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30 años de soluciones para la industria

5

# Titration

## KARL FISCHER TITRATION (VOLUMETRIC AND COULOMETRIC)


DASTEC
Representantes / Distribuidores Autorizados

Argentina
Tel: (+54 11) 5352 2500
Email: info@dastecsrl.com.ar
Web: www.dastecsrl.com.ar


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# 5. Karl Fischer Titration – the water determining method

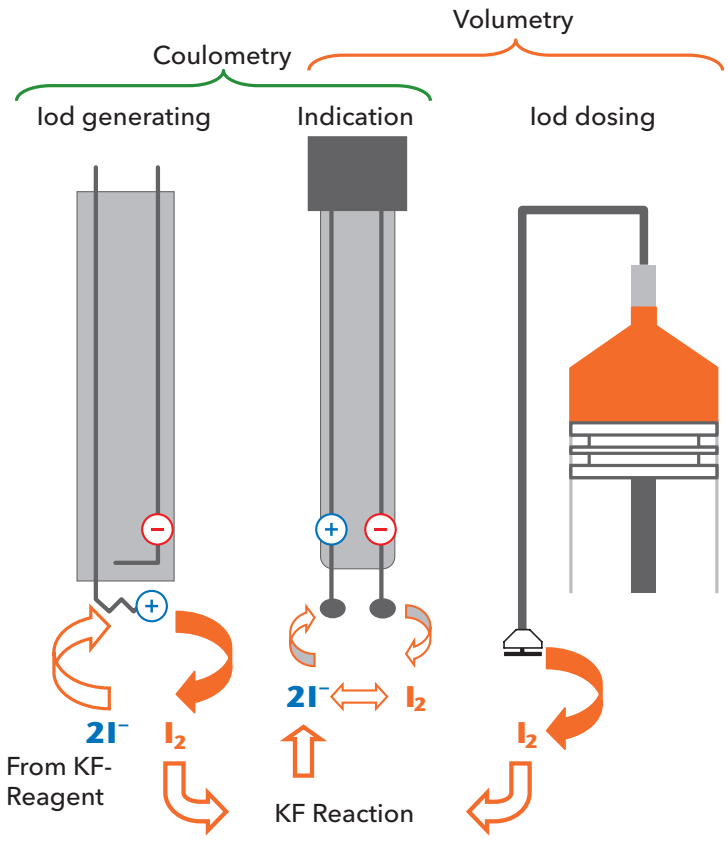
Experienced analyst may be unpleasantly reminded by the pyridine smell, when hearing the name Karl Fischer. However, modern reagents and most user-friendly analyzing instruments have eliminated the problem. Nowadays all applications can be handled and processed very easily by using the **coulometric** 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*



