Analytical Methods

Spectrophotometry/Element Analysis

Spectrophotometry applications are common in many laboratories across many industries. UV/Visible spectrophotometry is routinely used in the quantitative determination of elements and certain organic compounds in samples. Typical applications for IR spectrophotometry are as diverse as pharmaceutical research, medical diagnostics, food and agrochemical quality control, and combustion research.

Avantor has a reputation for offering high-purity acids and solvents for spectrophotometry applications based on years of quality, consistency, and innovation. In the 1970s, Avantor introduced the purest acids in the world with the J.T.Baker ULTREX product line and today, the ULTREX II product line represents the best purity available. Both the J.T.Baker and Macron Fine Chemicals acid product lines include products with three distinct levels of purity and characterization, allowing you to select the best value depending on your analysis. The three levels of acid purity are based on characterization of trace metals by flame atomic absorption and a product recommendation for usage is described below.

Our solvent lines continue to evolve with the technology, as shown by the recent introduction of J.T.Baker ULTRA LC/MS solvents designed specifically for use in UHPLC/MS applications.

We also offer a broad line of single element and multi-element standards for instrument calibration and standardization that are critical to spectrophotometry applications. Please see the Instrument Calibration and Standards section of this catalog starting on page 94 for more information about our standards.

Atomic Absorption Spectroscopy (AAS)

J.T.Baker BAKER ANALYZED ACS reagent and Macron Fine Chemicals AR ACS grades of acids are recommended for qualitative AAS applications, as well as general use.

Purity and consistency are key requirements for all reagent chemicals, but they are especially important with acids used for trace metal analysis by Atomic Absorption. J.T.Baker BAKER ANALYZED ACS reagent and Macron Fine Chemicals AR ACS grades of acids exceed American Chemical Society (ACS) specifications and are optimized for parts-per-million (ppm) detection of trace metals by flame atomic absorption. Wherever possible, products are packaged in poly or poly-coated glass bottles.

J.T.Baker BAKER ANALYZED ACS Reagent Acids

Product	Product Number
Acetic Acid, Glacial	9508
Acetic Acid, Glacial	9511
Ammonium Hydroxide, 28.0–30.0%	9721
Formic Acid, 88%	0128
Hydrobromic Acid, 47–49%	0160
Hydrochloric Acid, 36.5–38.0%	9535
Hydrofluoric Acid, 48.0–51.0 %	9560
Hydrogen Peroxide, 30%	2186
Lactic Acid, 85%	0194
Nitric Acid, 69.0–70.0%	9601
Nitric Acid, Fuming, 90%	9624
Perchloric Acid, 69–72%	9652
Perchloric Acid, 60–62%	9656
Phosphoric Acid	0260
Sulfuric Acid	9681
Sulfurous Acid	0370

For product specifications, packaging, and prices, please see the J.T.Baker brand A to Z section (pages 107-422) of this catalog or visit our web site at www.avantormaterials.com

Macron Fine Chemicals AR ACS Acids

Product	Product Number
Acetic Acid, Glacial	V193
Ammonium Hydroxide (28.0–30.0% as NH_3)	3256
Formic Acid, 88%	2592
Hydrochloric Acid	H613
Hydrofluoric Acid, 48%	2640
Hydrogen Peroxide, 30% Solution	5240
Lactic Acid, 85%	2676
Nitric Acid	2704
Nitric Acid	1409
Nitric Acid, Fuming	2713
Perchloric Acid, 70%	2766
Perchloric Acid, 70%	3999
Perchloric Acid, 60%	2764
Phosphoric Acid, 85%	2796
Sulfuric Acid	2876
Sulfurous Acid	2920
Nitric Acid	2706

For product specifications, packaging, and prices, please see the Macron Fine Chemicals brand A to Z product listing section (pages 423-568) of this catalog or visit our web site at www.avantormaterials.com.

Inductively Coupled Plasma—Optical Emission Spectrometry (ICP-OES/AES)

J.T.Baker BAKER INSTRA-ANALYZED and Macron Fine Chemicals AR Select grades of acids are recommended for use in ICP-OES/AES applications.

ICP—OES/AES has become one of the standards in trace metal analysis techniques due to its excellent limits of detection and linear dynamic range, multi-element capability, and reproducibility. J.T.Baker BAKER INSTRA-ANALYZED and Macron Fine Chemicals AR Select grades of acids were designed for routine trace metal analysis and EPA protocols by ICP-OES/AES. BAKER INSTRA-ANALYZED acids are analyzed for up to 35 metals in the low parts-per-billion (ppb) range. AR Select acids are analyzed for up to 32 metals in the low parts-per-billion (ppb) range.

