



INDUSTRIAL MANUFACTURING TECHNICAL REPORT

# Inspecting and Documenting Automotive Parts With Digital Microscopy: How Suppliers and Auto Manufacturers Can Verify Parts Specifications Quickly and Easily

## AUTHORS

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## Introduction: Checking Specifications is Critical

During the manufacture of auto parts, specifications must be met – whether by the auto parts supplier or the automobile manufacturer. It is important that the parts meet specifications as they are critical for maintaining the performance standards and safe operation of automobiles, trucks, and other vehicles during their lifetimes [1]. However, the demand for faster, cheaper production of parts while still meeting or exceeding ever-stricter quality standards keeps increasing. This report explains how digital microscopy is used to inspect and document parts easily and quickly in order to determine conformity with specifications.

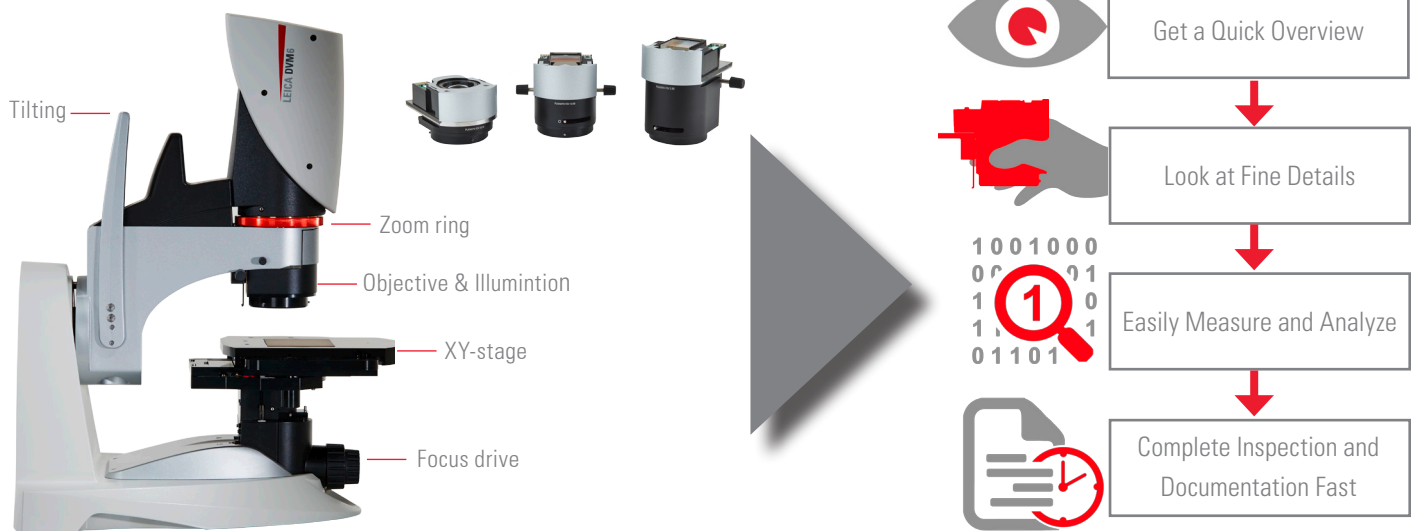
## The Role of Digital Microscopes in the Automotive Industry

Digital microscopes are optical microscopes without eyepieces which display the image directly on a monitor [2]. The design of digital microscopes makes them versatile and compatible with big and small parts alike. They are used for the investigation of diverse materials, from bigger, less sophisticated parts, such as tires and interior panels, to smaller, more complex, multi-component parts like microelectronics [3-5].

In the automotive industry, digital microscopes are cherished for enabling suppliers and manufacturers to share and discuss findings efficiently with each other, especially when current components are changed or new ones introduced. The instruments are designed for fast inspection and, especially digital microscopes of the most recent generation, also facilitate the easy documentation of results and creation of reports which can be referred to at a later time if the need arises. In addition, standard analysis methods and report templates can be developed for the obtaining of comparable results no matter who does the work. Systems such as the Leica DVM6 even allow configuration of multiple user profiles for the operation of the same digital microscope by several users doing a variety of applications.

