



INSIGHTS ON STATE-OF-THE-ART QUALITY CONTROL

Learn how to prepare and test for case depth
on surface hardened helical gears using an
automated and reproducible process

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PREFACE

Quality assurance is a critical process in automotive manufacturing. Quality control ensures customers receive products that meet their needs and are free from defects. If quality assurance processes are not supported by appropriate quality control procedures or these are done insufficiently or in the wrong way it potentially can put customers at risk.

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 determining the case depth of surface hardened helical gears. With highly-automated equipment and well-proven methods, it is possible to create a efficient and reproducible quality control.



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THE FIELD OF STUDY

Gears comes in many different sizes and shapes, they are often hardened to increase the wear resistance. The quality of the hardening is essential for the functionality of the component and therefore typically controlled by hardness testing.

Helical gears offer additional challenges in respect to the cutting, since it is often required to inspect perpendicular to the teeth surface.

Using automated equipment and special clamping methods for cutting, it is possible to conduct hardness tests on even the most difficult gear surfaces.

This fast and reproducible process eliminates manual handling replacing it with automated cutting and hardness verification.

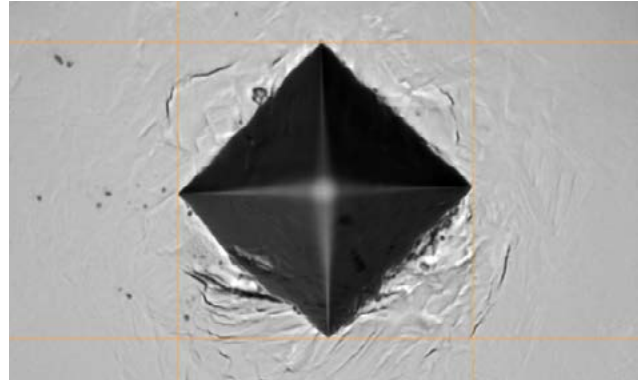


Exhibit 1: End result is an automated and informative report on the hardness of heat-treated helical gears.

Solution



Cutting
Axitom-5



Polishing
AbraPol-30



Verification
Duramin-40 AC1

AUTOMATED PREPARATION AND TESTING OF SURFACE HARDENING ON A HEAT-TREATED HELICAL GEAR

Cutting:



- Equipment: Axitom-5
- Cut-off wheel: 58A35
- Feed-rate: 0.5 mm/s
- Clamping tool: Base plate 12 mm (Cat. No. 06316908)
Vertical 12 mm (Cat. No. 05046904)
Clamping Set Tool (Cat. No. 06316920)

We performed the cutting process with a [Struers Axitom-5](#) and a 58A35 cut-off wheel with a feed-rate of 0.5 mm/s. The angles of the teeth of helical gears, makes it difficult to clamp these to allow for sectioning out several teeth where the cut is parallel to the teeth surfaces.

Furthermore internal stress in the part may force it to pinch the cut-off wheel, eventually breaking it. To avoid pinching of the cut-off wheel, the part has been clamped to the table in a manner that prevent pinching.

After this initial cut the part is raised and clamped to the table while aligning the angle of it with the cut-off wheel. The part is then gradually rotated to cut the desired number of specimens.

The specimens cut parallel to the teeth surfaces are then clamped in a baseplate clamp and cut perpendicular to the surface.



Exhibit 2: How to use special clamping setups to avoid pinching the cut-of wheel and to meet the need for the right cuts both parallel and perpendicular to the teeth surface.

Polishing:



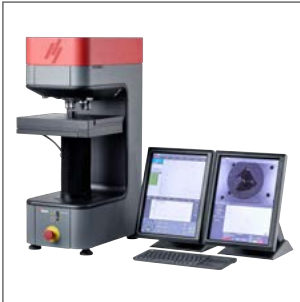
- Equipment: AbraPol-30
- Disc diameter: 300 mm / 12"
- Specimen holder: 02606916 - MAXCY

For grinding and polishing, we used [Struers AbraPol-30](#) with a carefully selected sequence of surfaces especially suited for obtaining edge retention. A four-step step grinding and polishing process was performed preparing the surface for hardness testing and microstructure analysis.

