



5

Titration

KARL FISCHER TITRATION (VOLUMETRIC AND COULOMETRIC)

SI Analytics
a **xylem** brand

5. Karl Fischer Titration – the water determining method

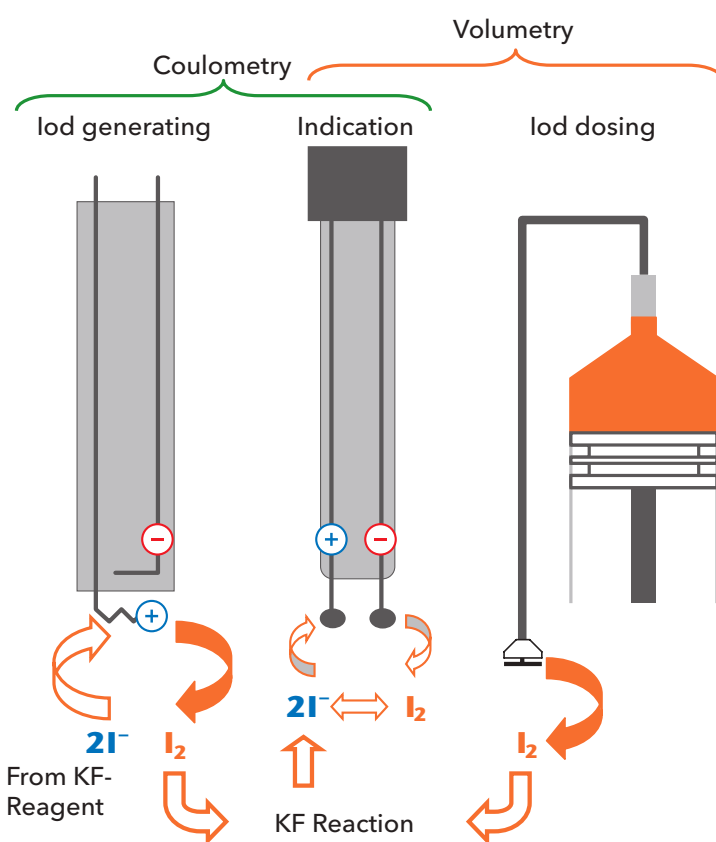
Experienced analyst may be unpleasantly reminded by the pyridine smell, when hearing the name Karl Fischer. However, modern reagents and most user-friendly analyzing instruments have eliminated the problem. Nowadays all applications can be handled and processed very easily by using the **coulometric** and **volumetric** Karl Fischer titration instruments. Thanks to its selectivity and precision, the Karl Fischer titration very easily and accurately established as the most important method for determining water and humidity.

The basic principle of the water determination according to Karl Fischer (short: KF) is a reaction of iodine with water in an alcoholic solution with presence of sulfurous acid and a base.

With the volumetric method, the iodine can be accurately added through a piston burette, while the coulometric method works with iodine produced directly in the reaction vessel.

The difference between the volumetry and coulometry mainly exists in the manner of dosing the iodine for the titration. The illustration shows the different ways of dosing:

