

Karl-Fischer Titration – the method for determining water

Quite some experienced analyst will be unpleasantly reminded by the pyridine smell, when hearing the name Karl Fischer. However, modern reagents and most user friendly analysing instruments have definitely cleared that picture. Nowadays all applications can be handled and processed very easily, fast and accurate by using the **coulometric** and **volumetric** Karl Fischer titration instruments. Thanks to its selectivity and precision, the Karl Fischer titration has achieved to be established as the most important method for determining water and humidity.

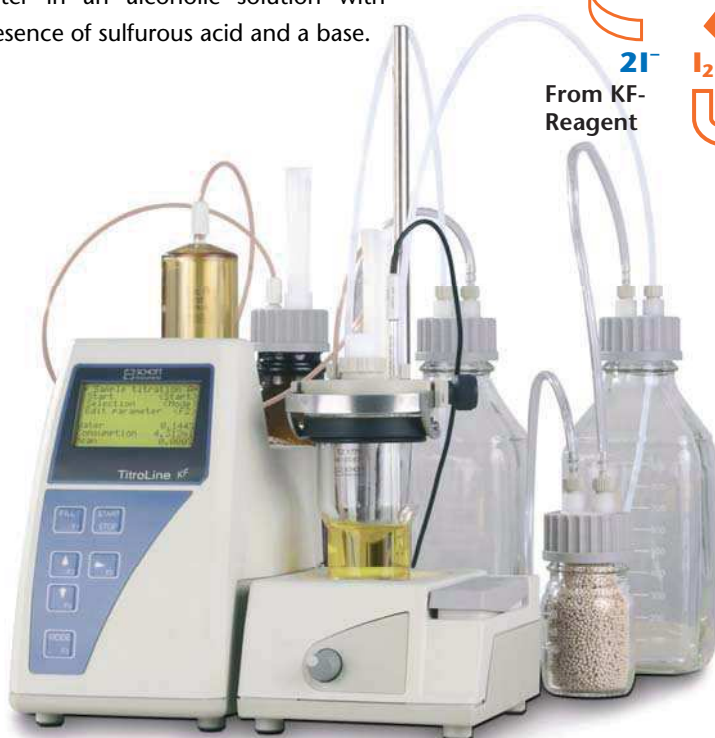
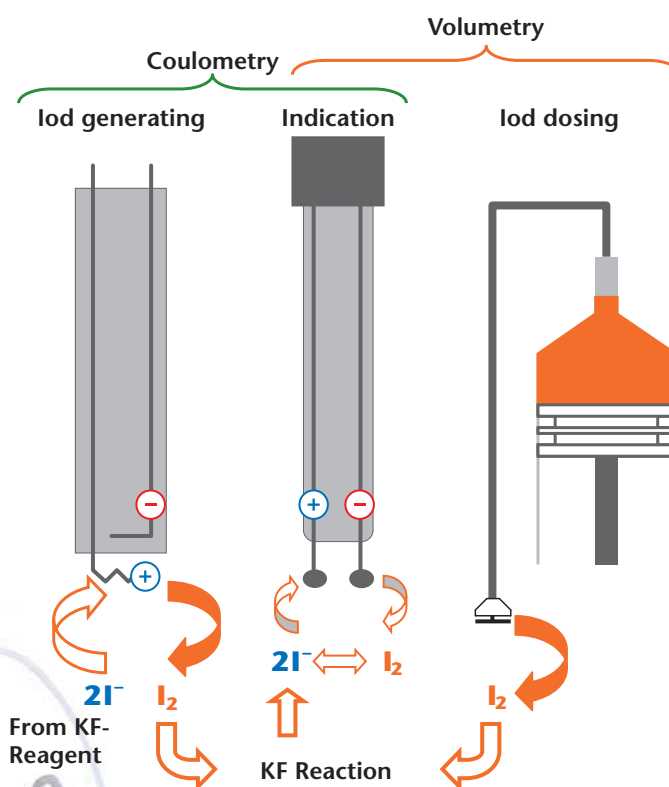
In the following, we would like to ease your decision for either the coulometric (TitroLine KF trace) or the volumetric (TitroLine KF) KF titrator a little.

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 sulfuric acid and a base.

