Malvern Panalytical
a spectris company

NETZSCH
Proven Excellence.

Shape the future of paints and coatings

Empower your research and production with advanced analytical solutions

Paints and coatings have a very long history. Since the ancient times of cave paintings, people have experimented with pigments to transform and color the world around them. This goes beyond decoration in today's modern industry: innovations in smart coatings, and an urgent focus on sustainability, are creating an almost limitless potential for growth. From solar paint and smart walls to military aircraft, paints and coatings have more power to change the world around us than ever before.

Amid all these possibilities, the future is still being shaped. Completely new applications demand new formulations – and demand a highly detailed, nanoscale understanding of those formulations. But achieving all this efficiently can be a challenge, especially when using older analytical methods.

At Malvern Panalytical and NETZSCH Analyzing & Testing, we leverage over six decades of experience in the design, manufacture and supply of analytical instruments to offer a complete range of laboratory and on-line analytical solutions. The unique range of possibilities offered – from elemental analysis through to visco-elastic properties – allow optimization throughout production and research. Whether you are a producer of pigments trying to ensure consistent particle size, a researcher determining molecular weights of the latest biopolymer, or a formulator optimizing the flow properties of a paint, our solutions offer you the level of insight and control you need to power the paints and coatings of the future.

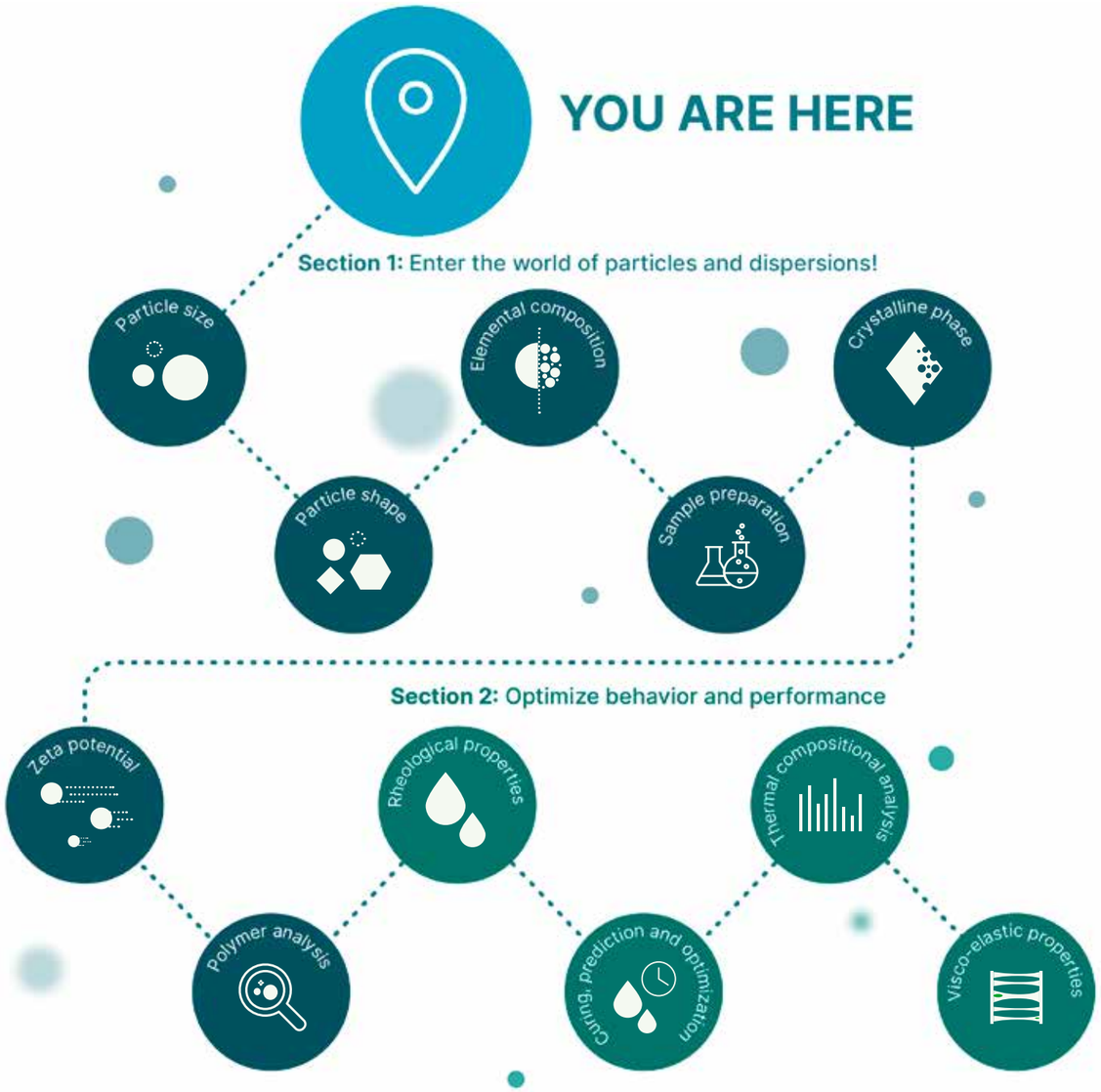
Optimize through insight

As consumer demands from paints and coatings become more complex, manufacturers need an increasingly detailed view inside their formulations. To deliver consistent overall quality they need a manufacturing process that monitors quality at every stage, as any imbalance or issue may cause more serious problems later in the process. From raw materials onward, accuracy at every step matters.

Characterization tools

Enter the world of particles and dispersions!

