

WATERMARK
A GFS CHEMICALS BRAND®

Karl Fischer Reagents and Standards

GFS
CHEMICALS®





Table of Contents	2
Karl Fischer Product List	3
Watermark® One-Component	4
One-Component Volumetric Selection Guide	5
Watermark® Two-Component	6
Two-Component Volumetric Selection Guide	7
Watermark® Coulometric	8
Watermark® Coulometric Selection Guide	9
Watermark® Reference Materials	10
Standards and Buffering	11
White Paper	12-13
Specialties	14
About GFS Chemicals	15



KARL FISCHER REAGENTS

VOLUMETRIC (Item - Description)

One Component Reagents

1600 - 5 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1601 - 2 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1884 - 1 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1893 - 5 mg/ml SINGLE SOLUTION, NON-HAZ
1894 - 2 mg/ml SINGLE SOLUTION, NON-HAZ

One Component Solvents

1610 - SOLVENT, GENERAL PURPOSE
3569 - METHANOL, ANHYDROUS
1885 - METHANOL PRIME
1609 - SOLVENT, METHANOL-FREE, FOR ALDEHYDES & KETONES
2978 - SOLVENT FOR OILS, ONE-COMPONENT SYSTEM

Two Component Reagents

1604 - 5.0 mg/ml TITRANT, NON-HYGROSCOPIC
1603 - 2.0 mg/ml TITRANT, NON-HYGROSCOPIC
1602 - 1.0 mg/ml TITRANT, NON-HYGROSCOPIC
1970 - 0.5 mg/ml TITRANT, NON-HYGROSCOPIC
1616 - 5.0 mg/ml TITRANT IN METHANOL

Two Component Solvents

5322 - SOLVENT, for ALDEHYDES AND KETONES, WITH CHLOROFORM
2991 - SOLVENT FOR OILS, TWO-COMPONENT SYSTEM
1609 - SOLVENT, FOR ALDEHYDES & KETONES
1610 - SOLVENT, GENERAL PURPOSE

COULOMETRIC

Vessel (Anolyte) Reagents

1607 - VESSEL SOLUTION, CFC FREE
1612 - VESSEL SOLUTION, PYRIDINE-FREE
1619 - VESSEL SOLUTION, FOR ALDEHYDES & KETONES
5202 - VESSEL SOLUTION, for OILS
1671 - VESSEL SOLUTION, DIAPHRAGMLESS, CHLOROFORM-FREE
1889 - VESSEL SOLUTION, OVEN

Generator Solutions

2321 - GENERATOR SOLUTION, UNIVERSAL

STANDARDS

2303 - WATER STANDARD, 10.0 mg/g (10,000 ppm)
2304 - WATER STANDARD, 5.0 mg/g (5,000 ppm)
2302 - WATER STANDARD, 1.0 mg/g (1,000 ppm)
2301 - WATER STANDARD, 0.10 mg/g (100 ppm)
3493 - WATER STANDARD, 0.50 mg/g (500 ppm)
2311 - WATER STANDARD, 0.05 mg/g (50 ppm)
2385 - WATER STANDARD, POTASSIUM CITRATE
805 - SODIUM TARTRATE, DIHYDRATE REAGENT (ACS)

BUFFERING AND ADDITIONAL PRODUCTS

1615 - BUFFER ACID
1973 - IMIDAZOLE, ACS
672 - BENZOIC ACID, ACS
963 - MOLECULAR SIEVE, 3A, 8 – 12 Mesh



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS



Watermark® One-Component

Volumetric Reagents

In one-component volumetric Karl Fischer Titration, a known concentration of iodine rich titer (Reagent) is added to the vessel solution (Solvent) to consume the water in the sample. By measuring the volume of the titer added, we can calculate the amount of water in the sample. In this method, the titrant contains all the ingredients required by the KF reaction: iodine, base, sulfur dioxide, and a solvent. The Watermark range includes titrants with titer values of 2 and 5 mg/mL of water in order to cover an array of applications.

Watermark® One-Component Titrants

The Watermark brand offers users a wide range of options for selecting the correct titrant. Thanks to the methanol-free formulation, all GFS KF volumetric titrants can be used for the determination of water in aldehydes and ketones.