These attributes work together synergistically to create a very efficient workflow for inspection and documentation [6,7].

Leica DVM6 with low, middle and high objectives



The chart above shows how the Leica DVM6 digital microscope makes the workflow efficient for auto part inspection and documentation, whether by the auto part supplier or automobile manufacturer.

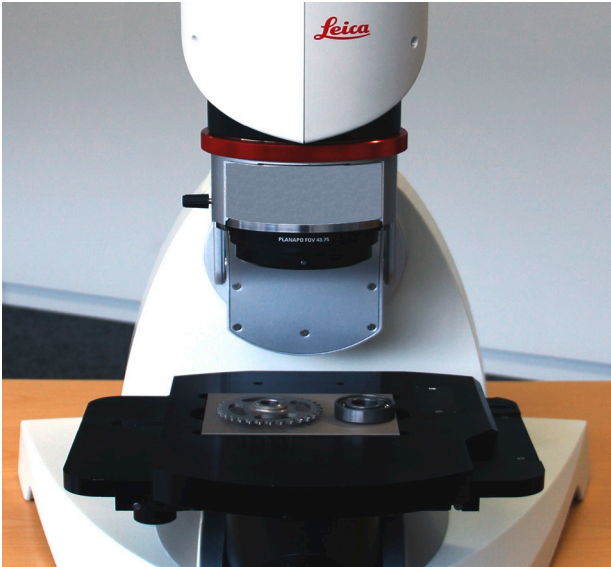
**Workflow Advantages for Inspection and Documentation with the Leica DVM6**

Certain tasks have to be performed during inspection and documentation and the Leica DVM6 digital microscope can help make the workflow easy and efficient.

Task	Advantage
Go quickly from an overview to fine detail in order to find deviations from the standard	→ Simple way to change magnification over the entire range → Powerful lateral (XY) image stitching [5]  These videos, <a href="#">overview</a> and <a href="#">mag. change</a> , demonstrate how easy it is [7].
View a part from multiple perspectives when inspecting holes, recesses, protrusions, etc.	→ One-handed, eucentric microscope head tilting → Fast and easy sample stage rotation  To see how tilting and rotating is done, watch this <a href="#">video</a> .
See easily the diverse characteristics of parts, even those composed of multiple materials	→ Versatile illumination → Fully integrated ring and coaxial light [3,4]
Make measurements easily, e.g., line profiles, heights, angles, lengths, widths, areas, etc.	→ Intuitive software for image analysis [5]
Fast recall of imaging parameters	→ Automated tracking and storing – encoded system [5]
Easy to learn and use	→ Intuitive microscope operation reduces training time → No need for prior microscopy experience [7]

**Auto Parts Examined**

The clutch disc of an automobile, a sprocket and a plate from an automobile body were examined with the Leica DVM6. Below are the images (each going from an overview to fine detail and measurement).