With the **volumetric** method the iodine can be accurately added through a piston burette or **coulometric** directly produced 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 types of dosing:



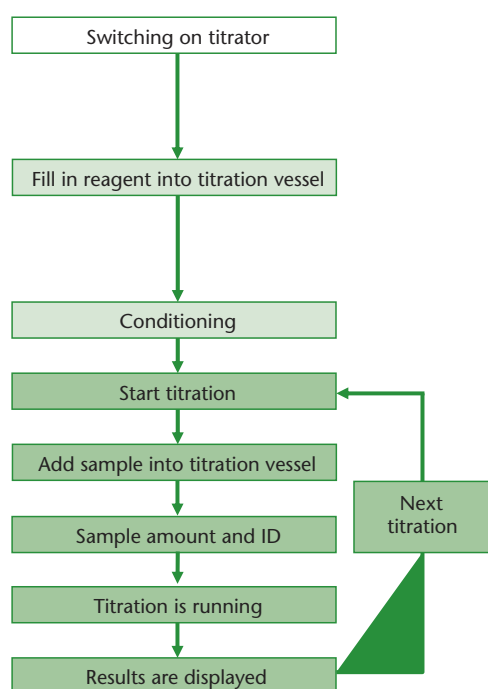
TitroLine KF



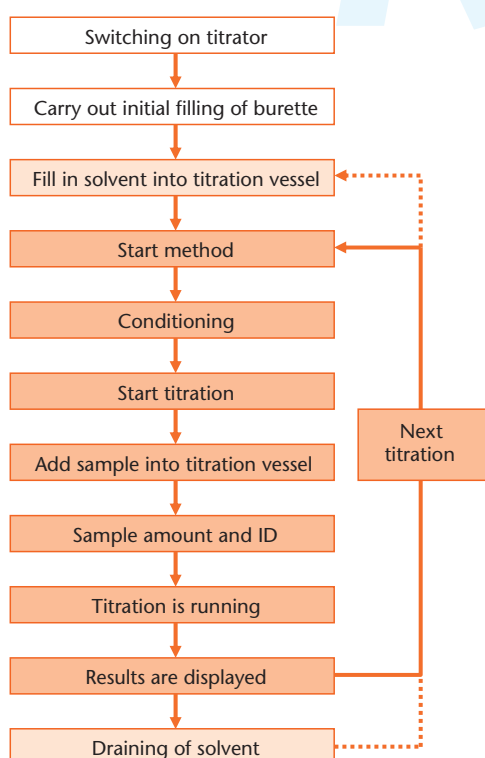
TitroLine KF trace

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 adding and solvent variations, offering more flexible operation potentials. Where on the other hand the coulometry can handle yet lower detection limits and score with the even simpler handling. 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 (i.e. KF oven) Solid samples with 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 homogenisator Working at higher temperature Direct with syringe
Working method	Very fast Very simple	Fast Simple
Working range	µg range 10 µg up to 5 mg water	mg range 200 µg up to 50 mg water
Trueness	Pretty good for small water amounts > 400 µg Wasser (± 0,5%)	Pretty good for water amounts > 5 mg water (± 0,5%, standardization required!)
Reproducibility	Typical RSD of appr. 1% for water > 400 µg	Typical RSD of appr. 1% for water > 5 mg

TitroLine KF *trace*

In dialogue the coulometric Karl Fischer Titration is quite easy!

Karl Fischer titrations made easy

With the new TitroLine KF *trace* the coulometric water determination according to Karl Fischer you cannot go wrong:

The large display shows every work step ahead in a dialogue structure. The pre-parameterized methods are easily recalled and enhance the total work process. Also the versatility makes the both KF titrators a trouble-free KF measuring place for nearly all areas in the industry, such as for pharmaceutical, chemical and petroleum industry.

The coulometric Karl Fischer titrator TitroLine KF *trace* is the dedicated instrument for determining even smallest water content in your samples. As the coulometric determination of water does not require a standardisation of a titrant, the handling is easier compared with the volumetric titration: Once the instrument is installed, the reagents are inserted into the titration cell and the instrument is switched-on. The TitroLine KF *trace* starts to operate immediately. The conditioning is triggered in the background and automatically determines the drift. Only few minutes later the TitroLine KF *trace* is ready for the first samples.



Conveniently with methods

The TitroLine KF is already programmed with the following methods: sample titration, titre water, titre liquid standard, titre tartrate dihydrate, blank value open and blank value solvent. The methods for titre determination cease to apply for the TitroLine KF *trace*. All methods are already set with the commonly used parameters. However, should it become necessary, the parameters can of course be changed.

Parameterization – just in case it will be necessary

The large display gives a clear overview of the next steps in process. Parameterization using the arrow key and the enter/F1 and ESC/F4 key is fairly easy. Taking a look into the operating manual is almost not necessary.



