The Metrologist

Edition 2 Jan - April 2016

Reagecon

www.reagecon.com

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Dear Customers, Readers and Business Partners

Welcome to the second edition of Reagecon's Metrologist Publication. Since our first publication we have held a Large International Distributor Conference at our Headquarters in Shannon, Ireland. This was an intensive two day program where our International Distributors received in depth product training.

This training was devised with you the enduser in mind and each session consisted of the following;

- Theory behind the technique the products are used for
- The use of our products in process
- Applications with actual demonstration of the product
- Features and Benefits of the Reagecon product range
- Scope of offering
- Benchmarking against main market competitors

We hope that as a result of this seminar your Distributor will be in a better position to understand and service your requirement for Standards and Reagents.

We hope that you find "The Metrologist" of value, that it will provide a conduit between Reagecon and end users through our channel partners and facilitate a valuable two-way flow of information.

Enjoy this second edition of "The Metrologist".

Regards,
John J Barron
Managing Director

Your Distributors at Reagecon

Some pictures from Reagecon's International Distributor Seminar
Held in Shannon Ireland on October 1st and 2nd 2015.

Product Ranges Produced at Reagecon

- Total Organic Carbon (TOC)
- Total Inorganic Carbon (TIC)
- Volatile Organic Carbon (VOC)
- Semi Volatile Organic Carbon (SVOC)
- Polycyclic Aromatic Hydrocarbons
- Phenolics
- Phthalates
- Azo Dyes
- Paraffins, Olefins, Naphthalates, Isoparaffins, Aromatics (PIANO's)
- Oxygenates
- Thiols
- Pesticides
- Fatty Acid Methyl Esters (FAME's)
- Fatty Acid Ethyl Esters (FAEE's)
- Refractive Index (RI)
- Brix
- Sucrose in water
- Density
- Viscosity
- Melting Point
- ICP-MS/ICP-OES
- Atomic Absorption
- Titrants/Indicators
- Total Acid Number (TAN)
- Total Base Number (TBN)
- Hydrocarbons
- Solvent Residues
- Ion Chromatography
- Cryoscope

- Osmolality
- Colour
  - Saybolt
  - Hazen
  - ASTM
  - Gardner
- Turbidity
- Spectrophotometry
  - Wavelength
  - Linearity
  - Stray light
  - Band width
- pH
- Conductivity
- Ion Selective Electrode
- Ionic Strength Adjusters
- Flame Photometry
- Ion Chromatography
- Redox
- Pharmacopoeia
  - European
  - Chinese
  - United States
  - Japanese
  - Indian
- Eluents/Mobile Phases
- Dissolution Solutions
- pH Electrode Care & Maintenance
- Reagents for DNA Synthesis and Sequencing

All these products can be viewed in detail at www.reagecon.com

Techniques & Instruments Employed

Reagecon has an extensive range of scientific instrumentation. We have at least one and in some cases several of the instruments listed.

- Gas Chromatography (GC)
  - Flame Ionisation Detection (GC-FID)
  - Mass Spectroscopy (GC-MS)
- Liquid Chromatography
  - Mass Spectroscopy (HPLC-MS)
  - Ultra Violet Detection
  - Preparative
  - Reverse Phase
- Ion Chromatography (IC)
- Flame Atomic Absorption Spectroscopy (FAAS)
- Induced Coupling Plasma-Mass Spectroscopy (ICP-MS)
- Bingham Pycnometry
- Vibrational Densitometer
- Refractometer
- Polarimeter
- Osmometer
- Total Organic Carbon Analysers
  - Membrane Exclusion
  - Carbon Oxidisation
- Rotational Viscometer
- Ubbelodhe Master Viscometer
- Cryoscope
- Coulometer
- Auto Titrator
- Spectrophotometer
- Fourier Transform Infrared Spectroscope (FTIR)
- Colourimeter
  - Hunter Solid/Liquid
  - Tintometer
- Volumetric Karl Fisher
- Turbidimeter
- Conductometer
- pH Meter
- Differential Scanning Calorimeter
- Chemical Oxygen Demand (COD)
- Biological Oxygen Demand Assay Unit
- Ex-rated Solvent Facility
- Radley Combinatorial Chemistry Synthesiser
- Buchi Rotary Evaporator
- Melting Point Apparatus
- TBN/TAN Titrator
- Class ISO7 (Class 10,000) Cleanroom
- Solvent Manufacturing Plant

Accreditations

Accreditation ISO 9001:2008

- Registration number 19.2769
- Accreditation held since May 1988
- Certificate of Registration of Quality Management System covering the manufacture and distribution of chemicals, reagents, consumables, apparatus, safety and scientific equipment. The provision of IQ/OQ, equipment maintenance and calibration services.
  The provision of Vendor Managed Inventory (VMI) services to allow customers to outsource the management and replenishment of their consumables and equipment.

Accreditations ISO 17025:2005

- ISO 17025:2005 (264T Testing accreditation)
- Accredited since May 1988 for some products
- pH Buffers
- Conductivity
- Titration
- Brix 0% - 60%
- Refractive Index 1.3331 – 1.6581
- Density 0.65 – 1.03 g/l
- ICP-OES, ICP-MS
- Colour and Spectrophotometry
- Melting point
- Viscosity
- Density 1.03 g/l – 3.1 g/l
- IC standards


Irish National Accreditation Board

Accreditation Certificate

Reagecon Diagnostics Ltd.

Testing Laboratory


NSAI

Certificate of Registration
of Quality Management System
to I.S. EN ISO 9001:2008

Reagecon Diagnostics Ltd
Shannon Free Zone
Shannon
Co. Clare

Physical Accreditations to ISO 17025:2005

- Density
- Viscosity
- Mass
- Temperature
- Volume


Irish National Accreditation Board

Accreditation Certificate

Reagecon Diagnostics Ltd.

Reference Material Producer

Accreditations ISO 17025:2005

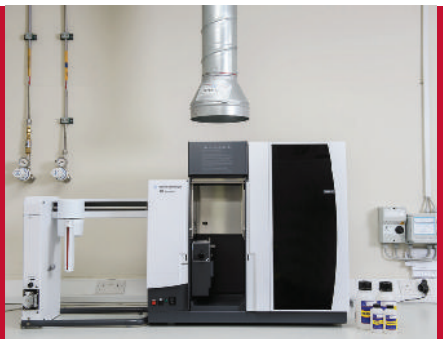
- ISO 17025:2005 (265C Calibration accreditation)
- Accredited since July 2010
- Balance, Volumetric and Temperature Calibration Laboratory

Accreditations ISO Guide 34

- ISO Guide 34 (001RM)
- Accredited since April 2014
- Accredited Producer of Reference Materials
- Only company in Ireland with this accreditation
- Production of materials used for the calibration of scientific instruments and the validation of test methods
- ISO Guide 34 accreditations demands a set of stringent requirements that ensures all aspects of the production of reference materials are carried out with measureable and traceable quality
- The Guide's comprehensive requirements includes production planning, raw material selection and characterization, assignment of certified values, uncertainty, traceability, homogeneity and stability, as well as packaging, documentation, supply chain and logistics.

CASE STUDY:

Integrated System Technology Company in the United Kingdom



The Chief Chemist within this company with responsibility for a Chemical and Metallurgical Laboratory, has been working with Reagecon for six years. The laboratory provides critical support to the Manufacturing Division through the chemical analysis of the composition of plating solutions for process control purposes, as well as the analytical testing of process and waste waters/trade effluent.

X-Ray Fluorescence and Atomic Absorption techniques are used to analyse the various metals in use in the plating process solutions and waste water applications. These metal solution standards include compositions at grams per litre to replicate plating solutions and trace content levels at parts per million to replicate waste water/trade effluent applications.

The laboratory identified the requirement for bespoke standards to calibrate X Ray Fluorescence and Atomic Absorption instruments. Reagecon embarked on a partnership programme to work with this company to mutually develop these standards to the required specifications. Reagecon's manufacturing techniques and quality systems provide a much higher level of accuracy than those that this company could have practically manufactured themselves.

Commenting on the relationship with Reagecon, this customer said: "Reagecon have provided an outstanding service to ourselves throughout the course of our relationship. Their Custom Made Solutions are critical to instrumentalise everything we do. The personnel from the account managers to the technical services chemists have provided a personable service that you don't often find in industry today. We have used Reagecon's Standards for 6 years including: Atomic Absorption, pH Buffers (NIST Traceable), ICP (Inorganic Spectroscopy Standards), plus a range of custom-blend liquid ICP/XRF.'

