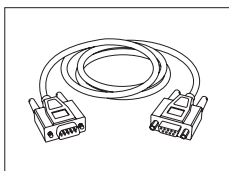
	<p>Triaxial SC Lemo 60 cable Length: 72 cm Length: 100 cm Length: 160 cm (Only for traditional titration electrodes)</p>	<p>51109183 51109184 51109185</p>
	<p>Holder</p>	<p>23960</p>
	<p>Magnetic stirrer bar</p>	<p>51191159</p>
	<p>Seal (titration stand drying tube)</p>	<p>51107492</p>
	<p>Reagent changing set with:</p> <ul style="list-style-type: none"> • Extraction adapter for Coulometer cell • Park sleeve • Teflon extraction tube 800 mm (23936) • Screw top (23937) • Drying tube with cover (23961) • 2 flat seals (23981) (minimum order quantity 5 pcs) 	<p>51105606</p>
	<p>Solvent Manager set with:</p> <ul style="list-style-type: none"> • Silicone tube 850 mm (51105581) • Silicone tube 170 mm • Drying tube with cover (23961) • 2 flat seals (23981) (minimum order quantity 5 pcs) 	<p>51105600</p>
	<p>Molecular sieve 250 g</p>	<p>71478</p>
	<p>Silicone grease</p>	<p>71300</p>
	<p>Draining tube</p>	<p>23936</p>

	Silicone tube (pressure tube to solvent manager) 850 mm	51105581
	Silicone tube 170 mm	51105578
	Drying tube with cover	23961
	Seal (titration stand drying tube)	51107492
	Brown glass bottle 1 l	71296
	Flat seal (minimum order quantity 5 pcs.)	23981
	Screw top (for bottles)	23937
	Syringes (100 pcs.) 1 ml 10 ml	71492 71482
	Injection needle 80 x 0.8 mm for 1 ml injections (100 pcs) 80 x 1.2 mm for 10 ml injections (12 pcs)	71484 71483



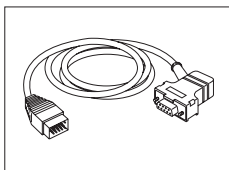
DO308 drying oven

D0308



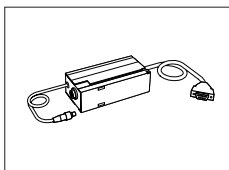
Connection cable for METTLER TOLEDO balance (RS9 interface)

11101051



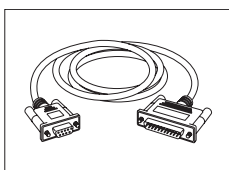
Connection cable for METTLER TOLEDO balance (MiniMettler)

229029



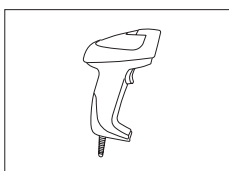
Connection cable for METTLER TOLEDO balance (LC interface)

229065



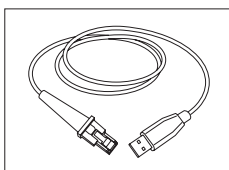
Connection cable for SARTORIUS balances (RS9-RS25)

51190363



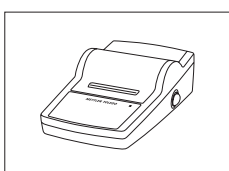
Barcode reader with USB interface

21901297



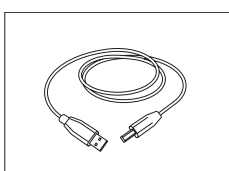
USB cable to barcode reader

21901309



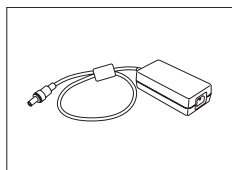
USB-P25 compact printer (including USB-cable)

USB-P25



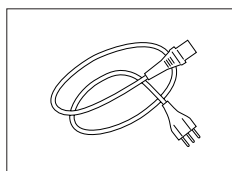
USB cable A-B (for PC or printer)
180 cm

51191926



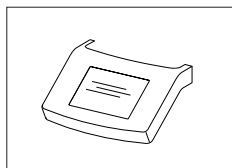
Separate power supply (100 – 240 Volt)

51105795



Power cable (country-specific)