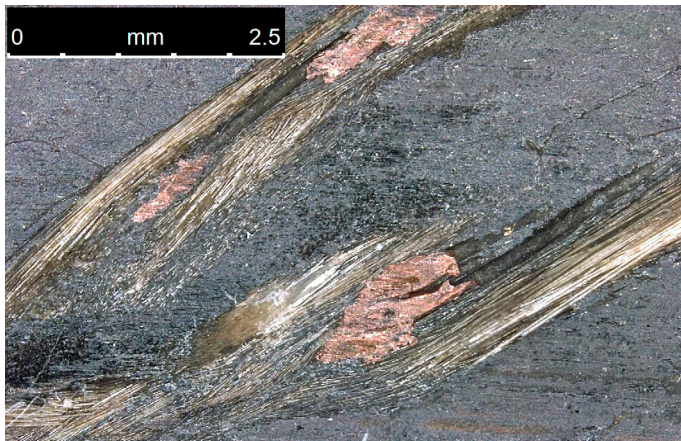


### Clutch disc friction surface

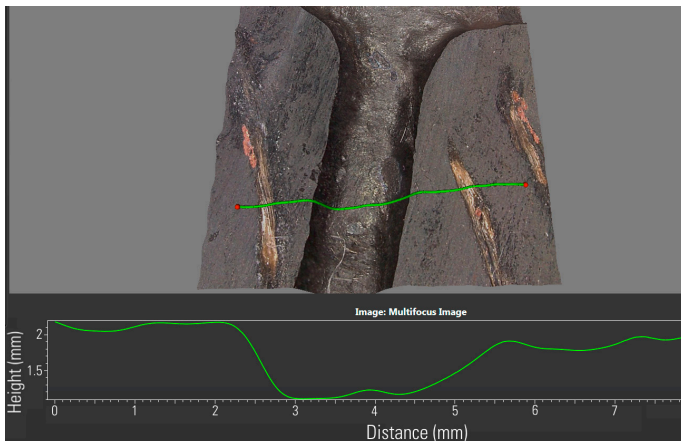
The friction surface of an automobile clutch disc examined with the Leica DVM6.



Overview: clutch friction surface



Fine details: clutch friction surface



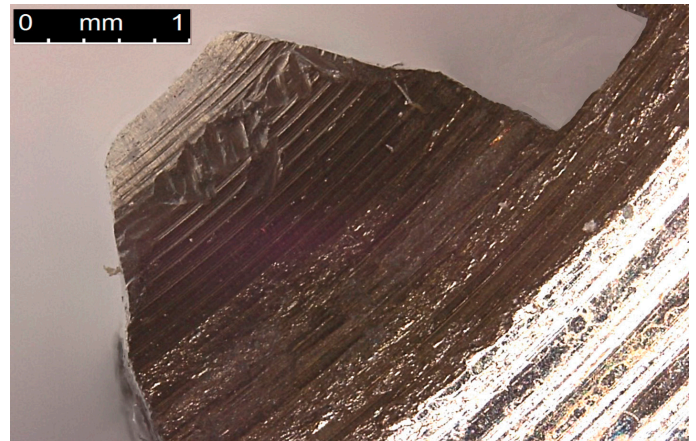
Measure: 3D image with line profile measurement

### Clutch disc splined hub

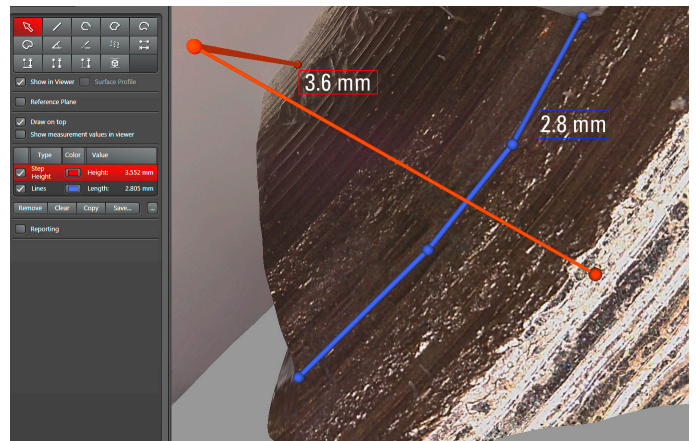
The splined hub of an automobile clutch disc examined with the Leica DVM6.