Reagecon's standards gives them the confidence they need in delivering the required results. The traceability of the products ensures accuracy, flexibility of manufacture for the required custom blends, and competitive pricing.

Standards for Anion & Cation Analysis & ICP-MS

Reagecon manufactures an extensive range of standards for metal analysis a summary of which is below;

Ion Chromatography Standards

- Cation Standards - 19 single elements
- Multi elements - 13 off the shelf
- Anion Standards - 15 single elements
- Also tested on ICP - MS as another quality check, where possible.

Flame Photometry Standards

- Single and Multi-Element solutions available.
- Industrial Standards, Clinical Standards and Multi-Element Linearity Standards
- Wide range of values and elements.
- A very high accuracy supported by a certificate of analysis.
- Products are non-hazardous and non - toxic.

Atomic Absorption Standards

Reagecon manufacture an extensive range of aqueous AA Standards. These include standards for the measurement of the most common alkali and transition metals.

Reagecon ICP-MS / ICP-OES Standards

Single Elements

- 70 single element standards
- 33 HNO3 only
- 14 HNO3 or HCl
- 9 have HF singly or with HNO3
- 7 HCl only
- 3 H2O only
- Small no Ammonium Hydroxide (2) or H2SO4 (1)

Controlled Environment

- Reagecon's standards are manufactured in a highly controlled Class 10,000 cleanroom environment using:
- High Purity starting materials
- Ultra-Pure water
- High Purity matrix materials
- Pre-leached and pre-cleaned bottles

Need a custom mix - please contact your distributor with details.

Multi Elements

- 160+ mixes catalogued
- 33 elements -> 2 elements
- Customised options
- Other Concentrations

In accordance to Test Methods

- US EPA Method 200.8
- US EPA Method 200.7
- US EPA Method 6020
- US EPA Method 6010
- CLP Method 05.2

Consignment Tracking

One of the major concerns of most of our distributors is the shipment and delivery of the goods ordered.

- How long does it take for the delivery to arrive?
- What if the merchandise becomes damaged while in transit?
- What are the guarantees that the courier will handle the goods with great care?
- Is it possible to keep track of the package from one stop to another?

We have been working with our Partners Titan Logistics to introduce shipment tracking and both our distributors and yourselves stand to gain many benefits. This will be fully integrated with our Sap system.

The ability to track a package, parcel or consignment gives both the distributor and enduser peace of mind. Distributors will know exactly where their orders are, from the time of dispatch to delivery or pick-up schedule, allowing them to make provisions for the receipt of the goods. Distributors will have access to this information, helping them answer queries with precision rather than speculation.

With a fully integrated shipment tracking system, all pertinent details related to a particular package can be checked out by simply typing in the tracking number. A more robust and fully integrated system enables strategic delivery planning, mobile and wireless management, delivery and route load planning, and dispatch coordination, all of which result in a professional and excellent logistics and transportation system.

Analyst Qualification Sets

Summary of Features & Benefits:

Commercial Benefits

- Proof of competence for individual analysts
- Extensive range of test materials available
- More cost effective than Laboratory based Proficiency Schemes
- Enhanced audit compliance
- Ready to Use

Technical Benefits

- Uncertainty of measurement clearly defined
- NIST Traceable where applicable
- Consistency of product - Independent, Traceable, Certified
- Certificates of Analysis and Safety Data Sheets available online

Traditionally laboratories have used Proficiency Schemes to provide evidence of their competence. Now with tightening audit requirements auditors from compliance and accreditation bodies are increasingly asking for evidence that each analyst in a laboratory is competent to carry out individual analytical tests. Proficiency Schemes are not a cost effective way of meeting this requirement and method witnessing or working with known samples are of limited value.

Reagecon now provides a new approach to proving analyst competency for a range of common laboratory tests. We will provide a set of unknown samples (detailed below) with password protected, online access to our ISO 17025 accredited test results of the samples. This allows Laboratory Managers to provide their analysts with "blind" samples and to cost effectively assess the competency of each individual analyst on a specific test. The assurance provided by the use of blind samples and independent ISO 17025 accredited testing in turn allows the Laboratory Manager to meet all external auditors' "proof of competency" requirements.

The unknown samples in the Reagecon range are prepared gravimetrically on a weight/weight basis from high purity raw materials. Both solute and solvent are weighed on a balance calibrated by Reagecon engineers using OIML traceable weights. Reagecon holds ISO 17025 accreditation for calibration of laboratory balances (INAB ref: 265C). The resulting Balance Certificate of Calibration is issued in accordance with the requirements of ISO/IEC 17025.

Test Materials (choose any six to make a set)

Product No.	Description	Concentration	Pack size
AQSPH001	Low Range pH @ 20°C	pH range 1 to 5	250ml
AQSPH002	Medium Range pH @ 20°C	pH range 5.1 to 8	250ml
AQSPH003	High Range pH @ 20°C	pH range 8.1 to 11	250ml
AQSPH004	Low Range pH @ 25°C	pH range 1 to 5	250ml
AQSPH005	Medium Range pH @ 25°C	pH range 5.1 to 8	250ml
AQSPH006	High Range pH @ 25°C	pH range 8.1 to 11	250ml
AQSCL001	Chloride Content Low	Chloride Range 0.01M to 0.49M	250ml
AQSCL002	Chloride Content Medium	Chloride Range 0.5M to 1.9M	250ml
AQSCL003	Chloride Content High	Chloride Range 2.0M to 4.0M	250ml
AQSA001	Acid Content Low	Acid Range 0.025M to 0.5M	250ml
AQSA002	Acid Content Medium	Acid Range 1.0M to 2.9M	250ml
AQSA003	Acid Content High	Acid Range 3.0M to 10M	250ml
AQSB001	Base Content Low	Base Range 0.05M to 0.99M	250ml
AQSB001	Base Content Medium	Base Range 1.0M to 3.0M	250ml
AQSB001	Base Content High	Base Range 3.1M to 10M	250ml
AQSCON001	Conductivity Ultra Low	Conductivity Range 1.3µS/cm to 50µS/cm	250ml
AQSCON002	Conductivity Low	Conductivity Range 80µS/cm to 1,000µS/cm	250ml
AQSCON003	Conductivity Medium	Conductivity Range 1,100µS/cm to 10,000µS/cm	250ml
AQSCON004	Conductivity High	Conductivity Range 100,000µS/cm to 500,000µS/cm	250ml
AQSDEN001	Density @ 20˚C Low	Density Range 0.7g/ml to 0.95g/ml	250ml
AQSDEN002	Density @ 20˚C High	Density Range 1.1g/ml to 2.8g/ml	250ml
AQSBRIX001	Brix Low	Sucrose (Brix) Range 5% to 19%	15ml
AQSBRIX002	Brix Medium	Sucrose (Brix) Range 20% to 34%	15ml
AQSBRIX003	Brix High	Sucrose (Brix) Range 35% to 60%	15ml
AQSOSM001	Osmolality Low	Osmolality Range 50mOsm/kg to 350mOsm/kg	5ml
AQSOSM002	Osmolality Medium	Osmolality Range 351mOsm/kg to 999mOsm/kg	5ml
AQSOSM003	Osmolality High	Osmolality Range 1,000mOsm/kg to 3,000mOsm/kg	5ml
AQSTOC001	TOC Ultra Low	TOC Range 0.5ppm to 10ppm	35ml
AQSTOC002	TOC Low	TOC Range 11ppm to 100ppm	35ml
AQSTOC003	TOC Medium	TOC Range 101ppm to 500ppm	35ml
AQSMP001	Melting Point	Melting point Range 40°C to 240°C	1g
AQSICP001	ICP - Multi-Element (7 Elements)	Concentration Range 1ppm to 1,000ppm	100ml
AQSICP002	ICP - Multi-Element (19 Elements)	Concentration Range 1ppm to 1,000ppm	100ml

Update to Viscosity Standards

Our previous catalogue listed the kinematic viscosity values only and so created a barrier for users interested in dynamic viscosity. So to help those of you interested in dynamic viscosity we have updated our Viscosity Standards' nominal kinematic viscosity, dynamic viscosity and density values.