The different ways of dosing



TitroLine® 7500 KF

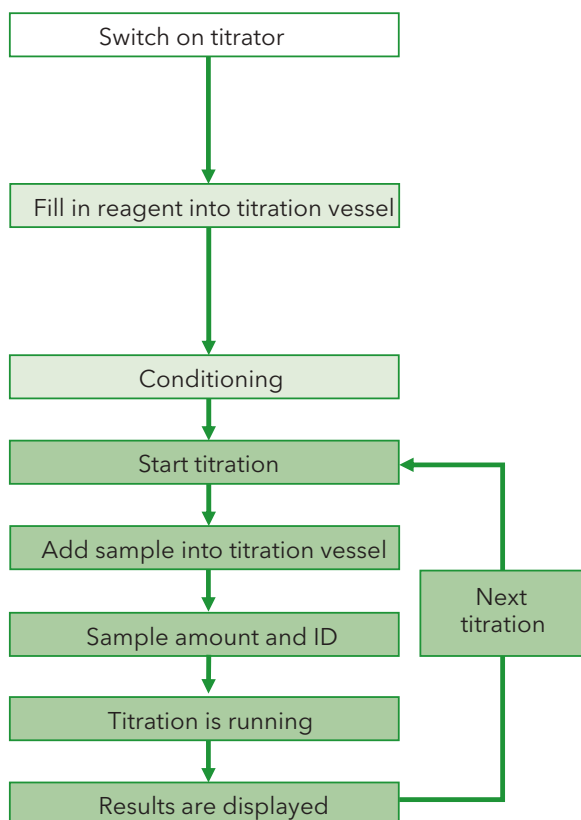


TitroLine® 7500 KF trace

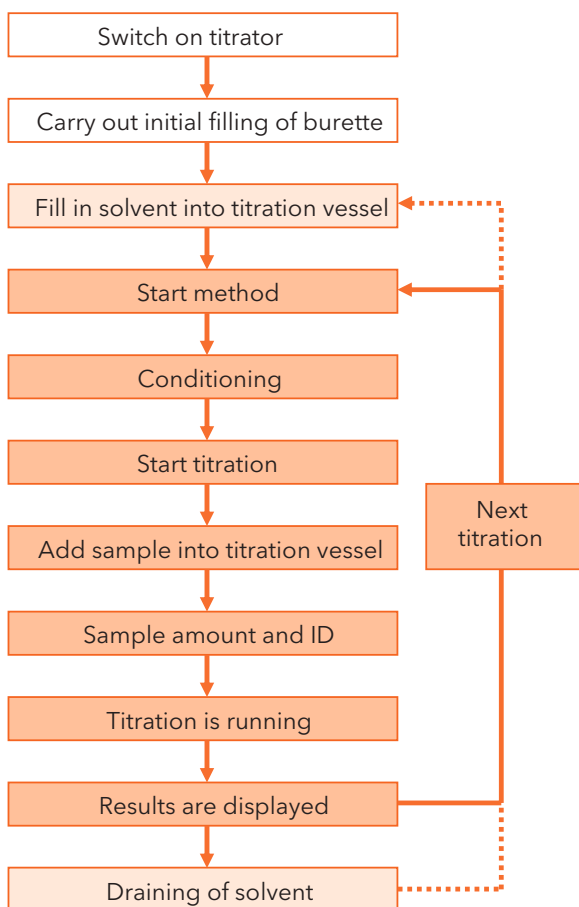
In practice small differences occur between the two methods which are displayed in the table. The advantages of the volumetry lie in the different types of sample addition and solvent variations, offering more flexible operation potentials. On the other hand, the

coulometry can handle lower detection limits, and the handling is even simpler. The compared work flow with coulometry and volumetry are shown with the following illustration. The clearly shorter and easier sequence is noticeable with the coulometry.

Coulometric KF titration



Volumetric KF titration



Comparison: Coulometric and volumetric Karl Fischer titration

Property	Coulometry	Volumetry
Water amount and sample amount	Small water amount Small sample amounts	Medium and large water amounts Adapted sample amount
Sample types	Liquid Gaseous Solid samples (with KF oven)	Solid Liquid
Sample addition and preparation	Direct with syringe Gas inlet with oven External extraction Solid samples are evaporated with an oven	Solid samples are added directly Sample preparation with homogenizer Working at higher temperature Direct with syringe
Working method	Very fast Very simple	Fast Simple
Working range (recommended)	µg range 10 µg up to 5 mg water	mg range 200 µg up to 50 mg water

TitroLine® 7500 KF and TitroLine® 7500 KF *trace* – Karl Fischer Titration made easy

You can't go wrong with the TitroLine® KF titrators

The TitroLine® 7500 KF is the volumetric generalist for a wide range of use and the TitroLine® 7500 KF *trace* is the specialist for low water contents. Both new titrators are to be characterized by the following features:

Benefits TitroLine® 7500 KF/KF *trace*

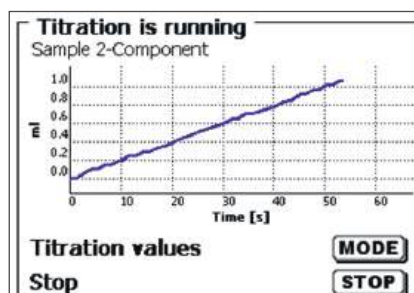
- ★ Fast, easy and precise
- ★ With standard methods for different applications (titer, blank value, one or two component reagents)
- ★ The addition of solvent and the extraction of the titrated sample are managed by the titration stand TM 235 KF (optional for TitroLine® 7500 KF *trace*)
- ★ Online display of curve and measurement drift during titration



TitroLine® 7500 KF *trace*

Live Titration curve

The online display of the measurement curve, measurement drift and titration solvent consumption (TitroLine® 7500 KF only) make accurate monitoring of the titration possible and one can determine any unwanted side reactions immediately.



