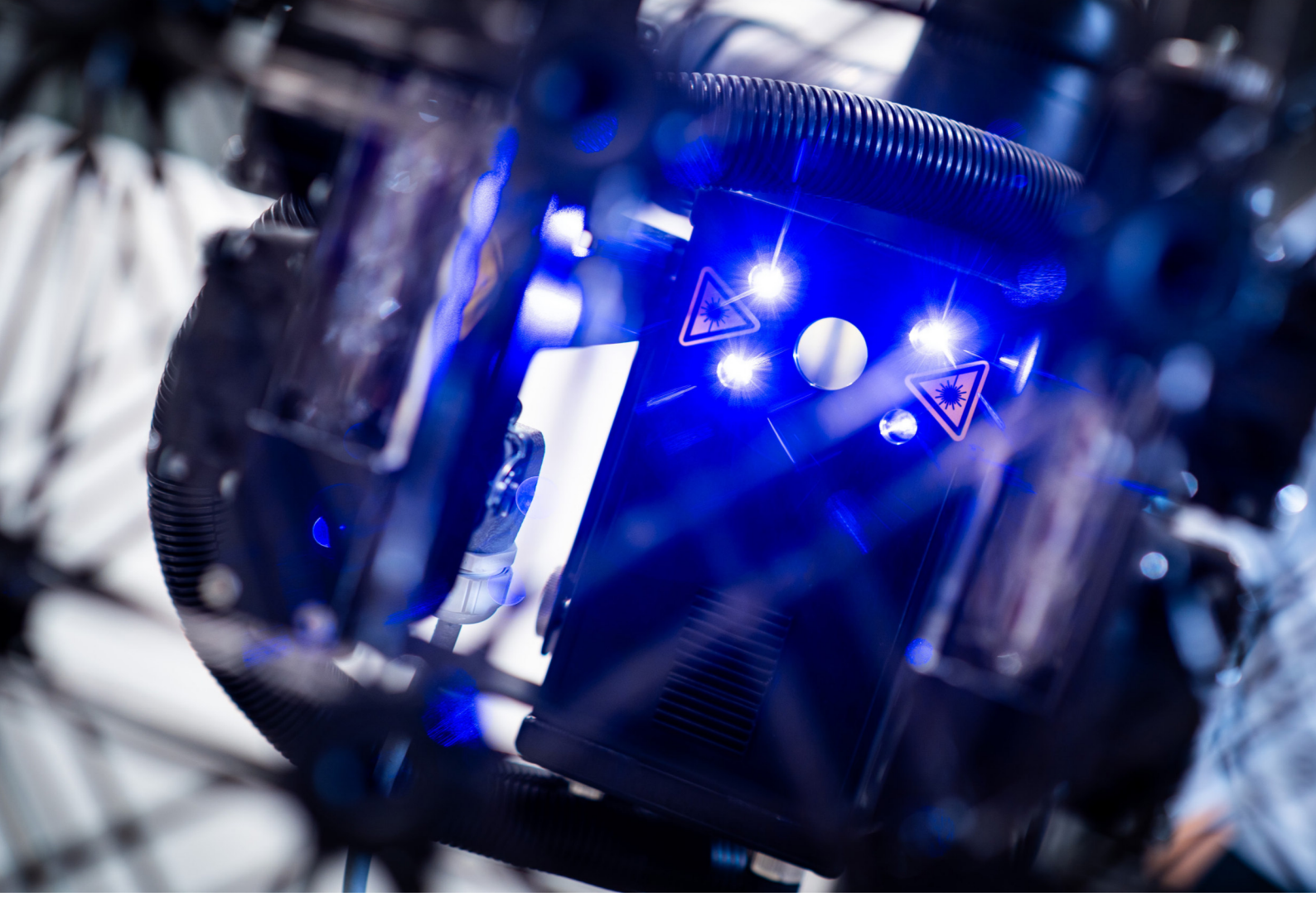
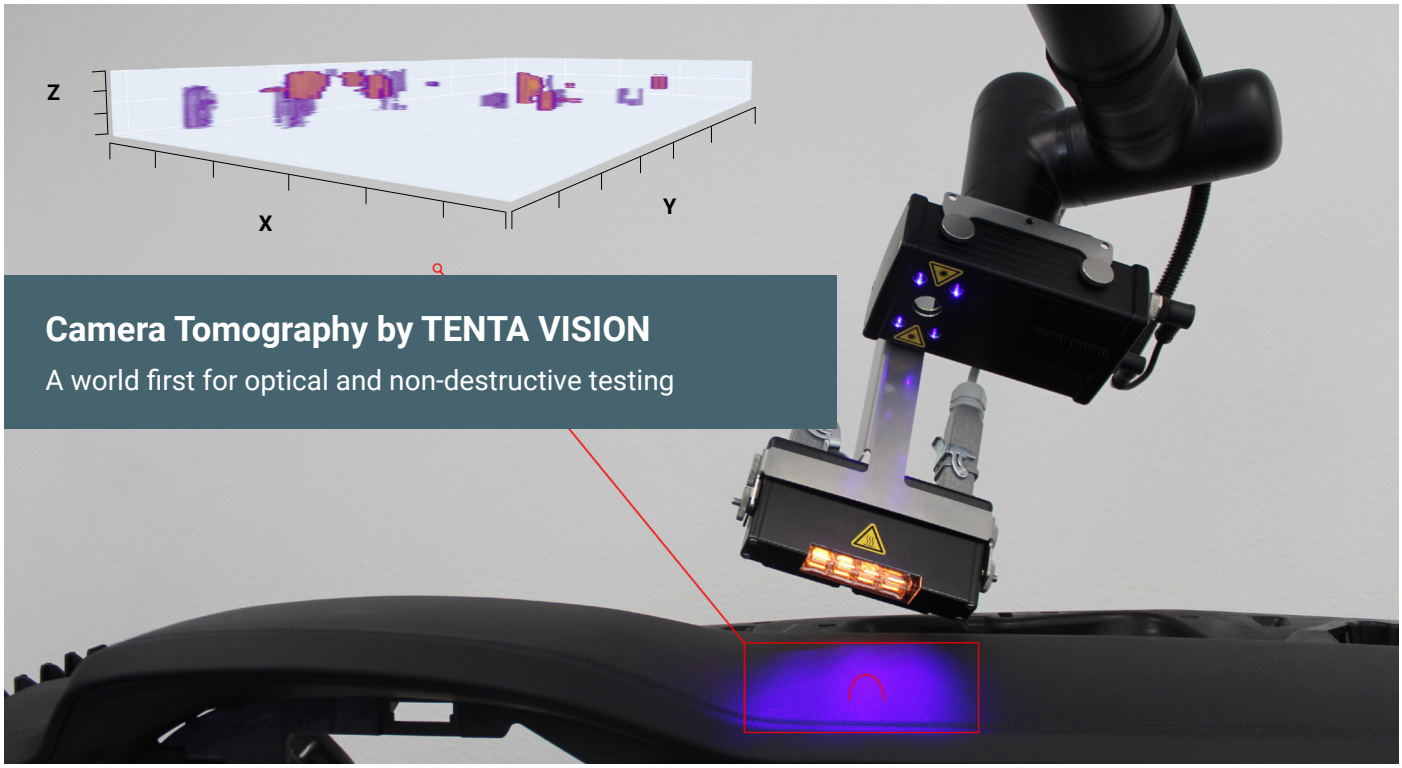