	KINEMATIC VISCOSITY mm2/s (cSt)					DYNAMIC VISCOSITY mPa.s (cP)					DENSITY (g/ml)				
Prod Code	20°C	25°C	37.78°C	40°C	50°C	20°C	25°C	37.78°C	40°C	50°C	20°C	25°C	37.78°C	40°C	50°C
REVIS-N.4	0.47	0.45	0.41	0.4	-	0.31	0.29	0.26	0.25	-	0.66	0.66	0.64	0.64	-
REVIS-N.8	0.74	0.7	0.61	0.6	-	0.5	0.47	0.41	0.4	-	0.69	0.69	0.68	0.68	-
REVIS-N1.0	1.3	1.2	1	0.97	0.87	0.91	0.84	0.71	0.69	0.61	0.73	0.72	0.71	0.71	0.7
REVIS-N2	2.9	2.6	2.1	2	1.7	2.1	1.9	1.5	1.4	1.2	0.72	0.72	0.71	0.71	0.7
REVIS-S3	4.4	3.9	3	2.9	2.4	3.6	3.2	2.4	2.3	1.9	0.82	0.82	0.81	0.81	0.8
REVIS-N4	6.7	5.8	4.2	4	3.2	5.5	4.8	3.4	3.2	2.6	0.84	0.83	0.83	0.82	0.82
REVIS-S6	10	8.7	6	5.7	4.4	8.7	7.4	5	4.7	3.7	0.84	0.84	0.83	0.83	0.82
REVIS-N7.5	14	12	8	7.5	5.8	12	10	6.7	6.3	4.8	0.85	0.85	0.84	0.84	0.83
REVIS-N10	20	16	11	10	7.5	18	15	9.3	8.7	6.4	0.84	0.83	0.82	0.82	0.82
REVIS-N14	30	24	15	14	10	25	20	12	11	8.2	0.84	0.83	0.83	0.82	0.82
REVIS-S20	43	34	20	18	13	36	29	17	15	11	0.85	0.85	0.84	0.84	0.83
REVIS-N26	59	47	27	25	18	46	37	22	20	14	0.84	0.84	0.83	0.83	0.82
REVIS-N35	88	66	35	32	21	76	58	30	28	18	0.87	0.87	0.86	0.86	0.85
REVIS-N44	110	87	48	44	30	85	66	37	35	23	0.84	0.84	0.83	0.83	0.82
REVIS-S60	160	120	60	54	35	140	110	54	49	31	0.88	0.87	0.87	0.86	0.86
REVIS-N75	210	160	83	75	50	170	130	69	63	42	0.84	0.84	0.83	0.83	0.82
REVIS-N100	320	220	110	95	59	270	190	91	81	50	0.88	0.88	0.87	0.87	0.86
REVIS-N140	400	300	160	140	90	360	270	140	120	78	0.84	0.83	0.83	0.83	0.82
REVIS-S200	550	400	200	180	110	460	340	170	150	95	0.84	0.84	0.83	0.83	0.82
REVIS-N250	790	580	280	250	160	690	500	250	220	140	0.84	0.84	0.83	0.83	0.82
REVIS-N350	980	710	340	310	190	834	609	294	262	161	0.84	0.84	0.83	0.83	0.82
REVIS-N415	1400	1000	470	410	250	1200	840	390	350	210	0.85	0.84	0.84	0.83	0.83
REVIS-S600	1800	1300	590	520	310	1700	1200	540	480	280	0.85	0.85	0.84	0.84	0.83
REVIS-N750	2700	1800	850	760	440	2300	1600	710	640	370	0.85	0.85	0.84	0.84	0.83
REVIS-N1000	3300	2300	1100	940	560	2800	2000	940	790	460	0.86	0.85	0.85	0.84	0.83
REVIS-N1400	4900	3500	1600	1400	830	4100	3000	1300	1200	690	0.84	0.84	0.83	0.83	0.82
REVIS-S2000	8400	5300	1900	1600	810	7300	4700	1700	1400	710	0.88	0.87	0.87	0.87	0.86
REVIS-N2500	8300	5900	2700	2400	1400	7000	5000	2200	2000	1200	0.84	0.84	0.83	0.83	0.82
REVIS-N4000	19000	12000	4100	3400	1700	16000	10000	3600	3000	1500	0.88	0.88	0.88	0.87	0.87
REVIS-N5100	28000	17000	6000	5100	2500	24000	15000	5200	4400	2100	0.89	0.89	0.88	0.88	0.87
REVIS-S8000	41000	25000	8000	6700	3200	32000	20000	7000	5900	2800	0.9	0.89	0.89	0.89	0.88
REVIS-N10200	58000	36000	12000	10000	4900	51000	32000	11000	8100	4400	0.89	0.89	0.88	0.88	0.88
REVIS-N15000	77000	47000	16000	13000	6100	64000	41000	14000	12000	5000	0.89	0.89	0.88	0.88	0.88
REVIS-N18000	100000	64000	21000	18000	8500	89000	56000	19000	16000	7500	0.9	0.89	0.89	0.89	0.88
REVIS-S30000	-	79000	28000	23000	11000	-	69000	23000	20000	9000	-	0.89	0.89	0.89	0.88

VOC Product Range Expanded

Reagecon already offer over 120 Volatile Organic Carbon standards details of these are available in our Physical and Chemical Standards catalogue these include single, multi, internal and surrogate standards. Reagecon's product portfolio is continually expanding so we are happy to add the following new products to our existing catalogue.

Product No.	Analyte	Concentration & Matrix	Pack size
REVOC300	1,2,3,4-Diepoxybutane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC301	1,2,3,4-Diepoxybutane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC302	1,4-Dioxane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC303	1,4-Dioxane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC304	1-Propanol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC305	1-Propanol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC306	2-Butanone (MEK)	1000µg/ml in Purge & Trap Methanol	1ml
REVOC307	2-Butanone (MEK)	2000µg/ml in Purge & Trap Methanol	1ml
REVOC308	2-Chloroethanol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC309	2-Chloroethanol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC310	2-Chloroethyl vinyl ether	1000µg/ml in Purge & Trap Methanol	1ml
REVOC311	2-Chloroethyl vinyl ether	2000µg/ml in Purge & Trap Methanol	1ml
REVOC312	2-Hexanone	1000µg/ml in Purge & Trap Methanol	1ml
REVOC313	2-Hexanone	2000µg/ml in Purge & Trap Methanol	1ml
REVOC314	2-Hydroxypropionitrile	1000µg/ml in Purge & Trap Methanol	1ml
REVOC315	2-Hydroxypropionitrile	2000µg/ml in Purge & Trap Methanol	1ml
REVOC316	2-Nitropropane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC317	2-Nitropropane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC318	2-Pentanone	1000µg/ml in Purge & Trap Methanol	1ml
REVOC319	2-Pentanone	2000µg/ml in Purge & Trap Methanol	1ml
REVOC320	2-Picoline	1000µg/ml in Purge & Trap Methanol	1ml
REVOC321	2-Picoline	2000µg/ml in Purge & Trap Methanol	1ml
REVOC322	2-Propanol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC323	2-Propanol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC324	2-Propanol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC325	2-Propanol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC326	3-Chloropropionitrile	1000µg/ml in Purge & Trap Methanol	1ml
REVOC327	3-Chloropropionitrile	2000µg/ml in Purge & Trap Methanol	1ml
REVOC328	4-Methyl-2-pentanone (MIBK)	1000µg/ml in Purge & Trap Methanol	1ml
REVOC329	4-Methyl-2-pentanone (MIBK)	2000µg/ml in Purge & Trap Methanol	1ml
REVOC330	Acrolein (Propenal)	1000µg/ml in Distilled Water	1ml
REVOC331	Acrolein (Propenal)	1000µg/ml in Purge & Trap Methanol	1ml
REVOC332	Acrolein (Propenal)	2000µg/ml in Distilled Water	1ml
REVOC333	Acrolein (Propenal)	2000µg/ml in Purge & Trap Methanol	1ml
REVOC334	Acrylonitrile	1000µg/ml in Purge & Trap Methanol	1ml
REVOC335	Acrylonitrile	2000µg/ml in Purge & Trap Methanol	1ml
REVOC336	Allyl alcohol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC337	Allyl alcohol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC338	Allyl chloride	1000µg/ml in Purge & Trap Methanol	1ml
REVOC339	Allyl chloride	2000µg/ml in Purge & Trap Methanol	1ml
REVOC340	Benzyl chloride	1000µg/ml in Purge & Trap Methanol	1ml
REVOC341	Benzyl chloride	2000µg/ml in Purge & Trap Methanol	1ml
REVOC342	Bromoacetone	1000µg/ml in Purge & Trap Methanol	1ml
REVOC343	Bromoacetone	2000µg/ml in Purge & Trap Methanol	1ml
REVOC344	Bromomethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC345	Bromomethane	2000µg/ml in Purge & Trap Methanol	1ml