The best formulations make the most of even the smallest components and their properties. Our particle analysis solutions open a window into your formulations and ingredients, allowing more precise control, data-driven innovation, and consistency throughout your production process – batch after batch. From particle size and shape to elemental composition and dispersion stability, our solutions add value starting with the micro-level view. Each instrument brings different benefits, but with this many options you're sure to find the best match for your research, development or production needs!



Particle size analysis

Laser diffraction (LD) measures the angular variation in light intensity as a laser beam passes through a particulate sample, and uses the Mie theory of light scattering to calculate particle sizes. Replacing legacy techniques such as sieves and grindometers, it measures the entire distribution of particle sizes, enabling much more accurate control and monitoring of pigment particles, droplets in sprays and emulsions, and powder coating particles.

Why particle size matters

The size and shape of particles influences how light interacts with a coating, affecting its opacity, tint and level of gloss, and can even make it waterproof. Particle size analysis plays an especially fundamental role in powder coatings, where optimal size distributions result in lower heat and less time needed for the curing process, and ensure a more consistent finish.

Mastersizer 3000

Spraytec

Optimize particle size distribution

To meet these needs, the **Mastersizer 3000** laser diffraction particle size analyzer delivers rapid, accurate particle size distributions for suspensions, emulsions and powders in the range of 0.01-3,500 µm. It's well-suited to a range of applications, from research and development (R&D) to monitoring milling processes and quality control for final products. It packs exceptional performance into the smallest of footprints, bringing operator-independent measurements every user can rely on.

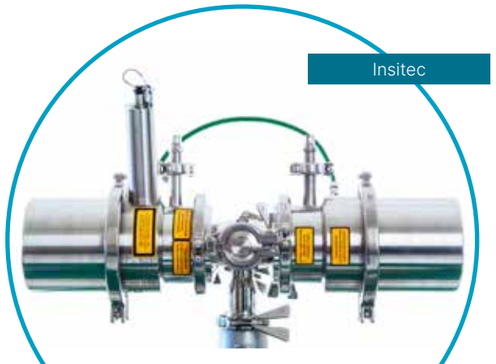
The **Hydro Insight** accessory gives particle shape insights alongside the Mastersizer's size analysis; read more in our dedicated Imaging Analysis section [p7].

