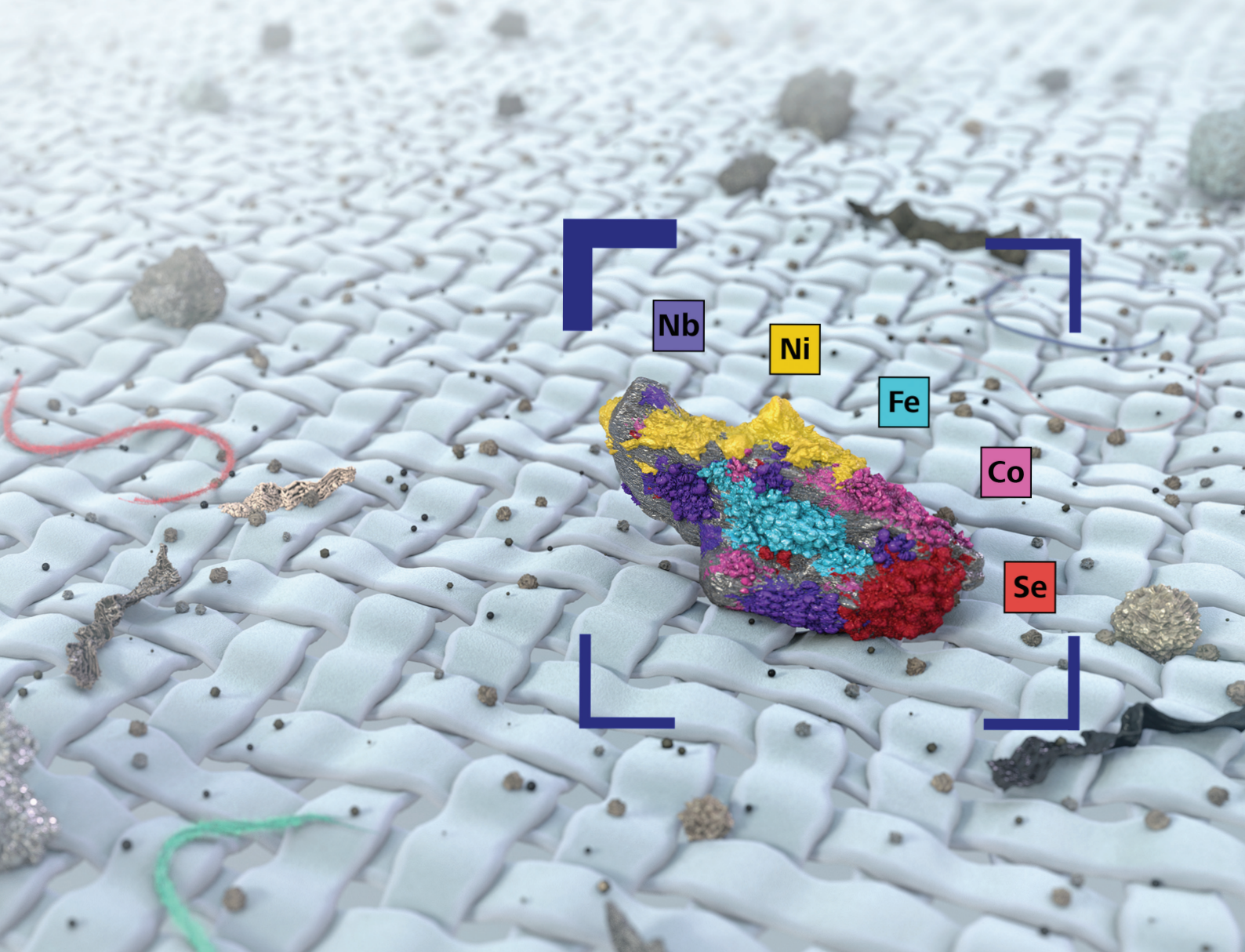


Identify the root cause.

Make the right
decision faster.



