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**ADDITIVE MANUFACTURING  
TESTING**



LEADING DEVELOPMENTS IN TESTING FOR THE COMPLETE ADDITIVE MANUFACTURING LIFE-CYCLE

As the use of additive manufacturing grows across industries, our experts are on the leading edge of this process, providing the most comprehensive level of additive manufacturing testing services in the industry. Whether your products go into a jet engine or are part of a hip implant, Element is your testing partner of choice.

OUR ADDITIVE MANUFACTURING SERVICES

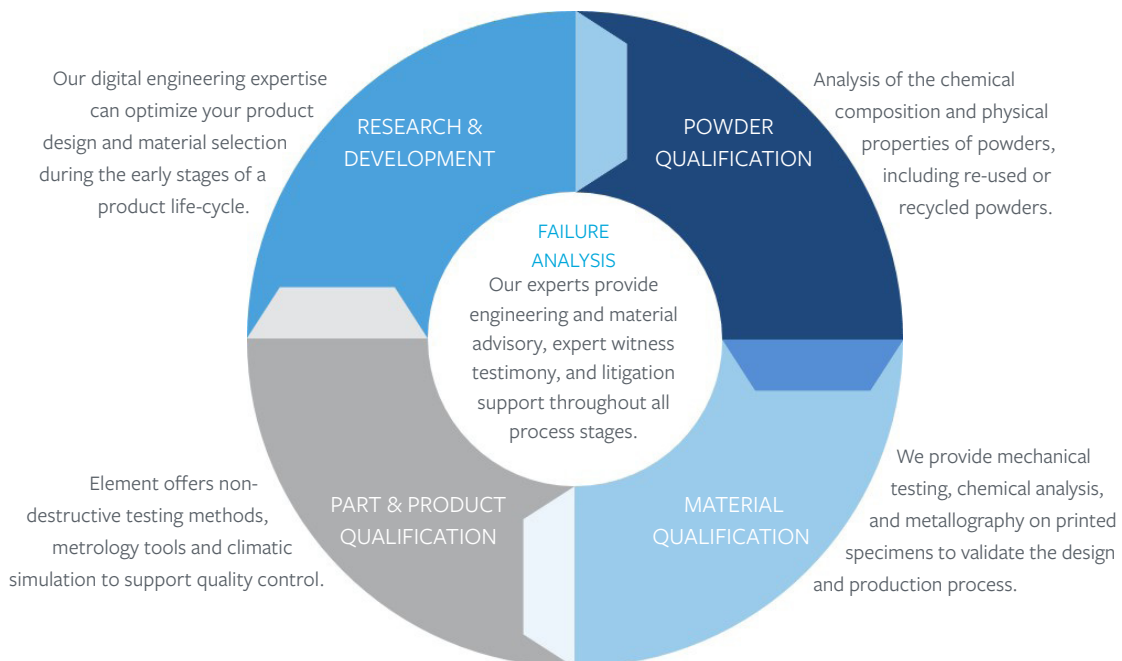
As a trusted testing partner, we are supporting our clients in a range of industries including the aerospace, medical device, transportation, industrials, and energy sectors by accelerating the creation of stringent international testing standards for additive manufacturing (AM).

In doing so, we have been able to qualify early in these highly-regulated industries characterized by rigorous validation. Our goal is to ensure that materials and products created with additive manufacturing methods are safe and fit for purpose in critical applications. Among our more than 200 global locations and centers of excellence in Europe and North America offer specialized services for the additive manufacturing industry.

With our experts actively involved in organizations such as

- the ASTM International Committee F42 on Additive Manufacturing Testing Technology,
  - the ASTM International Additive Manufacturing Center of Excellence,
  - and the National Additive Manufacturing Innovation Institute,
- our clients can be sure that we are staying at the forefront of additive manufacturing testing.

You can be certain that your results from Element are reliable, accurate, and dependable, no matter what the application. Our experts help ensure that your products can go to market quickly and safely.



## RESEARCH & DEVELOPMENT

Element has a long history of supporting research, development, and design stages of the product life-cycle with mechanical testing. Our digital engineering expertise can optimize the design and production and through-life processes with:

- Computation Fluid Dynamics (CFD)
- Development of Digital Twins
- Discrete Element Modeling (DEM)
- Engineering Critical Assessment (ECA)
- Finite Element Analysis (FEA)
- Virtual prototyping
- Computed tomography (for reverse engineering, dimensional measuring)
- Failure analysis

## POWDER QUALIFICATION

Laboratories in Europe and the US offer a range of powder qualification services. The Element Antwerp laboratory is accredited for full-scope powder characterization according to ISO/ASTM 52907.

### POWDER CHARACTERIZATION

The complete scope of investigating the physical properties of metal powders offered by Element includes:

- Representative sampling
- Particle size distribution, sieve analysis
- Apparent density
- Compacted 'tap' density
- Flowability, Hall funnel
- Morphology
- Contamination

### CHEMICAL ANALYSIS

Recommended methods for metal powders:

- Scanning Electron Microscopy SEM-EDX (fractography, contamination, morphology)
- Laser diffraction (particle size distribution)
- Combustion analysis
- Optical Emission Spectroscopy (spark OES and ICP-OES)
- Inert gas fusion

Other methods such as Mass Spectrometry (MS), Glow Discharge Mass Spectrometry (GD-MS), or Atomic Absorption are available for specific cases (e.g. some trace elements).