-



Protective cover for touchscreen

51105567

7 Technical data

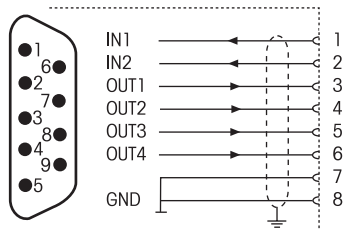
7.1 Titrator

Power supply	Input voltage	100–240 VAC \pm 10 %
	Input frequency	50–60 Hz
	Power consumption	40 VA
	Primary connection socket	3 pin, IEC C14
	Connected loads	24 VDC, 1.5 A
	Secondary connection plug	2 pin, DC plug
CPU	Processor	XScale
	SDRAM	64 MB
	Flash memory	256 MB (industrial CF card)
Dimensions	Width	210 mm
	Depth	340 mm
	Height	291 mm (with titration stand) 312 mm (ready-to-operate device)
	weight	3.3 kg
Materials	Titration housing	Crastin® PBT
	Cover sheet	PET
	Protective cover	Copolymer
	Chassis	Stainless steel
	Titration stand	Crastin® PBT
	Dispensing tube / extraction tube	FEP
	Air tubes	Silicone
	O-ring (screw top)	EPDM
	O-ring (threaded ring)	FEP / silicone
	Sealing ring (bottle)	PTFE / silicone
	Seal (dispensing tube / extraction tube)	PTFE
	Connecting piece	Polypropylene
Ambient conditions	Ambient temperature	+5 °C – 40 °C
	Relative humidity	Max. 80 % (non-condensing) at 31 °C, linear fall to 50 % at 40 °C
	Use	In interior spaces
	Overvoltage category	II
	Pollution degree	2
COM	Socket	9-pin male D-sub
	Configuration	Full-duplex
	Baud rate	1200...19200
	Handshake	X-On / X-Off

	Galvanic isolation	No
	ESD stability	Min. 1000 V
	Short-circuit protection	Yes
USB1 / USB2	USB host	USB full/low speed
	Max. power load	400 mA (total, both connections)
PC	USB client	USB 1.1
Ethernet	Socket	RJ45
	Speed	10/100 MBit/s
TTL / IO	Socket	9-pin female D-sub
	Inputs	2
	Outputs	4
CAN OUT	Socket	RJ12
	Speed	500 kBit/s
	Voltage	24 VDC \pm 10%
	Current	Max. 500 mA
Stirrer / pump	Socket	5-pin mini-DIN
	Pump detection	Yes
	Stirrer detection	Yes
	Pump voltage	24 V DC \pm 5 % (max. 400 mA)
	Stirrer voltage range	0 to 18 V DC \pm 10 % (max. 300 mA)
SENSOR	Socket	LEMO triaxial, 9 mm
	Current range	0 to 24 μ A AC
	Resolution	0.1 μ A
	Limits of error	1 μ A
	Measuring range	\pm 2000 mV
	Resolution	0.1 mV
	Limits of error	2 mV
GENERATOR	Socket	LEMO triaxial, 7 mm
	Voltage	Max. 36 V
	Limits of error	10 % of selected voltage step
	Current steps	100 mA, 200 mA, 300 mA, 400 mA
	Limits of error	0.2 % of selected current step
Magnetic stirrer (built-in)	Drive	Stepping motor
	Max. speed	1050 rpm
Display	Technology	Color TFT
	Size	5.7"
	Resolution	320 x 240 pixels
	Backlighting	LED
	Brightness control	Per software 50–100%
Input	Technology	Full-coverage touchscreen

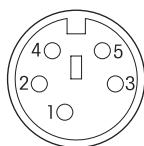
Contains runtime modules from decNumber (c) Copyright IBM Corporation 2001, 2004. All rights reserved.

TTL-I / O Port Pin Assignment



General	Socket	9-pin female D-sub
	GND	Signal ground, connected to titrator's electronic system
	Galvanic isolation	No
	Plug & Play support	No
In	Type	Pullup at 5 V, with overvoltage protection
	Voltage	V_{IL} max. 1 V V_{IH} min. 3.5 V
	Current	Max. 4.5 mA
Out	Type	Open collector
	Voltage	Min. 0.25 V Max. 24 V V_{OL} max. 0.33 V
	Current	Max. 20 mA

Stirrer/Pump Pin Assignment



3	Stirrer +
1	Stirrer -
4	Pump +
5	Pump -
2	Pump 2 +
5	Pump 2 -

7.2 Supported devices (periphery)

Balances

Balances can connect to the COM interface of the titrator. METTLER TOLEDO balances must be equipped with an RS-232 interface or an appropriate adapter. For a list of connection cables, see Optional accessories.