TitroLine® 7500 KF

Automated KF Titration of all Samples with a Headspace Oven and Sample Changer

The headspace oven technique allows the separation of the water to be titrated from liquid, solid and pasty samples.

The sample is weighed in a small glass vessel with lid and septum (vial) and heated in the oven to a defined temperature. A dry air or nitrogen stream flows over a needle through the sample and takes the water with it in a gaseous state. The air or nitrogen together with the water vapor is passed into the titration vessel and the water is immediately titrated coulometrically with the TitroLine® 7500 KF trace.

The advantage of this method is the avoidance of direct contact of the sample with the solvent/anolyte. The anolyte is not contaminated and therefore more samples can be analysed than with direct analysis. As a rule, side reactions do not occur.

The complete system consists of the TO 7280 headspace oven, the coulometric titrator TitroLine® 7500 KF trace and the TW 7650 sample changer. The headspace oven can also be operated without the sample changer with the TitroLine® 7500 KF trace (with or without TitriSoft software, see next page).

Benefits of the headspace oven and the sample changer:

- ★ Semi automatic or fully automatic water determination
- ★ No contamination of the anolyte, generator, and indicator electrodes
- ★ Application range from 35 to 280 °C

The headspace oven technique is suitable for the following samples:

- Pharmaceutical products
- Natural products
- Plastics
- Hygroscopic substances
- Freeze-dried products, e.g. lyophilisates
- Oils and lubricants, creams, pastes
- Viscous materials (bitumen, tar, sewage sludge)
- Powder and pellets
- Food
- Petrochemicals





The TO 7280 headspace oven for semi-automatic measuring

If you only have a few samples to measure per day, the semi-automatic headspace oven TO 7280 is the right choice.



Why semi-automatic? The user places the sample in the oven with the crimper and starts the method on the titrator or (optionally) on the TitriSoft software. Apart from entering the sample name and, if necessary, the initial weight, this is all that needs to be done in the next few minutes.

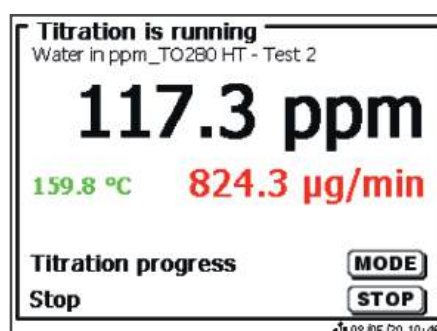
The needle head lowers automatically and the addition of air or nitrogen starts automatically as well. The desired bake-out temperature is stored in the method and is quickly reached.

Once the final criteria of the method are achieved, the result is displayed and documented and the next sample can be measured.



Benefits of the headspace oven:

- * Automatic lowering and raising of the needle head
- * Automatic switching on and off of the air/gas supply
- * Can be upgraded by the TW 7650 to a fully automatic system with sample changer



The TW 7650 sampler for fully automatic measuring



Advantages of the sample changer:

- * Can be upgraded to the TO 7280 oven at any time
- * Up to 49 samples can be measured. One position is reserved for the zero-vial to determine the start drift
- * The start drift can be determined before each sample
- * Each sample can be measured at a different temperature

If the number of samples exceeds 15-20/day, it is recommended to use the sample changer TW 7650.

The assembly of the sample changer and oven is within a minute done and immediately ready for use. There is no additional power supply unit or cable required. Power is supplied via the TO 7280.

The user places the sample vials in the changer and starts the method/work list with the TitriSoft software. The software TitriSoft is required when using the sample changer.

The sample plate rotates to the correct position; the changer head lowers onto the sample vial and sucks the lid tight with a pump. The changer arm moves to the headspace oven and places the sample vial in the corresponding opening.

The needle head lowers and the measurement begins as described on page 4. When the measurement is finished, the needle head lifts and the measured sample is transported back into the sample rack. Then the measurement continues with the next sample.