ZEISS Technical Cleanliness Solutions

Correlative workflow to identify particle contamination



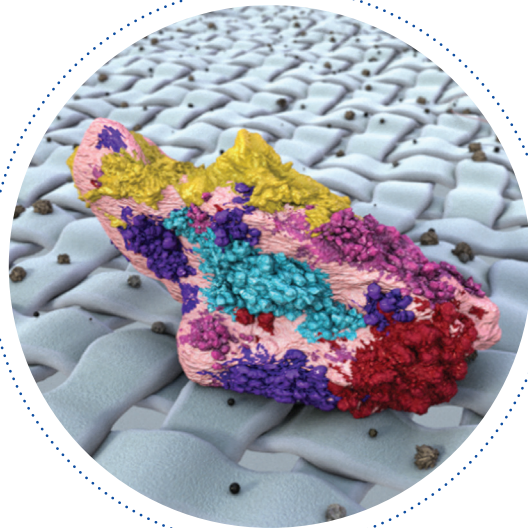
Particularly clean

Quality assured

Particle filters
from cleaning cabinet
or other particle
extraction methods



**Critical particle
comprehensively
characterized**



Particulate contamination is the enemy of any product's efficiency, functionality and longevity.

Suppliers, manufacturers and end users demand ever-increasing quality standards, so an advanced technical cleanliness program is fundamental to eradicating contamination of manufactured parts and components along the entire production process.

Additionally, investigations have shown that the major source of failure in hydraulic and oil-filled machines is based on particulate contamination. Oil analysis helps to minimize maintenance costs and improve machine uptime.

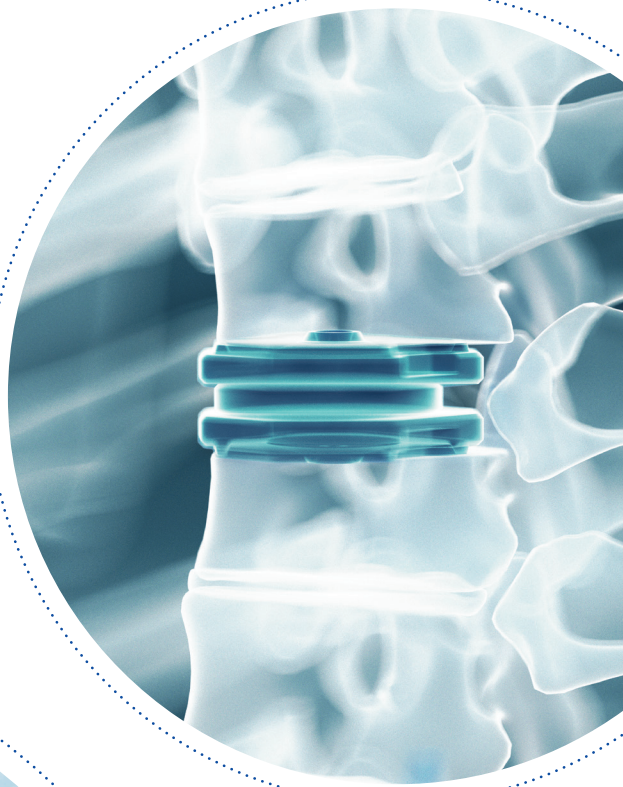
To achieve maximum quality, manufacturers need clear and comprehensive particle analysis data.

ZEISS Technical Cleanliness Solutions identify the root cause of contamination, allowing you to make the right decision faster.

Tailored precisely to the needs of manufacturing industries

Medical
Technology

Automotive
NEV



ZEISS Technical Cleanliness Solutions were developed in collaboration with automotive companies. They had a specific need for powerful particle identification and classification systems, which had to be simple to use.

As a result, ZEISS solutions are easy to apply, can be deployed to multiple sites within any manufacturing or industrial environment and used by operators who are not microscopy experts.

