Editorial

Dear Colleagues,

Our customers in the petrochemical and related physical testing sectors are an important part of the analytical community. Up to now the Sigma-Aldrich product portfolio of analytical standards and CRMs for petrochemical and fuel testing was mainly made up of chromatography standards with only a few physical property standards supporting the product range. But with more than 600 Certified Reference Materials (CRMs), standards and calibration products from Paragon Scientific Ltd. now available from Sigma-Aldrich for our global customer community in the petrochemical sector we really have something to get excited about!

I’ve known Paragon Scientific Limited since 2002 when, as Editor of Reference Material Report, I interviewed Jeff Morris, owner and technology specialist behind this innovative company. I was impressed by his vision, and we shared a belief that calibration and control materials had to be manufactured to the highest possible metrological standard. True to his belief, his business was among the first to achieve accreditation to the coveted ISO/IEC 17025 Standard and ISO Guide 34 as a producer of Certified Reference Materials. Paragon’s advanced manufacturing techniques, the use of primary laboratory test equipment and methodology, together with acute attention to detail, mean that its CRMs achieve the lowest possible levels of uncertainty.

The success of the Paragon product line has resulted in a rate of growth that made it essential to open a new and greatly expanded manufacturing facility not far from the original site. The new site was audited and approved by UKAS at the end of May 2013, so that production started on 3 June 2013.

Sigma-Aldrich has listed a small selection of Paragon Viscosity Standards for some time. Over the last 18 months, the two companies have worked towards the signing of an agreement that will ensure further development of Paragon’s product line and extend the availability of Paragon’s range of calibration standards and certified reference materials through the global Sigma-Aldrich sales and marketing network. A new SIAL website has been set up to provide direct access to the full range of Paragon products and provide full technical information.

On pages 4 and 5 you can read about the many new Paragon products now available from Sigma-Aldrich. For full details, please visit the new Sigma-Aldrich Paragon Web pages at:

sigma-aldrich.com/paragon

Peter Jenks, FRSC.
Manager, Strategic BD, Analytical.
Feature Article
4 Paragon Scientific Certified Reference Materials

Standards
6 New Veterinary Drug Standards
7 New TraceCERT® ICP Multielement Standard Solutions
Chemical Group Mixes Covering All Elements of the Periodic Table
8 Impress Your Auditors!
New product additions to the organic TraceCERT CRM portfolio
10 Active Ingredients of Sunscreens
Sigma-Aldrich extends its portfolio of analytical standards for UV blockers
11 Beauty with Safety
NEW Analytical Reference Materials for Cosmetics
12 Elevate Your Enjoyment
NEW Flavor & Fragrance Standards for the Food and Cosmetic Industry
13 Wanted! Better Tools for Micropollutant Detection in Wastewater
Found! Sigma-Aldrich’s NEW Environmental Standards for APIs and Their Metabolites

Trace Analysis
14 TraceSELECT® Solvents for Analysis of Metals in Oils
Superior Trace Metal Grades

Microbiology
15 Microbiological Fluorescence Assays
FluoroSELECT™ is a rapid test based on an assay with fluorogenic substrates.

Mass Spectrometry
17 Halogenated High Performance MALDI-MS Matrices
Rationally designed matrix derivatives allow for increased sensitivities & new areas of application

Reagents
20 New Derivatization Agents for LC-MS
Detection and Quantitation of Formaldehyde or Benzaldehyde
21 New IC Eluent Concentrates for Metrohm® Applications
Application tested on Metrosep columns

Titration
22 Determination of Water Content in Aldehyde and Ketone Samples
HYDRANAL®-K Reagent Line for Karl Fischer Titration
Paragon Scientific Certified Reference Materials

Paragon offers a wide range of CRMs that are all certified in accordance with the requirements of ISO-IEC 17025 and ISO Guide 34. All the activities needed to manufacture and certify reference materials at Paragon Scientific are accredited by UKAS to ISO-IEC 17025 and ISO Guide 34 so that Paragon CRMs are therefore “Gold Standard” certified Reference Materials of the same metrological standing as the renowned Sigma-Aldrich TraceCERT® range of CRMs (see pages 7 and 8). In developing data needed for Certification Paragon Scientific uses not only its own in-house accredited laboratory, but for many of the products offered, the candidate CRM is subjected to an inter-laboratory study conducted by collaborating ISO-17025-accredited testing laboratories, thus further strengthening the robustness of the data used to certify the CRMs. Full details of the certification process are included within the CRM supplied.

With almost 20 years of experience in the production and certification of quality reference materials that include Certified Reference Materials, Color, Density, Flash Point, Refractive Index, Total Acid Number (TAN), Total Base Number (TBN) and Viscosity Standards, Paragon Scientific has developed an international reputation synonymous with quality, affordability, and first-class customer service.

A combination of advanced manufacturing techniques, the use of primary laboratory test equipment and methodology, plus its acute attention to detail, enables it to produce reference materials with some of the lowest levels of uncertainty of measurement available.

Paragon Scientific reference materials are used in multiple industries throughout the world and are now available worldwide from Sigma-Aldrich (sigma-aldrich.com/paragon), and are sure to be of great interest to analysts working in the petrochemical and associated industries.

Petrochemical Industry Certified Reference Materials
- Cold Filter Plugging Point (CFPP)
- Cloud Point
- Distillation using ASTM/IP and EN test method protocols
- Flash Point using ASTM D92 (Cleveland Open Cup Flash Point) and ASTM D93 (Pensky Marten Closed Cup Flash Point)
- Freezing Point
- Fuels Testing
- Pour Point

Viscosity CRMs
Paragon has become a leading producer of CRMs for Viscosity measurement. The company was the first to offer “Gold Standard” CRMs for a wide range of viscosity measurement applications. Some of the notable product areas are highlighted below:
- CCS Viscosity Standards (Cold Cranking Simulator) oil testing to ASTM D5293 and SAE Specification J300.
- Cone & Plate Viscosity Standards (CAP) are specifically formulated for the paint and coatings industry and represent the most comprehensive range of standards available for this application.
- Flow Cup Viscosity Standards: designed for use in DIN, Ford, ISO, Shell and Zahn flow cups and are also dual purpose density standards. Certified at 20 °C and 25 °C, each value is tested to ASTM D2162 for viscosity measurement and ASTM D1480 for density measurement.
- General Purpose Viscosity Standards: tested in accordance with ASTM D2162, (“Standard Practice for basic calibration of master viscometers and viscosity standard oils”).
- Low Temperature Viscosity Standards: intended for the verification of viscometers at sub-zero temperatures on a routine basis.
- Medical Viscosity Standards: tested in accordance with ASTM D2162, typically used, but not limited to, the calibration and verification of viscosity measuring equipment used for measuring the viscosity of blood plasma.
- Mineral Oil Rotational Viscosity Standards provide both calibration and verification options for rotational viscometer test equipment from this most comprehensive range of standards. Kinematic Viscosity at temperatures 20.5 °C to 24.5 °C are calculated in accordance with ASTM D341.
- Silicone Rotational Viscosity Standards specifically formulated for use with rotational viscometers. Supplied in 600 ml “ready to use” packs specially designed to eliminate the need to transfer the sample to a test beaker.
Color
Color is an important part of the specification applied to many oils, fuels and chemicals. Paragon has developed CRMs, and for the calibration or verification of color measuring instruments, the range of liquid standards includes AOCS-Tintometer, ASTM, Gardner, Lovibond RYBN, Pt-Co and Saybolt Color.