Technical Data TITRONIC® 500 and TitroLine® 7xxx

Features	TITRONIC® 500	TitroLine® 7000
Display	Color online graphic	Color online graphic
Measuring input 1 pH/mV with reference input	—	■
Measuring input 2 digital (IDS)	—	—
Wireless electrode recognition	—	■
Measuring input Dead stop (2 x 4 mm connector)	—	■
Measuring input generator electrode (2 x 4 mm connector)	—	—
Measuring input temperature (2 x 4 mm connector)	—	■
Interfaces	1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232	1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232
Balance connection	RS232	RS232
Printer (USB-A)	HP PCL, Seiko DPU S445, PDF	HP PCL, Seiko DPU S445, PDF
Intelligent interchangeable modules (5, 10, 20 and 50 ml)	■	■
Burette solution (steps)	20,000	20,000
Manual titration	■	■
Dosing applications	■	■
Solution preparation (manual or automatic when connected to balance)	■	■
Automatic titration (Independent without external software)	1)	■
Titration to mV and pH end points	—	2 EP
Dynamic and linear titration to inflection points (EQ) mV and pH	—	2 EQ
Particularly suitable for non aqueous titrations	—	■
Dead-stop-titration	—	■
pH-stat-titration	—	■
Water determination according to KF volumetry (10 ppm - 100 %, recommended)	—	—
Accuracy volumetric Measurements	—	—
Water determination according to KF coulometry (1 ppm - 5 %, recommended)	—	—
Accuracy coulometric Measurements	—	—
Standard methods	■	■
Number of user methods	15	50
Controllable via TitriSoft 3.3 and higher	■	■

1) Can be used as titration and dosing burette in automatic titration systems

Technical Data TitroLine® 7500 KF/KF trace

TitroLine® 7750	TitroLine® 7800	TitroLine® 7500 KF	TitroLine® 7500 KF trace
Color online graphic	Color online graphic	Color online graphic	Color online graphic
■	■	—	—
—	■	—	—
■	■	—	—
■	■	■	■
—	—	—	■
■	■	—	—
1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232	1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232	1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232	1 x LAN, 2 x USB-A, 1 x USB-B 2 x RS 232
RS232	RS232	RS232	RS232
HP PCL, Seiko DPU S445, PDF	HP PCL, Seiko DPU S445, PDF	HP PCL, Seiko DPU S445, PDF	HP PCL, Seiko DPU S445, PDF
■	■	■	—
20,000	20,000	20,000	—
■	■	—	—
■	■	■	—
■	■	■	—
■	■	■	■
2 EP	2 EP	—	—
2 EQ	2 EQ	—	—
■	■	—	—
■	■	■	—
■	■	—	—
■	■	■	—
< 0.3% at ≥ 10 mg H ₂ O	< 0.3% at ≥ 10 mg H ₂ O	< 0.3% at ≥ 10 mg H ₂ O	—
—	—	—	■
—	—	—	< 0.3% at ≥ 1 mg H ₂ O
■	■	■	■
50	50	50	50
■	■	■	■

Features	TITRONIC® 500	TitroLine® 7000
Analogue measuring inputs		
Measuring input 1 (analog) pH/mV with reference electrode input	—	pH/mV-input with 24 bit transducer Electrode socket according to DIN 19 262 or additional with BNC socket insert RFID receiver for SI Analytics ID electrodes
Measuring range pH	—	-3.0 to 18.00
Display resolution pH / Accuracy pH (without sensor probe)	—	0.001 / 0.002 ± 1 Digit
Measuring range mV	—	-2000 to 2000
Display resolution mV / Accuracy mV (without sensor probe)	—	0.1 / 0.1 ± 1 Digit
Analogue measuring inputs - Dead Stop		
Measuring input Dead stop (2 x 4 mm socket)	—	Connector (µA) for double platinum electrodes Polarization voltage adjustable from 40 to 220 mV
Display resolution µA / Accuracy µA (without sensor probe)	—	0.1 / 0.2 ± 1 Digit
Measuring input temperature (2 x 4 mm socket)	—	Connector for Pt 1000 / NTC 30kΩ
Measuring range temperature °C	—	Pt 1000: -75 to 195 °C NTC 30kΩ: -40...125 °C
Display resolution °C / Accuracy °C (without sensor probe)	—	Pt 1000: 0.1/0.2 K ± 1 Digit NTC 30kΩ: 0.1/1.0 K (-40...0 °C) resp. 0.3 K (0...125 °C) ± 1 Digit
Digital measuring inputs		
Measuring input 2 (IDS)	—	—
Measuring range pH	—	—
Measuring range mV	—	—
Measuring range temperature °C	—	—
Measuring range conductivity	—	—
Display	3.5 inches -1/4 VGA TFT display with 320 x 240 pixels	3.5 inches -1/4 VGA TFT display with 320 x 240 pixels
Housing material	Polypropylene	Polypropylene
Front keyboard	Polyester coated	Polyester coated
Housing dimensions	15.3 x 45 x 29.6 cm (W x H x D), height with interchangeable unit	15.3 x 45 x 29.6 cm (W x H x D), height with interchangeable unit
Weight	2.2 kg for basic unit 3.5 kg for complete device incl. interchangeable unit (with empty reagent bottle, without magnetic stirrer)	2.3 kg for basic unit 3.5 kg for complete device incl. interchangeable unit (with empty reagent bottle, without magnetic stirrer)
Ambient conditions	Ambient temperature: +10 to +40 °C for operation and storage	Ambient temperature: +10 to +40 °C for operation and storage
Material: intelligent interchangeable units (5, 10, 20 and 50 ml)	Valve: PTFE/ETFE Cylinder: borosilicate glass 3.3 (DURAN®) Hoses: FEP, blue	Valve: PTFE/ETFE Cylinder: borosilicate glass 3.3 (DURAN®) Hoses: FEP, blue
Dosing accuracy according to DIN EN ISO 8655, part 3	Accuracy : 0.15 % Precision: 0.05-0.07 % (Depending on the used interchangeable unit)	Accuracy : 0.15 % Precision: 0.05-0.07 % (Depending on the used interchangeable unit)