Product No.	Analyte	Concentration & Matrix	Pack size
REVOC346	Chloroethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC347	Chloroethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC348	Chloromethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC349	Chloromethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC350	Chloroprene	1000µg/ml in Purge & Trap Methanol	1ml
REVOC351	Chloroprene	2000µg/ml in Purge & Trap Methanol	1ml
REVOC352	cis-1,4-Dichloro-2-butene	1000µg/ml in Purge & Trap Methanol	1ml
REVOC353	cis-1,4-Dichloro-2-butene	2000µg/ml in Purge & Trap Methanol	1ml
REVOC354	Crotonaldehyde	1000µg/ml in Purge & Trap Methanol	1ml
REVOC355	Crotonaldehyde	2000µg/ml in Purge & Trap Methanol	1ml
REVOC356	Dichlorodifluoromethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC357	Dichlorodifluoromethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC358	Epichlorohydrin	1000µg/ml in Purge & Trap Methanol	1ml
REVOC359	Epichlorohydrin	2000µg/ml in Purge & Trap Methanol	1ml
REVOC360	Ethanol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC361	Ethanol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC362	Ethyl acetate	1000µg/ml in Purge & Trap Methanol	1ml
REVOC363	Ethyl acetate	2000µg/ml in Purge & Trap Methanol	1ml
REVOC364	Ethyl methacrylate	1000µg/ml in Purge & Trap Methanol	1ml
REVOC365	Ethyl methacrylate	2000µg/ml in Purge & Trap Methanol	1ml
REVOC366	Ethylene oxide	1000µg/ml in Purge & Trap Methanol	1ml
REVOC367	Ethylene oxide	2000µg/ml in Purge & Trap Methanol	1ml
REVOC368	Hexachloroethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC369	Hexachloroethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC370	Iodomethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC371	Iodomethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC372	Isobutyl alcohol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC373	Isobutyl alcohol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC374	Malononitrile	1000µg/ml in Purge & Trap Methanol	1ml
REVOC375	Malononitrile	2000µg/ml in Purge & Trap Methanol	1ml
REVOC376	Methacrylonitrile	1000µg/ml in Purge & Trap Methanol	1ml
REVOC377	Methacrylonitrile	2000µg/ml in Purge & Trap Methanol	1ml
REVOC378	Methyl methacrylate	1000µg/ml in Purge & Trap Methanol	1ml
REVOC379	Methyl methacrylate	2000µg/ml in Purge & Trap Methanol	1ml
REVOC380	Nitrobenzene	1000µg/ml in Purge & Trap Methanol	1ml
REVOC381	Nitrobenzene	2000µg/ml in Purge & Trap Methanol	1ml
REVOC382	N-Nitroso-di-n-butylamine	1000µg/ml in Acetone	1ml
REVOC383	N-Nitroso-di-n-butylamine	1000µg/ml in Purge & Trap Methanol	1ml
REVOC384	N-Nitroso-di-n-butylamine	2000µg/ml in Acetone	1ml
REVOC385	N-Nitroso-di-n-butylamine	2000µg/ml in Purge & Trap Methanol	1ml
REVOC386	Pentachloroethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC387	Pentachloroethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC388	Propargyl alcohol	1000µg/ml in Purge & Trap Methanol	1ml
REVOC389	Propargyl alcohol	2000µg/ml in Purge & Trap Methanol	1ml
REVOC390	Propionitrile (ethyl cyanide)	1000µg/ml in Purge & Trap Methanol	1ml
REVOC391	Propionitrile (ethyl cyanide)	2000µg/ml in Purge & Trap Methanol	1ml
REVOC392	Pyridine	1000µg/ml in Purge & Trap Methanol	1ml
REVOC393	Pyridine	2000µg/ml in Purge & Trap Methanol	1ml
REVOC394	trans-1,4-Dichloro-2-butene	1000µg/ml in Purge & Trap Methanol	1ml
REVOC395	trans-1,4-Dichloro-2-butene	2000µg/ml in Purge & Trap Methanol	1ml
REVOC396	Trichlorofluoromethane	1000µg/ml in Purge & Trap Methanol	1ml
REVOC397	Trichlorofluoromethane	2000µg/ml in Purge & Trap Methanol	1ml
REVOC398	Vinyl acetate	1000µg/ml in Purge & Trap Methanol	1ml
REVOC399	Vinyl acetate	2000µg/ml in Purge & Trap Methanol	1ml
REVOC400	Vinyl chloride	1000µg/ml in Purge & Trap Methanol	1ml
REVOC401	Vinyl chloride	2000µg/ml in Purge & Trap Methanol	1ml

Addition of AzoDye product family

The following AzoDye compounds are a new product family for Reagecon - they offer the same features and benefits as the VOC standards listed above. Azodyes are synthetic dyes developed for use in the textile industry. Their release into the environment can cause visual pollution and their metabolites can be harmful to the aquatic environment due to their persistence. As a result, their use is no longer permitted in many countries. This range of azodye metabolites includes solutions for individual compounds.

Product No.	Analyte	Concentration & Matrix	Pack size
REAZO001	2,4-Diaminoanisole	1000µg/ml in HPLC Water	1ml
REAZO002	2,4-Diaminoanisole	2000µg/ml in HPLC Water	1ml
REAZO003	2,4-Diaminotoluene	1000µg/ml in Purge & Trap Methanol	1ml
REAZO004	2,4-Diaminotoluene	2000µg/ml in Purge & Trap Methanol	1ml
REAZO005	3,3-Dichlorobenzidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO006	3,3-Dichlorobenzidine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO007	3,3-Dimethoxybenzidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO008	3,3-Dimethoxybenzidine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO009	3-Aminobiphenyl	1000µg/ml in Ethyl Acetate	1ml
REAZO010	3-Aminobiphenyl	2000µg/ml in Ethyl Acetate	1ml
REAZO011	4,4,-Diaminodiphenylmethane	1000µg/ml in Purge & Trap Methanol	1ml
REAZO012	4,4,-Diaminodiphenylmethane	2000µg/ml in Purge & Trap Methanol	1ml
REAZO013	4,4-Methylenebis(2-chloroaniline)	1000µg/ml in Purge & Trap Methanol	1ml
REAZO014	4,4-Methylenebis(2-chloroaniline)	2000µg/ml in Purge & Trap Methanol	1ml
REAZO015	4-Aminoazotoluene	1000µg/ml in Purge & Trap Methanol	1ml
REAZO016	4-Aminoazotoluene	2000µg/ml in Purge & Trap Methanol	1ml
REAZO017	4-Aminobiphenyl	1000µg/ml in Purge & Trap Methanol	1ml
REAZO018	4-Aminobiphenyl	2000µg/ml in Purge & Trap Methanol	1ml
REAZO019	4-Chloroaniline	1000µg/ml in Purge & Trap Methanol	1ml
REAZO020	4-Chloroaniline	2000µg/ml in Purge & Trap Methanol	1ml
REAZO021	5-Nitro-o-toluidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO022	5-Nitro-o-toluidine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO023	Anilazine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO024	Anilazine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO025	Azobenzene	1000µg/ml in Purge & Trap Methanol	1ml
REAZO026	Azobenzene	2000µg/ml in Purge & Trap Methanol	1ml
REAZO027	Benzidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO028	Benzidine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO029	Dimethylaminoazobenzene	1000µg/ml in Purge & Trap Methanol	1ml
REAZO030	Dimethylaminoazobenzene	2000µg/ml in Purge & Trap Methanol	1ml
REAZO031	o-anisidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO032	o-anisidine	2000µg/ml in Purge & Trap Methanol	1ml
REAZO033	o-Toluidine	1000µg/ml in Purge & Trap Methanol	1ml
REAZO034	o-Toluidine	2000µg/ml in Purge & Trap Methanol	1ml

Pesticide product range extended

Reagecon already offer over 160 Pesticide standards details of these are available in our Physical and Chemical Standards catalogue these include Aroclors, Chlordanes, multi and single standards. The following pesiticide standards have recently been added to the Reagecon product range.