Droplets and sprays

Understanding droplet size and atomization in spray applications is essential when assessing atomization efficiency. Being able to manipulate variables such as nozzle geometry and atomization pressure allows you to maximize the amount of paint transferred onto a substrate, reducing waste and costs. The **Spraytec** system uses laser diffraction to deliver accurate, concentration-independent results, measuring across 0.1-2,000 microns without needing constant optics changes.

The Spraytec analytical software also controls the system during measurement and calculates spray size distributions by analyzing scattering data. The results are displayed as a 'size history' trend plot, making it easy to recognize any inconsistencies or changes.

Insitec



On-line efficiency

Finding an efficient way to analyze particle size during production can be difficult, but monitoring on-line allows cost-effective control of your processes in real time. The versatile **Insitec** system eliminates laboratory down-time, delivering analysis every few seconds using a feedback loop. Insitec can be applied across a wide variety of process streams, from dry powders to sprays, emulsions and full formulations – enabling easy alignment with smart factory manufacturing flows. It measures particles between 0.1 micron to 2.5 mm, and volumes from milligrams of material to hundreds of tons per hour.

Imaging analysis

Imaging analysis takes high-resolution images of particles and uses several different parameters to build a complete picture of particle shape. Measurements taken include aspect ratio, circularity, convexity and solidity. Calculating these individual parameters for each particle allows for distribution curves to be generated, giving insight into even these small and subtle irregularities. In static image analysis the sample is immobilized for maximum accuracy, while our dynamic image analysis instrument gives results in real time as a suspension flows through a measurement cell.

Formulation troubleshooting by particle shape

The variable of particle shape can affect not only the consistency of manufacturers' formulations, but also the final performance of a coating. For example, higher particle roughness or irregularity can cause an increase in viscosity either in manufacture or during product application. Our **Morphologi 4** systems use static image analysis to provide detailed morphological descriptions of dry powders, wet suspensions and particulates on filters. They cover a size range of 0.5 to >1,300 µm, quickly identifying any processing or formulation inconsistencies.

The **Hydro Insight** accessory for the Mastersizer 3000 provides real-time quantitative insight into particle shape in wet suspensions, alongside the particle size measurements from laser diffraction. Particles suspended in a flowing stream by the Mastersizer 3000's dispersion unit flow through the Hydro Insight, and are imaged by a high-resolution digital camera at up to 127 frames per second. The live particle images generated give a comprehensive and in-depth overview of a material's properties, making it easy to understand and troubleshoot a formulation.

Morphologi 4-ID

Hydro Insight

Elemental composition and regulatory compliance

In many countries, lead content in final paint formulations is heavily regulated to keep levels within a safe range. Respirable silica is similarly controlled by safety regulations, and many binders, such as oils and resins, also need to be carefully quantified and qualitatively measured. To avoid waste or penalties, the use of elemental analysis is key to knowing exactly what makes up a formulation and ensuring regulatory compliance. By using X-ray fluorescence, this is easily monitored.

X-ray fluorescence

In addition to regulatory compliance, the chemical composition of ingredients and formulations is crucial for manufacturers to provide high-quality performance and batch-to-batch consistency.

X-ray fluorescence (XRF) is a measure of the fluorescence produced by the various elements present in a sample when it is irradiated with X-rays. XRF is easier and often cheaper to run than ICP-MS, and eliminates the need for high-purity gases or other extras. Where possible, use of a benchtop XRF goes even further to improving efficiency.

Eliminate impurities with maximum sensitivity

For maximum measurement sensitivity, our wavelength-dispersive **Zetium** XRF instruments measure concentrations down to 0.1 ppm across the full elemental range (from Be to Am), making them suitable for both process control and R&D applications. The intuitive, intelligent software empowers non-expert users while providing a wide range of possibilities for specialists measuring both formulated paints and cured coatings.