TENTA VISION

Beyond Visibility

An innovative inspection system that detects both external and internal defects in fractions of a second



Camera Tomography by TENTA VISION

A world first for optical and non-destructive testing

Based on laser speckle interferometry, camera tomography provides a material-independent view down to a depth of 30 mm. A small, precise amount of energy is applied to the specimen, causing it to deform in the nanometer range. These deformations contain information about the mechanical structures inside the component. In a deformation analysis, this data is processed and visualized in a fraction of a second. This allows localized delamination, air bubbles, or other defects to be detected in real time. In addition to its speed, the technology is characterized by its accuracy and versatility.

Camera Tomography closes the gap between non-destructive inspection of individual parts and optical production monitoring. Conventional non-destructive testing (NDT) methods often have limited automation and require long inspection times. On the other hand, fast industrial cameras can only capture external surface features. Camera tomography combines the best of both worlds and ushers in a new era of quality assurance: a camera that can inspect beneath the surface to detect internal defects in fractions of a second.

Camera Tomography at a glance

Camera tomography enables the real-time detection of both external and internal defects such as voids, delaminations, foreign materials, and cracks. The technology is material-independent and can inspect up to 30 mm deep into non-metals.

The inspection systems combine hardware and software, both developed and manufactured in-house. The available sensor fleet can be customized to meet specific customer requirements and seamlessly integrated into existing production lines.

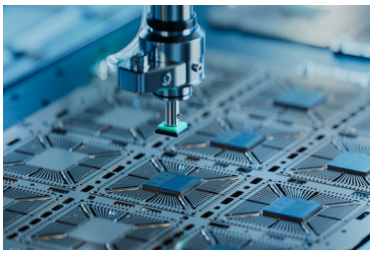
The intelligent software is modular and provides in-depth inspection with just one click. It offers comprehensive analysis functions for customized inspection reports. The open interfaces allow communication with all common information systems.

Areas of Application

The material-independent technology offers a universal tool for non-destructive material testing that can be applied across various industries, including automotive, electronics, medical technology, aerospace, and consumer goods production.