Advantages of Watermark® One-Component Titration:

- No changing titrants for specialty compounds...just the solvent!
- Fast and stable endpoints
- Long shelf life
- Convenient and simple to use



Karl Fischer Reagents

GFS Chemicals Watermark® Product Line





WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

VOLUMETRIC

One Component Volumetric Reagents

Product Number	Product Name
1600	5 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1601	2 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1884	1 mg/ml PYRIDINE-FREE SINGLE SOLUTION
1893	5 mg/ml SINGLE SOLUTION, NON-HAZ
1894	2 mg/ml SINGLE SOLUTION, NON-HAZ

Did you know? Due to interfering side reactions caused by ketones and aldehydes, solvents with methanol cannot always be used in KF titrations. Watermark 1600 and 1601 (one component single solutions) are formulated to work with 1609 (a specially designed methanol-free solvent) in lieu of standard methanol, to quickly find moisture in ketones. Methanol-free solvents allow for faster titration times as well as being less hazardous than conventional methanol based solvents.

One Component Solvents

Product Number	Product Name
1610	SOLVENT, GENERAL PURPOSE
3569	METHANOL, ANHYDROUS
1885	METHANOL PRIME
1609	SOLVENT, METHANOL-FREE, FOR ALDEHYDES & KETONES
2978	SOLVENT FOR OILS, ONE-COMPONENT SYSTEM



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS



Watermark® Two-Component Volumetric Reagents

For users who do frequent KF analysis and need a higher degree of accuracy than one-component volumetric titration can provide, two-component volumetric titration is the solution. The major differentiating factor between the two methods is that the components of the KF reaction are separated in two-component titration as opposed to being in the same bottle for one-component volumetric titration.

Advantages of Watermark® Two-Component Titration:

- Eliminates frequent standardizations
- Exact and stable titer strength
- Faster titrations
- Longer shelf life
- Greater accuracy for low water content

Watermark® Non-Hygroscopic Titrants

Watermark non-hygroscopic titrants are designed to be exceptionally stable with a guaranteed minimum shelf life of 2 years. The Watermark line also offers the titrant with the lowest titer strength on the KF market: 0.5 mg/mL for samples of very low water content - perfect for labs that don't have a coulometric titrator. Our products maintain a titer strength of +/- 0.05 mg/mL, making them the most advanced and stable KF reagents available.



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

VOLUMETRIC

Two Component Volumetric Reagents

Product Number	Product Name
1604	5.0 mg/ml TITRANT, NON-HYGROSCOPIC
1603	2.0 mg/ml TITRANT, NON-HYGROSCOPIC
1602	1.0 mg/ml TITRANT, NON-HYGROSCOPIC
1970	0.5 mg/ml TITRANT, NON-HYGROSCOPIC
1616	5.0 mg/ml TITRANT IN METHANOL

Did you know? Watermark non-hygroscopic titrants can be used with both methanol-based and methanol-free solvents (1609/1610). This allows for faster titrations as there is no need to change the titrant and clean the burette when switching to aldehyde and ketone analysis. Another key advantage of Watermark non-hygroscopic reagents is less frequent standardizations, providing users with increased accuracy.

Two Component Solvents

Product Number	Product Name
5322	SOLVENT, for ALDEHYDES AND KETONES, WITH CHLOROFORM
2991	SOLVENT FOR OILS, TWO-COMPONENT SYSTEM
1610	SOLVENT, GENERAL PURPOSE
1609	SOLVENT FOR ALDEHYDES & KETONES



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

COULOMETRIC

Known for its highly effective micro-determinations and automation, it's obvious why coulometric titration has found popular application in the KF determination of water. Watermark Karl Fischer Reagents are designed for use with most coulometric systems on the market. They are specially formulated to provide the ultimate in analytical performance.

Advantages of Watermark Water Standards:

- Lowest increment of detection (50x lower than volumetric)
- Ideal for small samples (<10 mg water)
- Auto-adjusts as the material reacts with water vapor in the air
- High accuracy



Watermark® Coulometric Range: Performance

Watermark Coulometric reagents offer the best value and performance for Karl Fischer titration on the market today. With extended shelf life, rapid moisture determinations, and a stable end point, it's easy to see why we outperform the competition. Our custom anolyte and catholyte solutions allow for faster and more accurate titrations than ever before, even when determining moisture content at microgram levels.



