Quality control: Turn data into answers

Automated particle analysis with Perception Software

thermo scientific

Scanning electron microscopes (SEMs) have come a long way since their invention. While they were first used for single sample research, further development made SEMs accessible for a wide variety of applications. They now provide fundamental insights into materials for both academic and industrial work.

In quality control, SEMs are routinely used to inspect steel, precision parts, and battery components for contamination or defects that mostly come in the form of tiny particles or inclusions in the material. Depending on their size, shape, and composition, particles can negatively affect the quality of a finished product. They can block flows, damage moving surfaces, or be the starting point of failure.

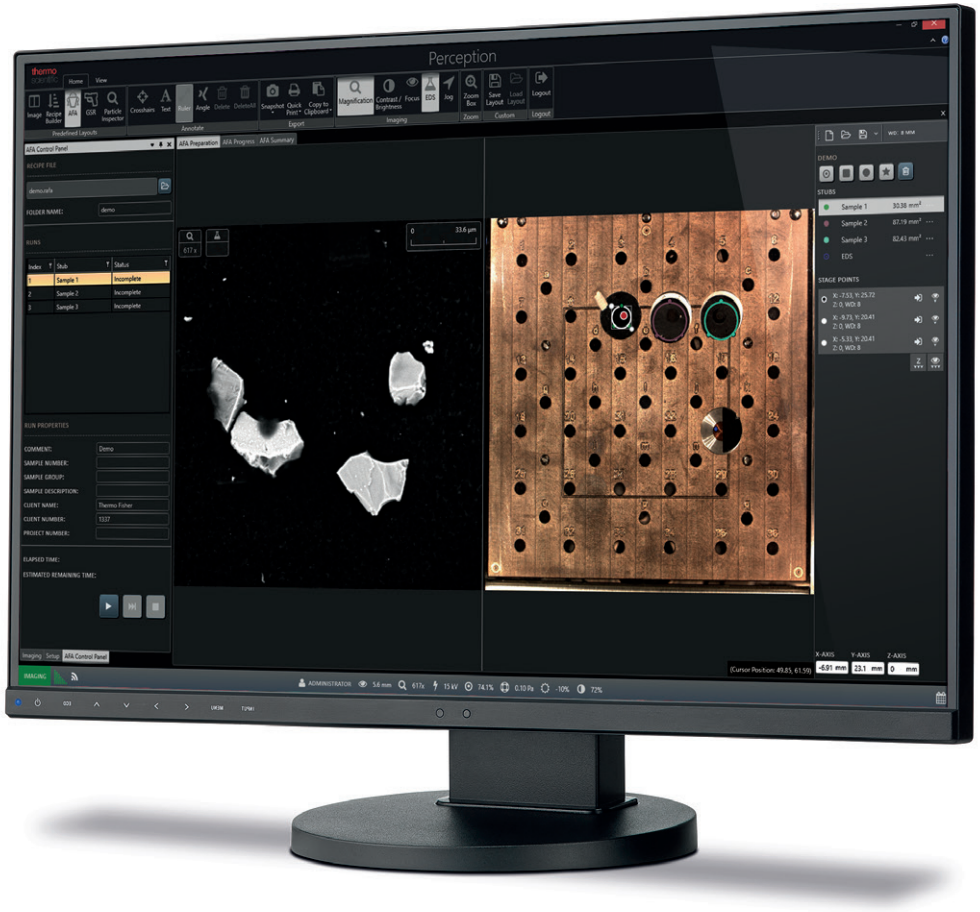
To protect product quality, it is critical to understand the properties of the particles found in or on your product. Thermo Scientific™ Perception Software automates particle analysis, simultaneously helping you improve product quality, increase efficiency, and reduce time spent on manual tasks.

