Fast measurements and process control in the line:
ZEISS Inline Measurement Technology
ZEISS Inline Measurement Technology:
Application fields for the use of inline metrology in automobile production.

SUPPLIERS
- Individual parts
- Pressed parts and assemblies
- Production and testing technology

CUSTOMER
- Body Shop
- Component Production
- Paint shop
- Final assembly
- Quality assurance

BODY-IN-WHITE – MAIN LINE –
- high production volumes
- several production lines
- high variety of variants
- many launches

- Surface quality
- No contact points of parts
- Gap / flush
- Bolt position & hole patterns
- Gap / flush
- Mounting points
- ISOFIX brackets
Fast Feature-Recognition inline:
Application fields for the use of inline metrology in automobile production.

In the context of bodywork production, ensuring the dimensional stability of important features is a major task:

- Positioning of ISOFIX brackets [1]
- Dimensional accuracy of body geometry [2]
- Correct pin position [3]
- Hole pattern position [4]
- Position of welding nut behind sheet [5]
- Bending edges [6]
Gap & Flush inline measurement in combination with PiWeb. Process transparency as the basis for the Smart Factory.

Gap & Flush from Body in White to final assembly.

**SUPPLIER**
- Assembly processes
- Dimensional stability of body
- Dimensional accuracy of the hang-on-parts

**BODY IN WHITE**

**PAINT SHOP**
- Temperature
- Components relaxation
- Vibrations
- Paintwork

**FINAL ASSEMBLY**
- Vehicle on wheels
- Doors disassembly and assembly
- Removing / installing the doors

ZEISS PiWeb
**ZEISS ABIS: Optical inline surface inspection in the line:**
Objective and highly precise surface inspection in automobile production.

**PRESS SHOP**
Automated surface inspection in the line

**HANG-ON PARTS**

**BODY IN WHITE**

CLOSE THE LOOP
ZEISS AICell guide [form & pierce]
Correcting the robot position for form and pierce process.

**FORM & PIERCE APPLICATION**
- Application to correct the robot position depending on the actual body geometry for the FORM & PIERCE process.

**FORM & PIERCE PROCEDURE**

**STEP 1:**
- AIMax Inline Fix-Sensors are used to measure specific car body points [Capture the actual body geometry & Alignment]

**STEP 2:**
- Production floor cameras placed on a steel frame above the cell and markers on the FORM & PIERCE tool are used to correct the robot position for the FORM & PIERCE process depending on the actual body geometry and sensor position.

**STEP 3:**
- After completing the Form & Pierce process, one AIMax sensor is used for the final quality measurement.

1. AIMax Inline Fix-Sensors to capture the actual body geometry & Alignment
2. FORM & PIERCE tool on a robot with mounted AIMax-sensor and markers.
3. Production floor cameras for detecting the position of the F&P tool.
COMPONENTS OVERVIEW – ZEISS INLINE METROLOGY –
Customer orientation through modular construction kit.

Different
- strategies
- manufacturing processes
- production volumes
- supply chains
of the various OEMs and suppliers require specific metrology solutions.

Vision // ZEISS is able to provide the right measuring system for every application of the customer.

Data processing: visualization | correlations | process steering | increase in efficiency and productivity
ZEISS AiMax
Measurement of complex geometric characteristics with maximum robustness.
ZEISS AlMax
Unique combination of three measuring principles in one sensor:

- gray scale image processing
- multi-line triangulation
- shadow analysis.
ZEISS AIMax
Unique combination of three measuring principles in one sensor.

- Digital-optical 3D sensor for sheet metal processing and car body construction.
- Digital (GigE) camera technology
- Combination of three measuring principles in one sensor for gray scale image processing, multi-line triangulation and shadow analysis.

1. Projector
2. Digital (GigE) camera
3. LED Illumination
ZEISS AIMax
Unique combination of three measuring principles in one sensor.

- Digital-optical 3D sensor for sheet metal processing and car body construction.
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1. Projector
2. Digital (GigE) camera
3. LED Illumination
Measurement of complex geometric characteristics with maximum robustness.

- Measurement of complex geometric characteristics such as holes, bolts, and gap and flush with maximum robustness, as well as attributive characteristic recognition.