Check film thickness and composition

With our Stratos analytical software you can obtain information about the compositions of multilayer coatings and the extent to which elements have ‘bled’ from one layer into another.

At-line analysis for solids and liquids

The energy-dispersive **Epsilon** series of XRF instruments offers at-line analysis of solids and liquids in a compact format, for an easy-to-maintain system. Capable of sophisticated XRF analysis, Epsilon instruments remain accessible for simpler elemental identification and quantification. With a sensitivity down to 1 ppm, they enable direct insight into production processes through their at-line capabilities – and offer options for automation too.

Specialized liquids analysis

The Epsilon Xflow is Malvern Panalytical’s specialized liquids XRF spectrometer, providing on-line process control with fast and accurate results. Simultaneous multi-element analysis keeps efficiency a priority, and the instrument’s robust design makes it ideal for demanding manufacturing applications.

Non-liquid coatings and films

For non-liquid coatings, the Epsilon Xline offers real-time non-destructive XRF measurement, giving information on elemental composition and coating thickness. It can accommodate patch, continuous and multi-lane coating processes, and material widths up to 1,000 mm. With results every few seconds, sampling time is eliminated.

LeNeo

Sample preparation

A major source of error in elemental composition analysis is sample preparation, as mineralogical or particle size effects can compromise the accuracy of the results.

In order to avoid costly waste and ensure reliable samples every time, Malvern Panalytical's sample preparation solutions **LeNeo** and **TheOx Advanced** make use of fusion to dissolve a fully oxidized sample at high temperature in a suitable solvent in a platinum, zirconium or graphite crucible. The melted mixture is then poured into a mold to create a glass disk for XRF analysis, or poured into a beaker to create the appropriate solutions for atomic absorption spectroscopy or ICP analysis.

Tailored solutions for different needs

The LeNeo instrument has the advantage of being easy to use and ensuring superior analytical performance, eliminating doubt and driving high-precision quality control. For high sample throughput needs, our TheOx Advanced instrument has six fusion positions and provides equally high accuracy. Both can eliminate error and doubt in one of the most critical analytical phases of production.

TheOx Advanced

Polymer characterization

OMNISEC

When applying polymers in a formulation, understanding their molecular weight and other characteristics such as branching is very valuable. These attributes affect rheology and stability in a formulation, and can therefore be used to predict and modify the final product characteristics.

Gel permeation chromatography (GPC), a size exclusion chromatography (SEC) method, is also known as gel filtration chromatography (GFC). It works by separating out polymers in solution based on their size, passing them through micron-scale beads containing pores of different sizes. After separation, up to four detectors are used to determine the polymer's characteristics.

Next-generation GPC analysis

Light-scattering detectors resolve the issues of older systems that traditionally relied on a single refractive index detector. Light-scattering detectors can provide measurements independent of polymer type or structure, using generic calibration standards to determine absolute values.

Malvern Panalytical's **OMNISEC** range offers superior detector stability, low-concentration measurements and temperature control. The OMNISEC system provides absolute molecular weight determination without the need for calibrations, with applications including product quality control, degradation analysis and R&D. The system also ensures overall efficiency and productivity, thanks to its easy-to-use software.

Empyrean

Aeris

Crystalline phase analysis

After milling, the crystalline microstructures in pigment particles can be destroyed or altered, making those particles unsuitable for use. To avoid waste, it is important for manufacturers and formulators to identify and select the materials which are most suitable and control the ratio of crystalline to amorphous phases.

By irradiating a sample with X-rays and measuring the intensities and scattering angles of the X-rays as they leave the material, X-ray diffraction (XRD) instruments measure a variety of parameters describing the crystal structure and microstructure of the sample material. This method can be applied to solids, thin films and nanomaterials, and can provide a wide range of information including the layer thickness, the chemical composition and more.