ZEISS particle analysis solutions work with established industry standards:

Technical cleanliness

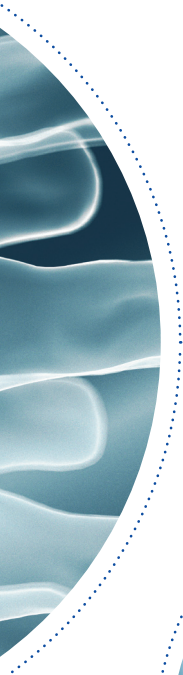
- VDA 19.1
- ISO 16232

Oil cleanliness

- ISO 4406
- ISO 4007
- DIN 51455*
- SAE AS 4059
- NAS 1638

Cleanliness of medical devices in the manufacturing process

- VDI 2083
-



**Additive
Manufacturing**

Aerospace



* Available as of 2021

Go beyond standards

Make informed decisions about the root cause of contamination

ZEISS solutions for cleanliness testing not only allow you to quantify particulate contamination according to industry standards.

The ZEISS solution portfolio enables combined particle detection and classification in a highly efficient workflow that not only finds particles, but also helps to classify them by contamination or wear origin.

With ZEISS you can combine data from both light and electron microscopes in a single workflow to get more comprehensive information.



Light microscopy systems

Estimate potential risk for contamination

Itemize particles by quantity, size distribution and morphology, and distinguish metallic shiny from non-shiny particles and fibers down to 2 μm . Create cleanliness reports according to industry standards.

Distinguish metallic shiny vs. non-shiny particles

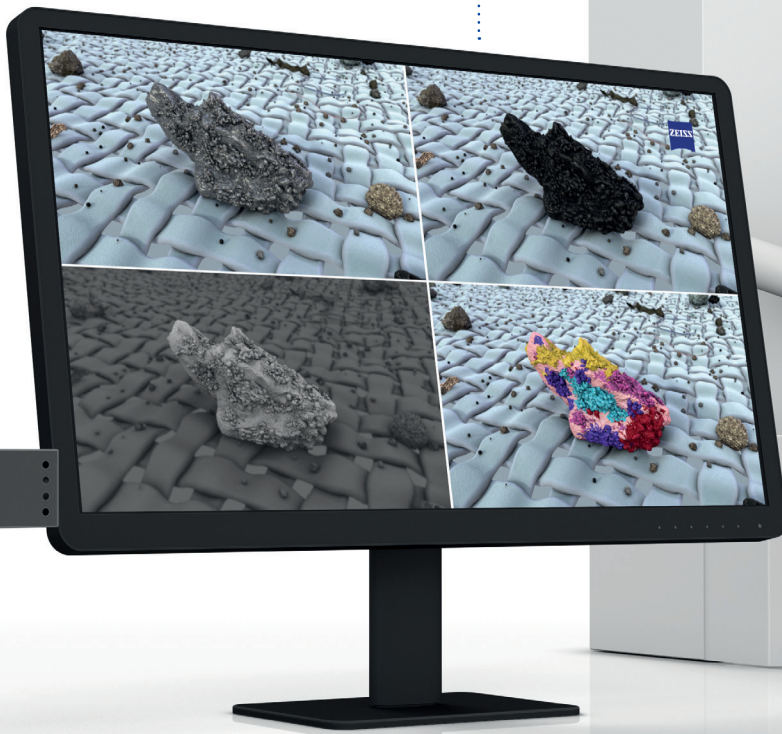


Correlative particle analysis

Establish advanced analysis workflow

Characterize process-critical particles and identify killer particles using Correlative Automated Particle Analysis (CAPA), which combines your data from both light and electron microscopes in a single workflow.

Seamless correlative workflow
& insights into particle origin



Electron microscopy and EDS systems

Pinpoint sources of contamination

Measure morphological characteristics of particles and use fully automated elemental analyses to classify particles by their chemical composition.