Overview: clutch splined hub



Fine details: clutch splined hub



Measure: 3D image with step height measurement

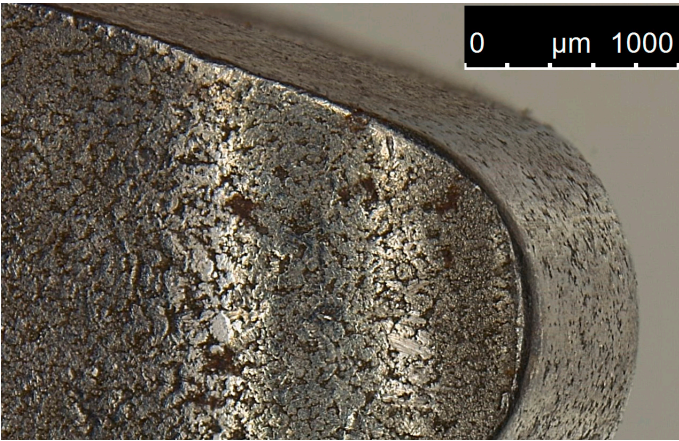


**Sprocket**

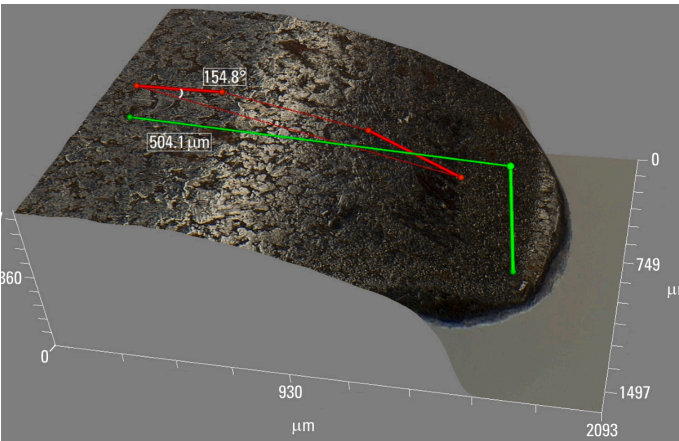
A sprocket of an automotive drive system imaged with the Leica DVM6.



Overview: Sprocket of an automotive drive system/transmission



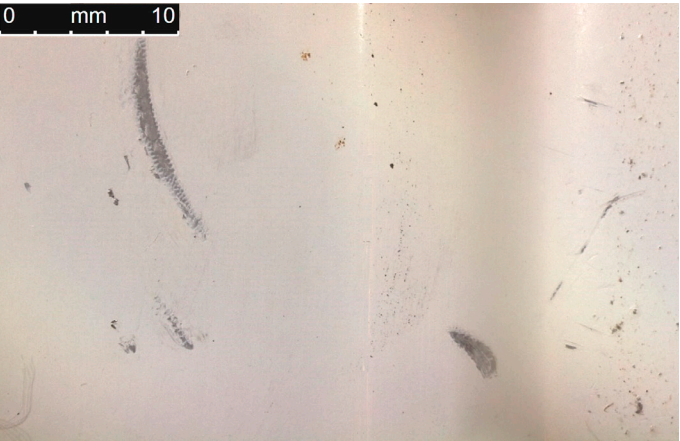
Fine details: Tooth of the sprocket



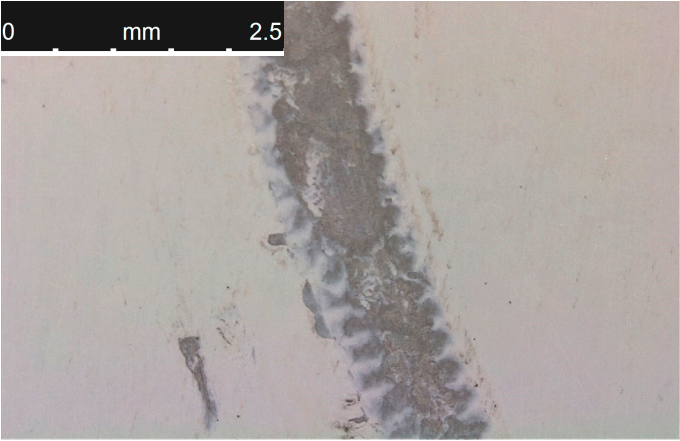
Measure: 3D image with step height and angle measurement