Density
Paragon Density CRMs are designed for the verification of instruments used to measure density of materials which are fluid within the range of 15 °C to 150 °C. They are compliant with ASTM D1480 to ensure full compliance to ASTM and IP test method protocols.

Total Base Number (TBN)
Paragon TBN CRMs are specifically manufactured for the verification of TBN by potentiometric titration, a technique used in, but not limited to, the analysis of used oils and lubricants. Tested and certified in accordance with ASTM D2896/IP 276.

Total Acid Number (TAN)
Paragon TAN CRMs are specifically manufactured for the verification of analytical instruments used to determine acid number by potentiometric titration. Tested and certified in accordance with ASTM D664/IP 177.

Sucrose Brix Refractive Index
Sucrose-based CRMs are manufactured using traceable high purity materials to four decimal places following ICUMSA methods.

Other Specialized Reagents
Lithium Chloride Electrolyte
A high quality analytical reagent manufactured and certified compliant for use in ASTM D664/IP 177, the “Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration”.

Synthetic Seawater
A high quality analytical reagent manufactured and certified compliant for use in ASTM D665/IP 135, the “Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water”.

Other CRMs
Paragon Scientific also offers a growing range of CRMs covering many important parameters widely measured across the petrochemical industry. These include the following important analytical techniques:
New Veterinary Drug Standards

Modern agriculture is based on the use of antibiotics to prevent infections, parasites or disease of the animals. However, in the processed food, no residues of these products are desired. Therefore, foodstuffs of animal origin need to be tested for residues of medicinal products and their metabolites.

Our VETRANAL™ product line includes over 300 high-purity standards for the active ingredients of veterinary drugs, including isotope labeled compounds as well as common metabolites. In the table below, the most recent new product additions of the VETRANAL line are listed. Please find a complete product listing on our website at sigma-aldrich.com/standardsantibiotics

Matthias Nold, Product Manager Analytical Standards
matthias.nold@sial.com
New TraceCERT® ICP Multielement Standard Solutions
Chemical Group Mixes Covering All Elements of the Periodic Table

Inorganic residue analysis is applied over the whole range of analytical application areas. The exact determination of elemental residues is of central importance not only in food and environmental testing, but also in quality control in the pharmaceutical and chemical industry. The classical chemical methods have, to a large extent, been replaced by more modern spectroscopic methods. This is also reflected by the current introduction of new pharmacopoeia monographs for testing of inorganic impurities [1]. Methods such as ICP-OES or ICP-MS that apply inductively coupled plasma (ICP) for ionization are widely used in analytical laboratories.

One big advantage of ICP is that it allows for simultaneous detection of up to 70 different elements. Therefore, for calibration, multielement standard solutions are needed.

The Fluka branded inorganic TraceCERT® products are highest quality certified reference materials (CRMs) that are developed and produced according to ISO/IEC 17025 and ISO Guide 34. For their production, very well characterized, highest-purity raw materials are used. TraceCERT CRM are traceable to at least two independent references (i.e. NIST, BAM or SI unit kg), and are delivered together with comprehensive documentation including a proper uncertainty calculation, expiry date and storing/handling instructions.

To offer a comprehensive portfolio to our ICP customers, we now complement the portfolio of single and multielement TraceCERT solutions with a series of solutions that cover all accessible elements of the periodic table. In these so-called ‘chemical group mixes’, elements belonging to the same chemical group are combined (alkali metals, alkali earth metals, rare earth metals, transition metals, post transition metals, non-metals and metalloids). The table below and the color-coded periodic table show product numbers, composition, and matrix of the eight new CRMs.

With these chemical group mixes, we provide our customers with the ability to calibrate their ICP instrument for multielement use, requiring only a handful of standards. We also offer tailor-made custom mixtures in order to better serve your needs. Please visit our online custom standards platform at sigma-aldrich.com/csp where, with a few simple mouse clicks, you can define components, concentrations, and matrix and send us a non-binding quote request.

For further technical information on the TraceCERT line and a complete product listing, please visit sigma-aldrich.com/tracecert or order our TraceCERT Brochure.

References:

Matthias Nold, Product Manager Analytical Standards matthias.nold@sial.com
Little more than a decade after it was first issued, the ISO/IEC 17025 standard has become indispensable to analytical testing laboratories. An ISO/IEC 17025 accreditation is the best proof of a laboratory’s competence. Customers, authorities, and other laboratories can assume that the data measured by an accredited lab are reliable and comparable to the results from other accredited labs throughout the world. To ensure such a high level of reliability, ISO/IEC 17025 covers all relevant aspects of quality testing, including the management system, method validation, technical competence and training of the staff. [1]

One crucial aspect, and the basis for reliable and comparable results, is the quality of the reference materials used for calibration. ISO 17025 states that “if possible”, analytical results should be traceable to SI units or certified reference materials (CRMs) of internationally recognized sources. In the past, the lack of availability of CRMs with this level of traceability led to the willingness to allow exceptions with regard to this point. However, as the number of available CRMs continues to grow rapidly, we believe that this requirement will increasingly come under auditors’ scrutiny in the coming years since only by using a truly traceable reference material is a laboratory capable of generating traceable results. The Sigmas Aldrich site in Buchs (Switzerland) achieved ISO/IEC 17025 accreditation for qNMR in 2008. In a recent publication, we showed that measurement uncertainties down to 0.1% are possible with qNMR [3]. The organic TraceCERT CRMs are produced under double accreditation (ISO Guide 34 in combination with ISO/IEC 17025) and the certified values are traceable to NIST Standard Reference Materials. The portfolio of organic TraceCERT products includes over 150 products, and keeps growing rapidly. The portfolio comprises of the most commonly tested analytes in food and environmental analysis, ranging from pesticides, PAHs, plasticizers and fatty acids, to amino acids and natural products. The list below shows recent product additions. A complete product listing can be found on sigma-aldrich.com/organiccrm

Using these products ensures that you will have at least one less thing to worry about when your next audit is approaching.