Automotive

Electronics



Consumer Goods

Aerospace

Automation Technology

Medical Technology

Product Segments

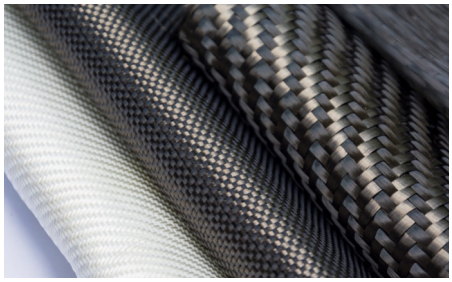
The current focus of application areas is on inhomogeneous and relatively soft materials or material mixes.

Adhesive Bonding

According to DIN EN ISO 9001, bonding is considered a „special process," which means adhesive bonds cannot be fully inspected non-destructively—at least, this has been the prevailing opinion. Camera tomography provides the first inline non-destructive adhesion inspection and is suitable for various types of adhesives.

Polymers / Elastomers

The focus is currently on testing thermoplastic and thermosetting plastics (including reinforced ones) as well as rubber and foams. Particularly with elastomers and foams, we achieve maximum tomographic penetration depth to characterize materials in terms of their distribution or stiffness homogeneity.

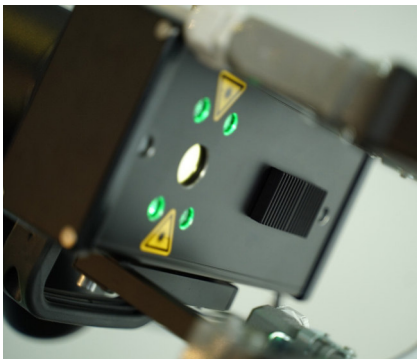


Composites

Fiber-reinforced composites are crucial in many high-tech industries, especially in aerospace and automotive. However, their complex structure presents a unique challenge for quality testing. The innovative camera tomography offers a fast solution here.

Your Inspection Solutions from TENTA VISION

Whether stand-alone or as an in-line system integrated into your production process



Mobiles System

The compact and portable hardware is designed forfor use in the field and allows a quick view into theto the depths

Lab system

For small batch testing or production accompanying parameter studies on the way to a stable manufacturing process

In-line system

Communicates with the common industrial interfaces andenables the shortest cycle times through real-time inspection

Technical Data

Specifications	Mobile system	Lab system	In-line system
Camera tomography for inspection within seconds	✓	✓	✓
Defect depth up to 30mm	✓	✓	✓
Automated defect detection from diameter D = 150 µm	✓	✓	✓
Modular hardware and software	✓	✓	✓
Portable hardware	✓	✓	—
Location-independent inspection	✓	—	—
Detailed component analysisin the laboratory environment	—	✓	—
Detailed component analysisin the laboratory environment	✓	✓	✓
Detailed component analysisin the laboratory environment	—	✓	✓
Parameter and feasibility studies	—	✓	—
Integration into production lines	—	—	✓
Compact system, fits into every machine	—	—	✓
Continuous quality assurance through immediate error detection	—	—	✓
Statistics control for process optimization	—	✓	✓
Reduction of rejects and waste	—	—	✓

System amortization typically in less than 1 year

Research & Development

Improve sales and R&D control with rapid material and process validation in seconds.

Production

Reduce quality costs and minimize waste with 100% real-time inspection with full traceability.

Management

Strengthen your innovation strategy and increase customer satisfaction with a new era of quality assurance. First to market with camera tomography.

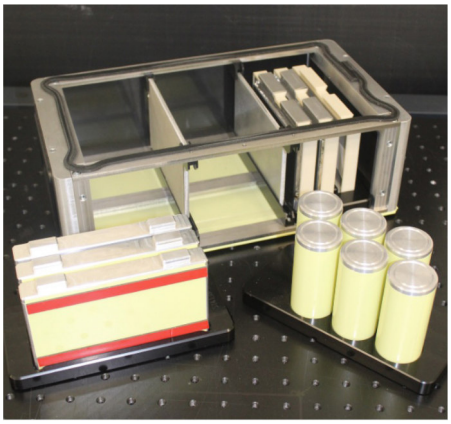
Application: In-line Delamination Inspection for Battery Electric Vehicle Production

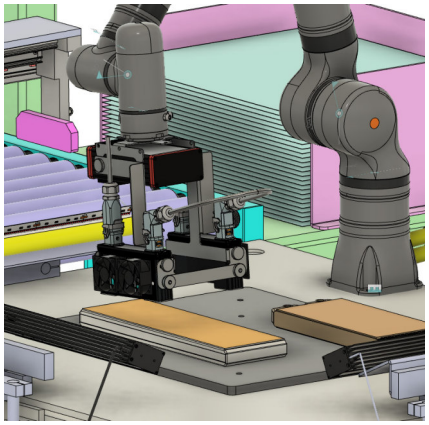
Electrification requires thoughtful management of heat and electrical flow. Films take on insulating or conductive functions and must be applied without air bubbles.