Easy and efficient X-ray diffraction

For ultimate ease of use and efficiency, the **Aeris** compact XRD from Malvern Panalytical offers accessible measurement and data analysis across a variety of experiment types. With automated batch measurement and analysis, no prior XRD expertise is needed and its dedicated analysis software streamlines workflows. With a wide range of additional options providing customization possibilities, the Aeris is versatile and can accommodate high throughput sampling of powders, solids and thin films – with results typically taking just a few minutes.

Expert insight – thousands of applications

The multi-purpose **Empyrean** range offers the widest possible range of measurements thanks to its unrivaled collection of sample stages and optical components. Enabling expert use of all functions, Empyrean hardware and dedicated software remain accessible for novice users. The Empyrean multicore modules enable automated batch measurements on a full suite of measurement types without requiring manual intervention. Its non-destructive, reliable and accurate measurements are well-suited to the characterization of organic materials, thin films and coatings, as well as routine crystalline phase analysis alongside the most demanding R&D applications.

Zeta potential and particle size analysis

A common way to achieve stability of a dispersion of nanoparticles in a solution is to ensure that their surfaces are adequately charged to achieve electrostatic repulsion between particles. This ensures that they do not agglomerate into unwanted larger particles. Agglomeration can lead to poor product performance and separation of the formulation during processing, storage or use. The quickest and easiest way to analyze these properties is to measure the zeta potential – the overall charge a particle acquires in a particular medium.

Measuring zeta potential

Zeta potential is measured using electrophoretic light scattering, measuring the velocity of charged particles in an electric field. A high zeta potential generally indicates greater stability, as particles are more likely to repel each other. In paint and ink formulations, this data is vital in understanding how to formulate a stable product that will perform consistently over time.

Particle size distributions

Dynamic light scattering (DLS) uses the intensity fluctuations of scattered light, caused by nanoparticles undergoing Brownian motion, to measure their diffusion coefficients. These, in combination with physical properties of the dispersing medium, are then converted into size distributions. DLS can be used to measure particle size distributions between 0.2 nm and 10 µm.

Monitor dispersion stability and nanoparticle size in any sample

To meet this need, Malvern Panalytical offers the **Zetasizer** range of instruments. Measuring both zeta potential and particle sizes between 0.2 nm and 10 µm, the Zetasizer can use a variety of cell types to accommodate different sample requirements. Instruments are available in several versions from standard to more highly specialized analyses, and can be upgraded on-site as requirements develop.

Zetasizer

Optimizing behavior and performance

Paints, inks and coatings need to stand the test of time. Formulations need to be easy to work with, no matter how high-tech their application – and as the world moves towards greater sustainability, they need to change with it. Innovative methods of application and curing offer great opportunities, but need testing and data to support them. At the formulation level, all these considerations affect how a paint or coating behaves, both at the time of application and long after.

Rheological properties

To ensure that a paint or coating is optimized for its application, manufacturers need to understand all the different aspects of its final behavior, which depends on the rheological characteristics of the formulation. Under different shear stresses, shear rates and timescales, many coatings will demonstrate different rheological behaviors – especially as many formulations are non-Newtonian and visco-elastic. This makes it vital to test these properties under the relevant conditions, as without this context, it will be impossible to predict a coating's final performance.

Rotational rheometry

Rheometers can measure a much broader range of shear rates than viscometers, allowing for more accurate simulation and measurement and more accurate differentiation between high- and low-performance products.

The **Kinexus** rotational rheometer from NETZSCH makes use of rotational and oscillatory shearing to measure a range of important properties, including shear viscosity, thixotropy, sag resistance, viscoelasticity, dispersion stability and yield stress.

Optional add-ons

Developed using a wealth of market research and feedback, the modular instrument offers the potential for add-ons such as the **Kinexus UV** option, which measures the curing of coatings under user-defined irradiance levels. Easy to use, and with comprehensive dedicated software, the Kinexus provides a plug-and-play solution for all measuring systems.