TitroLine® 7750		TitroLine® 7800		TitroLine® 7500 KF		TitroLine® 7500 KF trace	
pH/mV-input with 24 bit transducer Electrode socket according to DIN 19262 or additional with BNC socket insert RFID receiver for SI Analytics ID electrodes		pH/mV-input with 24 bit transducer Electrode socket according to DIN 19262 or additional with BNC socket insert RFID receiver for SI Analytics ID electrodes		—		—	
-3.0 to 18.00		-3.0 to 18.00		—		—	
0.001 / 0.002 ± 1 Digit		0.001 / 0.002 ± 1 Digit		—		—	
-2000 to 2000		-2000 to 2000		—		—	
0.1 / 0.1 ± 1 Digit		0.1 / 0.1 ± 1 Digit		—		—	
Connector (µA) for double platinum electrodes Polarization voltage adjustable from 40 to 220 mV		Connector (µA) for double platinum electrodes Polarization voltage adjustable from 40 to 220 mV		Connector (µA) for double platinum electrodes Polarization voltage adjustable from 40 to 220 mV		Connector (µA) for double platinum electrodes	
0.1 / 0.2 ± 1 Digit		0.1 / 0.2 ± 1 Digit		0.1 / 0.2 ± 1 Digit		—	
Connector for Pt 1000 / NTC 30kΩ		Connector for Pt 1000 / NTC 30kΩ		—		—	
Pt 1000: -75 to 195 °C NTC 30kΩ: -40...125 °C		Pt 1000: -75 to 195 °C NTC 30kΩ: -40...125 °C		—		—	
Pt 1000: 0.1/0.2 K ± 1 Digit NTC 30kΩ: 0.1/1.0 K (-40...0 °C) resp. 0.3 K (0...125 °C) ± 1 Digit		Pt 1000: 0.1/0.2 K ± 1 Digit NTC 30kΩ: 0.1/1.0 K (-40...0 °C) resp. 0.3 K (0...125 °C) ± 1 Digit		—		—	
—		Accuracy ± 1 Digit depending on the used IDS electrode		—		—	
		0.000 to 14.000 ± 0.004 pH		—		—	
		± 1200.0 mV ± 0.2 mV		—		—	
		-5.0 ... 105.0 °C ± 0.2 mV		—		—	
		0.00 ... 2000 mS/cm ± 0.5% v. Mw.		—		—	
3.5 inches -1/4 VGA TFT display with 320 x 240 pixels		3.5 inches -1/4 VGA TFT display with 320 x 240 pixels		3.5 inches -1/4 VGA TFT display with 320 x 240 pixels		3.5 inches -1/4 VGA TFT display with 320 x 240 pixels	
Polypropylene		Polypropylene		Polypropylene		Polypropylene	
Polyester coated		Polyester coated		Polyester coated		Polyester coated	
15.3 x 45 x 29.6 cm (W x H x D), height with interchangeable unit		15.3 x 45 x 29.6 cm (W x H x D), height with interchangeable unit		15.3 x 45 x 29.6 cm (W x H x D), height with interchangeable unit		15,3 x XX x 29,6 cm (W x H x D)	
2.3 kg for basic unit 3.5 kg for complete device incl. interchangeable unit (with empty reagent bottle, without magnetic stirrer or TM 235 KF)		2.3 kg for basic unit 3.5 kg for complete device incl. interchangeable unit (with empty reagent bottle, without magnetic stirrer)		2.3 kg for basic unit 3.5 kg for complete device incl. interchangeable unit (with empty reagent bottle, without magnetic stirrer or TM 235 KF)		2.3 kg for basic unit without magnetic stirrer TM 235 or TM 235 KF	
Ambient temperature: +10 to +40 °C for operation and storage		Ambient temperature: +10 to +40 °C for operation and storage		Ambient temperature: +10 to +40 °C for operation and storage		Ambient temperature: +10 to +40 °C for operation and storage	
Valve: PTFE/ETFE Cylinder: borosilicate glass 3.3 (DURAN®) Hoses: FEP, blue		Valve: PTFE/ETFE Cylinder: borosilicate glass 3.3 (DURAN®) Hoses: FEP, blue		Valve: PTFE/ETFE Cylinder: borosilicate glass 3.3 (DURAN®) Hoses: FEP, blue		—	
Accuracy : 0.15 % Precision: 0.05 - 0.07 % (Depending on the used interchangeable unit)		Accuracy : 0.15 % Precision: 0.05 - 0.07 % (Depending on the used interchangeable unit)		Accuracy : 0.15 % Precision: 0.05 - 0.07 % (Depending on the used interchangeable unit)		—	