Product No.	Analyte	Concentration & Matrix	Pack size
REPET300	1,2-Diphenylhydrazine	1000µg/ml in Purge & Trap Methanol	1ml
REPET301	1,2-Diphenylhydrazine	2000µg/ml in Purge & Trap Methanol	1ml
REPET302	1,4-Phenylenediamine	1000µg/ml in Purge & Trap Methanol	1ml
REPET303	1,4-Phenylenediamine	2000µg/ml in Purge & Trap Methanol	1ml
REPET304	5,5-Diphenylhydantoin	1000µg/ml in Purge & Trap Methanol	1ml
REPET305	5,5-Diphenylhydantoin	2000µg/ml in Purge & Trap Methanol	1ml
REPET306	Barban	1000µg/ml in Purge & Trap Methanol	1ml
REPET307	Barban	2000µg/ml in Purge & Trap Methanol	1ml
REPET308	Bromoxynil	1000µg/ml in Purge & Trap Methanol	1ml
REPET309	Bromoxynil	2000µg/ml in Purge & Trap Methanol	1ml
REPET310	Captafol	1000µg/ml in Acetone	1ml
REPET311	Captafol	2000µg/ml in Acetone	1ml
REPET312	Captan	1000µg/ml in Acetone	1ml
REPET313	Captan	2000µg/ml in Acetone	1ml
REPET314	Carbaryl	1000µg/ml in Acetonitrile	1ml
REPET315	Carbaryl	2000µg/ml in Acetonitrile	1ml
REPET316	Carbofuran	1000µg/ml in Purge & Trap Methanol	1ml
REPET317	Carbofuran	2000µg/ml in Purge & Trap Methanol	1ml
REPET318	Carbophenothion	1000µg/ml in Purge & Trap Methanol	1ml
REPET319	Carbophenothion	2000µg/ml in Purge & Trap Methanol	1ml
REPET320	Chlordane (NOS)	1000µg/ml in Hexane	1ml
REPET321	Chlordane (NOS)	2000µg/ml in Hexane	1ml
REPET322	Chlorfenvinphos	1000µg/ml in Acetone	1ml
REPET323	Chlorfenvinphos	2000µg/ml in Acetone	1ml
REPET324	Coumaphos	1000µg/ml in Acetone	1ml
REPET325	Coumaphos	2000µg/ml in Acetone	1ml
REPET326	Crotoxyphos	1000µg/ml in Purge & Trap Methanol	1ml
REPET327	Crotoxyphos	2000µg/ml in Purge & Trap Methanol	1ml
REPET328	Demeton O	1000µg/ml in Acetonitrile	1ml
REPET329	Demeton O	1000µg/ml in Purge & Trap Methanol	1ml
REPET330	Demeton O	2000µg/ml in Acetonitrile	1ml
REPET331	Demeton O	2000µg/ml in Purge & Trap Methanol	1ml
REPET332	Demeton-S	1000µg/ml in Acetone	1ml
REPET333	Demeton-S	2000µg/ml in Acetone	1ml

Product No.	Analyte	Concentration & Matrix	Pack size
REPET334	Diallate (cis or trans)	1000µg/ml in Acetone	1ml
REPET335	Diallate (cis or trans)	2000µg/ml in Acetone	1ml
REPET336	Dichlone	1000µg/ml in Purge & Trap Methanol	1ml
REPET337	Dichlone	2000µg/ml in Purge & Trap Methanol	1ml
REPET338	Dicrotophos	1000µg/ml in Purge & Trap Methanol	1ml
REPET339	Dicrotophos	2000µg/ml in Purge & Trap Methanol	1ml
REPET340	Dinocap	1000µg/ml in Purge & Trap Methanol	1ml
REPET341	Dinocap	2000µg/ml in Purge & Trap Methanol	1ml
REPET342	Dioxathion	1000µg/ml in Purge & Trap Methanol	1ml
REPET343	Dioxathion	2000µg/ml in Purge & Trap Methanol	1ml
REPET344	Diphenylamine	1000µg/ml in Purge & Trap Methanol	1ml
REPET345	Diphenylamine	2000µg/ml in Purge & Trap Methanol	1ml
REPET346	EPN	1000µg/ml in Acetone	1ml
REPET347	EPN	1000µg/ml in Purge & Trap Methanol	1ml
REPET348	EPN	2000µg/ml in Acetone	1ml
REPET349	EPN	2000µg/ml in Purge & Trap Methanol	1ml
REPET350	Ethyl carbamate (urethane)	1000µg/ml in Purge & Trap Methanol	1ml
REPET351	Ethyl carbamate (urethane)	2000µg/ml in Purge & Trap Methanol	1ml
REPET352	Ethyl methanesulfonate	1000µg/ml in Purge & Trap Methanol	1ml
REPET353	Ethyl methanesulfonate	2000µg/ml in Purge & Trap Methanol	1ml
REPET354	Famphur	1000µg/ml in Purge & Trap Methanol	1ml
REPET355	Famphur	2000µg/ml in Purge & Trap Methanol	1ml
REPET356	Fensulfothion	1000µg/ml in Acetone	1ml
REPET357	Fensulfothion	2000µg/ml in Acetone	1ml
REPET358	Fenthion	1000µg/ml in Acetone	1ml
REPET359	Fenthion	2000µg/ml in Acetone	1ml
REPET360	Fluchloralin	1000µg/ml in Purge & Trap Methanol	1ml
REPET361	Fluchloralin	2000µg/ml in Purge & Trap Methanol	1ml
REPET362	Isodrin	1000µg/ml in Purge & Trap Methanol	1ml
REPET363	Isodrin	2000µg/ml in Purge & Trap Methanol	1ml
REPET364	Isophorone	1000µg/ml in Purge & Trap Methanol	1ml
REPET365	Isophorone	2000µg/ml in Purge & Trap Methanol	1ml
REPET366	Isosafrole	1000µg/ml in Purge & Trap Methanol	1ml
REPET367	Isosafrole	2000µg/ml in Purge & Trap Methanol	1ml
REPET368	Kepone	1000µg/ml in Purge & Trap Methanol	1ml
REPET369	Kepone	2000µg/ml in Purge & Trap Methanol	1ml
REPET370	Leptophos	1000µg/ml in Purge & Trap Methanol	1ml
REPET371	Leptophos	2000µg/ml in Purge & Trap Methanol	1ml
REPET372	Malathion	1000µg/ml in Purge & Trap Methanol	1ml
REPET373	Malathion	2000µg/ml in Purge & Trap Methanol	1ml
REPET374	Methyl methanesulfonate	1000µg/ml in Purge & Trap Methanol	1ml
REPET375	Methyl methanesulfonate	2000µg/ml in Purge & Trap Methanol	1ml
REPET376	Mexacarbate	1000µg/ml in Purge & Trap Methanol	1ml
REPET377	Mexacarbate	2000µg/ml in Purge & Trap Methanol	1ml
REPET378	Mirex	1000µg/ml in Hexane:Toluene	1ml
REPET379	Mirex	2000µg/ml in Hexane:Toluene	1ml
REPET380	Monocrotophos	1000µg/ml in Acetonitrile	1ml
REPET381	Monocrotophos	2000µg/ml in Acetonitrile	1ml
REPET382	Naled	1000µg/ml in Methylene Chloride	1ml
REPET383	Naled	2000µg/ml in Methylene Chloride	1ml
REPET384	Nitrofen	1000µg/ml in Purge & Trap Methanol	1ml
REPET385	Nitrofen	2000µg/ml in Purge & Trap Methanol	1ml

Product No.	Analyte	Concentration & Matrix	Pack size
REPET386	O,O,O-Triethyl phosphorothioate	1000µg/ml in Purge & Trap Methanol	1ml
REPET387	O,O,O-Triethyl phosphorothioate	2000µg/ml in Purge & Trap Methanol	1ml
REPET388	Octamethyl pyrophosphoramide	1000µg/ml in Acetone	1ml
REPET389	Octamethyl pyrophosphoramide	2000µg/ml in Acetone	1ml
REPET390	Parathion	1000µg/ml in Purge & Trap Methanol	1ml
REPET391	Parathion	2000µg/ml in Purge & Trap Methanol	1ml
REPET392	Pentachlorobenzene	1000µg/ml in Purge & Trap Methanol	1ml
REPET393	Pentachlorobenzene	2000µg/ml in Purge & Trap Methanol	1ml
REPET394	Pentachloronitrobenzene	1000µg/ml in Purge & Trap Methanol	1ml
REPET395	Pentachloronitrobenzene	2000µg/ml in Purge & Trap Methanol	1ml
REPET396	Phorate	1000µg/ml in Purge & Trap Methanol	1ml
REPET397	Phorate	2000µg/ml in Purge & Trap Methanol	1ml
REPET398	Phosalone	1000µg/ml in Purge & Trap Methanol	1ml
REPET399	Phosalone	2000µg/ml in Purge & Trap Methanol	1ml
REPET400	Phosphamidon	1000µg/ml in Purge & Trap Methanol	1ml
REPET401	Phosphamidon	2000µg/ml in Purge & Trap Methanol	1ml
REPET402	Strychnine	1000µg/ml in Purge & Trap Methanol	1ml
REPET403	Strychnine	2000µg/ml in Purge & Trap Methanol	1ml
REPET404	Thionazine	1000µg/ml in Acetone	1ml
REPET405	Thionazine	1000µg/ml in Purge & Trap Methanol	1ml
REPET406	Thionazine	2000µg/ml in Acetone	1ml
REPET407	Thionazine	2000µg/ml in Purge & Trap Methanol	1ml
REPET408	Trimethyl phosphate	1000µg/ml in Purge & Trap Methanol	1ml
REPET409	Trimethyl phosphate	2000µg/ml in Purge & Trap Methanol	1ml
REPET410	Tris(2,3-dibromopropyl) phosphate	1000µg/ml in Methylene Chloride	1ml
REPET411	Tris(2,3-dibromopropyl) phosphate	2000µg/ml in Methylene Chloride	1ml

PIANO-PONA-PNA

PIANO-PONA-PNA analysis is useful for fuel type differentiation as well as for estimating alteration by weathering and biodegradation. These complex mixes are prepared from materials of the highest available purity, accurate to four decimal places, and include a detailed data sheet on the formulation composition. The exact composition on a weight % basis for each analyte is provided on the certificate.