- Flexible illumination control for optimal illumination such as individually switchable segment illumination and combinations to generate ideal contrast of difficult-to-measure features.

- Patented Bolt Measurement Technology:
  - Bolt measurement in 0.5 seconds
  - Regardless of the Material
  - Regardless of the Form (with / without thread)

1. Projector
2. Digital (GigE) camera
3. LED for illumination
4. Shadow illumination
**ZEISS AlMax**

Unique combination of three measuring principles in one sensor.

**MAIN BENEFITS**

✓ Measurement of complex geometric characteristics
✓ High resolution for increased measuring accuracy
✓ Fastest measuring speed for characteristic analysis
✓ Flexible illumination control to generate ideal contrast of difficult-to-measure features

**FEATURES**

✓ Unique combination of three measuring principles in one sensor for gray scale image processing, multi-line triangulation and shadow analysis.
✓ Digital (GigE) camera technology with signal lines up to 100 m
✓ Measuring time < 0.1 to 0.5 seconds / measuring position
✓ The typical measuring time, including robot movement, is 1.8 to 3.0 seconds / measuring position depending on the robot type and the measuring position on the part.
✓ Resolution 1280 x 1024 pixels
✓ Field of view 80 (X) x 65 (Y) x 20 (Z)
✓ Illumination AlMax: Near infrared, 880 nm | AlMax Laser: Hyper red, 635 nm
ZEISS AlMax cloud
Feature-Recognition of the next generation.
ZEISS AlMax cloud
Feature-Recognition of the next generation.

- The ZEISS AlMax cloud sensor generates point clouds for real-time analysis.
- Optimized FoV to get all relevant feature information (not that possible with bigger FoV of typ. bluelight scanners)
- Extreme fast (~0,5 sec)
- Extremely compact sensor for good reachability
- Intuitive & fast setup of feature extraction
ZEISS AlMax cloud
Feature-Recognition of the next generation.

ZEISS AlMax cloud – Measurement method –

The feature to be measured is selected in the 2D image.

An algorithm generates the 3D point cloud.

The measuring result is visualized immediately.

Example: bolt

Example: a nut under sheet metal

Rivets

Sphere

1. DLP® [Digital Light Processing]
2. Digital (GigE) camera
ZEISS AlMax cloud: Extremely fast with Structured Light & Phaseshift

MAIN BENEFITS
- High-precision analysis of complex features in a fraction of a second
- Measurability and testability of even smallest features thanks to high 3D resolution
- Highly compact sensor design for optimal accessibility
- Simultaneous analysis of multiple features in one sensor position

FEATURES
- DLP® [Digital Light Processing] technology optimized for in-line use
- Dense point clouds created quickly using structured illumination
- Greater robustness as compared to standard image processing through feature extraction in the point cloud.
- Measurements of features previously difficult to analyze (e.g., nut behind metal, rivets)
- Measuring time < 0.5 seconds / measuring position for typical features
- Camera resolution 2048 pixels x 2048 pixels
- Measuring range 80 mm x 80 mm x 40 mm | Measuring distance 165 mm
- Illumination DLP® projector in the range of 450 nm to 620 nm
ZEISS AICell trace
Reliable results starting with the very first component.
ZEISS AICell trace – Tracking System –
Reliable results starting with the very first component.

- Correlation-free process control for reliable results from the very first component.
- Networked system comprising a 3D sensor, cameras, reference points and markers.
- Position monitoring of the entire system via cameras.
The production floor cameras capture both the exact position of the robot as well as their own location, providing inherent self-monitoring for the entire measuring system.

The coded markers with integrated background illumination on the ZEISS AIMax cloud and on the robot are used to precisely identify the location and position of the sensor.

The ZEISS AIMax cloud sensor generates point clouds for real-time analysis.
**MAIN BENEFITS**

- Reliable results from the very first component // Acceleration of production ramp-up.
- Reduction of measuring room capacities and logistics costs by reducing the correlation measurements.
- Higher system accuracy compared to inline metrology without tracking components.
- Networked system comprising a 3D sensor, cameras, reference points and markers.
- Position monitoring of the entire system via cameras.
ZEISS ABIS II
Objective and highly precise surface inspection in automobile production.
ZEISS ABIS II
Optical Surface Inspection – objective and efficient quality control.