References:

Matthias Nold, Product Manager Analytical Standards matthias.nold@sial.com

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Product</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>55177</td>
<td>Fluka</td>
<td>Benzyl benzoate</td>
<td>1 g</td>
</tr>
<tr>
<td>42088</td>
<td>Fluka</td>
<td>Bisphenol A</td>
<td>100 mg</td>
</tr>
<tr>
<td>72609</td>
<td>Fluka</td>
<td>Coumarin</td>
<td>100 mg</td>
</tr>
<tr>
<td>72765</td>
<td>Fluka</td>
<td>α-Cyhalothrin</td>
<td>50 mg</td>
</tr>
<tr>
<td>76514</td>
<td>Fluka</td>
<td>2,4-Dichlorophenoxyacetic acid (2,4 D)</td>
<td>100 mg</td>
</tr>
<tr>
<td>95656</td>
<td>Fluka</td>
<td>Eucalyptol</td>
<td>100 mg</td>
</tr>
<tr>
<td>79891</td>
<td>Fluka</td>
<td>Eugenol</td>
<td>100 mg</td>
</tr>
<tr>
<td>64188</td>
<td>Fluka</td>
<td>D-Glucronic acid sodium salt</td>
<td>100 mg</td>
</tr>
<tr>
<td>74347</td>
<td>Fluka</td>
<td>Hydroquinone</td>
<td>100 mg</td>
</tr>
<tr>
<td>40394</td>
<td>Fluka</td>
<td>Magnesium L-lactate hydrate</td>
<td>100 mg</td>
</tr>
<tr>
<td>77928</td>
<td>Fluka</td>
<td>1-Methyl-2-pyrrolidinone</td>
<td>100 mg</td>
</tr>
<tr>
<td>88173</td>
<td>Fluka</td>
<td>D-n-octyl phthalate</td>
<td>50 mg</td>
</tr>
<tr>
<td>41231</td>
<td>Fluka</td>
<td>Pentachlorobenzene</td>
<td>100 mg</td>
</tr>
<tr>
<td>40430</td>
<td>Fluka</td>
<td>Potassium sorbate</td>
<td>100 mg</td>
</tr>
<tr>
<td>30899</td>
<td>Fluka</td>
<td>1,2,3-Trichloropropane</td>
<td>100 mg</td>
</tr>
<tr>
<td>19566</td>
<td>Fluka</td>
<td>2,4,6-Triiodophenol</td>
<td>100 mg</td>
</tr>
<tr>
<td>68325</td>
<td>Fluka</td>
<td>2,3,4-Trimethoxybenzaldehyde</td>
<td>100 mg</td>
</tr>
</tbody>
</table>

Product Table - New organic TraceCERT CRMs
accuracy of calibrators depends on accuracy of spiking solutions

DID YOU KNOW ?
Quality and characterization of critical starting materials, difficulty in material handling, and weighing technique can affect calibrator accuracy. Our shelf stable Snap-N-Spike® format eliminates painstaking weighing operations – providing the ability to spike a known concentration of analyte into your matrix of choice.

Cerilliant…when results matter

Check out our comprehensive portfolio of

Pharmaceutical Standards and Certified Reference Materials!

Including:
- Pharmaceutical Secondary Standards
- Impurity Standards
- Residual Solvent Standards
- Phytopharma Standards

sigma-aldrich.com/pharmaceuticalstandards
Skin damage caused by exposure to sunlight’s UVA and UVB radiation can be effectively prevented by using sun creams or sunscreen lotions. The active ingredients in these products are commonly aromatic compounds which absorb high energy UV-light and release the energy as lower energy rays. Due to their effectiveness in absorbing or scattering ultraviolet radiation, they are able to protect the skin and avoid severe damage such as sunburns and skin cancer.

The compounds permitted to be used in sunscreens and the allowed maximum concentration differ among the US, Europe, Japan and other countries due to varying legislation.

Sigma-Aldrich recently extended its offering of analytical standards for compounds employed as ingredients in sunscreens, both for quality control in the cosmetic industry and for environmental analysis. The structures of the new product additions are shown below. Table 1 provides a total listing of all available analytical standards for UV blocking substances and the countries where they are allowed to be used. Find these products on our Website at sigma-aldrich.com/uvblockers.

**Table 1** Analytical Standards for Sunscreen Lotion Ingredients

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Compound</th>
<th>Package Size</th>
<th>US</th>
<th>EU</th>
<th>JP</th>
</tr>
</thead>
<tbody>
<tr>
<td>01973</td>
<td>p-Aminobenzoic acid</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>16633</td>
<td>Avobenzone</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>94257</td>
<td>Benzophenone-9</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>67790</td>
<td>Cinoxate</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>92841</td>
<td>Dioxybenzone</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>55901</td>
<td>Ecamsule</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PHR1085</td>
<td>Homosalate</td>
<td>1 g</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>73675</td>
<td>Menthyl anthranilate</td>
<td>1 mL</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>66158</td>
<td>4-Methylbenzylidene camphor</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>68790</td>
<td>Drometrizole trisiloxane</td>
<td>50 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>50572</td>
<td>2,2’-(1,4-Phenylene)bis-1H-benzimidazole-4,6-disulfonic acid</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>02343</td>
<td>Octocrylene</td>
<td>1 mL</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>55529</td>
<td>Octyl methoxycinnamate</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>52184</td>
<td>Octyl salicylate</td>
<td>1 mL</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>59647</td>
<td>Oxybenzone</td>
<td>50 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>74309</td>
<td>Padimate O</td>
<td>1 mL</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>68569</td>
<td>Phenylbenzimidazole sulfonic acid</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>50194</td>
<td>Sulisobenzone</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>30184</td>
<td>Bisoctizol</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>51825</td>
<td>Bemotrizinol</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>74412</td>
<td>Trolamine salicylate</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>05846</td>
<td>Iscotrizinol</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>93777</td>
<td>Hexyl 2-[4-(diethylamino)-2-hydroxybenzoyl]benzoate</td>
<td>25 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>93465</td>
<td>Ethylhexyl triazone</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>93632</td>
<td>Zinc oxide</td>
<td>100 mg</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Matthias Nold, Product Manager Analytical Standards matthias.nold@sial.com

Avobenzone – 16633
Benzophenone-9 – 94257
Ecamsule – 55901
Homosalate – PHR1085
Drometrizole trisiloxane – 68790
2-Ethylhexyl 4-methoxycinnamate – 55529
Oxybenzone – 59647
2-Phenyl-5-benzimidazolesulfonic acid – 68569
Bemotrizinol – 51825
Trolamine salicylate – 74412
Iscotrizinol – 05846
Hexyl 2-[4-(diethylamino)-2-hydroxybenzoyl]benzoate – 93777
Ethylhexyl triazone – 93465

sigma-aldrich.com/uvblockers
Cosmetics and personal care products have a long history. Ancient civilizations used paints and fragrant plants for religious reasons – and like today – for improving hygiene, health, appearance and scent. Within the EU the manufacture of cosmetics is regulated [1], since some cosmetic products contained allergenic or carcinogenic substances. This regulation No. 1223/2009, which became effective in 07/2013, bans more than 1000 substances from cosmetic products.

Sigma-Aldrich offers a comprehensive range of analytical standards, including more than 300 neats and 100 single component solutions for EU-banned substances to ensure the safety and quality of cosmetic products. Our broad portfolio also includes 16 certified reference materials (CRMs), which are produced in our accredited laboratory fulfilling both ISO 17025 and ISO Guide 34.