Product No.	Product Name	Constitutents	Conc/Property	Matrix	Pack Size	ASTM
REPIANO-P	Piano Paraffins	N-Pentane	Varies per Batch	None	1ml	D6279
		N-Hexane				D6733
		N-Heptane				D5134
		N-Octane				D3710
		N-Nonane				D2789
		N-Decane				
		N-Undecane				
		N-Dodecane				
		N-Tridecane				
		N-Tetradecane				
		N-Pentadecane				
REPIANO-I	Piano Isoparaffins	Isopentane	Varies per Batch	None	1ml	D6279
		2,3-Dimethylbutane				D6733
		2-Methylpentane				D5134
		3-Methylpentane				D3710
		2,2-Dimethylpentane				D2789
		2,4-Dimethylpentane				
		2,2,3-Trimethylbutane				
		3,3-Dimethylpentane				
		2-Methylhexane				
		2,3-Dimethylpentane				
		3-Methylhexane				
		3-Ethylpentane				
		2,2-Dimethylhexane				
		2,5-Dimethylhexane				
		2,2,3-Trimethylpentane				
		2,4-Dimethylhexane				
		2,3-Dimethylhexane				
		2-Methylheptane				
		4-Methylheptane				
		3-Methylheptane				
		3-Ethylhexane				
		3,3-Dimethylheptane				
		2,5-Dimethylheptane				
		3,5-Dimethylheptane				
		2,3-Dimethylheptane				
		3,4-Dimethylheptane				
		2-Methyloctane				
		3-Methyloctane				
		3,3-Diethylpentane				
		2,2-Dimethyloctane				
		3,3-Dimethyloctane				
		2,3-Dimethyloctane				
		3-Ethyloctane				
		2-Methylnonane				
		3-Methylnonane				
		ccc-1,3,5-Trimethylcyclohexane				
		1,1,4-Trimethylcyclohexane				
		ctt-1,2,4-Trimethylcyclohexane				
		ctc-1,2,4-Trimethylcyclohexane				
		1,1,2-Trimethylcyclohexane				
		Isobutylcyclopentane				
		Isopropylcyclohexane				
		n-Butylcyclopentane				
		Isobutylcyclohexane				
		t-1-Methyl-2-propylcyclohexane				
		t-1-Methyl-2-(4MP)cyclopentane				

Product No.	Product Name	Constitutents	Conc/Property	Matrix	Pack Size	ASTM
REPIANO-A	PIANO Aromatics	Benzene	Varies	None	1ml	D6279
		Toluene	per Batch			D6733
		EthylBenzene				D5134
		m-Xylene				D3710
		p-Xylene				D2789
		o-Xylene				
		Isopropylbenzene				
		n-Propylbenzene				
		1-Methyl-3-ethylbenzene				
		1-Methyl-4-ethylbenzene				
		1,3,5-Trimethylbenzene				
		1-Methyl-2-ethylbenzene				
		1,2,4-Trimethylbenzene				
		tert-Butylbenzene				
		Isobutylbenzene				
		sec-Butylbenzene				
		1-Methyl-3-isopropylbenzene				
		1-Methyl-4-isopropylbenzene				
		1-Methyl-2-isopropylbenzene				
		1-Methyl-3-n-propylbenzene				
		1-Methyl-4-n-propylbenzene				
		n-Butylbenzene				
		1,2-Diethylbenzene				
		1-Methyl-2-n-propylbenzene				
		1,4-Dimethyl-2-ethylbenzene				
		1,3-Dimethyl-5-ethylbenzene				
		1,2-Dimethyl-4-ethylbenzene				
		1,3-Dimethyl-2-ethylbenzene				
		1,2-Dimethyl-3-ethylbenzene				
		1,2,4,5-Tetramethylbenzene				
		2-Methylbutylbenzene				
		trans-1-Butyl-1-2-methylbenzene				
		n-Pentylbenzene				
		t-1-Butyl-1,3,5-dimethylbenzene				
		t-1-butyl-ethylbenzene				
		1,3,5-Triethylbenzene				
		1,2,4-Triethylbenzene				
		n-Hexylbenzene				
REPIANO-N	PIANO Naphthalenes	Cyclopentane	Varies	None	1ml	D6279
		Methylcyclopentane	per Batch			D6733
		Cyclohexane				D5134
		1,1-Dimethylcyclopentane				D3710
		cis-1,3-Dimethylcyclopentane				D2789
		trans-1,2-Dimethylcyclopentane				
		trans-1,3-Dimethylcyclopentane				
		Methylcyclohexane				
		Ethylcyclopentane				
		ctc-1,2,3-Trimethylcyclopentane				
		cct-1,2,4-Trimethylcyclopentane				
		ctc-1,2,4-Trimethylcyclopentane				
		trans-1,4-Dimethylcyclohexane				
		1-Ethyl-1-methylcyclopentane				
		trans-1,2-Dimethylcyclohexane				
		ccc-1,2,3-Trimethylcyclopentane				
		Isopropylcyclopentane				
		cis-1,2-Dimethylcyclohexane				
		n-Propylcyclopentane				

Quality of the Analytical Result

Introduction

Getting a high quality result is equally applicable to all objective analytical measurements whether they are:

- Routine, ad-hoc or part of Research & Development
- Quantitative, semi-quantitative or qualitative
- Laboratory, side-room or field
- Manual, automated or performed on-line/in-situ.

Although there are many factors that effect the quality of an analytical result, special emphasis will be placed in this article on traceability, calibration, uncertainty of measurement and the sample.

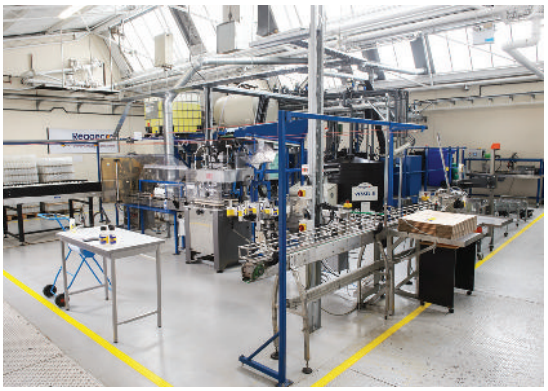
Before dealing with these subjects other factors that effect quality of result such as the test environment, staff/operator and equipment will be dealt with in a general way. Other contributors will cover such critical elements as standards, quality control, methods/procedures and validation.

1.1 Test Environment

Integrity

Samples, reagents and standards should be stored so as to ensure their integrity. Loss of integrity may take the following forms:

- Deterioration
- Contamination
- Hydration
- Evaporation
- Loss of Identity



Restriction

It may be necessary to restrict access to particular areas of a laboratory because of the nature of the work carried out. Although such restrictions might be for safety or security reasons, sensitivity to contamination of the sample or reagents is what is of most concern here. Typical examples of such sensitivity might apply to analytical work involving trace analysis, forensic examinations, DNA analysis or the handling of pathogenic organisms.

It is extremely important where such restrictions are in force that all staff should be made aware of:

(1) The intended use of an area
(2) The specific restrictions imposed on working within an area
(3) The reasons for imposing the restrictions.

Conditions & Controls

All laboratory staff should be provided with appropriate environmental conditions and controls necessary for particular tests. Such conditions include temperature, humidity, freedom from vibration and in specialised applications control of microbial contamination, special lighting and radiation screening. Control of such conditions could include a vibration free plinth to facilitate accurate analytical weighing, humidity control of a room or a chamber for the handling of certain hygroscopic powders or simply the maintenance of laboratory temperature at approx. 20°C to facilitate the accurate use of analytical volumetric standards and vessels.