Ordering information TITRONIC® 500, TitroLine® 7xxx

Type No.	Order No.	Description
T 500	285220200	TITRONIC® 500 basic unit without magnetic stirrer, with stand rod and titration clamp Z 305, controller TZ 3880, power supply 100-240 V
T 500-M1	285220210	TITRONIC® 500 basic unit with magnetic stirrer TM 235, with stand rod TZ 1510, electrode clamp Z 305, hand controller TZ 3880, power supply 100-240 V
T 500-M2/20	285220220	TITRONIC® 500 basic unit with magnetic stirrer TM 235 and 20 ml exchange unit WA 20, with stand rod TZ 1510, electrode clamp Z 305, hand controller TZ 3880, power supply 100-240 V
TL 7000	285220100	TitroLine® 7000 basic unit without magnetic stirrer, with stand rod and titration clamp Z 305, power supply 100-240 V
TL 7000-M1/10	285220140	TitroLine® 7000 basic unit with magnetic stirrer TM 235 and 10 ml exchangeable unit WA 10, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
TL 7000-M1/20	285220150	TitroLine® 7000 basic unit with magnetic stirrer TM 235 and 20 ml exchangeable unit WA 20, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
TL 7000-M1/50	285220160	TitroLine® 7000 basic unit with magnetic stirrer TM 235 and 50 ml exchangeable unit WA 50, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
TL 7000-M2/20	285220170	TitroLine® 7000 basic unit with magnetic stirrer TM 235 and 20 ml exchangeable unit WA 20, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip. With pH-combination electrode and buffer set
TL 7000-TitriSoft	285220960	basic unit with magnetic stirrer TM 235, with stand rod and titration clamp Z 305, power supply 100-240 V, software TitriSoft 3.5 (TZ 3071)
TL 7500 KF 10	285220820	Volumetric KF-Titrator, scope of supply: basic titrator unit, exchange unit WA 10, TM 235 KF titration stand with integrated stirrer and pump, titration vessel TZ 1770, micro double platinum electrode KF 1100 and starter kit, power supply 100-240 V
TL 7500 KF 20	285220830	volumetric KF-Titrator, scope of supply: basic titrator unit, exchange unit WA 20, TM 235 KF titration stand with integrated stirrer and pump, titration vessel TZ 1770, micro double platinum electrode KF 1100 and starter kit, power supply 100-240 V
TL 7750	285220240	Basic unit without magnetic stirrer, with stand rod; TZ 1510, electrode clamp Z 305, hand controller TZ 3880, power supply 100-240 V
TL 7750-M1	285220250	Basic unit with magnetic stirrer TM 2325, with stand rod; TZ 1510, electrode clamp Z 305, hand controller TZ 3880, power supply 100-240 V
TL 7750 KF 05	285220930	TitroLine® 7750 with KF accessories, scope of supply: basic titrator unit, exchange unit WA 05, TM 235 KF titration stand with integrated stirrer and pump, titration vessel TZ 1770, micro double platinum electrode KF 1100 and starter kit, power supply 100-240 V
TL 7750 KF 10	285220940	TitroLine® 7750 with KF accessories, scope of supply: basic titrator unit, exchange unit WA 10, TM 235 KF titration stand with integrated stirrer and pump, titration vessel TZ 1770, micro double platinum electrode KF 1100 and starter kit, power supply 100-240 V
TL 7750 KF 20	285220950	TitroLine® 7750 with KF accessories, scope of supply: basic titrator unit, exchange unit WA 20, TM 235 KF titration stand with integrated stirrer and pump, titration vessel TZ 1770, micro double platinum electrode KF 1100 and starter kit, power supply 100-240 V
TL 7750-TitriSoft	285220970	basic unit with magnetic stirrer TM 235, with stand rod and titration clamp Z 305, power supply 100-240 V, software TitriSoft 3.5 (TZ 3071)
TL 7800	285220980	TitroLine® 7800 basic unit with two measuring inputs, one analogue and one digital (IDS) measuring input
TL 7800-M1	285220990	TitroLine® 7800 basic unit with two measuring inputs, one analogue and one digital (IDS) measuring input, with magnetic stirrer TM 235
TL 7800-TitriSoft	285221030	basic unit with two measuring inputs, one analogue and one digital (IDS) measuring input, with magnetic stirrer TM 235 and TitriSoft 3.2

