VERDER

CARBOLITE ELTRA QATM Retsch MICROTRAC ERWEKA



ENABLING THE FUTURE OF AEROSPACE

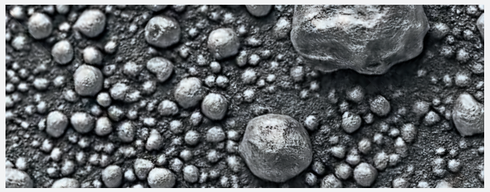
INNOVATION IN THE NEXT GENERATION OF SKY MOBILITY

ENABLING PROGRESS

MICROTRAC

PARTICLE CHARACTERIZATION
microtrac.com

PARTICLE SIZE AND SHAPE



Particle analysis via Dynamic Image Analysis (DIA) and Laser Diffraction (LD) is essential for the **characterization of powders and materials used in aerospace applications**, following international standards **ISO 13322-2** and **ASTM B822**. Microtrac systems facilitate the detection of agglomerates in metal powders, helping to prevent defects and improve the reliability of critical aerospace components.
- Dynamic Image Analysis - selection and qualification of materials for **additive manufacturing** and **coating processes**.
- Laser Diffraction - performance in **propulsion systems, composite manufacturing**, and **advanced ceramics**.

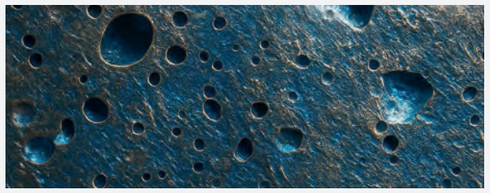
Particle Size & Particle Shape Analysis

EMULSION STABILITY & SHELF LIFE TESTING FOR AEROSPACE COATINGS

Dynamic Light Scattering (DLS), Static Multiple Light Scattering (SMLS) and Electrokinetic Analysis provide fast, accurate insight into key stability parameters:
- **Zeta potential, pH, and conductivity** measurements in accordance with **ISO 13099-1/3** and **ASTM E2865**, to assess electrostatic stabilization mechanisms.
- DLS techniques for particle size distribution in concentrated emulsions, without dilution to detect early aggregation.
- Advanced stability testing ensures aerospace coatings remain robust, reliable, and high-performing under real-world storage and temperature conditions.

Stability Dispersibility Analysis

POROSITY AND DENSITY



Porosity analysis of metal powders and composites is performed according to **ISO 15901-1** and **ISO 15901-2**, supporting material qualification for critical aerospace components.
Density measurement of additive manufacturing (AM) powders follows **ISO 12154** and **ASTM B923**, ensuring consistent powder quality and optimal process performance.

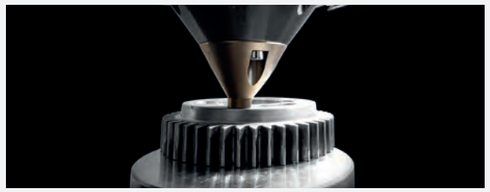
Gas Pycnometry: Density Measurement

Surface Area & Pore Size Distribution Analyzers

QATM

MATERIALOGRAPHY & HARDNESS TESTING
qatm.com

MATERIALOGRAPHY IN ADDITIVE MANUFACTURING POWDERS



- Metallographic preparation and hardness testing of metal powders and 3D-printed specimens following **ASTM E3**, **ASTM E407**, and **ASTM E384** standards.
- Hardness testing methods (Rockwell, Vickers, Brinell, and Knoop) are applied to AM components in accordance with **ASTM E18**, **ASTM E92**, and **ASTM E384**, ensuring reliable assessment of mechanical properties.
- Grain size and phase distribution analysis, as per **ASTM E112**, supports material qualification and process optimization.
- All procedures comply with aerospace requirements such as **AMS2750 and NADCAP**, and are suitable for titanium, Inconel, steel, and other critical alloys used in the aerospace industry.