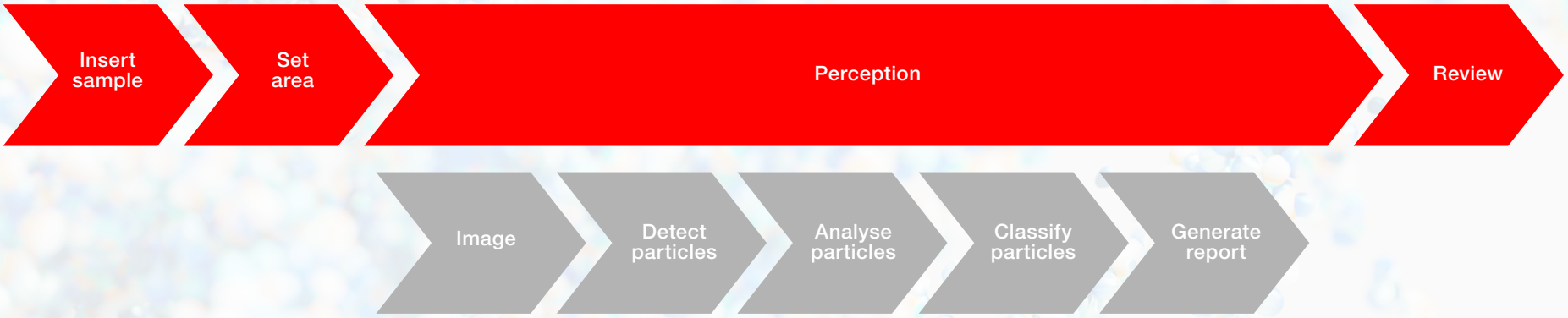
Automation that simplifies analysis

To make informed conclusions, you need a lot of data. And to collect that data, you have to image thousands of particles and scan large areas of your material. This work can take hours and sometimes days if done manually.

Perception Software automates data collection and analysis with a standardized, recipe-based workflow that reduces time spent on manual analysis to just minutes. All you have to do is place your samples inside the SEM, define the sample area, load the recipes, and press play.

The software automatically performs the analysis, detecting particles and acquiring morphology and compositional data for each one. This process can run day and night without the need for any manual intervention, leaving you free to perform other tasks.





Perception Software automates many steps of the particle analysis workflow, reducing time spent on manual tasks.

Throughout the analysis, Perception Software collects a wide-ranging dataset of measured parameters. It then sorts and classifies particles to help organize the data and make it easier to interpret. For example, particles can be classified as metallic or non-metallic based on their composition. When the analysis is complete, Perception Software generates a customizable report.

Consistent, unbiased data

Perception Software uses recipes to create a standardized way of working. To help you get started, it includes several industry-specific workflows based on years of particle analysis experience. These workflows include three primary recipes:

- The **Stage Recipe** sets the area to be analyzed
- The **Automated Feature Analyses Recipe** contains the tasks and analysis steps Perception Software performs automatically
- The **Classification Recipe** contains rules for classifying particles based on their morphology, size, and chemical composition

You can refine these recipes to tune the analysis for your unique needs. You can also share recipes across multiple systems and locations, which makes it possible to compare data from systems spread around the world.

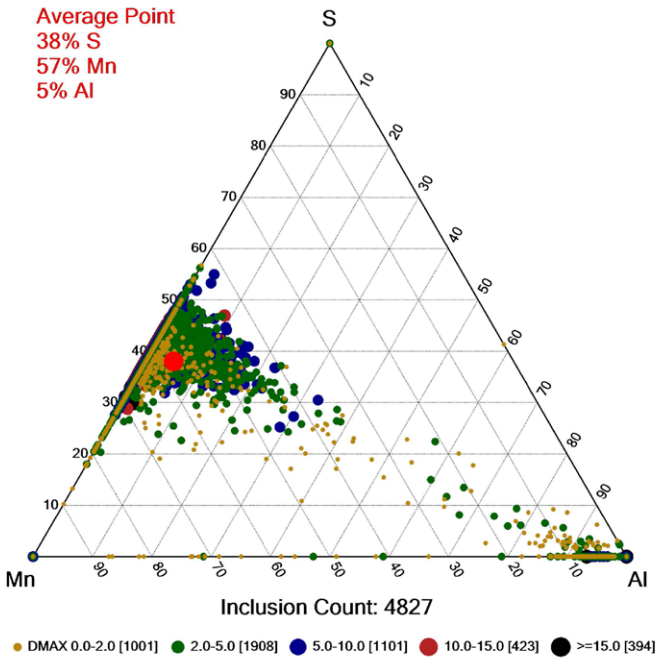
Automatic visualization and reporting

To make an informed decision about your material, collected data must be sorted, visualized, and compared to existing specifications.