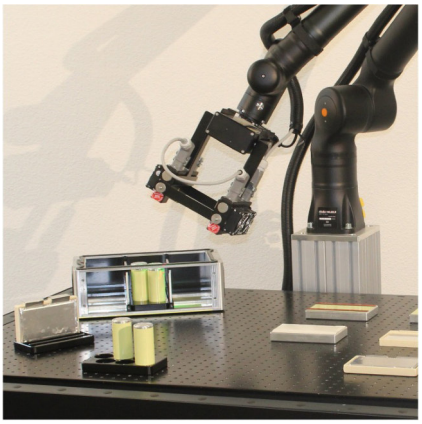
The World's First Real-time Non-destructive Inspection of Adhesive Bonds

TENTA VISION offers the solution for non-destructive delamination inspection in mass production. In contrast to the established AQL approximation, we now offer 100% inspection at a rate of once per second. Until now, the quality of adhesive bonds could not be reliably assessed, which is why adhesive bonding is often excluded from safety-critical applications. However, bonding is cost-effective, energy-efficient, and offers additional benefits such as corrosion protection, electrical or thermal conductivity, and system sealing.

Other inspection methods fail when faced with the so-called Kissing Bond—non-adhering, yet closed surfaces. **TENTA** VISION enables 100% inspection in approximately 0.6 seconds, detecting delamination regardless of its cause, such as air inclusions, contamination, or non-activated surfaces.



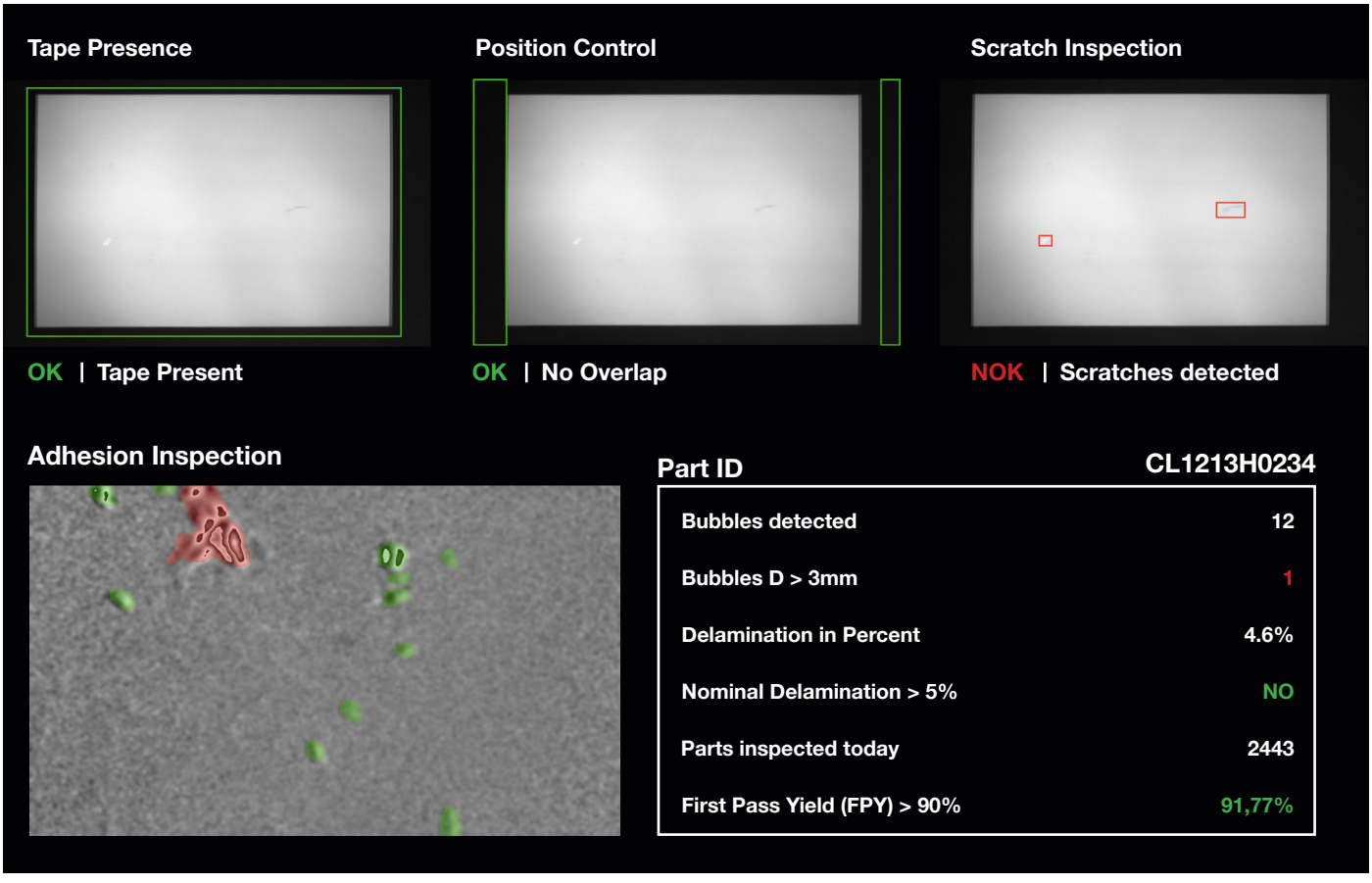




Find defects that are not visible to the naked eye

The sensor optically monitors film application (tape presence, position, and scratch control) and non-destructively inspects for potential delaminations or air bubble inclusions.