1.2 Staff/Operator

While appropriate qualifications and appropriate experience are important for all staff, it is a combination of experience and qualifications that makes a greater contribution to attaining the correct result. Such qualifications and experience need only be fit for purpose. However, a much more important contributory factory towards the quality of test results is training. Such training should include the following:

- Performance of tests
- Operation of equipment
- Understanding of the test and equipment
- Consequences of the result
- Interpretation of the result
- Understanding of all aspects of the sample/sampling procedure

The quality of the training and the competence of the analyst must be monitored by QC techniques and retraining provided if necessary. Appropriate training must include on the job internal training and access to both internal and external training courses where appropriate. As with qualifications and experience, training must be fit for purpose. Most importantly it needs to be planned and documented.

1.3 Equipment

Equipment found in the analytical laboratory generally falls into the following five categories:

(1) General equipment not used for and with minimal influence on measurements. Such equipment would include non-volumetric glassware, glassware used for rough volume measurements, hotplates and stirrers.
(2) Volumetric Equipment e.g. burettes.
(3) Measuring instruments e.g. hydrometers, thermometers, spectrophotometers, electrochemical meters and balances.
(4) Physical Standards e.g. weights.
(5) Computers and data processors.

General Equipment

A calibration or performance check of such equipment is only necessary where the setting can significantly effect the test or analytical result. Such examples include tests where the speed of stirring is important or specified, temperature of water bath, incubator, oven, or auto-clave. Typically, such equipment need otherwise be maintained only by cleaning and safety checks carried out as necessary.

Volumetric Equipment

The correct use of such equipment is critical to analytical measurement. Specific detail on the maintenance and calibration of such equipment must be documented. Attention needs to be paid to the following considerations:

- Maintenance and Calibration
- Selection of correct grade
- Cleanliness
- Operation at correct temperature
- Contamination or cross-contamination
- Leaching and adsorption

Measuring Instruments

All measuring instruments must be:

- Used correctly
- Serviced periodically
- Cleaned
- Calibrated

However the correct application of these factors may not ensure that a measuring instrument is performing adequately. It may also be necessary to carry out any or all of the following performance checks:

(1) Check response linearity and stability of light sources, sensors and detectors.
(2) Check the separating efficiency of chromatographic systems.
(3) Check resolution alignment and wavelength accuracy of spectrophotometers etc.

The frequency of such performance checks must be determined by experience and based on need, type and previous performance of the equipment. The intervals between checks should be shorter than the time the equipment has been found to take to drift outside acceptable limits based on historical use. Where possible such performance checks should be built into test methods and carried out before the equipment is used for the particular test method.

Physical Standards.

Wherever physical parameters are critical to the correct performance of a test, the laboratory must hold relevant Reference Standards, which are certified, calibrated and traceable to a Primary Standard in a nonbroken chain. It is vitally important that not only the Reference Standards are stored and used in a correct manner but also that the accompanying Certification is properly stored and easily retrievable. Classically such physical standards would include one or more calibration weights.

Computers and Data Processors

In analytical laboratories computers have a wide variety of uses. These can be classified into three broad categories:

(1) Control of Inventory, maintenance/calibration schedules, and scheduling of work.
(2) Communication, word processing, storage/retrieval and processing of test data.
(3) Computation of test results including the design and performance of statistical experiments.

It is in categories (2) and (3) that particular emphasis must be paid to validation of the computer and in particular where a LIMS system is in operation. Particular validation requirements of a LIMS system includes control of access to the various functions and audit trails to catalogue alterations and file management.

1.4 Measurement Uncertainty

Definition

Measurement uncertainty is an estimate attached to a measurement, which characterises the range of values within which the true value is asserted to lie. Every analytical measurement has an uncertainty associated with it, resulting from errors arising in the various stages of sampling and analysis and from imperfect knowledge of factors effecting the result. For a measurement to be of value it is necessary:

(1) To have knowledge of the reliability of uncertainty
(2) The uncertainty statement conveys the quality of the result.

Uncertainty is normally expressed as a standard deviation or as a multiple of the standard deviation. Computation of the uncertainty must consider all possible sources of error leading to that uncertainty. Repeatability or reproducibility are not acceptable as estimates of the overall uncertainty since neither has taken into account any systematic errors inherent in the method.

Factors Effecting Measurement

There are many reasons why an analytical measurement result will deviate from the true value:

- Temperate effects on volumetric equipment
- Reflection and stray light in spectroscopic instruments
- Variations in electrical supply voltage
- Individual analyst's interpretation of specified methods
- Incomplete extraction
- Errors in sampling or sample handling
- Deterioration of the sample.

Variation of matrix between the standard material and the test material is also a substantial contributor to uncertainty of measurement. As far as possible, such errors should be minimised by external control or should be corrected for, for example in the case of matrix error by applying a suitable correction factor. However, even after taking all factors effecting uncertainty into account, exact deviation of a single measurement result from the true value is impossible to obtain, so the likely range of deviation must be computated.

Types of Uncertainty

There are two main classifications of effects that can contribute to overall uncertainty associated with the result. These are (i) random effects and (ii) systematic effects. These two effects can be defined as follows:

(i) Random effects cause errors, which vary from measurement to measurement, giving rise to components of uncertainty in the estimate of the true value. Such a component of uncertainty may be referred to as "random uncertainty". The value of the uncertainty component associated with random effects may be estimated by measuring the dispersal in results over a suitable number of determinations under a representative range of conditions.

(ii) Systematic effects result in errors, which are constant within repeatability time scales.

Where the possibility of a particular systematic effect is recognised, but its effect on the result is not known exactly, a second type of uncertainty contribution arises.

This second type of uncertainty contribution is commonly referred to as type 2 uncertainty and is often difficult to determine. The size can be estimated on the basis of a mathematical model, experience, or international laboratory inter-comparisons. Also, this type 2 uncertainty contribution has to be expressed as a standard deviation. Even where a systematic effect such as a method bias is recognised and a correction can be made, the exact correction required is like the true value unknown. The difference between the exact correction and the estimate used also gives rise to an uncertainty in the estimate of the true value.

It needs to be noted that type 2 components of uncertainty arise even when the correction for systematic deviation arising from a particular cause is expected to be zero.By way of example, during the calibration of an Atomic Absorption Spectrophotometer instrument using an appropriate reference solution implies that the correct for systematic error should be zero. However, the match of reference solution and sample is unlikely to be perfect and the difference in instrument response will produce an unknown systematic error in analytical result for that type of sample. Further, the reference solution itself will, in general, deviate by a small unknown amount from its nominal analyte content. Both of these cases give rise to type 2 uncertainty components. Similarly, in the measurement of an ion using an ion selective electrode similar differences may occur between sample matrix and standard matrix. However, in such cases an attempt is made to reduce the type 2 systematic errors using ionic strength adjusting solutions. The type 2 systematic error arising from such matrix adjustment will never be zero.

Mathematical Computation of Measurement Uncertainty

The primary task in assigning a value to the uncertainty of measurement is the identification of the relevant sources of uncertainty and the assignment of a value to each contribution. The separate contributions must be combined applying the general law of error propagation. This is achieved by taking the square root of the sum of the squared contributing uncertainty components all expressed as standard deviations. Where interim results are combined by multiplication or division, the combined relative standard deviation (RDS) is calculated by taking the square root of the sum of the squared or the RSDs for each interim result and the combined standard deviation calculated from the combined RSD. The overall uncertainty is expressed in the overall standard deviation or as a multiple of it. In some cases it is preferable to express the overall uncertainty to a confidence interval. In such a case two times the overall standard deviation is estimated to approach a 95% confidence interval could be used by way of example.

In identifying relevant sources of uncertainty, consideration must be given to the complete sequence of events necessary to achieve the purpose of the analysis.

Where individual sources of error for each stage cannot be practically measured, it may be possible to consider group effects. For example the repeatability of a measurement may serve as an estimate of the total random uncertainty for these stages over which the process is strictly repeatable. Similarly, an estimate of part of the type 2 uncertainty may be derived from known inter-laboratory variation for a method, derived from inter-laboratory studies.

Categorisation of Measurement Uncertainty

In summary, uncertainty contributions for analytical results fall into four main categories:

(1) Contributions from random effects typically estimated from repeatability experiments.
(2) Type 2 contributions such as operator, calibration uncertainty, scale graduation errors, equipment and laboratory effects, estimated from inter-laboratory reproducibility trials.
(3) Type 2 contributions outside the scope of inter-laboratory trials such as reference material uncertainty.
(4) Other sources of uncertainty such as sample variability and matrix effects.