J.T.Baker BAKER INSTRA-ANALYZED Acids

Product	Product Number
Acetic Acid, Glacial	9524
Ammonium Hydroxide, 30%	9733
Hydrochloric Acid, 36.5–38.0%	9530
Hydrofluoric Acid	9563
Nitric Acid, 69.0–70.0%	9598
Perchloric Acid, 69–72%	9653
Sulfuric Acid	9673

For product specifications, packaging, and prices, please see the J.T.Baker brand A to Z section (pages 107-422) of this catalog or visit our web site at www.avantormaterials.com

Macron Fine Chemicals AR Select Acids

Product	Product Number
Acetic Acid, Glacial	8817
Ammonium Hydroxide	6665
Hydrochloric Acid	5587
Hydrogen Peroxide, 30% Solution	V340
Nitric Acid	6623
Perchloric Acid, 70%	8828
Sulfuric Acid	5557

For product specifications, packaging, and prices, please see the Macron Fine Chemicals brand A to Z product listing section (pages 423-568) of this catalog or visit our web site at www.avantormaterials.com.

Inductively Coupled Plasma — Mass Spectrometry (ICP-MS)

J.T.Baker ULTREX II and Macron Fine Chemicals AR Select Plus grades are recommended for use in ICP-MS applications.

ICP-MS is highly sensitive and capable of the determination of a range of metals and several non-metals at very low (parts-per-trillion) concentrations. Unlike AAS, which can only measure a single element at a time, ICP-MS has the capability to scan for all elements simultaneously, allowing rapid sample processing.

J.T.Baker ULTREX II and Macron Fine Chemicals AR Select Plus grades are high-performance acids for your most demanding trace element analyses by ICP-MS, ICP-OES/AES and Graphite Furnace Atomic Absorption (GFAA). ULTREX II acids are analyzed for up to 65 trace elements in the ppt range, with specifications of less than 10 ppt for 50 elements, and total element impurities that typically do not exceed 500 ppt. AR Select Plus acids are tested for up to 45 elements in the low ppt range. AR Select Plus acids are produced by double sub-boiling distillation in quartz stills. Both ULTREX II and AR Select Plus acids are packaged in inert, pre-leached fluoropolymer bottles under Class 100 environment to protect the purity of the acids.

J.T.Baker ULTREX II Acids

Product	Product Number
Acetic Acid, Glacial	6903
Ammonium Hydroxide, 20%	4807
Hydrochloric Acid	6900
Hydrofluoric Acid	6904
Hydrogen Peroxide, 30%	5155
Nitric Acid	6901
Perchloric Acid, 70%	4806
Phosphoric Acid	6908
Sulfuric Acid	6902
Water	6906
ULTREX Bottle-Top Dispenser	6910
ULTREX Dispenser Base	6912

For product specifications, packaging, and prices, please see the J.T.Baker brand A to Z section (pages 107-422) of this catalog or visit our web site at www.avantormaterials.com

Macron Fine Chemicals AR Select Plus Acids

Product	Product Number
Hydrochloric Acid	V078
Nitric Acid	V077

For product specifications, packaging, and prices, please see the Macron Fine Chemicals brand A to Z product listing section (pages 423-568) of this catalog or visit our web site at www.avantormaterials.com.

Analytical Methods

ULTREX II Dispenser System

The J.T.Baker ULTREX II dispenser system was designed to reduce the risk of contamination and to maintain the purity of ULTREX II acids. The dispenser is made of fluoropolymer PFA or TFM (modified PTFE) and it will eliminate leaching and airborne contamination, minimize waste and enhance safe handling of these acids. The dispenser is pre-cleaned to maintain <0.1 ppb metal blank levels in routine use. All wet parts are made with fluoropolymer PFA to maintain product purity and each unit comes with a PTFE air filter to reduce the risk of airborne contamination. The unit dispenses 0 to 5 mL in 0.5 mL increments with an accuracy of ±0.02 mL (water at 20 °C) and a precision of ±3% at 3 mL.

J.T.Baker ULTREX II Dispenser System

ULTREX Dispenser Specifications	
Volume:	0–5 mL in 0.5 mL increments
Accuracy:	± 0.02 mL (water at 20 °C)
Precision	± 3% at 3 mL

UV/Visible/IR Spectrophtometry

J.T.Baker PHOTREX grade solvents are recommended for use in UV, visible, and IR spectrophotometry applications. Macron Fine Chemicals ChromAR and UltimAR grades are recommended for use in UV spectrophotometry applications.

The principle of spectrophotometry is fairly straightforward—that the identification and concentration of a species in solution can be determined by measuring the transmittance or absorbance of radiation passed through the solution. A simple concept, but to make it work, you need a solvent that doesn't interfere with the measurement at the specific wavelength being measured.

Avantor solvents for spectrophotometry are manufactured to minimize lot-to-lot variability and contaminants that can interfere with UV, and in some cases IR, spectra, including residue after evaporation, and acid and base concentrations. Function testing confirms maximum absorbance in selected wavelengths, and for PHOTREX solvents, 50% to 100% transmittance windows in IR wavelengths are reported. ChromAR solvents meet ACS specifications. UltimAR solvents meet ACS specifications for UV spectrophotometry applications

For more information on Macron Fine Chemicals ChromAR and UltimAR solvents, please see the Analytical Chromatography section of this catalog starting on page 22.