In addition, we offer analytical reference materials, traceable to NIST standard reference materials, for allergenic substances including fragrances (see also page 12), propellants (CFCs), metals, preservatives (parabens), plasticizers (phthalates), colors and emulsifiers. Our newest additions are listed below in Table 1. Additionally, we offer our customers analytical standards for UV blockers used in skin care products (see page 10).

For an up-to-date product list and product ordering information, please visit our Website sigma-aldrich.com/cosmetics

Reference

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
<th>Composition</th>
<th>Concentration</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>32124</td>
<td>Paraben Internal Standard Mix Solution</td>
<td>Methyl 4-hydroxybenzoate-ring-^{13}C_6, Ethyl 4-hydroxybenzoate-ring-^{13}C_6, Propyl 4-hydroxybenzoate-ring-^{13}C_6, Butyl 4-hydroxybenzoate-ring-^{13}C_6</td>
<td>10 μg/mL in acetone</td>
<td>5 mL</td>
</tr>
<tr>
<td>32125</td>
<td>Paraben Internal Standard Mix Solution</td>
<td>Methyl 4-hydroxybenzoate-ring-^{13}C_6, Ethyl 4-hydroxybenzoate-ring-^{13}C_6, Propyl 4-hydroxybenzoate-ring-^{13}C_6, Butyl 4-hydroxybenzoate-ring-^{13}C_6</td>
<td>50 μg/mL in acetone</td>
<td>1 mL</td>
</tr>
<tr>
<td>32126</td>
<td>Paraben Target Analyte Mix Solution</td>
<td>Methylparaben, Ethylparaben, n-Propylparaben, iso-Propylparaben, n-Butylparaben, iso-Butylparaben, Benzylparaben</td>
<td>10 μg/mL in acetone</td>
<td>5 mL</td>
</tr>
<tr>
<td>32127</td>
<td>Paraben Target Analyte Mix Solution</td>
<td>Methylparaben, Ethylparaben, n-Propylparaben, iso-Propylparaben, n-Butylparaben, iso-Butylparaben, Benzylparaben</td>
<td>50 μg/mL in acetone</td>
<td>1 mL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
<th>Concentration</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>50138</td>
<td>4-Methoxybenzyl alcohol</td>
<td>100 mg</td>
<td></td>
</tr>
<tr>
<td>16760</td>
<td>Allyl phenoxyacetate</td>
<td>1 mL</td>
<td></td>
</tr>
<tr>
<td>69139</td>
<td>Benzyl cinnamate</td>
<td>100 mg</td>
<td></td>
</tr>
<tr>
<td>44542</td>
<td>γ-Nonalactone</td>
<td>1 mL</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 NEW Preservative Standards and Fragrance Reference Materials for Cosmetics
In the food industry, flavorings and fragrances are extensively used either to add taste and/or scent to food lacking aroma, to cover a bad smell, or to maintain the stability of the original flavor of the food. Also used in the cosmetic industry, these compounds are applied to neutralize unpleasant odors that may be in the chemicals or to enhance the individuality and appeal of products.

The analysis of flavorings and fragrances is crucial for product development as well as for quality control in the food and cosmetic industry. However, taste and odor do not usually originate from single compounds, but rather from complex blends of aroma compounds. This makes the analysis of flavorings and fragrances a challenging task and requires a suitable analytical method as well as reliable analytical reference materials for improved confidence in results and instrumentation. Therefore, in 2012, Sigma-Aldrich launched a NEW Flavor and Fragrance standards portfolio with more than 300 analytical neat and standard solutions for precise quality control. The latest product additions (Table 1) are mostly analytical reference materials, which are certified by quantitative nuclear magnetic resonance (qNMR). The qNMR value is measured under ISO/IEC 17025 accreditation and the result is traceable to NIST standard reference materials. These standards allow us to fulfill the needs of many accredited laboratories.

In fact, some flavor and fragrance substances show allergenic effects and are therefore banned in many countries [1]. To assure that both the raw and final products are free of harmful substances, our assortment also includes allergenic compounds for precise quality control.

Please find an up-to-date product list of all Flavor & Fragrance Standards by their occurrence in food and beverages, by substance classification, and in alphabetical order at sigma-aldrich.com/flavor

Each product has been carefully formulated to meet the needs of analysts in the food and beverage and the cosmetic industries.

---

Table 1 NEW Flavor & Fragrance Analytical Reference Materials and Standards

Reference
Micropolllutants, such as pharmaceutical and hormone-active substances and their metabolites, constantly contaminate worldwide municipal wastewater. They usually enter the wastewater after being excreted in urine. In most case, wastewater from hospitals shows an especially high level of pharmaceuticals, most likely resulting from improper disposal in the toilet. A fraction of these substances gets eliminated through techniques such as sorption or biological degradation. Others remain and can later be detected in surface water in relevant concentrations – if an analytical reference material is available. The detection is challenging but highly important, as these pollutants can harm the health of animals and plants when entering drinking water sources (lakes, rivers, groundwater . . .) [1].

For greater protection of the environment, we are pleased to offer analytical standards and reference materials for convenient detection of active pharmaceutical ingredients (APIs) and their metabolites. Our analytical reference materials are certified by quantitative nuclear magnetic resonance (qNMR), and the measured value is traceable to NIST standard reference materials (ISO/IEC 17025). Our newest products can be found in Table 1.

For more information and an up-to-date product list of all APIs and their metabolites, please visit us at sigma-aldrich.com/pharmametabolites. There you will find all analytical standards and reference materials sorted by their parent substance and corresponding metabolites.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Description</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>43827</td>
<td>Fluka</td>
<td>4-Aminoantipyrine</td>
<td>100 mg</td>
</tr>
<tr>
<td>90567</td>
<td>Fluka</td>
<td>Antipyrine</td>
<td>100 mg</td>
</tr>
<tr>
<td>74827</td>
<td>Fluka</td>
<td>Atenolol</td>
<td>100 mg</td>
</tr>
<tr>
<td>40922</td>
<td>Fluka</td>
<td>Levofloxacin</td>
<td>100 mg</td>
</tr>
<tr>
<td>72516</td>
<td>Fluka</td>
<td>Bezafibrate</td>
<td>500 mg</td>
</tr>
<tr>
<td>41326</td>
<td>Fluka</td>
<td>Clofibrate</td>
<td>100 mg</td>
</tr>
<tr>
<td>90323</td>
<td>Fluka</td>
<td>Clofibric acid</td>
<td>100 mg</td>
</tr>
<tr>
<td>50632</td>
<td>Fluka</td>
<td>2-Dimethylaminooctanol</td>
<td>1 mL</td>
</tr>
<tr>
<td>53358</td>
<td>Fluka</td>
<td>Ifosfamide</td>
<td>100 mg</td>
</tr>
<tr>
<td>94876</td>
<td>Fluka</td>
<td>Sulbactam</td>
<td>10 mg</td>
</tr>
</tbody>
</table>

Table 1 | **NEW** Analytical Reference Materials for APIs and Metabolites

Reference

In the manufacturing and oil industries, the determination of trace metal contamination in oils such as fuel oil, crude oil, gas oil, or lubricating oil plays an important role. These impurities can originate at the oil field or be introduced by wear of machine components by friction and/or corrosion. Depending on the type of product, certain concentrations of these metal contaminants can adversely affect the quality and performance of the oil products. Atomic spectrometry methods based on atomic absorption (e.g. AAS) or atomic emission (e.g. ICP-OES/AES) are often used to measure trace-metal content in oils, with ICP-OES offering the possibility of measuring many elements at once, as well as the ability to perform the analysis from a sample diluted in an organic solvent, without the need for sample digestion.