ZEISS ABIS

- Efficient, highly precise quality control of surface quality.
- Objective classification and documentation of surface quality.
- Easy operation and fast evaluation.
- Fully-automated process.
- Fewer rejects and complaints in downstream areas.
- Reduction of rework costs.
- Sustainable optimization of the production processes.
**ZEISS ABIS II:**
Optical Surface Inspection in the line – objective and efficient.

**ABIS – objective and highly precise surface inspection:**
- Detection of all relevant defect types with ABIS II.
- Ensuring the surface quality along the process chain from press shop to body in white.
- ZEISS ABIS systems allow the fast, reliable and ultra-accurate detection of surface defects.
- ZEISS ABIS II systems ensure the reliable quality inspection of safety-relevant constrictions and cracks on inner parts.
- Early defect recognition saves costs and makes production processes more resource-efficient.
ZEISS ABIS II:
Optical Surface Inspection in the line – objective and efficient.

Early defect detection with ABIS

Cost savings and increased resource efficiency in production.
ZEISS ABIS
Optical Surface Inspection – objective and efficient quality control

ZEISS ABIS – System Setup –

- Measuring volume: 300 x 220 x 40 mm³
- Laterale resolution: 0.19 mm
- Triangulation angle: 50°
- Detection rate down to 10 µm
- One image acquired in 0.1 msec = 0.0001 sec
- Roboter speed = max 5m/sec

1. Sensor
2. Xenon- Flash Lamp

Principle of fringe projection
COMPONENTS – ZEISS INLINE METROLOGY –
ZEISS Measuring & Inspection Components in the Line

ZEISS Measuring & Inspection Components

ZEISS standard Inline metrology components:

1. ZEISS Aimax Inline and BestFit
2. ZEISS AICell trace – Tracking System & ZEISS Aimax cloud
3. ZEISS AICell with ZEISS Aimax or ZEISS Aimax cloud
4. ZEISS ABIS
ZEISS Inline Measurement Technology
VOLKSWAGEN AG [Września, Poland]
Customer Success Story
Fast Feature-Recognition inline:
ZEISS AIMax – from body-in-white to final assembly

Bsp. VW Polen // Film // EN

Quality Assurance at the VW Crafter Production Facility
In-line and offline measurements with the ZEISS AIMax

Carl Zeiss Industrial Metrology
www.zeiss.com/industrial-metrology
Task: Production of 100,000 Crafters and MAN TGE transporters per year, highly efficient and in excellent quality.

Solution: Fast inline measurements as a basis for efficient process control and closed-loops.

“We wanted the best robot-based 3D in-line measuring technology on the market”
Werner Steinert
Head of PWQ-3/1 QS- Analysis/Metrology in Września

01 In the Volkswagen Commercial Vehicles production facility in Września (Poland), 100,000 Crafter and MAN TGE vans will be produced each year.

02 New Volkswagen production facility performs in-line inspections with the ZEISS AIMax.
More than 60 base versions and between 82 and 122 measurement points are inspected in just 3.5 minutes.

“This speed allows us to inspect a lot of characteristics on our car body parts within the prescribed cycle time. This has helped us enormously with optimizing our processes.”

Werner Steinert
Head of PWQ-3/1 QS- Analysis/Metrology in Września

01/02 The ZEISS AIMax makes it possible to measure complex geometric characteristics
03 100% Inline inspection: Every car body part – from the undercarriage (shown here) to the side panels – passes through the corresponding in-line measuring station.
04 ZEISS AIMax sensor
05 The monitor shows Quality Assurance employees how close characteristics are to exceeding tolerance.
Partner of the elaborate design is an offline station in the measuring lab with four ZEISS AIMax sensors which have been set up just like the in-line stations to program completely independently.

This independence is important because it enables the team “to act very quickly if we need to optimize the robot programs or image processing parameters.”

“It was already clear after the first few weeks of production that the in-line approach was the way to go. All five stations work perfectly. I would certainly opt for ZEISS again”

Werner Steinert
Head of PWQ-3/1 QS-Analysis/Metrology in Września