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

COULOMETRIC

Coulometric Vessel (Anolyte) Reagents

Product Number	Product Name
1607	VESSEL SOLUTION, CFC FREE
1612	VESSEL SOLUTION, PYRIDINE-FREE
1619	VESSEL SOLUTION, FOR ALDEHYDES & KETONES
5202	VESSEL SOLUTION, for OILS
1671	VESSEL SOLUTION, DIAPHRAGMLESS, CHLOROFORM-FREE
1889	VESSEL SOLUTION, OVEN

Did you know? The Watermark 1671 Fritless Reagent is both versatile and easy to use. Designed for use with fritless cells, Watermark 1671 can also be used with titrators that contain diaphragms or ceramic frits providing:

- Convenience of a single solution
- Accurate and reproducible results
- Fast pre-titration times
- Free of chlorinated hydrocarbons
- Suitable for all titrators and titration cell types

Coulometric Generator Solutions

Product Number	Product Name
2321	GENERATOR SOLUTION, UNIVERSAL



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS



Watermark® Reference Materials

Standardization of a KF reagent is necessary in order to determine its water equivalency. GFS is the primary manufacturer of a broad range of reference materials, all made in-house at our Columbus, Ohio facilities. The (liquid) water standards are delivered in boxes of 10 single-use ampoules with a shelf life of over 5 years. Watermark water standards are methanol-free and can be used for all applications. All standards come with a certificate of analysis.

Advantages of Watermark Reference Materials:

- Manufactured according to ISO 9001:2008 & 17025
- NIST Traceable
- Single-use ampoules
- C of A included

Custom reference materials can also be made for applications requiring other levels of water content.





WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

STANDARDS

Karl Fischer Standards

Product Number	Product Name
2303	WATER STANDARD, 10.0 mg/g (10,000 ppm)
2304	WATER STANDARD, 5.0 mg/g (5,000 ppm)
2302	WATER STANDARD, 1.0 mg/g (1,000 ppm)
2301	WATER STANDARD, 0.10 mg/g (100 ppm)
3493	WATER STANDARD, 0.50 mg/g (500 ppm)
2311	WATER STANDARD, 0.05 mg/g (50 ppm)
2385	WATER STANDARD, POTASSIUM CITRATE
805	SODIUM TARTRATE, DIHYDRATE REAGENT (ACS)

Did you know? Watermark water standards are perfect tool to assist you in validation a new process as well as your titrator to meet GMP, ISO or other guidelines within your organization. Compare them to pure water and see the increased reproducibility they can provide.

BUFFERING

Buffering & Additional Products

Product Number	Product Name
1615	BUFFER ACID
1973	IMIDAZOLE, ACS
672	BENZOIC ACID, ACS
963	MOLECULAR SIEVE, 3A, 8 – 12 Mesh



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

WHITE PAPER

Water Determination in an Insecticide

Introduction

Water determination in powders can be performed through coulometric or volumetric Karl Fischer titration. Some of these materials do not dissolve in any of the common solvents used for Karl Fischer (KF) titration (i.e. methanol, 2-methoxyethanol, ethanol, etc.). Because powder materials can clog the frit of a coulometric KF unit, or because the user does not have access to this equipment, alternate methods must be found.

Anon-hygroscopic volumetric titrant of low titer strength (0.5 mg/mL (+/- 0.05 mg/mL)) is specially designed for volumetric titrations of samples with low moisture content. This application note demonstrates use of the reagent and its efficacy for the determination of water.

The following equipment and reagents were used. Instrumentation: model DL38 volumetric titrator (Mettler-Toledo, Greifensee, Switzerland). Reagents: item #1970, non-hygroscopic titrant, 0.5 mg/mL; item #1610, general purpose solvent, methanol-based; item #2302, water standard, 1.00 mg/g; and item #1604, non-hygroscopic titrant, 5 mg/mL.

All reagents were from GFS Chemicals, Inc. (Powell, OH).

Procedure

The solvent was changed after each determination. Because the titrant is of very low strength (0.5 mg/mL), pre-titration was accelerated by adding item #1604 (5 mg/mL titrant) to the cell using a syringe. Addition of the titrant ceased when the drift of the titrator decreased to approximately 100 microgram per milliliter.

The following parameters were used in the DL38 titrator method – current (microampere): 20; endpoint (mV): 100; dV min (microliter): 3.0; dV max (microliter): 8.0; dV max factor (%): 40; drift stop: relative drift (microgram per minute): 50.

Titer determination was performed by using a 1.00 mg/g water standard. The standard was first checked by coulometric titration at 0.99 mg/g.