Capillary rheometry

At extremely high shear rates and low viscosities, such as for printing inks and spray paints, accurate characterization is made easy with the **Rosand** capillary rheometer. Samples are extruded at user-defined temperatures through a cylindrical die at a controlled series of speeds.

Better together

Combining the Rosand capillary rheometer with the Kinexus rotational rheometer gives a uniquely comprehensive overview of the flow properties of a sample under the whole range of real-world processing conditions.


KINEXUS


Rosand RH2000

Curing, prediction and optimization

The curing process is a fundamental part of a paint or coating's overall performance. Alongside how appropriate the product is for its application, the conditions for curing also have an impact on sustainability, ease of use and final finish. As the phase in which volatile organic compounds (VOCs) are released at the highest concentrations, this is an area seeing rapid innovation as the modern industry seeks more environmentally friendly solutions.

DSC *Caliris*

Understanding curing properties using DSC analysis

Part of the appeal of powder coatings is that they release almost no emissions at all into the environment. But as these types of coatings are being continuously improved upon, it is vital for manufacturers to understand the curing properties and reaction kinetics of their powder formulations. The best way to gain insight into these properties is through Differential Scanning Calorimetry (DSC).

DEA *Ionic*

DSC analysis enables an in-depth overview of many different parameters, including melting and crystallization temperatures, glass transition, degree of curing, heat capacity, oxidative stability, and decomposition onset.

The **DSC 300 *Caliris*®** from NETZSCH is a highly versatile instrument for thermal analysis, which offers exchangeable modules to cover a wide range of temperatures, heating rates and sensitivities, making it future-proof for users.

Monitoring curing state using DEA analysis

The curing process is affected by the properties of each individual additive and component, particularly accelerators, inhibitors and antioxidants. Understanding the effectiveness of each of these components allows manufacturers to optimize and control the development process. For liquid and paste applications, changes in the ion viscosity and cure state of resins, paints and other polymers can be measured through Dielectric Analysis (DEA) – for example, to characterize the curing of acrylic or polyurethane paints. DEA relies on two electrodes passing a sinusoidal voltage through a sample to monitor curing progress.

Rapid results, reliable insight

The **DEA 288 *Ionic*** from NETZSCH covers a wide range of measurement frequencies – 1 mHz to 1 MHz – providing accurate and reliable insight into dielectric property changes during reaction. With a minimum measurement time of less than 5 ms, the DEA 288 Ionic can also be used for fast-curing systems such as UV curing. Flexibility is built in through its modular design and capacity for simultaneous multi-channel measurements, allowing it to be customized to the user – not only in a lab environment, but also in-process.

KINETICS NEO

Model reaction kinetics easily

Analysis of reaction kinetics is made easy with NETZSCH's specialized software, **Kinetics Neo**. Understanding the reaction rates of chemical processes can give insight into reaction behavior and, with the addition of temperature data, enables modeling and prediction of reactions under a variety of user-defined temperature conditions. These models can also be used for advanced process optimization.

Thermal compositional analysis

Controlling the performance over time of a paint or coating is made possible through sophisticated measurement and testing of its properties. Thermogravimetrical Analysis (TGA) measures the mass change of a sample as a function of temperature or time, under a controlled and defined environment. This provides insight into many aspects of a sample's composition characteristics including thermal stability, oxidation, decomposition and aging behavior.

In combination with an evolved gas analyzer system, TGA can also be used to determine composition of the pigment by observing the evolved gases during heating.

Make your TGA analysis truly efficient

The NETZSCH TG 209 ***F1*** *Libra*® thermobalance ensures free and safe access to samples through clever top-loading design, with easy crucible exchange and a stable position for the sample carrier in the furnace. Alongside ease of use, this ensures homogenous temperature distribution and high sample-to-sample reproducibility. Reaching 1,100°C at heating rates of up to 200 K/min, the instrument is well-suited to investigate the decomposition and thermal stability of materials by fast QC checks.