The new TraceSELECT grade ICP solvent (54362) is an ideal replacement for kerosene and xylenes, which are usually used to dilute the oil sample before analysis with ICP-OES. It offers very low odor, low toxicity, and over forty individual metal traces are listed on the certificate. In addition, TraceSELECT DMF and 1-Propanol have also been used to successfully determine metal traces in oils directly from the organic solvent matrix.

### Product Table

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Description</th>
<th>Grade/Specification</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>54362</td>
<td>Fluka</td>
<td>ICP solvent TraceSELECT, ≥99.99995%</td>
<td>1 L</td>
<td></td>
</tr>
<tr>
<td>72781</td>
<td>Fluka</td>
<td>N,N-Dimethylformamide TraceSELECT, ≥99.99995%</td>
<td>1 L</td>
<td></td>
</tr>
<tr>
<td>09158</td>
<td>Fluka</td>
<td>1-Propanol TraceSELECT, ≥99.8%</td>
<td>500 mL</td>
<td></td>
</tr>
</tbody>
</table>

Proficiency Testing from Sigma-Aldrich®

Sigma-Aldrich RTC is an ACLASS accredited PT provider (certificate# AP-1469) providing Proficiency Tests according to the relevant sections of ISO 17043.

RTC also has a registered ISO9001:2008 quality system. It has been producing environmental laboratory proficiency testing programs for more than 20 years and regularly sends out more than 20,000 PT samples a year to over 2,500 participants throughout the world.

Request your copy of the RTC Environmental Proficiency Testing Brochure today

sigma-aldrich.com/ptbrochure
The FluoroSELECT Assay system is a presumptive screen intended for the rapid detection of *E. coli* and Gram-negative bacteria from a surface swab sample using the FluoroSELECT handheld fluorometer and the fluorescent assay. It can also be used as a confirmation test after using a classical or modern method. *E. coli* is commonly found in the lower intestine of warm-blooded organisms and is therefore an indicator of fecal contamination. Most strains are harmless, but some serotypes can cause serious food poisoning in humans, and are occasionally responsible for product recalls due to food contamination. Gram-negative bacteria are bacteria that are defined by their inability to retain crystal violet dye in the Gram staining protocol. This test was and still is vital for the differentiation and the classification of bacteria. Compared with Gram-positive bacteria, Gram-negative bacteria are more resistant to antibiotics because of their impenetrable cell wall.

FluoroSELECT utilizes specific fluorogenic substrates which are cleaved from characteristic enzymes of *E. coli* or Gram-negative bacteria. During the typical peptide hydrolysis, the specific enzymes hydrolyze the fluorogenic substrates and produce a fluorescence which is read by a portable, low-cost fluorometer. The excitation wavelength is at 360 nm (UV), while the emission wavelength is at 460 nm (blue light), the intensity of which is then measured to decide if the sample is positive or negative. It is a rapid test, since the assay takes only 30 minutes, although it may require some incubation time. Because the enzymes are specific, the assay is highly specific and robust. In addition, since it is a typical fluorescence assay, it is also highly sensitive and even small amounts of the cleaved fluorogen will be detected. The detection performance for both tests is immediate detection of 100,000 cfu (colony forming units), while 100 cfu are detected in 8 hours, and 1 cfu is detected within 10 hours of incubation time.

**Simplified testing procedures:**

1. A cotton swab is used to wipe a particular surface of the detection area. The swab is then inserted into 0.5 mL of distilled water for an immediate test, or into 0.5 mL of incubation solution for an incubation period ranging from 3 to 10 hours at 38.5 °C, before measuring. Add an enzyme inducer after inserting the swab into the water or incubation solution.

2. Then add a lysing agent to the solution and let incubate for 5 minutes.
3. Next, a substrate is added to the solution and allowed to stand for 5 minutes.

4. Afterwards, the solution is transferred into a glass test tube and then inserted into the Fluorometer. The first measurement is taken immediately, and after 20 minutes, another measurement is taken. The findings can then be used to determine a positive or negative result.

Table 1: Product list of microbiology FluoroSELECT kits and equipment

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>53649</td>
<td>Fluka</td>
<td>FluoroSELECT E.coli Assay Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>91333</td>
<td>Fluka</td>
<td>FluoroSELECT Gram-Negative Assay Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>Z805726</td>
<td>Fluka</td>
<td>FluoroSELECT single channel fluorometer (λex 360 nm; λem 460 nm)</td>
<td>1 EA</td>
</tr>
<tr>
<td>Z805823</td>
<td>Fluka</td>
<td>Glass vials for FluoroSELECT fluorometer (O.D. x L 6 mm x 25 mm, volume nominal capacity 200 μL)</td>
<td>100 EA</td>
</tr>
</tbody>
</table>

Table 2: Non microbiology FluoroSELECT assays

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>53659</td>
<td>Fluka</td>
<td>FluoroSELECT Ammonia Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>89872</td>
<td>Fluka</td>
<td>FluoroSELECT Formaldehyde Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>00254</td>
<td>Fluka</td>
<td>FluoroSELECT Glycerol Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>76691</td>
<td>Fluka</td>
<td>FluoroSELECT Ascorbic acid Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>76786</td>
<td>Fluka</td>
<td>FluoroSELECT Acetate Assay Kit</td>
<td>50 Tests</td>
</tr>
<tr>
<td>91218</td>
<td>Fluka</td>
<td>FluoroSELECT Lactose Detection Assay</td>
<td>50 Tests</td>
</tr>
</tbody>
</table>

There are more enzymatic tests available for quantitative detection of acetate, ammonia, ascorbic acid, formaldehyde, glycerol, and lactose with the FluoroSELECT system. See more under sigma-aldrich.com/fluoroselect or in Table 2.
Halogenated High Performance MALDI-MS Matrices
Rationally designed matrix derivatives allow for increased sensitivities and new areas of application

MALDI Mass Spectrometry (MALDI-MS)
Matrix-assisted laser desorption/ionization (MALDI) is a “soft” ionization technique for sensitive detection of a multitude of analyte classes including large, non-volatile and thermally labile biomolecules. It was developed in the 1980s by Profs. Hillenkamp and Karas at the University of Münster in Germany and soon developed to an indispensable tool in analytical chemistry. A key feature of the technique is the cocrystallization of the analytes with an excess of small organic molecules called “matrix”. Key application areas of MALDI-MS are proteome analysis, functional genomics, peptide, lipid, metabolite or carbohydrate detection, imaging, nucleic acid analysis and quality control.