Ordering information accessories for TITRONIC® 500 TitroLine® 7xxx

Type No.	Order No.	Description
WA 05	285220300	5 ml exchangeable unit with integrated chip for reagent data, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
WA 10	285220310	10 ml exchangeable unit with integrated chip for reagent data, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
WA 20	285220320	20 ml exchangeable unit with integrated chip for reagent data, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
WA 50	285220350	50 ml exchangeable unit with integrated chip for reagent data, with brown glass bottle for titrant, GL 45 and S 40-bottle adapter, tubes, drip tube and titration tip
TM 235, 115-230 V	285220400	Magnetic stirrer for vessels up to 500 ml, agitator speed infinitely adjustable from 500 - 2000 rpm, for the connection to TitroLine® 6000/7000 and TITRONIC® 500
TM 235 KF, 115-230 V	285220900	Titration stand with pump; Scope of delivery: Basic unit with 1 l DURAN®-reagent bottle TZ 1791, 1 l DURAN®-waste bottle TZ 1792, moisture bottle, tubes and screw threads, power supply TZ 1855 (110 to 240 V)
TZ 1052	285214721	KF-drying stove, 230 V
TZ 1055	285215183	KF-drying stove, 115 V
TZ 1060	285218115	Accessories set for KF drying stove TZ 1052/TZ1055
TZ 1065	285201973	Flowmeter with valve and hose connectors for gas volumes (air, nitrogen) from 50 - 500 ml/min
KF 1100	285102030	Micro double platinum electrode for Karl Fischer titrations, with fixed cable, double platinum pin and taper NS 7.5 for TZ 1770 and TZ 1772
TZ 1748	285216560	Stand rod stainless steel Ø 10 mm
TZ 1770	285216677	Karl Fischer titration vessel. DURAN® glass vessel TZ 1775 (approx. 30...150 ml), removable head made of polypropylene/PTFE, 1 drilling NS 19, NS 14,5, NS 7,5 and 3 drillings with screw threads, titration tip, moisture trap and weighing funnel
TZ 1789	285221120	Starter kit KF consisting of molecular sieve, needles with syringes and glass wool
TZ 3863	285220480	USB-thermo printer, 112 mm for TitroLine® 6000/7000/7500 KF/7500 KF trace/7750 and TITRONIC® 500
TZ 3864	285220710	Thermal paper for TZ 3863 with very high durability (5 rolls)
TZ 3865	285220440	DIN A4 standard printer, HP PCL-compatible, with USB-connection cable, 230 V

Technical Data TO 7280

Sample dosing:	Headspace vials (5 ml...)
Measuring range:	1 µg...100 mg absolute
Resolution:	0.1 µg
Reproducibility:	± 3 µg for 10...1000 µg, 0.3 % for > 1 mg
Temperature range:	35 °C ... 280 °C (isothermal)
Resolution:	1 °K
Power supply:	115 ... 230 V, 50/60 Hz
Power input:	250 W
Dimensions:	300 x 450 x 240 mm (W x H x D)
Weight:	7 kg
Ambient conditions:	Ambient temperature + 10 ... + 40 °C for operation and storage