**Automobile body metal plate**

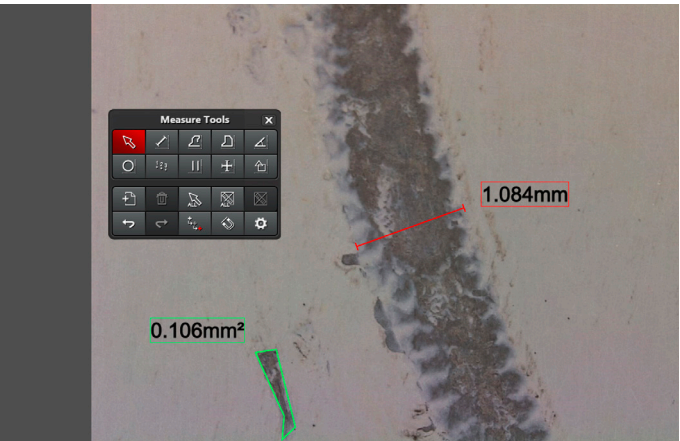
A metal plate covered with white paint inspected with the Leica DVM6



Overview: Painted metal plate showing scratches



Fine details: Zoom-in of a scratch on the plate's painted surface



Measure: 2D image with scratch width and area measurement

Summary

The table below shows the advantages from key features of the Leica DVM6 when doing auto parts inspection and documentation.

	Leica DVM6 Feature								
	2D Imaging	16:1 Zoom Optics			Eucentric Tilting	Rotate	Integrated Ring & Coaxial Light Illumination	Intuitive LAS X Software	3D Imaging
	X-Y Stitching	Objectives			±60°	±180°			Extended Depth of Field
		High	Middle	Low					
		12x to 2,350x							
Advantages Auto Parts Inspection & Documentation	Fast Large Overview	Quick & Easy Magnification Change			Change Viewing Perspective Rapidly		Versatile Contrast Methods	Easy Use, Measurement & Imaging Analysis	Fast 3D Models

Conclusions

The results reported here for inspection of auto parts demonstrate that a very efficient workflow can be achieved with a digital microscope such as the Leica DVM6 digital microscope, when confirming auto part specifications. Auto part suppliers and auto manufacturers can use the Leica DVM6 to easily check that the parts meet specifications in order to maintain performance and safety standards.

The Leica DVM6 allows users to go easily from seeing an overview to fine details to making measurements during documentation and inspection of auto parts. This efficiency results from a convenient way to: 1) change magnification rapidly over the full range, 2) tilt and rotate, 3) use the versatile, integrated illumination, 4) do analysis with intuitive software, and 5) operate the microscope with little training.

## References / Additional Reading

1. [Production Part Approval Process](#); Automotive Industry Action Group (AIAG); German Association of Automotive Industry (VDA)
2. J. DeRose, G. Schlaffer, [What You Always Wanted to Know About Digital Microscopy, but Never Got Around to Asking](#), Science Lab
3. J. DeRose, G. Schlaffer, [Digital Microscopy with Versatile Illumination and Various Contrast Methods for More Efficient Inspection and Quality Control: Example applications using the Leica DVM6 with integrated ring light or coaxial illumination system](#), Science Lab
4. J. DeRose, G. Schlaffer, [Automotive Industry: Rapid and Precise Surface Inspection on Hard-to-Image Samples](#), Science Lab
5. J. DeRose, G. Schlaffer, [Inspecting and Analyzing Printed Circuit Boards Quickly and Reliably with a Digital Microscope](#), Leica DVM6 Product Page
6. J. DeRose, G. Schlaffer, [Work Up to 3X Faster with the Leica DVM6 Digital Microscope](#)
7. Leica DVM6 Product Page, [Technical Specifications](#)

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