Fluorescence Spectrophotometry

J.T.Baker HPLC and LC/MS solvents and Macron Fine Chemicals UltimAR solvents are recommended for use in fluorescence spectrophotometry applications.

Fluorescence spectrophotometry applications have expanded rapidly in areas as diverse as trace metal analysis, environmental applications, and medicine. Fluorescence spectrophotometry has some significant advantages over absorption spectroscopy, including that two wavelengths (excitation and emission) are used, that the technique by its nature has a low signal to noise ratio, and that fluorescence methods have linearity over a broader range. These advantages make the sensitivity of fluorescence spectrophotometry much greater than absorption spectrophotometry. Also, many more compounds exhibit UV absorption than strong fluorescence, making fluorescence much more selective.

Fluorescence spectrophotometry techniques are very sensitive to pH changes, and any suspended particles can cause false signals due to light scattering. Interference by contamination of trace levels of organic chemicals require that the highest quality solvents be used.

J.T.Baker PHOTREX Solvents

Product	Product Number
Acetone	9010
Alcohol, Anhydrous, Reagent	9229
1-Butanol	9189
n-Butyl Acetate	9191
Chloroform	9183
1,2-Dichloroethane	9302
Dimethyl Sulfoxide	9194
Dimethylformamide	9222
p-Dioxane	9196
Methanol, Absolute	9069
Methyl iso-Butyl Ketone	9212
Methylene Chloride	9329
Paraffin Oil	9388
Petroleum Ether, 35–60 °C	9270
2-Propanol	9083
Tetrachloroethylene	9218
Toluene	9456
2,2,4-Trimethylpentane	9479
Xylenes	9516

For product specifications, packaging, and prices, please see the J.T.Baker brand A to Z section (pages 107-422) of this catalog or visit our web site at www.avantormaterials.com

Avantor offers a range of products for use in fluorescence spectrophotometry applications. J.T.Baker HPLC solvents are controlled for high assay and low UV absorption, fluorescence, residue, and water. Selected J.T.Baker LC/MS solvents are also controlled for fluorescence and residue and are filtered through a 0.2 µm filter. Macron Fine Chemicals UltimAR solvents also are tested for fluorescence interferences and controlled for residue.

For more information on these products, please see the Analytical Chromatography section of this catalog starting on page 22.

Wet Chemical Analysis

Wet chemical analysis refers to classical chemistry-based analytical methods that exclude the use of instrumentation. These methods are generally done in the liquid phase using relatively larger quantities of reagents than required by many instrumental techniques. Many wet chemical analysis applications are widely used today across all types of industries and have been effectively automated and computerized for efficiency.

Avantor offers a broad range of general reagents and specialty products for use in wet chemical analysis applications. Our products are sometimes designed with a specific application in mind, such as Karl Fischer titrations. Other products take a more generalized approach, such as our volumetric solutions, which aren't for a specific application, but are traceable to NIST standards to assure reliability in all applications. Whatever your wet chemistry application, you can have confidence that J.T.Baker and Macron Fine Chemicals brand products are of the highest purity and lot-to-lot consistency, and are among the finest chemicals available for wet chemical analysis in the market today.

Water Determination (Karl Fischer)

Water determination by Karl Fischer titration is a technique used in many industries in both research and quality control applications. The Karl Fischer

method has several major advantages over alternative methods, including speed, accuracy, and reliability. The method is highly selective for water, requires small sample sizes, has a short analysis time, and is suitable for automation.

The J.T.Baker HYDRA-POINT product line was developed with a pyridine-free formulation specifically for use in Karl Fischer volumetric and coulometric titrations. In comparison studies with other brands of Karl Fischer Reagents, HYDRA-POINT titers have been shown to be more stable and have less drift, helping to save time and reduce reagent usage.

HYDRA-POINT Karl Fischer Reagents

J.T.Baker HYDRA-POINT Karl Fischer reagents make water determination easy and trouble-free. Products are formulated to give you consistent and reliable results for all types of samples. HYDRA-POINT products reach endpoint quickly, accurately, and with reproducibility, allowing you to perform more titrations in less time.

Volumetric Reagents

HYDRA-POINT volumetric reagents are pyridine-free, eliminating the hazards and unpleasant odor of pyridine-based solvents in the laboratory. These products are available as two-component systems with the reactants in two separate solutions, or as a one-component system where all reactants are in a single reagent, and the sample is placed in a methanol solution. We also offer dry methanol and a buffer solution for use in volumetric determinations.

J.T.Baker HYDRA-POINT Volumetric Reagents

One-Component Systems

Product	Product Number
HYDRA-POINT Comp 5	8890
HYDRA-POINT Comp 2	8891
HYDRA-POINT Comp 5K	8892
HYDRA-POINT Methanol Dry	8898
HYDRA-POINT Comp Buffer	8899

Two-Component Systems

Product	Product Number
HYDRA-POINT Titrant 5	8844
HYDRA-POINT Titrant 2	8845
HYDRA-POINT Solvent G	8855

For product specifications, packaging, and prices, please see the J.T.Baker brand A to Z section (pages 107-422) of this catalog or visit our web site at www.avantormaterials.com