Technical Data TM 235 TO

Housing material:	Polypropylene, plastic coated
Dimensions:	80 x 130 x 250 mm (W x H x D), height without stand rod, bottles, and titration vessel
Weight:	1.9 kg
Ambient conditions:	Ambient temperature + 10 ... + 40 °C for operation and storage
Power supply:	Via low-voltage connection (12 V) from TitroLine® 7500 KF trace titrator or power supply
Control:	Via USB port by TitroLine® 7500 KF trace titrator
Pump:	Integrated, for supplying the TO 7280 with air from the environment
Valve:	Automatically switching valve for air/nitrogen supply
Gas flow meter:	Adjustable between 50 - 500 ml/min

Technical Data TW 7650

Number of positions:	49 samples + 1 zero vial
Power supply:	Supply via TO 7280
Power input:	Supply via TO 7280
Dimensions:	420 x 450 x 460 mm (W x H x D) incl. TO 7280
Weight:	10 kg without/17 kg with TO 7280
Ambient conditions:	Ambient temperature + 10 ... + 40 °C for operation and storage

Ordering information accessories and spares

Type No.	Order No.	Description
TZ 3988	285227870	Vials, 5 ml with crimp caps and septa, 100 pcs
TZ 3989	285227880	Vials 5 ml, 100 pcs.

Ordering information TitroLine® 7500 KF/KF trace

Tye No.	Order No.	Description
TL 7500 KF trace M1	285220860	Module 1, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1752 without diaphragm + cable, magnetic stirrer TM 235, stand rod, titration vessel TZ 1751, Mikro-Doppelplatinelektrode KF 1150
TL 7500 KF trace M2	285220870	Module 2, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1752 without diaphragm + cable, TM 235 KF titration stand with built-in stirrer and pump, stand rod, titration vessel TZ 1754, micro double platin electrode KF
TL 7500 KF trace M3	285220880	Module 3, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1753 with diaphragm + cable, magnetic stirrer TM 235, stand rod, titration vessel TZ 1751, micro double platin electrode KF 1150
TL 7500 KF trace M4	285220890	Module 4, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1753 with diaphragm + connection cable, TM 235 KF titration stand with built-in stirrer and pump, stand rod, titration vessel TZ 1754, micro double platinum electrode KF 1150
TL 7500 KF trace M5	285221000	Module 5, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1752 without junction, connection cable, magnetic stirrer TM 235, stand rod, titration vessel TZ 1754, micro double platinum electrode KF 1150
TL 7500 KF trace M6	285227800	Module 6, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1752 without junction, connection cable LB 04 NN, TM 235 TO titration stand, stand rod, titration vessel TZ 1754, micro double platinum electrode KF 1150, connection cable TZ 3094
TL 7500 KF trace M6-TitriSoft Pharma	285227810	Module 6, coulometric KF titrator, scope of supply: basic titrator unit, generator electrode TZ 1752 without junction, connection cable LB 04 NN, TM 235 TO titration stand, stand rod, titration vessel TZ 1754, micro double platinum electrode KF 1150, connection cable TZ 3094 and TitriSoft 3.5 P

Ordering info TO 7280, TM 235 TO, TW 7650

Tye No.	Order No.	Description
TO 7280	285227820	For water determination according to Karl Fischer method. Maximum temperature 280 °C. Including power supply for 100 - 240 V
TW 7650	285227830	For the use with headspace oven TO 7280. Up to 50 vials (1 zero vial + 49 samples) with 5 ml size
TW 7650-TitriSoft	285227840	For the use with headspace oven TO 7280. Up to 50 vials (1 zero vial + 49 sample vials) with 5 ml size. With TitriSoft 3.5 P
TO 7280 - TW 7650 set	285227850	Set includes KF headspace oven TO 7280 and the autosampler TW 7650. With TitriSoft 3.5 P
TM 235 TO	285227860	For TO 7280. Scope of supply: basic unit with two 100 ml DURAN®-bottles including threads, holder TZ 3992 for the bottles, PTFE tubes including screw connections, gas flow meter and holder, 100 vials and grimper, molecular sieve, power supply (110... 240 V)

Ordering information accessories and spares

Tye No.	Order No.	Description
TZ 3990	285227890	Crimp caps made of aluminum with opening, 10 mm diameter, septa made of silicone/PTFE, 100 pcs
TZ 3993	285227920	Connection tube including screw connections for connection headspace oven TO 7280 - titration vessel TZ 1754/gas flow meter
TZ 3994	285227930	Fittings set drying bottle for TM 235 TO, 2 x fittings and 2 x O-ring
TZ 3997	285227960	Tube set complete for connection headspace oven TO 7280 - TM 235 TO
TZ 1632	285227990	Dosing tip made out of glass for titration vessel TZ 1754