Visualization of insulation film application results by means of camera tomography



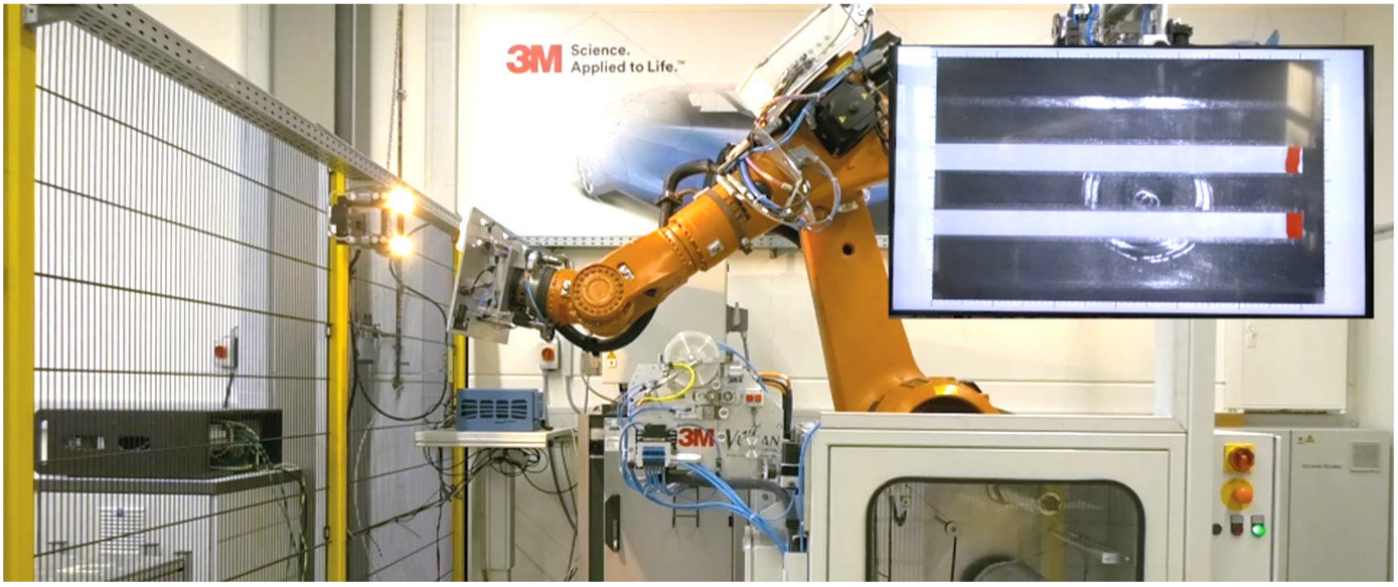
Application: Inline delamination test of acrylic foam tapes

Return on Invest in less than a year by switching to camera tomography

Acrylic adhesive tapes are widely used for joining, sealing, and gasketing applications. The double-sided tapes combine strong adhesion with easy handling, making them a popular choice in industries such as automotive, aerospace, and beyond.

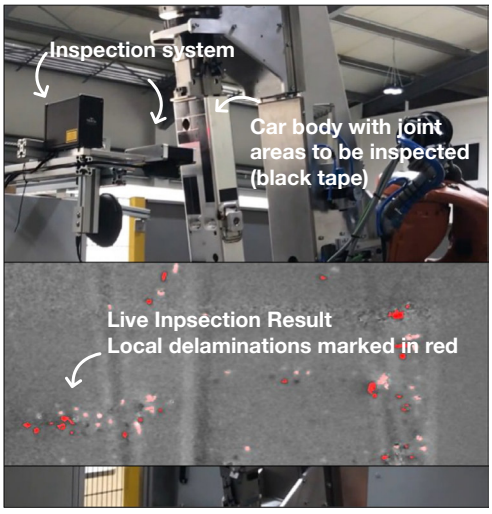
In the automotive sector, acrylic adhesive tapes are particularly common, for instance, in securing exterior parts like spoilers. However, until now, adhesion could only be verified through random sampling, despite the high safety risk posed by detachment during driving. Spoilers with applied tape are systematically tested destructively, leading to high costs and industrial waste.