With its reporter tool, Perception Software makes it easy to set up reports. The tool uses blocks with specific reporting functionality that you can place in a desired order. Each block can be further tuned to present the desired data. For example, a block could create a bar graph displaying glass particles in the size range of 1 µm to 50 µm.

The tool can automatically generate graphs, tables, and ternary diagrams for visual interpretation, which makes drawing conclusions easier and faster. You can set your specifications and compare them to measured values, providing a pass or fail classification for performed analyses.

Perception Software offers specific functionality for particle analysis according to standards and norms. Pre-made blocks guarantee that data is reported according to the chosen norm, and you can save reports as templates for automatic generation after each analysis. The only manual task is sending the report to your stakeholders.



Inclusion Classification Summary													
Classification	Particles	[%]	N	Mg	Al	Si	S	Ca	Ti	Mn	Features/ mm_2	Area%	Incl.Index
Mn Sulfide	4130	84.8	1.5	1.2	1.3	0.6	36.2	2.1	2.2	54.0	20.1	94.4	0.02154
Ti Nitride	511	10.5	30.7	0.2	0.5	0.7	5.5		51.2	10.5	2.5	3.0	0.00068
Spinel Pure	201	4.1	0.1	32.1	56.5	2.5	1.3	0.9	1.4	4.7	1.0	0.9	0.00021
Spinel Rich	23	0.5	4.6	19.3	39.2	1.4	7.4	1.0	12.0	14.4	0.1	0.1	0.00001
Alumina	7	0.1	1.9	0.4	82.7	2.4	1.0	0.3	4.9	5.6	0.0	1.6	0.00037
Mg Rich	1	0.0		49.8	1.4	1.5	18.8			28.6	0.0	0.0	0.00001
All above combined	4873	100.0	4.5	2.5	3.8	0.7	31.3	1.8	7.3	47.2	23.7	100.0	0.02283

Sample Information		Sample Prep Information		Run Information	
Company:		Component Surface By:	Volume	Magnification:	220x
Operator Name:		Volume of Extraction(cm^3)	100	Number of Stage Fields:	61
Part # / Sample ID:		Projected Volume(cm^3)	100	Area Scanned(mm^2):	36.42
Analysis Date:	3/29/2021 1:30:40 PM	Filter Size (mm):	300	RunID's Present:	Run_1

Particle Results												
Size Class		B-C	D	E	F	G	H	I-J				
Size Range (um)	Total	5 ≤ X < 25	25 ≤ X < 50	50 ≤ X < 100	100 ≤ X < 150	150 ≤ X < 200	200 ≤ X < 400	400 ≤ X < 1000				
Glass	119		64	49	4	1	1					
Al2O3	111		34	68	9							
Si Rich	99		96	3								
SiO2	9		7	1		1						
Ca-Aluminosilicates	5		3	1	1							
Aluminosilicates	4		1	2	1							
Steel	2		1	1								
Oxidized Al	1		1									
Misc	19		12	6			1					
Mineral	3		3									
Non-Ferrous Metal	1		1									
Misc Salts	7		7									
Total Counts	380	0	230	131	15	2	2	0				
Cleanliness Level		00	8	8	4	1	1	00				
Component Cleanliness Code (CCC):			V(B-C00/D8/E8/F4/G1/H1/I-J00)									
Specification:			V(B-C00/D10/E8/F4/G3/H3/I-J00)					Pass specification				

Turn your data into answers

No matter your field, quality control can be summed up in one question: Does my product meet the set specifications?

Perception Software can help you answer that question.

- By automatically collecting accurate, repeatable data from your samples
- It can help you identify production trends and correct issues before they affect the quality of your product.

Here are a few examples of how Perception Software can be used for a variety of applications.