It has to be said that it is often commercially impracticable to measure uncertainties for every test and sample type. Where a particular test is carried out frequently, it may be sufficient to investigate the uncertainty once only or at discreet intervals. Alternatively, adequate investigation of a similar test or system may suffice, the value being treated as an estimate of standard deviation.

1.5 Sampling, Sample Handling and Preparation

No matter how good the analytical method, how carefully the analysis is performed or the degree of traceability, calibration, or validation applied to the analytical method, the final result will always be dependent on the sampling process. Recently, sampling has been highlighted and accorded the status that it deserves in analytical chemistry. The following considerations have been dealt with in the last couple of years:

- As analytical methodology improves the use of smaller test portions has become a feature of modern instrumentation. This makes sampling increasingly important and more difficult.
- Many areas of chemical testing have addressed sampling issues and sampling methods have been validated and published for a lot of industries.
- Where specific methods for sampling are not available, the analyst should rely on experience or adapt methods from similar applications.
- When in doubt about the material of interest and the samples taken, it should always be treated as heterogeneous unless proved otherwise.
- The sampling must be carried out under direction of a skilled sampler who has an understanding of the overall context and importance of the analysis. If a person who is not experienced as an analyst or specifically trained in sampling is used to do the sampling procedure, the laboratories must liase with and apply training to the people who are performing the sampling regime.

Sampling Strategy

There are important rules to be followed when designing, adapting or following a sampling strategy.

(1) The analytical problem necessitating that sampling should be understood and the sampling procedure designed accordingly. The sampling strategy used will depend on the nature of the problem, for example:

- Is the average analyte concentration of the material required.
- Is it an analyte profile across the material that is required.
- Is the material suspected of contamination by a particular analyte.

(2) It may be wrong to assume that the material under analysis is homogenous, even when it appears to be. Where material is clearly in two or more physical phases, the distribution of the analyte may vary between each phase. It may be appropriate to separate the phases and treat them as separate samples. Similarly, it may be appropriate to combine and homogenise the phases to form a single sample.

(3) The properties of the analyte of interest should be taken into account. The following considerations, by way of example, may be of interest in designing the sampling strategy and choosing the equipment, packaging, and storage conditions:

- Volatility
- Sensitivity to Light
- Thermal liability
- Chemical reactivity

Equipment used for sampling or sample extraction should be selected in order to avoid unintended changes to the nature of the sample, which may include the final result. In some instances it may be necessary to add chemicals such as acids or anti -oxidants to the sample to stabilise it. This is of particular importance in trace analysis where there is a danger of adsorption of the analyte in to the storage vessel.

(4) It may be necessary to consider the use and value of the rest of the original material once the sample has been removed for analysis. Badly considered sampling, especially if destructive, may render the whole consignment valueless or inoperative.
(5) It is vitally important that the sampler keeps a clear record of the procedures followed in order that the sampling process may be repeated exactly, or in the case of dubious results that a traceability check can be carried out.
(6) Where more than one sample is taken from the original material it may be useful to include a diagram as part of the documentation to indicate the pattern of sampling. This will make it easier to repeat the sampling at a later date and also may assist in drawing conclusions from the test results. A typical application where such a scheme would be useful is the sampling of soils over a wide area to monitor fall out from stack emissions.

Sample Packaging

Sample packaging, containers and instruments for sample extraction or manipulation, should be selected so that all surfaces in contact with the sample are essentially inert. Particular attention should be paid to:

(a) Possible contamination of samples by metals or plasticisers leaching from the container or its stopper into the sample.
(b) The packaging should also ensure that the sample can be handled without causing a chemical or microbiological hazard.
(c) The enclosure of the packaging should be adequate to ensure there is no leakage of sample from the container and that contamination cannot enter. In some circumstances, for example where samples have been taken for legal purposes the sample may be sealed so that access to the sample is only possible by breaking the seal. Confirmation of the satisfactory condition of the seals will normally form part of the analytical report.
(d) The sample label is an important aspect of documentation and should unambiguously identify the sample to related plans or notes. Labelling is particularly important further into the analytical process when the sample may have been divided, sub-sampled or modified in some way. In such circumstances, additional information may be appropriate, such as references to the main sample and to any processes used to extract or sub-sample the sample.
(e) Samples should be stored so that there is no hazard to laboratory staff and the integrity of the sample is preserved. The storage area should be kept clean and organised, so that there is no risk of contamination or cross-contamination, nor of packaging, or any related seals being damaged.
(f) Extremes of environmental conditions should be avoided that might change the composition of the sample particularly, loss of analyte through degradation or adsorption.
(g) All staff concerned with administration of the sample, at any level including the sampling right through to sub-sampling and analysis should be properly trained. This training should be documented, as should a documented policy be put in place for the retention, disposal and management of samples. Such documentation should include a clear policy on th e retention of samples for a fixed and agreed practical period of time.

1.6 Traceability of Measurement

Definition

It is now established practice for all types of laboratories, including analytical laboratories active in various fields of testing, to have their working instruments calibrated against more accurate instruments, or standards and for those standards to be checked back in turn in one or more calibration steps against national standards, such as those held by the National Physical Laboratory (NPL) in the UK. Traceability can be defined therefore as the ability to relate measurements back to appropriate measurement standards, through an unbroken chain of calibrations. This is also termed as traceability of measurement.

Calibration and Traceability of Measurement

Traceability of measurement is essential if the results of various measurements are to be comparable and if uncertainty of measurement is to be meaningfully assigned. It is a requirement that all measurement necessary for the proper performance of a calibration, or test, be traceable. This requirement for traceability applies to any measurements that may significantly effect the result of the calibration or test or its validity, including subsidiary measurements.

Physical Calibration

If the requirement for traceability is to achieve its purpose, not only must the unbroken chain of calibrations exist, but every calibration in the traceability chain must be carried out in a technically sound manner; the staff, equipment, reference materials, environment and procedures involved in the calibration must be adequate for the task involved and must be controlled. The precise technical requirements that are appropriate for any given calibration depend on a number of features, including ht e accuracy sought in the calibration, the nature of the equipment/reference materials involved and the use to which the calibrated equipment is to be put. For most types of calibration it is necessary for the calibrations to be carried out in accordance with quite stringent technical requirements, at all stages of the calibration chain.

Chemical Calibration

While chemical measurements are usually more complex than physical measurements, the concept of traceability is essentially similar. Chemical traceability has the following purposes:

- Facilitate accuracy of measurements
- Establish uncertainty of measurements
- Facilitate comparability over time
- Facilitate comparability from place to place

Chemical properties are measured with reference to those of known chemical standards. This may be a direct comparison, but is usually accomplished by means of scales or instruments that have been calibrated with respect to knows. Herein lies an often overlooked component of uncertainty of chemical measurements. The standards may fulfil all of the requirements for traceability but may not correspond fully to the unknowns and full correspondence may be very difficult to achieve in a given situation. Accordingly the analyst must use methodology with minimum matrix effects and use where appropriate matrix modifiers, apply corrections for matrix effect, or remove the component of interest from the matrix by, for example extraction, dissolution or distillation, before measurement. All of the above steps introduce uncertainties into the measurement process that must be evaluated.

Reagecon Technical Focus -
The Quality Of The Analytical Result

The uncertainty of the chemical standards used may be considered from two points of view:

- Appropriateness
- Accuracy

Appropriateness is a qualitative judgement and precedes all other requirements. In many cases the standard used only calibrates the final measurement steps. Intermediate steps are not calibrated, yet they can introduce major sources of measurement uncertainty. Uncertainty of the compositional accuracy of the standards used, may be a critical factor in some cases and not in others, but this must always be considered. This is where traceability enters the picture.

When standards are made by anyone other than the analyst using them, they should not be taken for granted. Only standards with documented uncertainty should be used and this should be the policy of every laboratory and every analyst. Similarly, it is the obligation of every supplier of standards to provide all of the information required above. It needs to be re-emphasised that in any major analytical situation the major uncertainty is not in the standards used but in the performance of the test as a whole. Because of its complexity a measurement system may have many sources of error and may need to be stabilised by a strict system of quality control. It cannot be over emphasised that statistical control must be attained and maintained, if the measurements are to have any logical significance. The efficacy of the control procedures and overall quality of the data needs to be monitored and evaluated by quality assessment techniques.

Reference materials play key roles in quality assessment of such activities as control samples using control charts, proficiency tests and performance audits. Questions of appropriateness of a reference material and accuracy of its compositional values are again of prime importance, thus the concept of traceability applies to reference materials, as it does to standards for measurement in general.

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