In-line application including adhesion test of 3M acrylic adhesive tape, automated by Vulkan Technik



With camera tomography, these costs can be reduced by enabling 100% non-destructive inspection of every spoiler's adhesive tape application. The sensor performs both optical inspections and non-destructive delamination checks. Optically, the presence of the tape, dimensional accuracy, liner integrity, and the proper placement of pull tabs are inspected. The depth inspection detects internal defects such as foreign material inclusions and delaminations caused by air bubbles, contamination, or improper surface activation.

This process increases safety, reduces costs, and supports sustainable manufacturing. In a production cell, four sensors connected in series can inspect a spoiler in 1.4 seconds. We also check the positioning and dimensional accuracy of the tape and communicate with the in-house MES system via standard interfaces.Additionally, the system is suitable for inspecting various adhesive types, including 1K and 2K adhesives, as well as transparent and UV-curing adhesives.



Inspect 100% of safety-related bonds

The in-line capability enables new lightweight design concepts and process flexibility, which not only yield long-term benefits over the product lifecycle but also provide short-term cost savings through process optimization. Camera tomography handles both optical and non-destructive testing, replacing conventional image processing systems and reducing investment costs.

After installation, operating costs decrease due to the prevention of scrap, as demonstrated by the following model calculation: By avoiding systematically destroyed parts, 100% inspection in a single production cell results in material savings of approximately €135,000 per year. This model does not even account for external quality costs.
This translation mirrors the technical content and structure of the original text while maintaining clarity and precision.

Application: IN-LINE AIR BUBBLE AND ADHESION TESTING FOR PCB (VACUUM) MOLDING - WITHOUT X-RAYS

Whether for the laboratory as a stand-alone system or as an in-line system integrated into your production process

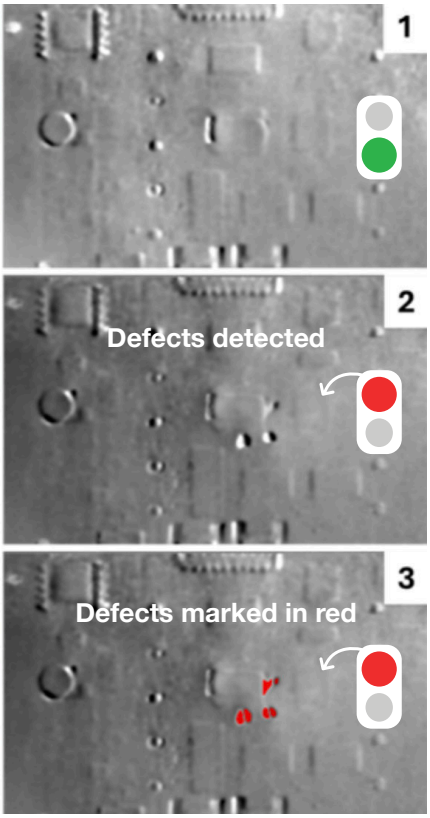
TENTA VISION offers the solution for non-destructive air bubble detection in series testing. Compared to CT, a cost saving of €60,000 is already possible for small series testing of 5,000 parts. Air inclusions within the encapsulation compound lead to hotspots and, consequently, inhomogeneous thermal expansions. Another issue is the reduced adhesion between the circuit board or electronic components and the encapsulation compound. Both result in accelerated aging and voltage spikes that can destroy high-value components like motor control units through contamination. X-ray and CT testing do not provide a reliable solution due to their high cost, difficulty integrating into the production line, and poor result quality due to image overlay. The laboratory system enables manual tests, allowing for sample-size tests during production. The entire process—from individual part inspection to result discussion—takes only a few seconds. This reduces setup phases for stable encapsulation or bonding processes by up to 34%.

Improvement in quality assurance for dispensing technology

Often, the question of a reliable and perfect application of adhesives and sealants is reduced to the bonding process itself. However, practical questions arise about the adhesion between the bonding partners or whether material inhomogeneities are present.
For example, during leak testing, bonded and sealed systems are tested for leaks. If the component is not leak-proof, it is classified as N.i.O. (not in order). This is often determined through a functional test, which can take several minutes and generate false rejects. Here, the optical leak test based on camera tomography steps in, verifying the system's sealing in milliseconds through a contactless test. The deformation analysis on the nanometer scale is also used here, where a minimal pressure difference of about 20 mbar is applied.

Which polymer-based materials can be tested with TENTA VISION systems?

Our focus is currently on thermoplastic and thermosetting plastics (including reinforced ones), as well as rubber and foams. The maximum tomographic penetration depth is achieved with elastomers and foams. In addition to characterizing materials in terms of their distribution or stiffness homogeneity (e.g., bubble size in foams, particle count in recyclates, local plasticizer concentrations in vulcanized products), material defects such as voids, delaminations, and cracks can also be detected. Cracks, in particular, are often undetectable by other non-contact techniques, as they must open to become visible. This is where our technology comes in. A slight, precise energy input mechanically stresses the invisible crack, which is then visible through the nanometer-scale deformation of the component.