Fast, repeatable, and reproduceable results

- Collect accurate, reliable data
- Operate using standard procedures

High-quality data sets

- Visually explore composition and morphology
- Find trends across samples

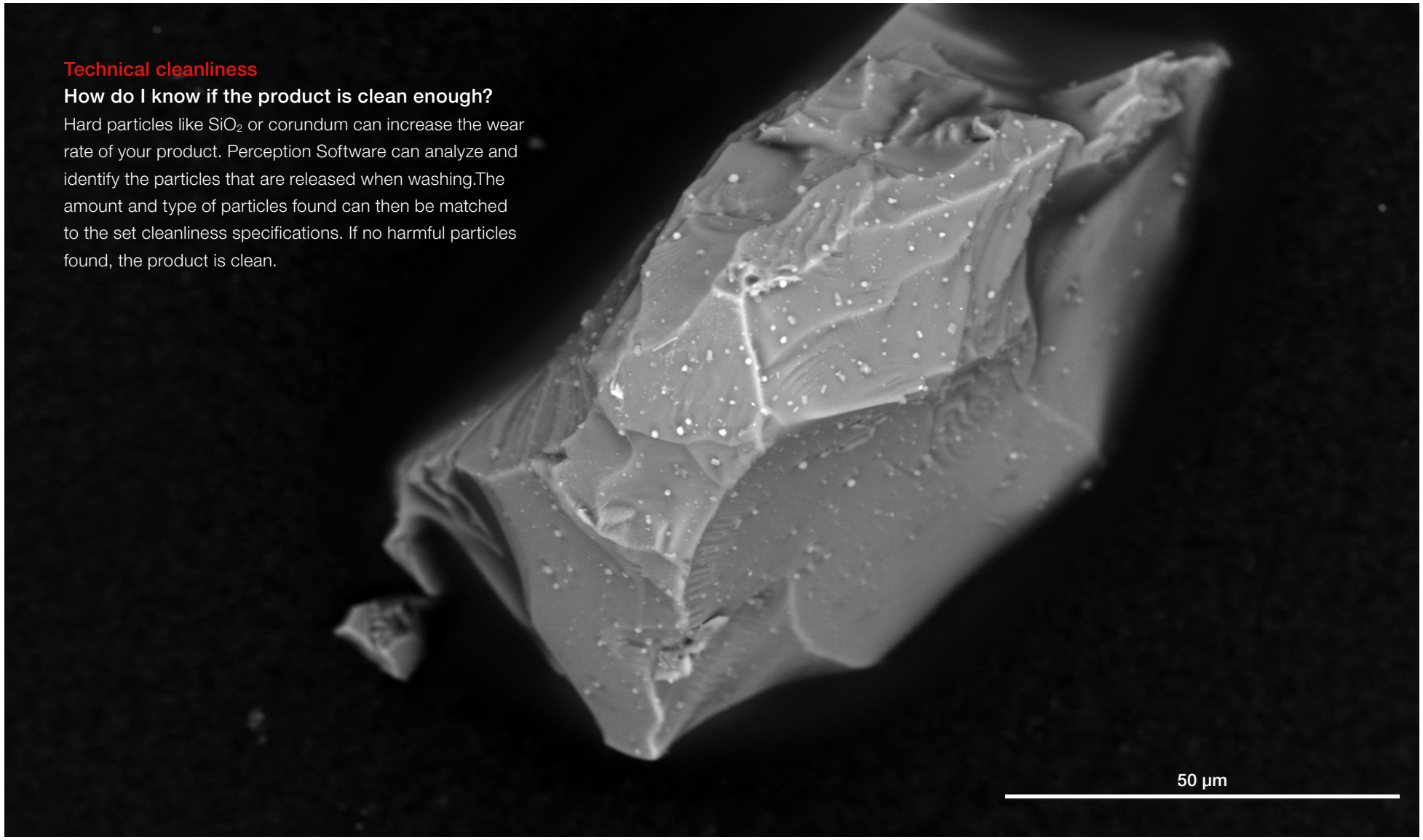
Cost savings

- Improve product quality with an efficient system
- Complete analysis without operator oversight

Technical cleanliness

How do I know if the product is clean enough?

Hard particles like SiO_2 or corundum can increase the wear rate of your product. Perception Software can analyze and identify the particles that are released when washing.The amount and type of particles found can then be matched to the set cleanliness specifications. If no harmful particles found, the product is clean.