Importance of the Matrix
Numerous prerequisites have to be fulfilled for a successful MALDI-MS analysis. The matrix has to enable, among others, codesorption and ionization of the matrix and analyte molecules. These processes require energy which is applied as laser radiation and necessitate a sufficient absorption of the matrix at the irradiation wavelength.

One major drawback is that only a fraction of the analyte is ionized and, therefore, detectable. Although typically used matrices such as α-cyano-4-hydroxycinnamic acid (CHCA) already allow for sensitive measurements, they have severe limitations in challenging cases with low analyte amounts, peptides with scarce post-translational modifications, weakly basic or small peptides or other hard-to-protonate analyte classes.

Optimization of Matrix Structures
It was long assumed and has now been demonstrated that proton transfer reactions from protonated matrices to counteranions of positively precharged analytes as well as to neutral analytes are the dominant reactions leading to analyte protonation. To increase the efficiency of these processes, the strength with which the positively charged proton is bound to the matrix must be lowered. This can be achieved by insertion of electron-withdrawing substituents into the matrix structure, which decrease the electron density, see Figure 1. Halogens are exceptionally well-suited for this purpose. As a result, the proton affinity as a measure of the bond strength between proton and matrix decreases from 866 kJ/mol for the standard matrix CHCA to 842 kJ/mol for 4-chloro-α-cyanocinnamic acid (CICCA) to 837 kJ/mol for α-cyano-2,4-difluorocinnamic acid (DiFCCA) [3]. This reduction is accompanied by increasing reactivities, especially at irradiation wavelengths of 337 nm. Simultaneously, the absorption profiles of the matrices are shifted to shorter wavelengths, which limit the number of possible matrix halogens in cases where standard laser systems with fixed wavelengths are used. Consequently, higher halogenated matrix derivatives require the use of matrix mixtures including an absorber.

Typical Applications
The higher reactivities of the halogenated MALDI matrices open a multitude of possible applications. Possible approaches include more sensitive protein identification using peptide mass fingerprinting (PMF). Regardless of whether the protein is small or large, or of acidic, neutral or basic nature, the use of halogenated matrices such as CICCA allow for detection of a higher number of and more intense peptides resulting in substantially higher sequence coverages. This advantage is independent of the cut-specificity of the chosen protease or the digested protein amount, see Figure 2. A comparison between standard CHCA and the halogenated CICCA matrix for the example of 50 fmol of a tryptic α/β-casein digest is given in Figure 3. The higher sensitivity of CICCA not only results in detection of more peptides and an increase of the highest absolute analyte intensity from 160 to about 4400 counts, but also in a higher number of phosphopeptides with a tenfold increase in signal-to-noise ratio, on average [2]. In addition, halogenated matrices...

Figure 1 Molecular electrostatic potential of neutral CHCA, CICCA, and DiFCCA matrices. Areas with low electron densities are illustrated in red, regions with high density in blue. The matrix structures were energetically optimized by density functional theory (DFT), B3LYP/6-311++G(3df,3pd).

Thorsten W. Jaskolla received his Ph.D. from the University of Frankfurt in 2011. After a research stay at the German Cancer Research Center in Heidelberg, he moved to the University of Münster where he works on gas phase ionization and fragmentation processes. Dr. Jaskolla is the author of numerous publications and a book contribution, and has been the recipient of several grants and awards. Together with Prof. Karas, he is the inventor of two MALDI-matrix patents.
with higher sensitivities enable lower amounts of “one hit wonders” of analytes which are at the border of detection using conventional matrices [4]. Lowering the detection limit allows for analysis of otherwise undetectable acidic and low-abundance peptides with rare post-translational modifications or peptides that are generated by uncommon protease cut-specificities [5].

MALDI analyses in the negative-ion mode are usually less common due to typically lower sensitivities. Depending on the nature of the analyte, halogenated matrices also allow for more sensitive analyte anion detection, see Figure 4. In addition to CICCA:DiFCCA -mixtures, 4-bromo-α-cyanocinnamic acid (BrCCA) and its mixtures with CICCA or DiFCCA are also well suited for negative-ion mode analysis.

The higher reactivities of halogenated matrix derivatives also enable sensitive detection of other substance classes such as phospholipids, e.g., sphingomyelins or phosphatidylcholines [7]. Halogenated phospholipids as products of inflammatory processes and intermediates of lipid peroxidation are of low basicity and exclusively detectable by halogenated matrices such as CICCA in MALDI-MS, see Figure 5.

The lower internal analyte energy using CICCA and other halogenated derivatives better preserves fragile sidechain modifications in the MS mode than „hotter” matrices such as CHCA [8]. Nevertheless, resulting from the higher analyte ion intensities, fragmentation can yield a wealth of information under CID-MS/MS conditions using these derivatives.
<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Synonym</th>
<th>Compound</th>
<th>Typical Application</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>77081</td>
<td>Fluka</td>
<td>FCCA</td>
<td>α-Cyano-4-fluorocinnamic acid</td>
<td>peptides, phosphopeptides, phospholipids, chlorinated lipids, drugs, fragile analytes, ionic liquids (quantification), ME-SIMS, CID-MS/MS</td>
<td>100 mg</td>
</tr>
<tr>
<td>94141</td>
<td>Fluka</td>
<td>CICCA</td>
<td>α-Cyano-4-chlorocinnamic acid</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>89063</td>
<td>Fluka</td>
<td>BrCCA</td>
<td>4-Bromo-α-cyanoacetic acid</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>77646</td>
<td>Fluka</td>
<td>DiFCCA</td>
<td>α-Cyano-2,4-difluorocinnamic acid</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>38419</td>
<td>Fluka</td>
<td>PentAFCCA</td>
<td>α-Cyano-2,3,4,5,6-pentafluorocinnamic acid</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>39379</td>
<td>Fluka</td>
<td>CICCA:DiFCCA</td>
<td>4-Chloro-α-cyanoacetic acid – α-Cyano-2,4-difluorocinnamic acid mixture</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>03841</td>
<td>Fluka</td>
<td>CHCA:DiFCCA</td>
<td>α-Cyano-4-hydroxycinnamic acid – α-Cyano-2,4-difluorocinnamic acid – PentAFCCA</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>55841</td>
<td>Fluka</td>
<td>BrCCA:CICCA</td>
<td>4-Bromo-α-cyanoacetic acid – α-Cyano-2,4-difluorocinnamic acid mixture</td>
<td></td>
<td>100 mg</td>
</tr>
<tr>
<td>68914</td>
<td>Fluka</td>
<td>BrCCA:CICCA</td>
<td>4-Bromo-α-cyanoacetic acid – 4-Chloro-α-cyanoacetic acid mixture</td>
<td></td>
<td>100 mg</td>
</tr>
</tbody>
</table>

This is especially helpful for de novo approaches or automatic database analyses of fragment ion spectra, see Figure 6.

