

INSIGHTS ON STATE-OF-THE-ART QUALITY CONTROL

Learn how controlled removal rates can identify paint layer defects as small as 10 microns.

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PAINT LAYER

PREFACE

Quality assurance is a critical element in automotive manufacturing. Even microscopic defects can have detrimental effects on vehicle quality and industry reputation.

Manufacturers are under constant pressure to meet market demands for safety, operational stability, environmental standards, and durability while at the same time improving productivity and remaining competitive in a global market.

At Struers, we aim to support manufacturers in meeting these demands in the global marketplace.

Our range of technology and expertise helps manufacturers prepare, analyse and ensure the highest quality of raw and processed solid materials in the manufacturing process.

In this materialographic report, we describe the procedure and method for identifying microscopic error sources that can cause imperfection in the paint layer. When detected, these defects enables the paint shop to perform process improvements and thereby deliver a paint layer with higher quality and ressistance.



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THE FIELD OF STUDY

It is difficult to identify microscopic defects and imperfections in paint layers. Manual processes used to examine paint samples pose a risk of over-grinding the point of interest, and with defects as small as 10 microns the risk is even bigger.

In this field of study, we prepared and examined five painted metal parts from car bodies. Examined colours included yellow, blue-metallic, dark grey, red and light grey.

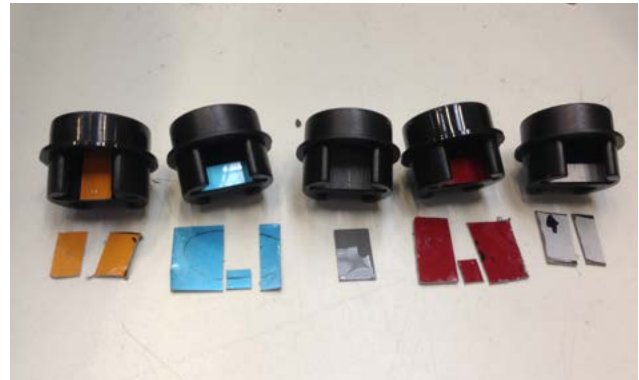


Exhibit 1: Five color samples from car bodies.

Our core objective was to apply highly-automated equipment and processes to reveal the sources of error that caused microscopic defects in the paint layers during the production process.

In this report, we used the blue-metallic sample to describe the process and create a visual identification of the target for further examination in the production environment.

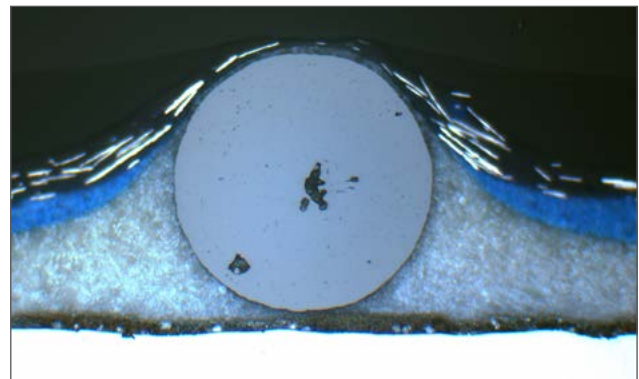


Exhibit 2: The end-result from processing the blue-metallic metal part.

Solution



EFFICIENT AND REPRODUCIBLE PROCESS OF IDENTIFYING MICROSCOPIC DEFECTS USING CONTROLLED REMOVAL RATES

A complete materialographic examination of blue-metallic metal parts is conducted.

Cutting:



- Equipment: Accutom-100
- Cut-off wheel: 10S15
- Feed-rate: 0.5 mm/s

The sample is cut with the highest precision in order to be mounted on a 30mm-diameter sample chair.

It is important to make the cut as close as possible to the point of interest – in this case 2mm from the area. The closer the cut is made to the target, the shorter the successive processing time.

This process used a [Struers Accutom-100](#) with a 10S15 cut-off wheel and a feed-rate of 0.5 mm/s.