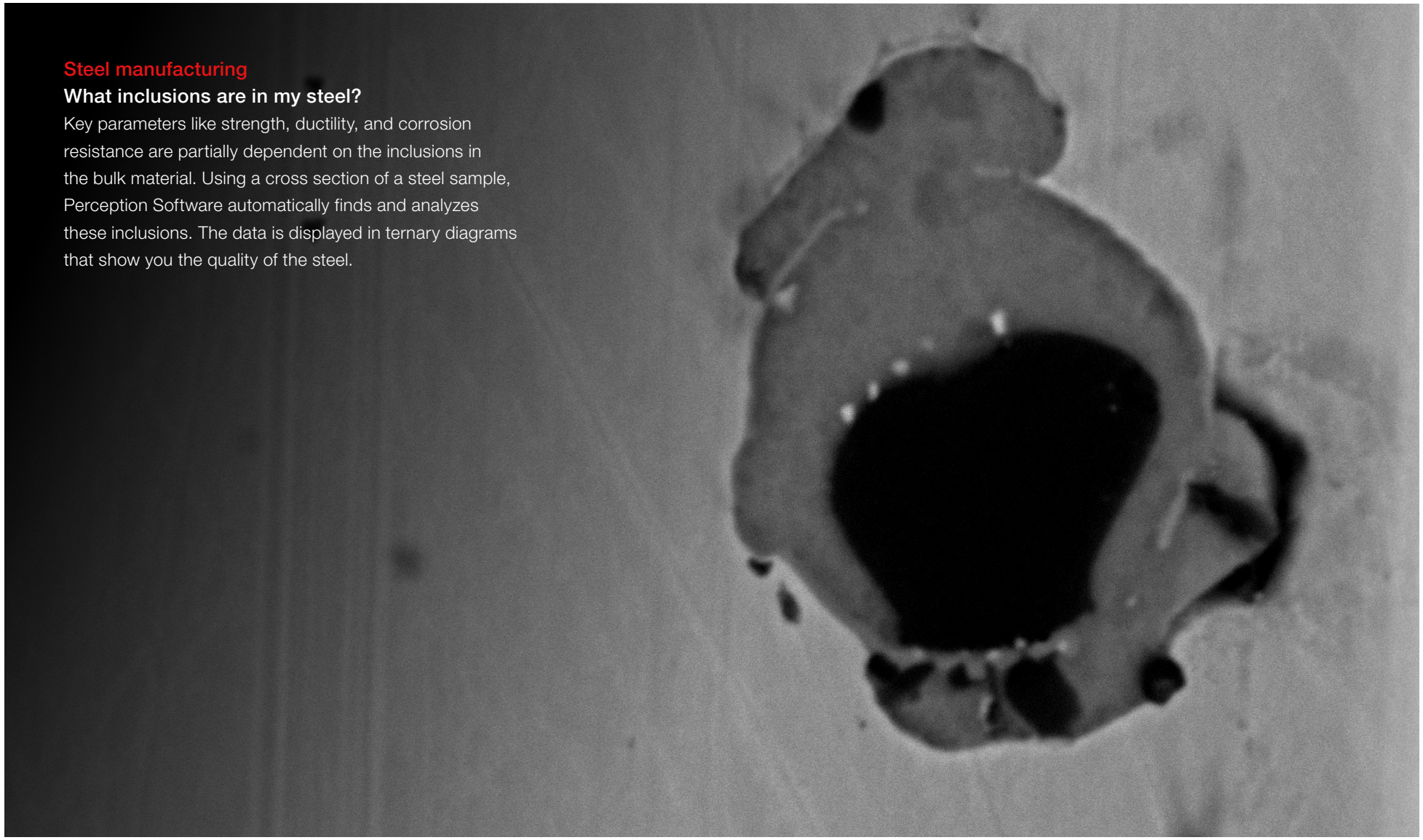


A hard, sharp particle of Al_2O_3.