Manufacturer	Type	RS	LocalCAN	Note
METTLER TOLEDO	AB / PB	•	•	COM interfaces
	AB-S / PB-S	•		COM interfaces

	AG / PG / PR		•	COM interfaces
	AT / MT / UMT	•		COM interfaces
	AX / MX / UMX	•	-	COM interfaces
	PG-S	•	-	COM interfaces
	XP	•	-	COM interfaces
	XS	•	-	COM interfaces
Sartorius	Various	•		COM interfaces

• Standard

- Option

Printer

Printers can be connected to the USB1 or USB2 interface of the titrator. PCL-compatible printers from various manufacturers are supported. The METTLER TOLEDO USB-P25 is a durable easy-to-operate dot matrix printer which prints onto standard quality paper. A current list of supported printers can be found on the Internet at: <http://www.mt.com/titration-printers>.

Manufacturer	Type	Note
Various	Generic PCL printers	Connection via USB1 or USB2
METTLER TOLEDO	USB-P25	Connection via USB1 or USB2

Barcode reader

Sample data can be read in via an appropriate barcode. The barcode reader can also be used to enter text in open input fields. Barcode readers can be connected to the USB1 or USB2 interface of the titrator.



A standard USB hub can be used if more than two devices are to be connected to the USB connections of the titrator.

8 Service and maintenance

8.1 Clean casing

- Clean the housing of the titrator using a cloth moistened with alcohol.

8.2 Clean measuring cell

Clean the cell as follows.

- a) Empty the measuring cell.
- b) Remove the sample plug, measuring electrode and generator electrode.
- c) Rinse thoroughly with methanol. Stubborn dirt can be removed using conventional cleaning agents (laboratory washing liquid).
- d) Dry with a lint-free cloth.
- e) Leave to dry for several hours at 70 – 80 °C in the drying oven.
- f) Lightly grease microsections with the silicone grease supplied.

8.3 Cleaning the generator electrode

Clean the generator electrode as follows.

- a) Empty the generator electrode.
 - b) Rinse thoroughly with methanol.
 - c) Dry with a lint-free cloth.
- ▶ Soiled diaphragm.
- a) Place electrode in a suitable solvent (ideally methanol) for several hours.
 - b) Dry with a lint-free cloth.
 - c) Leave to dry for several hours at 70 – 80 °C in the drying oven.



The use of a fritting cleaning agent is not recommended.

8.4 Transporting the titrator

Note the following instructions when transporting the titrator to a new location.



- Empty the measuring cell and remove from the titration stand.
- Remove all tube connections.



- Remove all cable connections.



When sending or transporting the titrator over long distances, please use all of the original packaging.

9 Declaration of system validation

AQC22

We hereby give notice that this product / system and its software and accessories, were developed, tested and successfully certified on the basis of the product life-cycle policies of Mettler-Toledo AG, Analytical. These policies are based on ISO Standard 9001:1994. Life-cycle checkpoint details were reviewed and approved by the Project Supervisory Group (PSG). The products / systems were tested in respect of functionality and specification prior to shipment. In order to support GLP and validation requirements, we will make the following documents available to authorized persons for inspection:

- Performance specifications
- Software specifications
- Quality plan
- Project management system
- Test Plan
- Customer requirements
- Review reports
- Source code

Mettler-Toledo AG, Analytical will retain possession of all documents and their reproductions and may wish to conclude a nondisclosure agreement with those requesting access to these documents.