Live titration process

The TitroLine KF *trace* allows watching over the titration by displaying a real-time measuring curve. With just a keystroke you have the option to switch between the standard or graphic display.

Documentation – exactly the way you require it

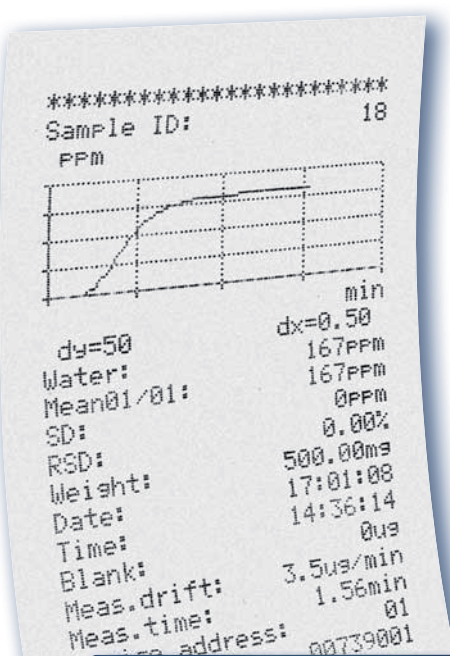
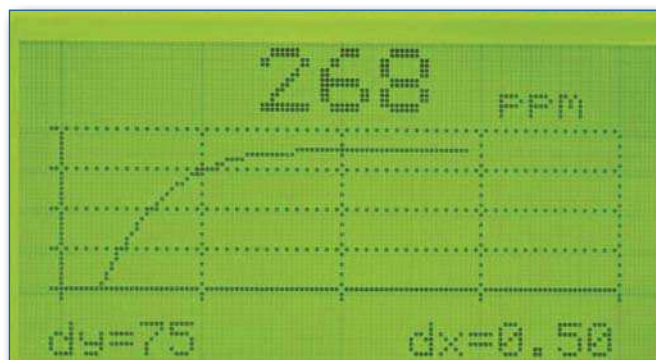
You can decide if you want to print the results in either a short form, as standard form with a curve (only TitroLine KF *trace*) or as complete GLP printout including all method parameters. Of course all results are also indicate with the mean value and the drift on the display.

Automatic selection of the correct calculation formula

Two different may be used to calculate the results. When choosing the method, the correct formula is automatically selected and pre-assigned with the corresponding values. Measurement units for the result can be selected from %, ppm, mg, mg/l, mg/pc (pc= piece) μg (TitroLine KF *trace*) or ml (TitroLine KF). The blank value is calculated in ml or μg and automatically subtracted from the sample titration result.

Statistics

For the statistical evaluation of the analysis the mean value, standard deviation or the relative standard deviation can be determined. The mean value of the titre at the TitroLine KF is the automatic reference for the calculation of the sample result.



Titration stand and titration vessel: Accessories made to match

Titrated samples can be extracted through pushing a button on the titration stand TM KF (standard with TitroLine KF and KF *trace* Module 2 + 4). A further keystroke provides a new reagent. An integrated magnetic stirrer in TM KF takes care of the balanced distribution of reagents and sample.



The titration vessels are hermetically sealed and avoid the penetration of moisture extensively (low drift!). The removable glass vessel from the TitroLine KF is available in two sizes and it is easy to clean. For the TitroLine KF *trace* are to be used two different glass vessels with 3 and 5 openings. Both have a very low drift.

Connection of analytical balances, printers, PC KF oven ...