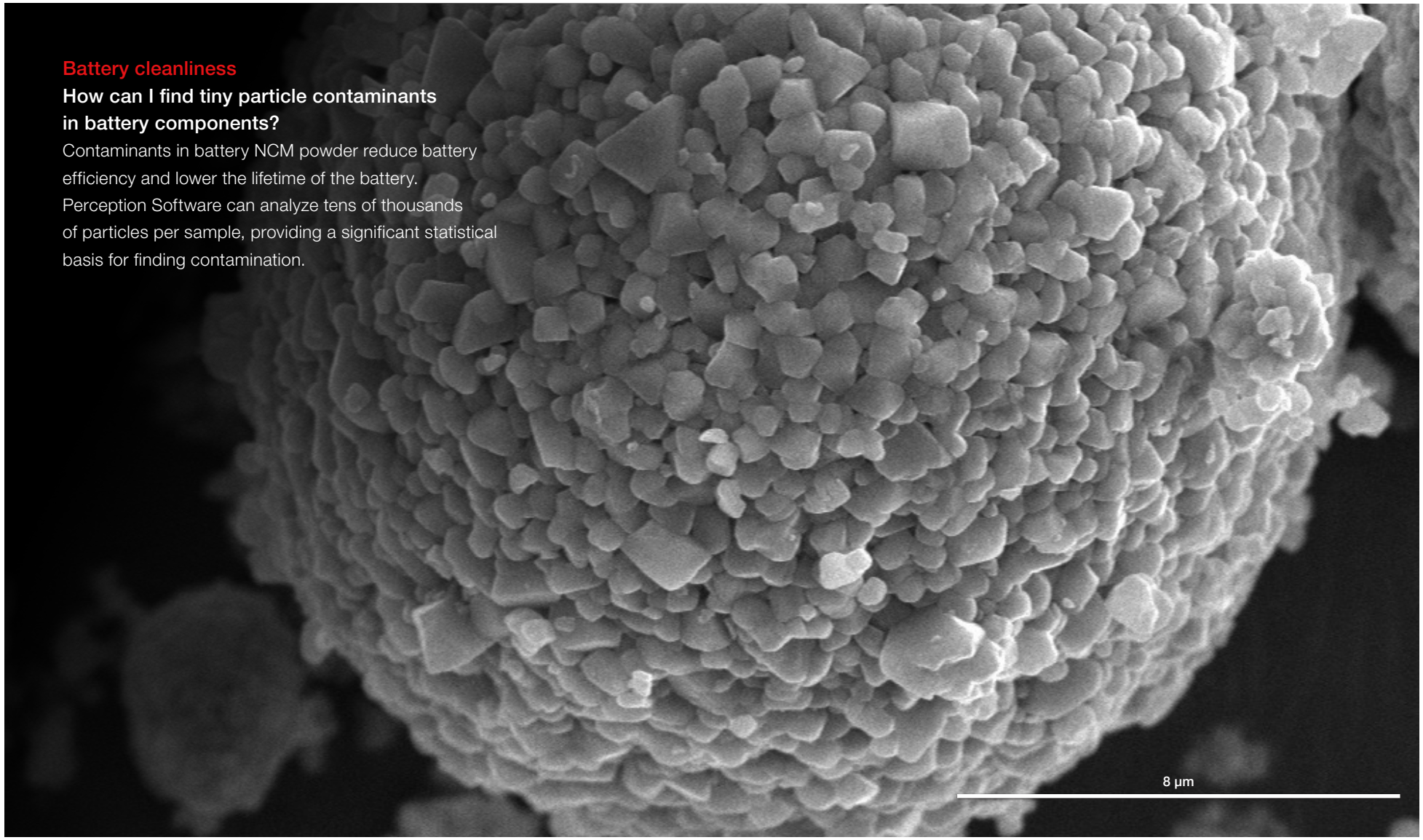
Steel manufacturing

What inclusions are in my steel?

Key parameters like strength, ductility, and corrosion resistance are partially dependent on the inclusions in the bulk material. Using a cross section of a steel sample, Perception Software automatically finds and analyzes these inclusions. The data is displayed in ternary diagrams that show you the quality of the steel.



Inclusion found in a polished steel cross section.