Measures the elemental
composition of the metallic particles

Full color mapping
of all elements detected



Correlative Particle Analysis Workflow



Particle filters
from cleaning cabinet
or other particle
extraction methods



Light Microscopy Workflow

| Hardware | | Software |
|---------------------------------|---|---|
| Light Microscopy Filter scan | | ZEISS Technical Cleanliness Analysis Quantification & basic classification |
| | ZEISS SteREO Discovery.V8 Particle size $\geq 15 \mu\text{m}$ | <ul style="list-style-type: none"> ✓ One-scan technology: only one filter scan is needed to acquire both brightfield and crossed polarization image information; ✓ Particle quantification by size, shape, distribution; ✓ Particle qualification by metallic shiny, non-shiny, fibers; ✓ Particle height measurement (Axioscope 7, Axio Imager 2)*; ✓ Oil cleanliness analysis (Axio Imager 2). |
| | ZEISS Axioscope 7 Particle size $\geq 50 \mu\text{m}$ | |
| | ZEISS Axio Zoom.V16 Particle size $\geq 5 \mu\text{m}$ | |
| | ZEISS Axio Imager 2 Particle size $\geq 1 \mu\text{m}$ | |

Electron Microscopy Workflow

| Hardware | | Software |
|---|---|---|
| Electron Microscopy Filter scan with EDS | | ZEISS SmartPI Quantification & advanced classification |
| | ZEISS EVO Particle size $\geq 20 \text{nm}$ | <ul style="list-style-type: none"> ✓ Particle quantification by size, shape, distribution; ✓ Advanced particle morphology studies; ✓ Advanced classification by elemental composition and material characterization to locate the root cause of contamination. |
| | ZEISS Sigma Particle size $\geq 20 \text{nm}$ | |

CRITICAL PARTICLES DETECTED



REPORT

- ✓ Automated reporting at the click of a button according to all major industry standards* and customized company standards.

AUTOMATICALLY RELOCATE CRITICAL PARTICLES



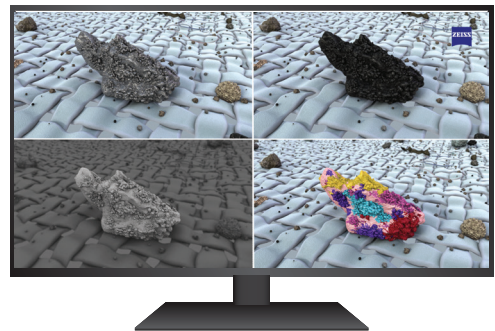
REPORT

- ✓ Automated reporting at the click of a button according to all major industry standards** and customized company standards.

ORIGIN OF CONTAMINATION LOCATED

ZEISS CAPA

Correlative Automated Particle Analysis



Correlated analysis across Light and Electron microscopy in a seamless integrated workflow

- ✓ Automatic integrated LM / EM reporting;
- ✓ Pinpoint sources of contamination;
- ✓ Make informed decisions faster;
- ✓ Continually improve production quality.



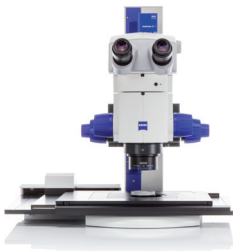
UP TO 10X FASTER RESULTS VERSUS CONSECUTIVE INDIVIDUAL ANALYSIS

** Supported industry standards: VDA 19.1, ISO 16232, ISO 4406, ISO 4007, DIN 51455*, SAE AS 4059, VDI 2083, NAS 1638

* Available as of 2021

Light Microscopy Systems

ZEISS SteREO Discovery.V8



For particle size $\geq 15 \mu\text{m}$
Recommended for standard analyses according to VDA 19.1

Identify fibers and differentiate between metallic shiny and non-shiny particles with this cost-effective system for standard cleanliness testing applications.

ZEISS Axio Zoom.V16



For particle size $\geq 5 \mu\text{m}$
Recommended for extended analyses according to VDA 19.1

Perform accurate and repeatable analyses with this fully automated digital zoom microscope that supports rapid large field scanning and extended analyses requirements.

ZEISS Axio Imager 2



HARDWARE



For particle size $\geq 1 \mu\text{m}$
Recommended for advanced analyses, particle height measurement*, and oil analyses

Meet your high-resolution particle analyses requirements with this fully automated microscope for fast and precise measurement of particle length, width, and height*.