## MATERIAL QUALIFICATION

Our AM testing laboratories are ISO17025 accredited and offer a complete range of materials testing and research services. Some locations also hold Nadcap accreditations and received industry approvals from companies like Airbus, Boeing, GE, Honda, Honeywell, Rolls-Royce, Safran, Snecma, and Shell. Our mechanical testing services include:

- Tensile and compression testing
- Fatigue and fracture toughness testing
- Creep and stress rupture testing
- Impact testing
- Hardness testing
- Metallography
- Failure analysis

Many tests can be performed at elevated or cryogenic temperatures.

## TESTING OF POLYMERS

Element supports the testing of non-metallic basic materials and final products:

- Chemical Composition
  - Fourier Transform Infrared (FTIR)
  - Ash Content
- Thermal Analysis
  - Thermomechanical Analysis (TMA)
  - Differential Scanning Calorimetry (DSC)
  - Dynamic Mechanical Analysis (DMA)
  - Thermogravimetric Analysis (TGA)

## EXPOSURE TESTING

In climate and environmental simulations, we test the behavior of metallic and non-metallic materials, including:

- Accelerated weathering
- Chemical resistance
- Corrosion and salt spray testing
- High pressure, high temperature (HPHT) testing
- UV testing



## PART & PRODUCT QUALIFICATION

Additional to destructive testing methods we offer inspection for surface or inner defects and dimensional integrity. Wear and abrasion testing ensure that your final product will withstand different levels of fatigue, compression, torsion, and bending.

### NON-DESTRUCTIVE INSPECTION

Our experts hold NDT master level staff for all inspection techniques:

- Magnetic particle inspection (MPI)
- Liquid penetrant inspection (LPI)
- Eddy current testing (ET)
- Ultrasonic testing (UT)
- Visual inspection
- X-Ray & Digital radiography (RT, DR)
- Computed tomography (CT)

### SURFACE MEASUREMENT AND METROLOGY SERVICES

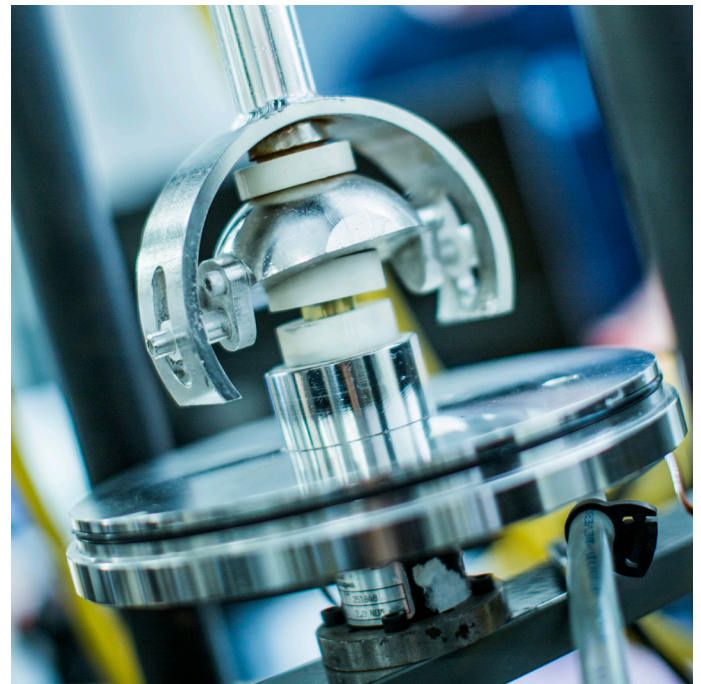
- Dimensional inspection with coordinate-measuring machines (CMM) and computed tomography
- Surface roughness measurements
- Surface depth and defects measurements
- Determination of microscopic particle dimensions
- Dimensioning of microscopic fractographic features
- Defect analysis (porosities, cracks, inclusions)

### MEDICAL DEVICE PRODUCT TESTING

- Spine (Porous matrices, integrated fixation, SIJ, fusion & non-fusion)
- Knee (Femurs, tibial trays & inserts)
- Hip (Acetabular Cups, Stems, Coatings and Liners)
- Trauma (Shoulder, Ankles, Small Joints, Screws & Plates)
- Instruments & Patient Specific Guides

### MEDICAL DEVICE ADDITIVE SERVICES

- IQ / OQ / PQ for build plate qualification
- Coupon Design and Testing
- Technical Consulting
- Regulatory Submission Services
- Particulate Characterization
- Wear Debris Analysis



## FAILURE ANALYSIS & ADVISORY

There are numerous causes for a failure ranging from flawed designs and production errors to incorrect use of components, material wear or incalculable environmental influences. Element uses failure analysis as a holistic and systematic method to determine how and why a material failed with the goal of improving products and production processes.

Our failure analysis methods include:

- Macroscopic and microscopic documentation and assessment
- Scanning electron microscopy
- Destructive and non-destructive testing methods
- Corrosion testing
- Fractography
- Chemical analysis
- Material characterization

## ABOUT ELEMENT

Element is a leading global provider of Testing, Inspection, and Certification services on a wide range of products, materials, processes and services and products for a diverse set of end markets, where failure in service is simply not an option. Element's scientists, engineers, and technologists, working

in our global network of over 200 laboratories, support customers from early R&D, through complex regulatory approvals and into production ensuring that their products, materials, processes, and services are safe, compliant, and fit for purpose.

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