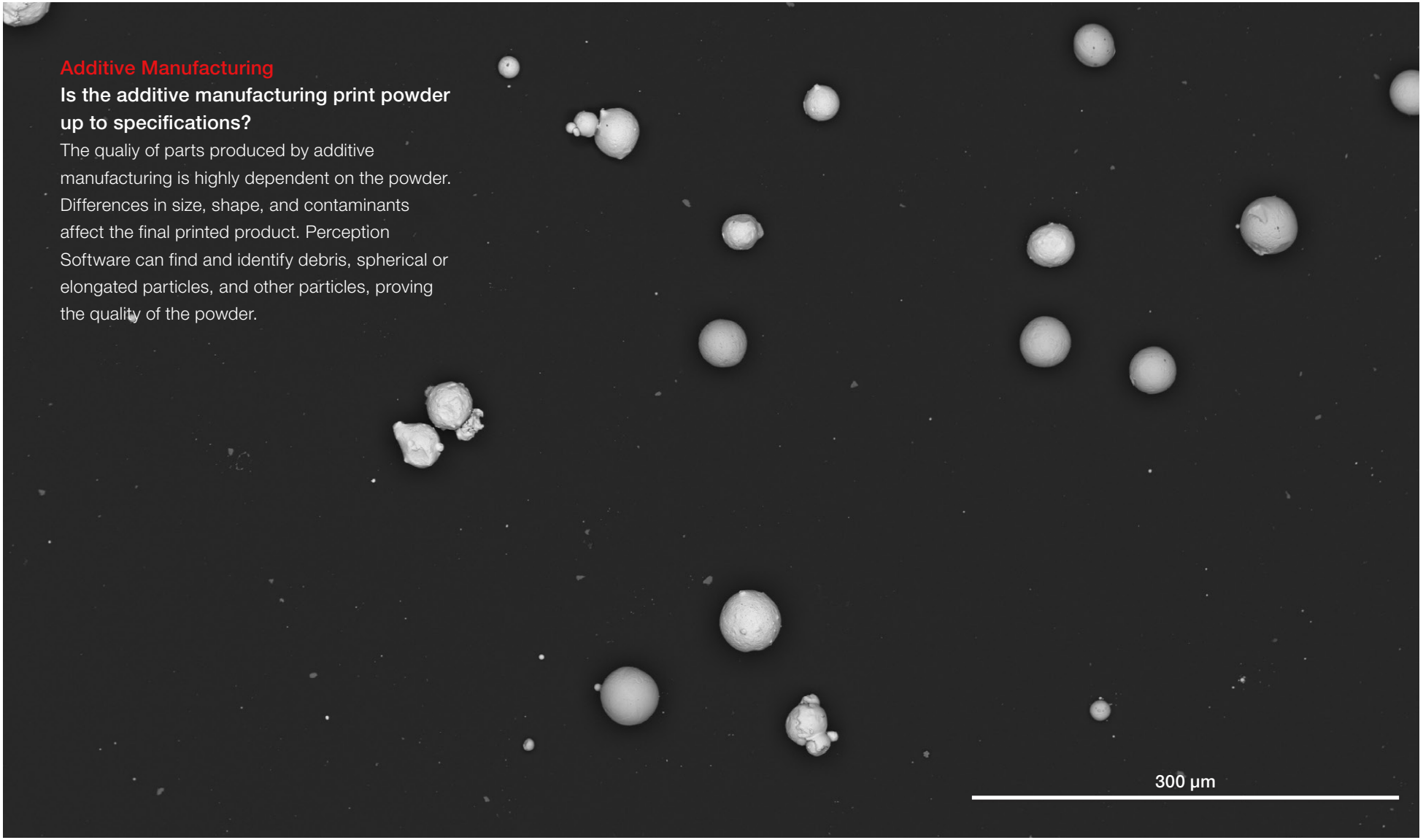


Battery cleanliness

How can I find tiny particle contaminants in battery components?

Contaminants in battery NCM powder reduce battery efficiency and lower the lifetime of the battery. Perception Software can analyze tens of thousands of particles per sample, providing a significant statistical basis for finding contamination.

Cathode powder used in battery production.



316L powder for additive manufacturing.

Uncover details that make a difference

Thermo Scientific Perception Software is your solution for advanced automated particle analysis, classification, and unparalleled reporting. This all-in-one software package will turn your SEM of choice into a dedicated solution for your particle analysis needs. Plus, it seamlessly integrates with Thermo Scientific energy dispersive X-ray spectroscopy (EDS) detectors, delivering an optimized, high-speed workflow.

Built on more than 30 years of experience in SEM-EDS automated particle analysis, Perception Software is a complete and proven automated particle analysis solution.