ZEISS Axioscope 7



HARDWARE



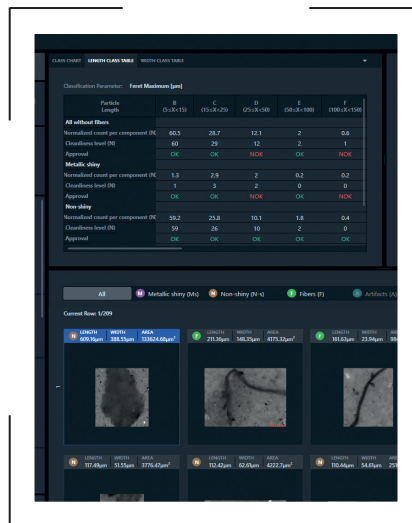
For particle size $\geq 50 \mu\text{m}$
Recommended for standard analyses according to VDA 19.1

Enable automation for your standard analysis. This microscope allows fully motorized axes of motion for automated imaging and height measurement (2020/21) in everyday operations.

ZEISS Technical Cleanliness Analysis



SOFTWARE



Particle analysis software for light microscopes

This easy-to-use software for standards-compliant cleanliness analyses enables the automated identification and classification of particles. Unlike conventional analysis methods, metallic shiny particles are detected with only one filter scan, which dramatically speeds up not only cleanliness reporting but also the identification of contamination sources. ZEISS Technical Cleanliness Analysis is part of ZEISS ZEN core, the software suite for connected microscopy, and can therefore be seamlessly integrated into extended analysis workflows. Regulatory requirements such as FDA21 CFR Part 11 can be fulfilled by the module GxP as optional part of the ZEN core TCA Software.

Electron Microscopy Systems

ZEISS EVO

ZEISS Sigma 300



HARDWARE



C-SEM with EDS

Recommended for automated routine particle analyses

Utilize this SEM/EDS system for routine particle analyses applications. EVO is available with variable pressure (VP) to enable imaging and analysis of non-conductive samples, such as particle filter membranes.



FE-SEM with EDS

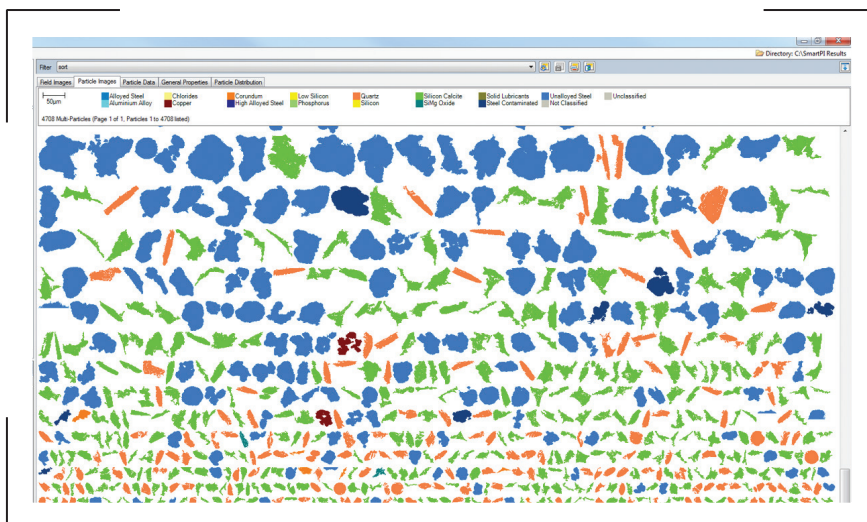
Recommended for high-resolution particle analyses

Sigma 300 is the SEM of choice for particle analyses in the nanometer scale range. The system provides outstanding imaging results and is very well suited to elemental analysis, particularly on magnetic samples.

ZEISS Smart PI



SOFTWARE



Particle analysis software for electron microscopes

SmartPI automates detection, analysis, and classification of particles, incorporating microscope control, image processing and elemental analysis within a single application. When used in correlative workflows, the software automatically retrieves critical particles previously identified under the light microscope, enabling rapid determination of chemical composition to identify the root cause of contamination quickly.

* Available as of 2021

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