Mounting:



- Specimen holder: TargetGrip
- Resin: Epofix
- Size of mounts: 30 mm

After the sample is cut, it is glued and mounted to the sample chair using quick glue. Measuring of target distance before mounting and using metal tape as a barrier.

We used the [Struers TargetGrip](#) with sample chair as the mounting accessory. It was set for the preparation of a 30mm sample.

Exhibit 3: Mounting the sample into sample chair.

Grinding and Polishing:



- Equipment: TargetMaster
- Disc diameter: 200 mm / 8"
- Specimen holder: TargetGrip

The remaining steps in this materialographic examination are critical to the quality control process.

This fully-automated process uses a controlled removal rate for grinding and polishing the sample. This is important when working with a very small point, as it ensures that the defect is isolated and the target is not lost in the grinding process.

This process used the Struers [TargetMaster](#) with a disc diameter of 200 mm / 8".

The settings for Target Mode are easily configured. The following five-step grinding/polishing process takes only 12.5 minutes to complete:

Removal rates for Target Mode:

- Step 1: Down to 175 μm before last three steps remaining removal
- Step 2: 200 μm (Target Mode used)
- Step 3: 40 μm (Target Mode used)
- Step 4: 10 μm (Target Mode used)
- Step 5: Time mode

The following IRR-values are used in the configuration:

- SiC#500 = 1800 $\mu\text{m}/\text{min}$.
- SiC#1200 = 1100 $\mu\text{m}/\text{min}$.
- MD-Sat = 25 $\mu\text{m}/\text{min}$
- MD-Dac = 5 $\mu\text{m}/\text{min}$

Step	1	2	3	4	5
 Disc / Cloth	SiC Foil #500	SiC Foil #1200	MD-Sat	MD-Dac	MD-Chem
Speed [rpm]	300	300	150	150	150
Dressing [μm]					
 Cooling					
 Suspension			DiaPro Allegro/ Largo 9 μm	DiaPro Dac 3 μm	OP-S NonDry
Pre-dosing			2	2	5
Dosing			6	7	13
 Lubricant	Water	Water			
Pre-dosing					
Dosing					
 Force [N] Single/Holder	25 /	25 /	20 /	15 /	10 /
Holder speed	150	150	150	150	150
 Rotation direction	>>	>>	>>	>>	>>
Holder offset					
 Time [min]	2:00	2:00	5:00	3:00	0:30
Stock removal [μm]					
Pause between steps	No	No	No	No	No
 IRR [$\mu\text{m}/\text{min}$]	1.800	1.100	25	5	

Exhibit 4: Configuration of the grinding/polishing process.

RESULT AND OVERVIEW

This reproducible procedure and method represents a highly-automated solution. Precision cutting to isolate the target of interest followed by a five step grinding and polishing process for precise controlled material removal.

The complete method allowed us to detect a very small target causing imperfections in the paint layer. A procedure enabling the paint shop to make quality control improvements and thereby deliver a paint layer with higher quality and resistance.

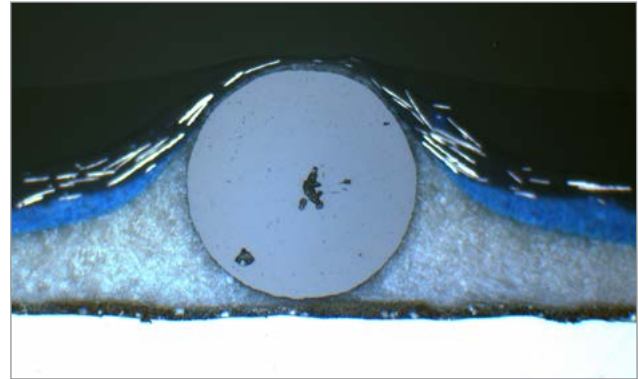
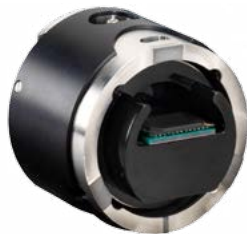


Exhibit 5: The end-result from processing the blue-metallic metal part.

Solution



Cutting
Accutom-100



Mounting
TargetGrip



Grinding/Polishing
TargetMaster



Verification
Axio Observer

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