Learn more

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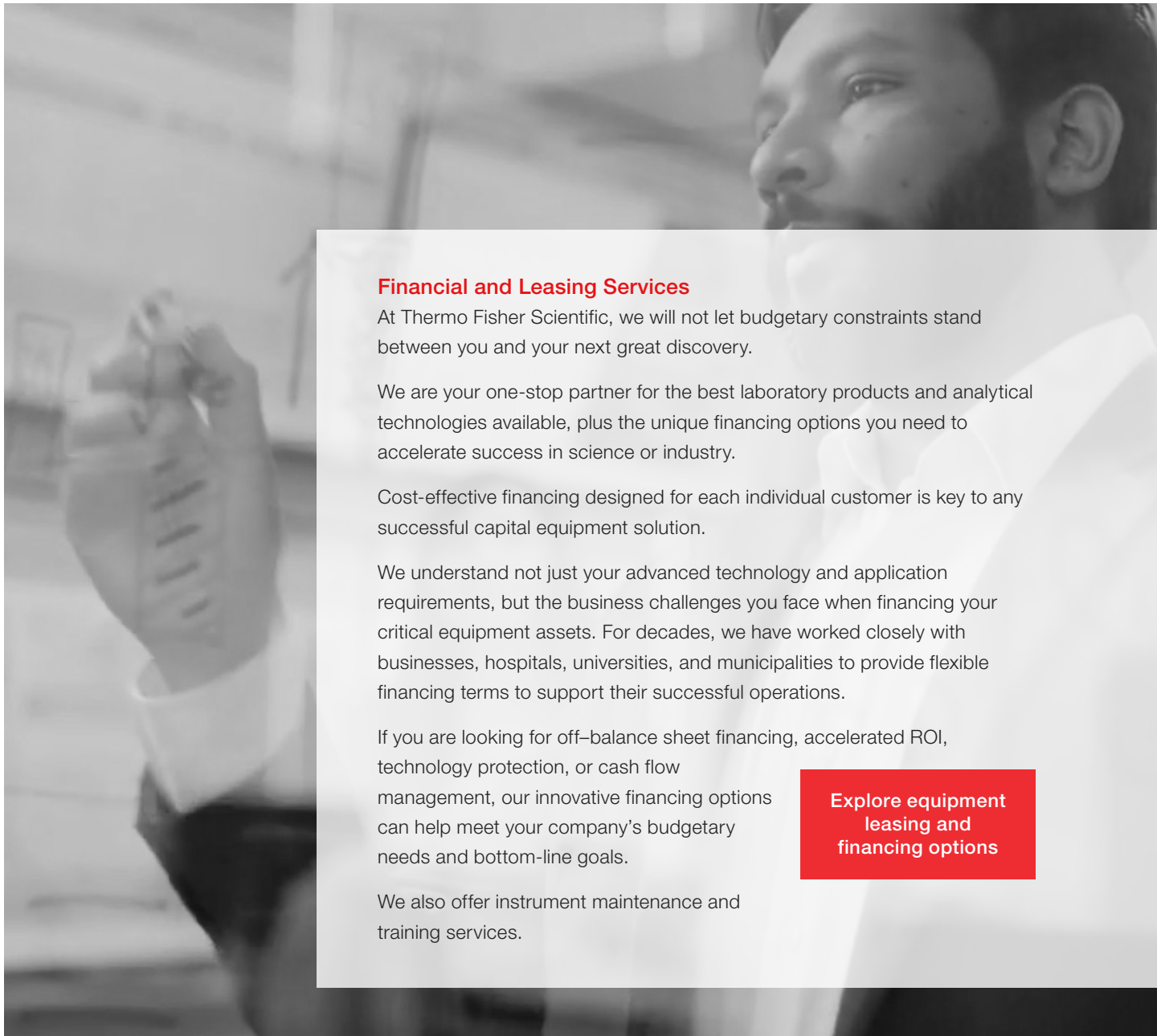

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We support you across the lifetime of your system

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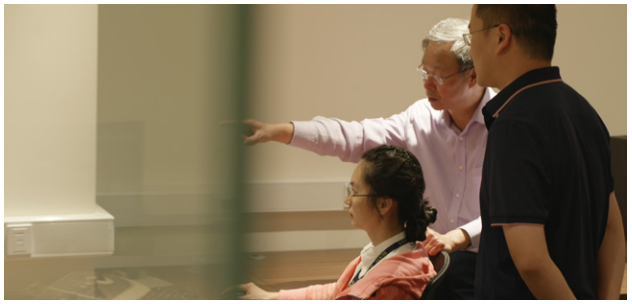

Service innovation

Our service innovation team is focused on improving our customer's experience by collaborating with R&D to drive reliability and supportability of next-generation systems. Service innovation focuses on anticipating future service needs and trends by developing new tools and capabilities to improve system performance.

Learn more at **thermofisher.com/perception**

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