AUTOMATED WELD SEAM ANALYSIS FOR AEROSPACE MANUFACTURING

QATM provides the **Qeye automated weld inspection system** for reliable, high-resolution analysis of weld seams.
- **Automated defect detection** ensures objective and repeatable quality control.
- **Dimensional analysis** of weld geometry—including throat thickness, leg length, and penetration—meets aerospace tolerances and supports compliance with **AWS D17.1** and **NADCAP** requirements

Preparation Methods for Metallographic Analysis

VERDER

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BET ANALYSIS AND GAS ADSORPTION

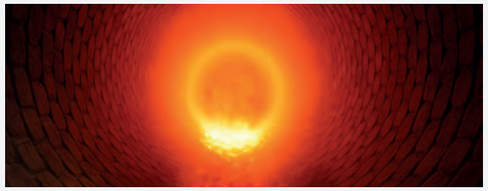
BET surface area analysis is essential in aerospace for predicting sintering behavior and optimizing material performance, following **ISO 9277**.
Gas adsorption techniques are applied to characterize activated carbons and catalysts, ensuring high efficiency in filtration and propulsion systems.

Surface Area & Pore Size Distribution Analyzers

CARBOLITE

HEAT TREATMENT
carbolite.com

HEAT TREATMENT AND STRESS RELIEVING



Stress relieving, sintering, and annealing of metal alloys and additive manufacturing (AM) parts according to **AMS2750 and Nadcap requirements**, ensuring precise temperature control and full traceability for aerospace qualification.
- Vacuum heat treatment of **Inconel 718** and titanium alloys provides optimal mechanical properties and microstructure consistency, supporting high-performance applications.

DEBINDING AND ADVANCED PROCESSING TECHNOLOGIES



- **Catalytic debinding** of Catamold parts is supported, allowing for clean and controlled removal of binders before sintering.
- **Graphitization of carbon-carbon composites** is performed to achieve high thermal stability and strength for demanding aerospace environments.

Carbolite Ovens & Furnaces for Heating Applications

Retsch

MILLING & SIEVING
retsch.com

MILLING AND SIEVING



ASTM B214 sieving provides accurate metal powder sizing for additive manufacturing and powder metallurgy.
Mills grind and **homogenize materials** for quality control, enabling precise analysis (XRF, XRD, SEM).
Consistent sample prep supports failure analysis, **coating evaluation**, and identification of defects or contaminants.
Mechanical alloying with Retsch mills allows development of **advanced aerospace materials** through controlled processes.

Solutions for sample preparation in the aerospace industry

ELTRA

ELEMENTAL ANALYSIS
eltra.com

ELEMENTAL ANALYSIS IN THE AEROSPACE INDUSTRY

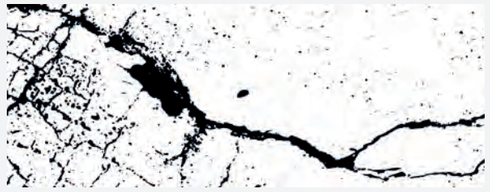
Precise quantification of oxygen, nitrogen, hydrogen, carbon, and sulfur in a broad array of aerospace materials. ELTRA's instrumentation is designed to meet the stringent demands of the industry, providing highly accurate and reproducible results while ensuring full compliance with key aviation standards, including **ASTM E1019, ASTM E1447, DIN EN 3976: 2007**, and many others.

OXYGEN, NITROGEN & HYDROGEN (ONH) ANALYSIS



Precise determination of oxygen, nitrogen, and hydrogen in **metals and ceramics** is critical for meeting the rigorous specifications of aerospace materials. Compliance with industry norms like e.g. **ASTM E1447** and **ASTM E 1409-13** for hydrogen, oxygen and nitrogen detection in titanium or, **ISO 22963:2008** and **DIN EN 3976: 2007** for alloys.