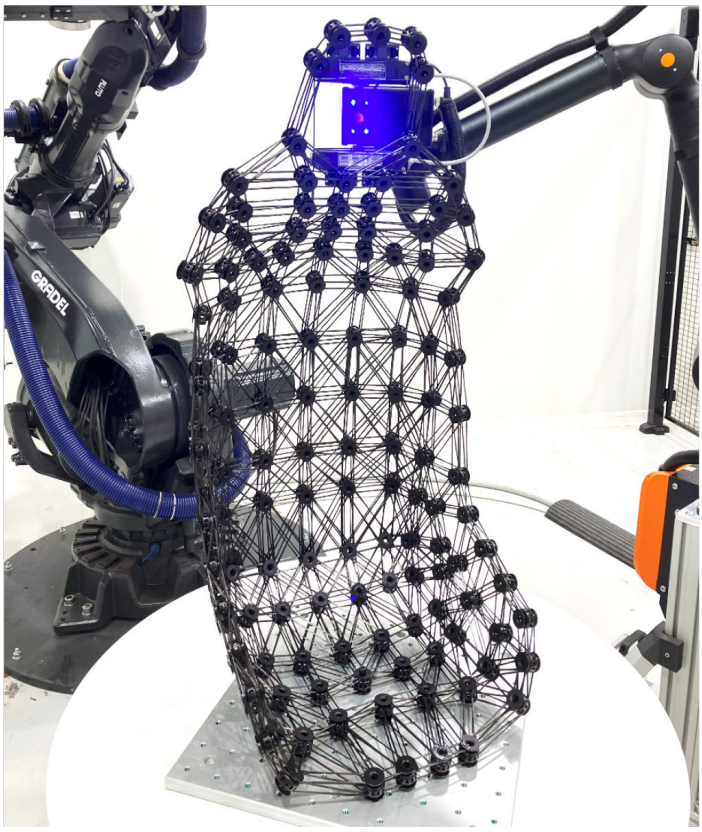


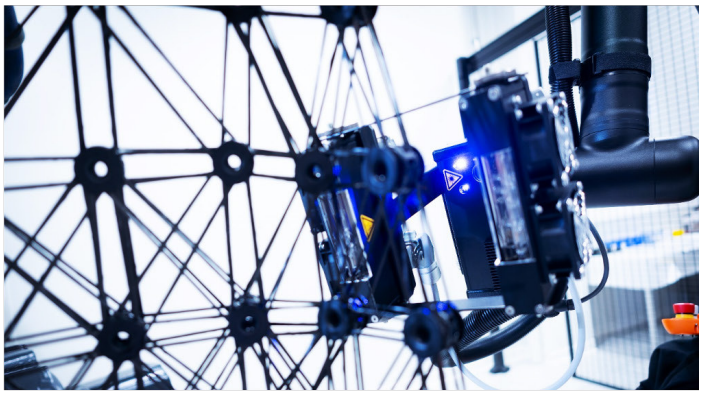
Robot-guided fiber composite inspection in mobile design

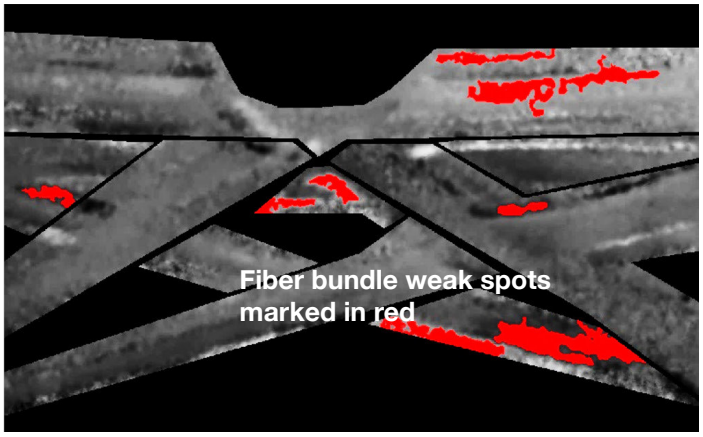
3D filament winding (xFK in 3D) combines maximum performance with minimum material usage

Fiber-reinforced composites combine high strength with low weight, offering outstanding mechanical properties. They enable designs that are lighter, more efficient, and more durable than ever before. Applications can be found in areas such as aerospace or motorsport, where components are subjected to extreme loads while weight must be kept to a minimum.

Camera tomography performs inspections independently of the composite material used, such as CFRP, GFRP, or NFRP. The laser-camera-based imaging method is suitable for all geometries, such as flat sandwich components, cylindrical winding structures, or even complex-shaped geometries.