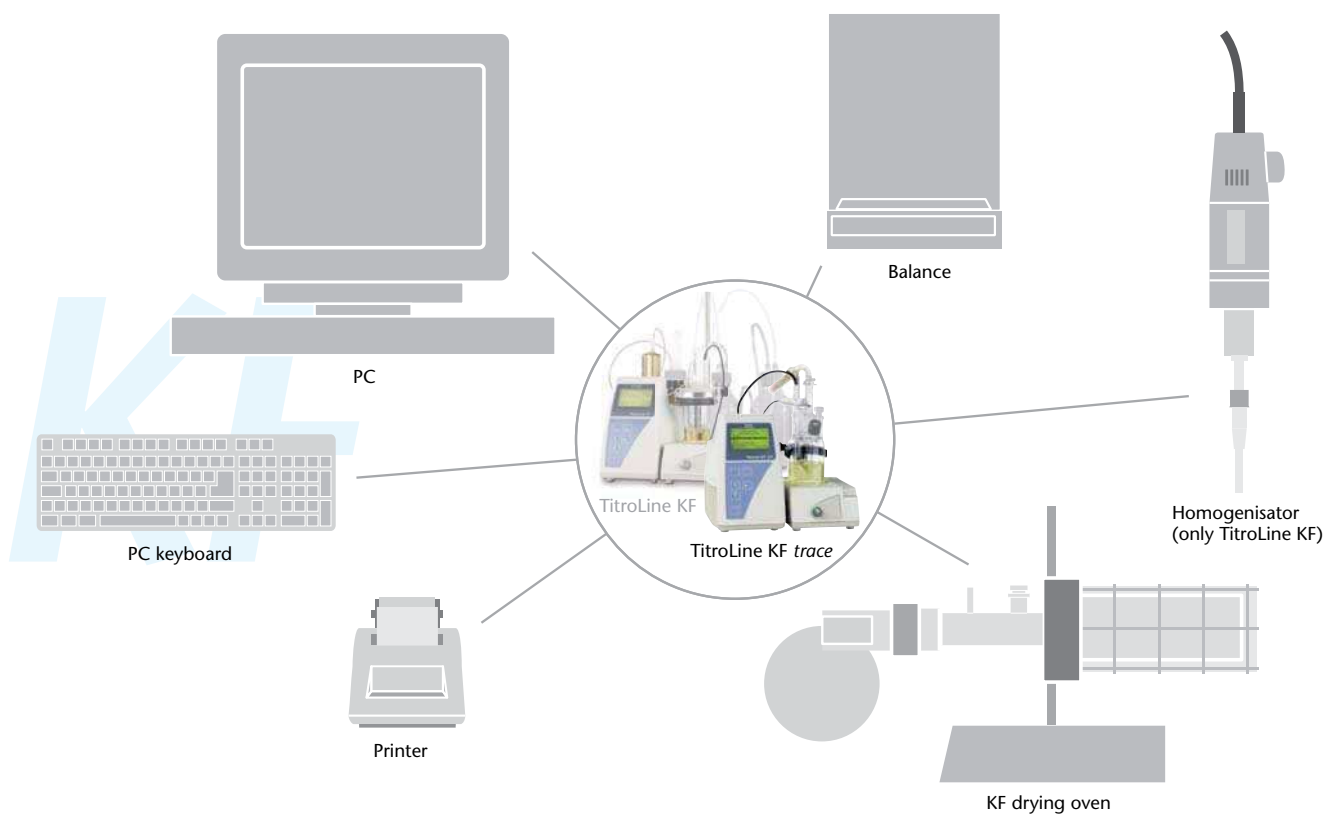
The two RS-232C interfaces and one USB-port* allow you to connect a balance and for automatic transfer of the weighing data and a printer at the same time. It is also possible to connect a PC via the additional USB-port*.

* only TitroLine KF trace

PC control

Both titrators can be easily connected at a PC. The software "KF-Soft"* allows an easy transfer of the data and titration curve on a PC and store it in the integrated database. *

* only TitroLine KF



Technical Specifications TitroLine KF / TitroLine KF *trace*

Hardware

	TitroLine KF	TitroLine KF <i>trace</i>
Display	High contrast 8-lines LCD with 64 x 128 pixel and background illumination ; contrast adjustable	High contrast 8-lines LCD with 64 x 128 pixel and background illumination ; contrast adjustable
Interfaces	2 x RS232 for PC or printer, balance and further devices („daisy chain“)	2 x RS232 for PC or printer, balance and further devices („daisy chain“) 1 x USB („slave“) for PC
Indicator electrode	Dual platinum electrode Connection 2 x mm socket	Dual platinum electrode Connection 2 x mm socket
Generator electrode		Generator electrode Connection 2 x mm socket
Keyboard	5-pole DIN-socket for PC-keyboard	For PC-keyboard with PS/2-plug such as TZ 2835
Stirrer/pump	Stirrer TM 135 respectively stirrer and pump of the titration stand TM KF	Stirrer TM 135 respectively stirrer and pump of the titration stand TM KF
Cylinder	20 ml made out of DURAN®	
Valve	Motor driven 3/2 way valve made out of PTFE/ETFE	
Dimensions	310 x 265 x 205 mm (h x w x d), height with titration stand and titration vessel	200 x 265 x 205 mm (h x w x d) with titration stand TM 135/TM KF 310 x 265 x 205 mm (h x w x d), height with titration vessel
Weight	2,1 kg for basic unit; appr. 3,2 kg for complete unit with titration stand TMKF	Appr. 1,4 kg for basic unit; appr. 2,5 kg for complete unit with titration stand TMKF (module 2 and 4)
Casing	Polypropylene	Polypropylene
Front foil	Polyester	Polyester
Temperature	Ambient temperature: + 10 ... + 40 C for operation and storage	Ambient temperature: + 10 ... + 40 C for operation and storage
Power supply	Mains 230 V, 50/60 Hz or 115 V ; 50/ 60 Hz power drain: 30 VA	Universal power adapter 100-140 V; 50/60 Hz, power drain: 30 VA