Schwerzenbach,
December 2009

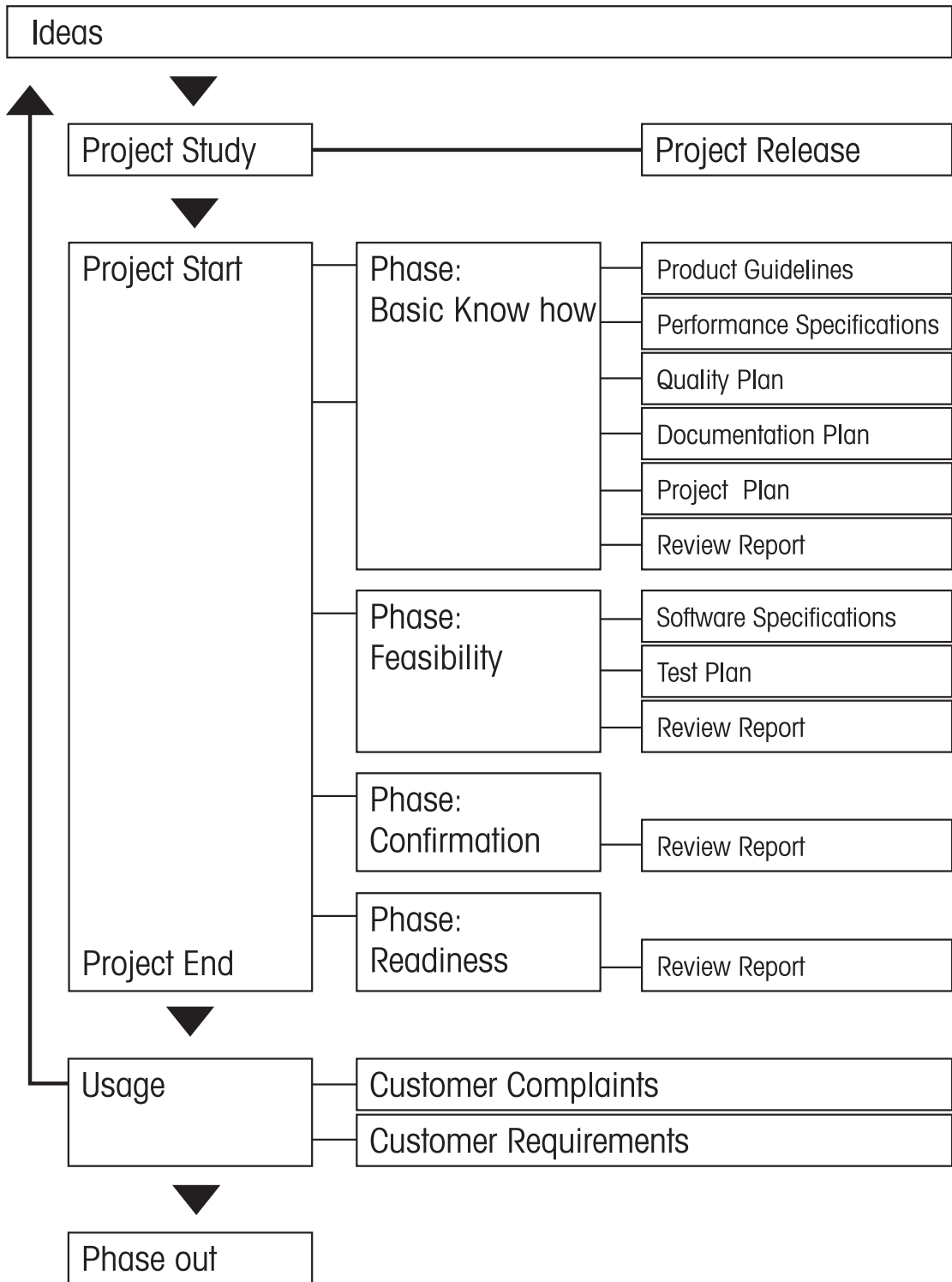
Dr. Chris Radloff
General Manager
Business Unit Analytical

Dr. Christof Bircher
Manager Business Area
Analytical Chemistry

ISO 9001 certification for METTLER TOLEDO

Mettler-Toledo AG, Greifensee, was reviewed and evaluated in 1991 by the Swiss Association for Quality and Management Systems (SQS), and was awarded the ISO 9001 certificate. This certificate verifies that Mettler-Toledo AG, Greifensee, has a quality management system in place which meets the requirements of the ISO 9000 series of international standards. Repeat audits are carried out by the SQS at intervals to verify that the quality management system is properly administered and continuously updated in relation to operational changes.

10 Product life cycle model



For **AQUASTAR®** titrator Troubleshooting and Technical Support call: **1-888-871-3535**
For a listing of our North American Distributors, please visit **www.emdchemicals.com**