HYDROGEN EMBRITTLEMENT IN METALS



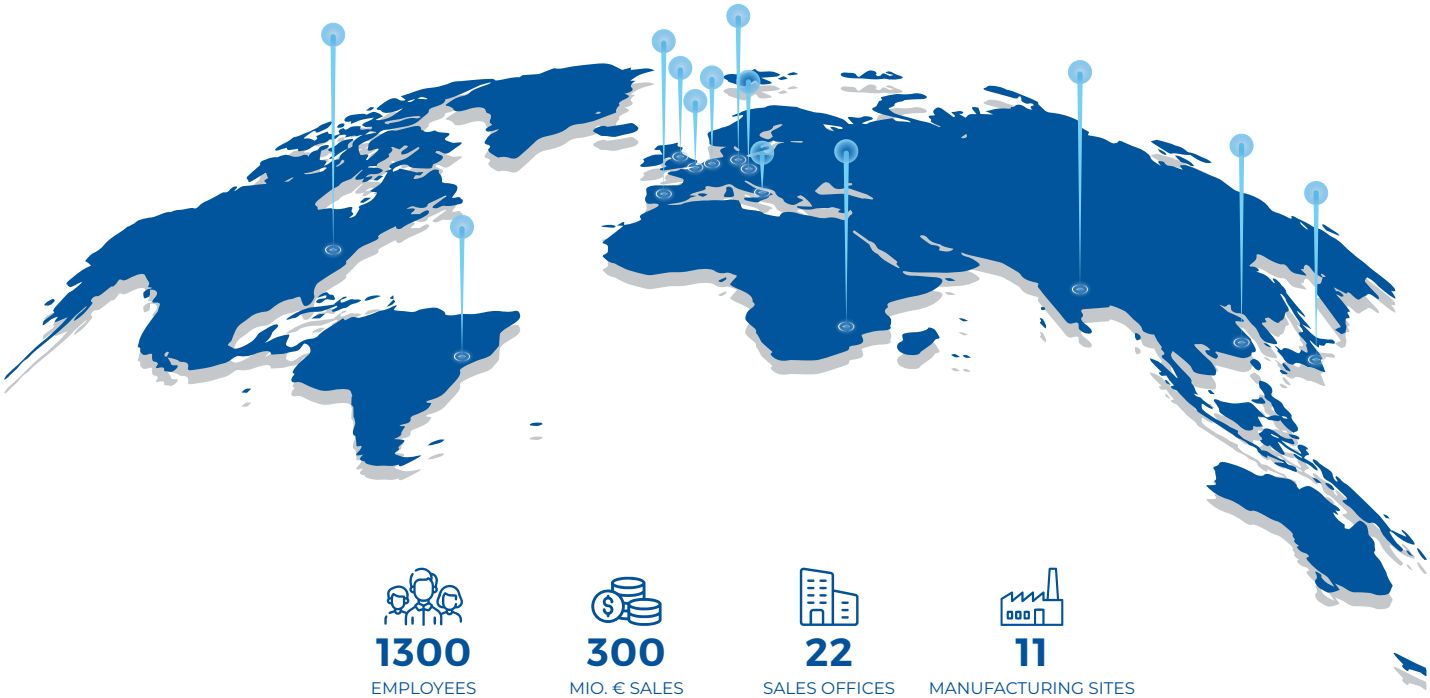
Hydrogen embrittlement represents a significant risk for aerospace components.
Accurate quantification of diffusible and total hydrogen is essential to ensure the structural integrity of **high-strength steels, titanium, and nickel alloys**, preventing delayed failure. Thermal desorption and inert gas fusion techniques, as implemented in the Elementrac ONH-p and Elementrac H-r instruments, enable precise measurement of diffusible and/or total hydrogen in metallic samples.

CARBON AND SULFUR ANALYSIS IN INCONEL AND TITANIUM ALLOYS

We ensures rapid and accurate determination of carbon and sulfur in steel, titanium, Inconel, and powders for additive manufacturing, in full accordance with **ASTM E1019**. This supports process control and material qualification in demanding aerospace environments.

Elemental Analysis in the Aerospace Industry

ENABLING PROGRESS



1300
EMPLOYEES

300
MIO. € SALES

22
SALES OFFICES

11
MANUFACTURING SITES

VERDER

GLOBAL REACH, LOCAL EXPERTISE

CARBOLITE
HEAT TREATMENT

ELTRA
ELEMENTAL ANALYSIS

QATM
MATERIALOGRAPHY & HARDNESS TESTING

Retsch
MILLING & SIEVING

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