Results for the titer determination (three titrations) are as follows:

Concentration: 0.473 mg/mL; standard deviation: 0.005 mg/mL; relative standard deviation: 0.96%.



WATERMARK® KARL FISCHER REAGENTS AND STANDARDS

WHITE PAPER

Determination of the water in the insecticide

The water content of this insecticide was known to be fairly low, and this powder is not soluble in methanol. To check method validity and to obtain better accuracy, water determination was performed by spiking samples with various known amounts of water (from item #2302). The same method as that used for the titer determination was used, but this time with a stir time of 60 sec. When spiking the sample, the known amount of water standard was added to the vessel during the stirring time, after addition of the sample. The results are shown in Table 1.

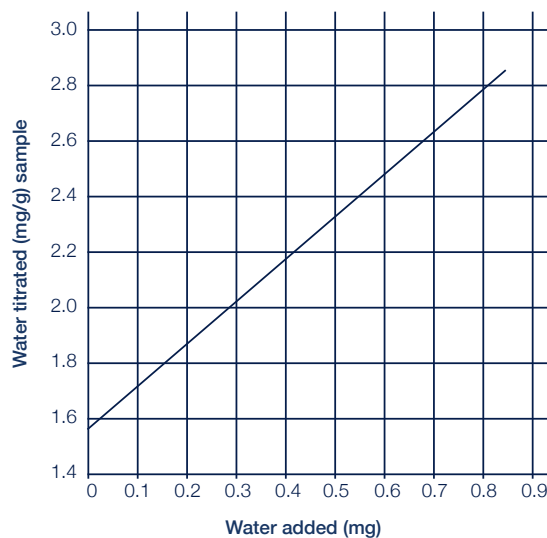
Table 1

Titration results: Four samples spiked with various amounts of water

Experiment No.	Sample size (g)	Water Spike (mg)	Titration volume (mL)	Amt of water titrated per gram of sample (mg/g)
1	0.530	0.000	1.501	1.33
2	0.585	0.850	3.576	2.87
3	0.570	0.505	2.873	2.37
4	0.600	0.250	2.518	1.97

The water titrated in each sample, per gram of sample, is proportional to the known amount of water added. Therefore, the intercept of the graph in Figure 1 (water titrated per gram of sample vs. water added) is the amount of water initially present in the sample, per gram of sample.

The following parameters can be calculated. Equation: $Y = 1.5704 X + 1.5549$; regression parameter: $R^2=0.998$. Y is the water titrated (in mg) per gram of sample, and R is the correlation coefficient. The R^2 value (close to 1) indicates the efficiency and validity of the method. Water in the sample can be estimated to be 1.555 mg/g.



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SPECIALTIES

GFS Chemicals is a US based manufacturer of specialty and fine chemicals serving customers worldwide since 1928. As an ISO 9001:2015 and an ISO 17025:2017 manufacturer, GFS' manufactures and offers a vast variety of materials for use in the research, analytical and manufacturing laboratories. Besides Karl Fischer Reagents, some of our specialties include:

- ACS Reagents
- Veritas® HPLC Solvents
- HPLC/GC/UV-Vis Solvents
- Reagent Grade Solvents
- LC-MS Solvents
- LC-MS Eluents
- Spectroscopy Products
- Primary Standard Salts
- Normality Solutions
- Dyes and Indicators
- Reagents for Water & Wastewater Labs
- Organic Halogen ReagentOHR/Halogen Level Field Test Kits
- Conductivity Standards and pH Buffers
- AA and ICP Standard Solutions
- Standard Solutions for Trace Metal Analysis

For more information about GFS Chemicals, please visit:
www.gfschemicals.com or call GFS at (800) 858-9682.



ABOUT GFS

GFS Chemicals is a Columbus, OH, USA based ISO 9001:2015 certified manufacturer. GFS' capability to produce specialty alkynes and olefins, pharmaceutical building blocks, trace metal salts and solutions, low moisture/anhydrous salts, and specialty rare earth salts and solutions makes GFS a preferred partner for organizations across an array of industries. GFS has delivered results in demanding markets – including: pharmaceutical, electronics, energy, flavors & fragrances, agrichemicals, and specialty polymers. From research lab to pilot plant, from production to commercialization, GFS Chemicals is here to give you knowledgeable answers to any of your technical questions.

In addition to GFS' proprietary product portfolio of 8000 discrete high-quality products available from small bottles to drum quantities, GFS offers:

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