A particular challenge is the so-called spatial winding (xFK in 3D), which combines the geometric freedoms of additive manufacturing with the high strength of the winding process. Based on a complex simulation, fiber bundles are wound around bushings that are freely arranged in space, creating a complex structure additively. The individual fiber bundles are mechanically optimized for tensile loading. Similar to a truss structure, material that does not lie along the force path is saved. The two images show examples of the xFK in 3D winding technology. Both lightweight prototypes were developed and realized in project consortia that included AMC GmbH, BMW M GmbH, csi, DITF, Lasso, Gradel, and others. Both the wound “BMW M Visionary Material Seat” and the sustainable center console “NaMiKo” were awarded the Altair ENLIGHTEN AWARD.

The production of fiber-reinforced composites is highly complex. Even the smallest defects, such as air inclusions, delaminations, resin pockets, fiber breaks, or micro-cracks, which are invisible to the naked eye, can significantly impair the structural integrity and lifespan of a component. To ensure that these materials provide the required performance and safety, non-destructive testing (NDT) is essential. Camera tomography detects stiffness inhomogeneities and makes not only defects but also the stress distribution in the respective fiber bundles visible. Thus, in a kind of optical FEM analysis, the real stress path can be retrospectively correlated with the simulation. We are ready for the new generation of high-performance designs, made possible by extreme lightweight construction.

Work with us: Inspect 100% in-line

From idea generation to series production

We tailor the camera tomography precisely to your application. Including installation, calibration and training

1

FEASIBILITY ANALYSIS

Send us test samples, for us to analyze.

2

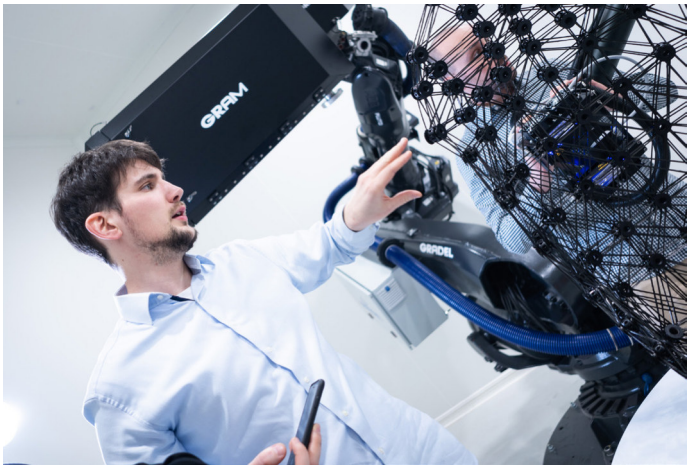
SYSTEM LAYOUT

We design your system and create your inspection profile.

3

FEASIBILITY ANALYSIS

We install your system in-line and train your staff.



Sample Tests

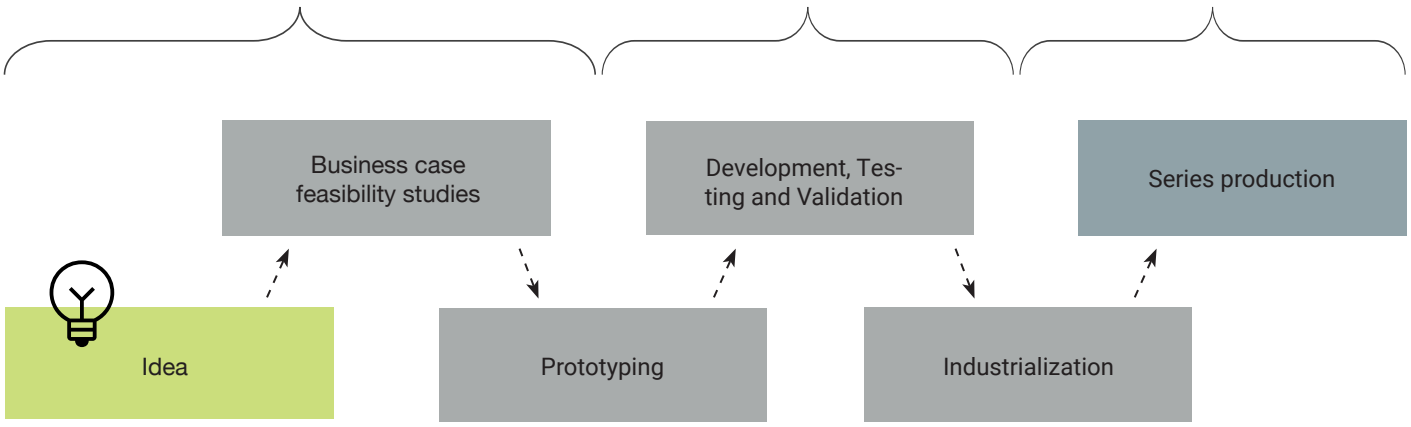
Simply send us your test samples. We will analyze and propose a customized system solution.

Lab System

Detailed inspection with lab report

In-line System

Detailed inspection with statistics for the production line.



✓ Including installation, calibration and training

Book a test day for your prototypes now

We look forward to working with you to take production quality assurance to the next level.

Send your request to

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TENTA VISION

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