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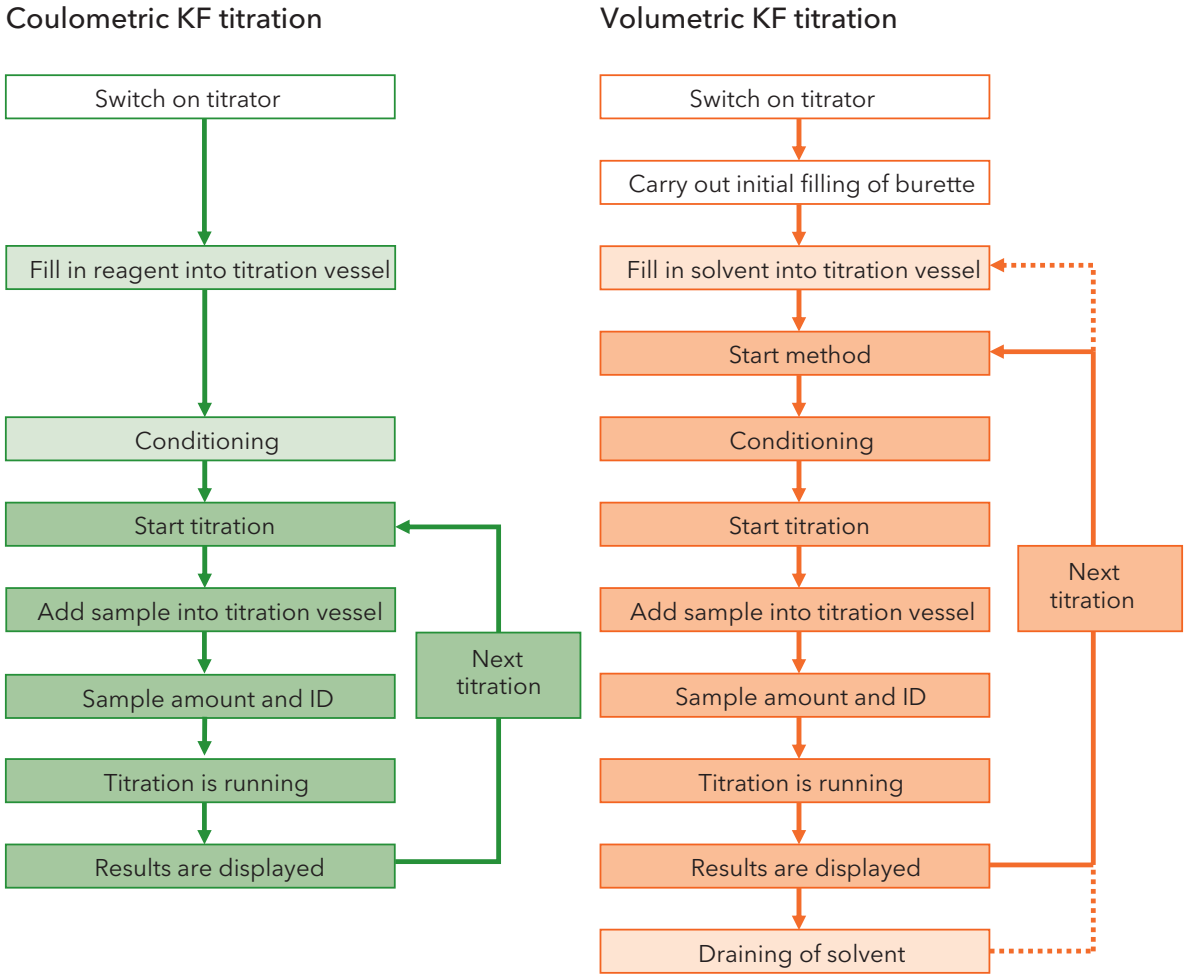
**www.xylemanalytics.com**

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.




## Comparison: Coulometric and volumetric Karl Fischer titration

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



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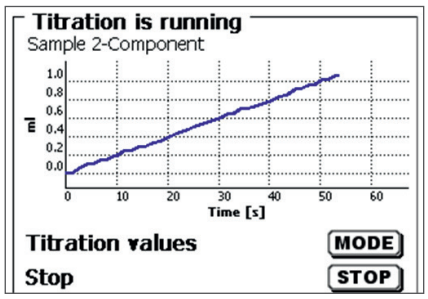
# Live Titration curve

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



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Main menu
2.0
µg/min
Method parameter
Select method / system
START
EDIT
MODE
MODE
EDIT
OK
ESC
START
STOP

# 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.

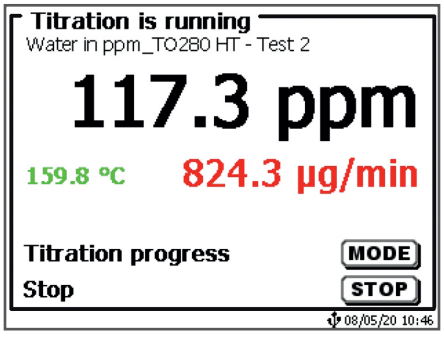
Why semi-automatic? The user places the sample in the oven with the crimper and starts the method on the titrator or (optionally) on the TitriSoft software. Apart from entering the sample name and, if necessary, the initial weight, this is all that needs to be done in the next few minutes.

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**



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# 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<br>2 x RS 232 | 1 x LAN, 2 x USB-A, 1 x USB-B<br>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



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# 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 $H_2O$ | < 0.3% at ≥ 10 mg $H_2O$ | < 0.3% at ≥ 10 mg $H_2O$ | — |
| — | — | — | ■ |
| — | — | — | < 0.3% at ≥ 1 mg $H_2O$ |
| ■ | ■ | ■ | ■ |
| 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) |



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| 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 to14.000 ± 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 |



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Hattenbergstr. 10 · 55122 Mainz · Germany · Tel: +49 6131 665111 · Fax: +49 6131 665001 · info.si-analytics@xylem.com
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# 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 | Titriation 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 tapper 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

| Tye 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. |



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Xylem Analytics Germany Sales GmbH & Co. KG, SI Analytics
Hattenbergstr. 10 · 55122 Mainz · Germany · Tel: +49 6131 665111 · Fax: +49 6131 665001 · info.si-analytics@xylem.com
www.xylemanalytics.com

# 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 |