Sigma-Aldrich is proud to be the only authorized distributor of halogenated MALDI matrix materials. The Product Table lists the newly available matrices and matrix mixtures.

For our complete product offering for MALDI-MS products, including standards, reagents, solvents and supplies, please visit sigma-aldrich.com/maldi

References
New Derivatization Agents for LC-MS
Detection and Quantitation of Formaldehyde or Benzaldehyde

In a previous publication we showed the reaction of DMABC (67954) and 17β-estradiol (E2), which is suitable for the sensitive quantitation by UHPLC/MS [1-3].

New Derivatization Agents for Aldehydes and Ketones

Aldehydes and ketones cannot be detected by ESI and are hardly detected by APCI/APPI sources. Benzaldehyde is a typical example of this. Two new derivatization agents, 4-(dimethylamino)benzohydrazide (DMABH, 92989) and 4-(diethylamino)benzohydrazide (DEABH, 06963) for LC-MS help to solve this problem by attaching 4-(dialkylamino)-benzohydrazide moieties to aldehydes and ketones.

The advantages of the derivatization become obvious when a sample is analyzed on a LC/UV/MS system. The analytes are separated from the reagent very well using a Supelco Ascentis Express C8 column. Both detectors UV and MS show a high and very high sensitivity and enable the detection of 200 ppb benzaldehyde with a good signal-to-noise ratio. Figure 1 shows the MS (BPC, EIC) und UV (330 nm) chromatograms after a derivatization reaction of ca. 1 mg DEABH in 100 µL aqueous benzaldehyde standard plus 100 µL acetonitrile. The UV spectrum shows a maximum absorption at 245 nm, which allows a higher wavelength selection and selective detection of the analyte.

References

Derivatization of Benzaldehyde
1. Ca. 1–2 mg DEABH are added to 100 µL of an aqueous benzaldehyde standard and 100 µL acetonitrile.
2. The solution is heated and shaken (1400 r.p.m.) for 5 min at 60 °C (Eppendorf Thermomixer).
3. 1 µL of the reaction solution is injected into the UHPLC/MS system.

LC-MS Method for Benzaldehyde
- Solvents: (A) water, (B) acetonitrile
- Column: Supelco Ascentis Express C8, 2.1×50 mm, 2.7 µm @ 35 °C
- Gradient: 0 min 95% (A), 6 min 5%, 9 min 5%
- Flow rate: 0.6 mL/min
- Injection volume: 1 µL
- MS: ESI source: 60 psi nebulizer, 7 L/min dry gas, 200 °C dry gas temp., 4000 V capillary, (Bruker micrOTOF-Q II)
New IC Eluent Concentrates for Metrohm® Applications
Application tested on Metrosep columns

Magdalena Ulman, Product Manager Analytical Reagents magdalena.ulman@sial.com

Ion chromatography is a largely independent technique which allows all separations of ionic species within HPLC. IC is especially the method of choice in anion analysis, thanks to the wide range of separating columns, as well as the elution systems and detectors. Other techniques for anion analysis, such as gravimetric and volumetric methods, are limited by their sensitivity and selectivity.

Cation analysis with IC has achieved a certain level of importance in the analysis of alkali and alkaline earth metals, as well as in the determination of ammonium-nitrogen.

Today one of the most important fields of application for anion chromatography is the analysis of drinking water. It can also be used for the analysis of the element species in anionic elements or complexes for solving environmentally relevant problems, as well as in the semiconductor industry [1].

Sigma-Aldrich® offers a comprehensive range of reagents, eluents and standards for separation and low-level quantification of cations and anions via ion chromatography. In an effort to expand the selection of our well-characterized solutions of common eluents for ion chromatography, a novel group of reagents has been introduced.

- Application tested using Metrosep columns
- Certified according to ISO Guide 31
- High purity solution components
- All details about the exact content, specifications, and expiry date are described in the certificate

References:

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand</th>
<th>Description</th>
<th>Application</th>
<th>Concentration</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>62414</td>
<td>Fluka</td>
<td>Sodium bicarbonate/ Sodium carbonate concentrate</td>
<td>Metrosep A Supp 5</td>
<td>Na₂CO₃, 64mM and NaHCO₃, 20 mM in water</td>
<td>1 L</td>
</tr>
<tr>
<td>61905</td>
<td>Fluka</td>
<td>Nitric acid/ Dipicolinic acid concentrate</td>
<td>Metrosep C4</td>
<td>HNO₃, 34 mM and dipicolinic acid 14 mM in water</td>
<td>1 L</td>
</tr>
<tr>
<td>72784</td>
<td>Fluka</td>
<td>Sodium carbonate concentrate</td>
<td>Metrosep A Supp 7</td>
<td>Na₂CO₃, 72 mM in water</td>
<td>1 L</td>
</tr>
<tr>
<td>75335</td>
<td>Fluka</td>
<td>Sodium bicarbonate/ Sodium carbonate concentrate</td>
<td>Metrosep A Supp 10</td>
<td>Na₂CO₃, 100 mM and NaHCO₃, 100 mM in water</td>
<td>1 L</td>
</tr>
<tr>
<td>38302</td>
<td>Fluka</td>
<td>Sodium carbonate/ Sodium hydroxide concentrate</td>
<td>Metrosep A Supp 16</td>
<td>Na₂CO₃, 150 mM and NaOH 15 mM in water</td>
<td>1 L</td>
</tr>
</tbody>
</table>

Product Table New Metrohm eluent concentrates (20x). Visit our Website to view our products at: sigma-aldrich.com/ic

Do You Use IC High Purity Certified Reference Standards?
In that case, our IC TraceCERT® standards might be what you are looking for!
- Produced in a double-accredited laboratory fulfilling ISO/IEC 17025 and ISO Guide 34
- The certified value of the reference material is directly traceable to the SI unit (kg) and also measured against an internationally recognized reference material (from NIST, BAM or other)
- Information about traceability and uncertainty are included in the certificate according to ISO Guide 31
- IC standards offered in HDPE bottles

Visit our Website to view our products at: sigma-aldrich.com/ic
Determination of Water Content in Aldehyde and Ketone Samples
HYDRANAL®-K Reagent Line for Karl Fischer Titration

Andrea Felgner, Market Segment Manager HYDRANAL andrea.felgner@sial.com
Thomas Wendt, HYDRANAL Technical Service thomas.wendt@sial.com

The HYDRANAL-K reagent product line is designed to meet the needs of the analytical chemist by providing accurate water content determination using Karl Fischer (KF) titration of aldehyde and ketone samples. HYDRANAL-Composite 5K, prevents side reactions that occur during KF titration of aldehydes or ketones. These side reactions can compromise the water content determination. HYDRANAL-Composite 5K is a special formulation consisting of imidazole, sulfur dioxide, and iodine dissolved in diethylene glycol monoethyl ether. Three Fluka®-branded working media for use with HYDRANAL-Composite 5K are supplied by Sigma-Aldrich:

1. HYDRANAL-KetoSolver (free of halogenated hydrocarbons)
2. HYDRANAL-Medium K
3. HYDRANAL-Working Medium K (very toxic / excellent dissolving properties)

Suppression of Side Reactions that lead to Erroneous Water Content Determinations

The HYDRANAL-K line of reagents does not contain the conventional methanol component. Methanol has been omitted in order to prevent nucleophilic addition with aldehydes and ketones which leads to the formation of water (Figure 1). Water produced by this side reaction would cause elevated water content results and vanishing end points. The HYDRANAL-K reagents are also designed to guard against bisulfite addition to aldehydes (Figure 2). This second side reaction consumes a portion of the original water content from the sample and results in erroneously low water content measurements. HYDRANAL-Composite 5K is a variant of HYDRANAL-Composite 5 with a slightly slower reaction speed to maximize suppression of the bisulfite addition side reaction.