The TG 209 ***F1*** *Libra*®'s autonomous detection software offers operator-free evaluation of all thermogravimetric effects, saving time and costs. Its automatic compensation for external factors also eliminates the need for time-consuming baseline determinations, often necessary when using other thermobalances, adding to its outstanding efficiency credentials.

TG *Libra*

Viscoelastic properties

Certain materials, such as polymers, exhibit viscoelastic behavior – in other words, they show both elastic and viscous properties.

Dynamic Mechanical Analysis (DMA) is an indispensable tool for determining the viscoelastic properties of paints and coatings during a controlled temperature or frequency program.

The process applies a sinusoidal force to a sample and measures the strain in the material. The sample's viscoelastic behavior causes shifting of the corresponding stress and strain curves, allowing the complex modulus to be calculated.

User-friendly expert insight

The DMA 242 E *Artemis*® from NETZSCH makes these calculations simple with its easy-to-use design and user-friendly accompanying software, *Proteus*®. Capable of measurements in the range between -180°C and 600°C, it returns rapid results to characterize a specimen's dynamic-mechanical properties as a function of frequency, temperature and time.

Modular design for ultimate flexibility

The DMA 242 E *Artemis*® is also highly flexible, with a modular design that allows for a wide variety of sample-holders and cooling systems. Other add-on options include an immersion bath for the measurement of samples in a defined liquid medium, plus coupling options for a DEA analyzer, a UV lamp, or a humidity generator.

DMA *Artemis*

Contact us

To discuss how we can help with your paints and coatings project, get in touch today!

Malvern Panalytical
a spectris company

NETZSCH
Proven Excellence.

Malvern Panalytical
a spectris company

NETZSCH
Proven Excellence.

WHY CHOOSE US?

When you make the invisible visible, the impossible is possible.

Our analytical systems and services help our customers to create a better world. Through chemical, physical and structural analysis of materials, they improve everything from the energies that power us and the materials we build with, to the medicines that cure us and the foods we enjoy.

We partner with many of the world's biggest companies, universities and research organizations. They value us not only for the power of our solutions, but also for the depth of our expertise, collaboration and integrity.

With over 2200 employees, we serve the world, and we are part of Spectris plc, the world-leading precision measurements group.

Malvern Panalytical. We're BIG on small™.

NETZSCH ANALYZING AND TESTING

The NETZSCH Group is an owner-managed, international technology company with headquarters in Germany. The Business Units Analyzing & Testing, Grinding & Dispersing and Pumps & Systems represent customized solutions at the highest level. More than 4,000 employees in 36 countries and a worldwide sales and service network ensure customer proximity and competent service.

Our performance standards are high. We promise our customers Proven Excellence – exceptional performance in everything we do, proven time and again since 1873.

When it comes to Thermal Analysis, Accelerating Rate Calorimetry, the determination of Thermophysical Properties, Rheology and Fire Testing, NETZSCH has it covered.

Our 60 years of applications experience, broad state-of the-art product line and comprehensive service offerings ensure that our solutions will not only meet your every requirement but also exceed your every expectation.

Elevate the understanding of materials.

60 YEARS ANNIVERSARY

MALVERN PANALYTICAL

Grovewood Road, Malvern,
Worcestershire, WR14 1XZ,
United Kingdom

Tel. +44 1684 892456
Fax. +44 1684 892789

Lelyweg 1,
7602 EA Almelo,
The Netherlands

Tel. +31 546 534 444
Fax. +31 546 534 598

www.malvernpanalytical.com/en/industries/specialty-chemicals/paints-coatings

NETZSCH-Gerätebau GmbH

Wittelsbacherstraße 42
95100 Selb
Germany

Tel. +49 9287 881-0
Fax. +49 9287 881 505

at@netzsch.com

www.netzsch.com/ta