Software

	TitroLine KF	TitroLine KF <i>trace</i>
Measuring range	100 ppm – 100 %	10 µg – 100 mg / 1 ppm – 5 % (recommended)
Number of methods	8 (3 x sample, 3 x titre, 2 x blank value)	10 (9 x sample, 1 x blank value)
Conditioning	On start, automatic drift correction	Automatic after switch on, drift correction
End criteria	End point delay, drift	Drift, drift stop tolerance
Autostart after sample addition	Only after conformation of sample weight	■
Statistic	Mean value, standard deviation and rel. relative standard deviation	Mean value, standard deviation and rel. relative standard deviation
Recalculation	After new weighted sample or sample volume has been entered Erasing of one result from a series of measurement	After new weighted sample or sample volume has been entered Erasing of one result from a series of measurement
Online curve		■
Documentation	GLP	GLP + curve print out
Result output	%, ppm, mg, mg/l, mg/pc (pc= piece), ml	%, ppm, mg, mg/l, mg/pc (pc= piece, µg
Password		■
Update software	EPROM-change	Update via RS232 and USB



Ordering information TitroLine KF and TitroLine KF *trace*

TitroLine KF and TitroLine KF <i>trace</i>		Order no.
TitroLine KF <i>trace</i> M1 Complete module for coulometric Karl-Fischer titration	Scope of delivery: TitroLine KF <i>trace</i> basic unit, magnetic stirrer TM 135, generating electrode TZ 1752 without diaphragm, titration vessel TZ 1751, micro dual platinum-electrode KF 1150, connection cable generating electrode	285212258
TitroLine KF <i>trace</i> M2 Complete module for coulometric Karl-Fischer titration	Scope of delivery: TitroLine KF <i>trace</i> basic unit, titration stand with pump TM KF, generating electrode TZ 1752 without diaphragm, titration vessel TZ 1754, micro dual platinum-electrode KF 1150, connection cable generating electrode	285212268
TitroLine KF <i>trace</i> M3 Complete module for coulometric Karl-Fischer titration	Scope of delivery: TitroLine KF <i>trace</i> basic unit, magnetic stirrer TM 135, generating electrode TZ 1753 with diaphragm, titration vessel TZ 1751, micro dual platinum-electrode KF 1150, connection cable generating electrode	285212278
TitroLine KF <i>trace</i> M4 Complete module for coulometric Karl-Fischer titration	Scope of delivery: TitroLine KF <i>trace</i> basic unit, titration stand with pump TM KF, generating electrode TZ 1753 with diaphragm, titration vessel TZ 1754, micro dual platinum-electrode KF 1150, connection cable generating electrode	285212288
TitroLine KF-230 V Volumetric KF-Titrator	Scope of delivery: titration unit, titration stand with integrated stirrer and pump TM KF, titration vessel TZ 1770, micro dual platinum-electrode KF 1100 and starter kit	285212248
TitroLine KF-115 V Volumetric KF-Titrator	Scope of delivery: titration unit, titration stand with integrated stirrer and pump TM KF, titration vessel TZ 1770, micro dual platinum-electrode KF 1100 and starter kit	285212231

Accessories for TitroLine KF and TitroLine KF *trace*

TZ 2835	PC-keyboard (with PS2/DIN-adapter for TitroLine KF)	1007852
TZ 1052	Evaporation oven for water determination according to Karl-Fischer	285214721
TZ 1060	Accessory for Evaporation oven TZ 1052	285218115
TZ 2073	KF-Soft for TitroLine KF	285221733
TZ 3460	RS-232-C printer for TitroLine KF, incl. connection cable TZ 3090, 230 V	285225608
TZ 3461	RS-232-C printer for TitroLine KF <i>trace</i> , incl. connection cable TZ 3090, 230 V	285225610
TZ 3465	RS-232-C printer for TitroLine KF, incl. connection cable TZ 3090, 115 V	285225657
TZ 3466	RS-232-C printer for TitroLine KF <i>trace</i> , incl. connection cable TZ 3090, 115 V	285225660