HYDRANAL-K reagents are also suitable for some amines, siloxanes and other titrations requiring methanol-free working media. HYDRANAL-Medium K, HYDRANAL-Working Medium K, and HYDRANAL-KetoSolver can each act as the solvent for the determination of water in any substance where methanol can interfere with the titration and therefore must be avoided. The general utility of these reagents implicates a universal applicability for KF titration.

Distinctives of the HYDRANAL-K Working Media

All these Fluka-branded working media are free of methanol, but each possesses unique properties for optimization with particular samples. HYDRANAL-KetoSolver is primarily 1-methoxy-2-propanol and is entirely free of halogenated hydrocarbons. It is used with HYDRANAL-Composite 5K for the KF titration of aldehydes and highly reactive ketones such as cyclohexanone, trifluoroacetone, and diacetyl. For certain less reactive ketones, HYDRANAL-Composite 5 can be used as the titrating agent.

HYDRANAL-Working Medium K has exceptional solvating power but must be designated as toxic because it contains 2-chloroethanol. This hazardous component is omitted from HYDRANAL-Medium K and replaced with less toxic alcohols in order to lower the toxicity rating; HYDRANAL-Medium K contains a percentage of chloroform. Not only is the toxicity level lowered, but the revised formulation of HYDRANAL-Medium K provides performance advantages with very reactive aldehydes such as propionaldehyde, butyraldehyde and crotonaldehyde. Capacity and accuracy are also improved for other compounds such as salicylaldehyde, acetylacetone, 2,4-dihydroxyacetophenone, and 2-benzopyridine.

Figure 1: Aldehydes and ketones undergo nucleophilic addition of methanol resulting in formation of acetal or ketal and water

Figure 2: Bisulfite addition reaction consuming water
Replacement of HYDRANAL-Working Medium K with HYDRANAL-Medium K

Essentially, HYDRANAL-Medium K is a full-fledged substitute for HYDRANAL-Working Medium K, providing the same sample capacity, speed, and accuracy. In addition, HYDRANAL-Medium K offers important application, safety and transportation benefits. It not only improves workplace safety, but also reduces the amount of packaging material required for shipment and the associated handling and disposal of that packaging material.

The Sigma-Aldrich laboratories compared HYDRANAL-Working Medium K and HYDRANAL-Medium K and have reported these findings:

- Equal sample capacity in 30 mL medium
- Equal results for water content and standard deviation
- Equal titration speed
- Equal accuracy of recovery rate of added water after sample titration

Benefits of HYDRANAL-Medium K over HYDRANAL-Working Medium K

- Reduced toxicity for improved workplace safety while providing equal reactivity
- Performance advantages with very reactive aldehydes
- Improved capacity and accuracy
- Less waste of packaging material

Coulometric KF Titration in Ketones

For the coulometric water determination in ketones, Sigma-Aldrich offers specially designed HYDRANAL-Coulomat reagents: Coulomat AK and Coulomat CG-K.

HYDRANAL-Coulomat AK is an analytic reagent for the coulometric determination of water in ketones. It contains imidazole, sulfur dioxide, and iodide dissolved in a suitable solvent mixture and has a capacity of approximately 100 mg of water per 100 mL. HYDRANAL-Coulomat AK can also be used as a single reagent for coulometry without diaphragm. HYDRANAL-Coulomat CG-K is the corresponding catholytic reagent. It does not contain halogenated hydrocarbons. The water capacity of 5 mL HYDRANAL-Coulomat CG-K is 100 mg.

Application Example: Determination of Water in Acetone

The water content in acetone can be determined using both volumetric and coulometric KF titration techniques:

- **Volumetric titration**
  Add 30 mL HYDRANAL-Medium K to the titration vessel and titrate to dryness with HYDRANAL-Composite 5 K. Add approximately 5 mL of the acetone sample, weighed by difference, to the vessel. Titrate the water content with HYDRANAL-Composite 5 K.

- **Coulometric titration**
  Add 100 mL HYDRANAL-Coulomat AK to the anolyte compartment of the titration vessel and 5 mL HYDRANAL-Coulomat CG-K to the catholyte compartment. After starting the titrator, the cell is dried automatically. When the drift is stable, add approximately 0.5 g of the sample, weighed by difference, to the cell.

**Table 1** Selected HYDRANAL products (complete list can be found on Sigma-Aldrich website)

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Brand Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34816</td>
<td>Fluka HYDRANAL-Composite 5K</td>
</tr>
<tr>
<td>34805</td>
<td>Fluka HYDRANAL-Composite 5</td>
</tr>
<tr>
<td>34738</td>
<td>Fluka HYDRANAL-KetoSolver</td>
</tr>
<tr>
<td>34698</td>
<td>Fluka HYDRANAL-Medium K</td>
</tr>
<tr>
<td>34817</td>
<td>Fluka HYDRANAL-Working Medium K</td>
</tr>
<tr>
<td>34820</td>
<td>Fluka HYDRANAL-Coulomat AK</td>
</tr>
<tr>
<td>34821</td>
<td>Fluka HYDRANAL-Coulomat CG-K</td>
</tr>
</tbody>
</table>

To obtain application reports and more information on HYDRANAL-K reagents as well as on our other high-quality HYDRANAL reagents for pyridine-free water determination by KF titration, please visit our Website [sigma-aldrich.com/hydranal](http://sigma-aldrich.com/hydranal) or contact our HYDRANAL laboratories:

**Europe and Global Market**
Mr. Thomas Wendt  
Technical Service HYDRANAL  
Wunstorfer Straße 40  
D-30926 Seelze, Germany  
Tel.: +49 (0) 5137 8238-353  
Fax: +49 (0) 5137 8238-698  
E-mail: hydranal@sial.com

**USA and Canada**
Mr. Doug Clark  
HYDRANAL Technical Center  
545 S. Ewing Ave  
St. Louis MO 63103, USA  
Toll free: +1 800 493-7262 (USA and Canada)  
Fax: +1 314 286-6699  
E-mail: hydranal@sial.com