Step	1	2	3	4
 Disc / Cloth	MD-Piano 220	MD-Allegro	MD-Dur	MD-Chem
Speed [rpm]	300	150	150	150
Dressing [µm]				
 Cooling				
 Suspension		DiaPro Allegro/Largo 9 µm	DiaPro Dur 3 µm	OP-U NonDry
Pre-dosing		2	3	4
Dosing		6	9	12
 Lubricant	Water			
Pre-dosing				
Dosing				
 Force [N] Single/Holder	40 /	55 /	50 /	20 /
Holder speed	150	150	150	150
 Rotation direction	>>	>>	>>	>>
 Time [min]	1:00	3:00	3:00	1:00
Stock removal [µm]				
Pause between steps	No	No	No	No

Exhibit 3: The 4-step configuration of the grinding and polishing process with surfaces.

Verification:



- Equipment: Duramin-40 AC1
- Method type: Vickers

For the verification process, we used the [Struers Duramin-40 AC1](#) hardness tester to conduct an automated CHD measurement with 15 indentations. The results of the CHD measurements were delivered in an informative report.

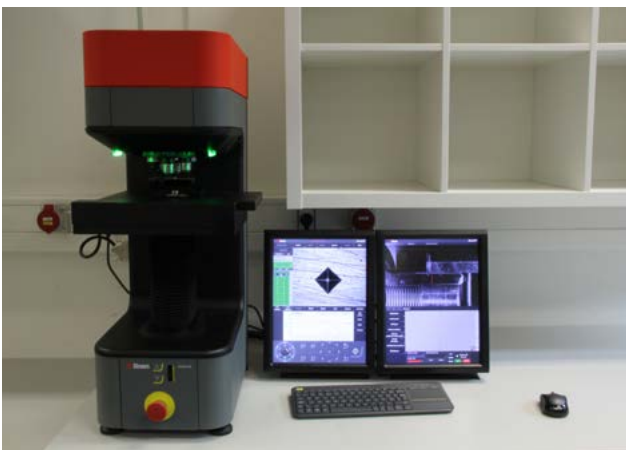


Exhibit 4: The sample is placed in vise before the hardness test is performed with a series of 15 automated indentations.

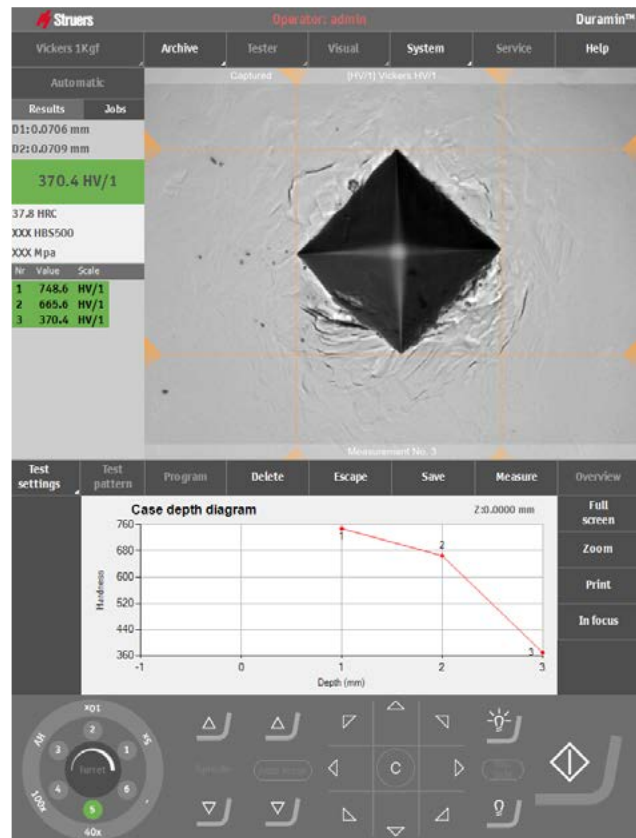
RESULT AND OVERVIEW

This reproducible method for evaluating the surface hardening result of heat treatment on helical gear reduces the conventional time-consuming manual preparation process and replaces it with automated processes for cutting and hardness verification.

Special clamping methods to cut off difficult geometry surfaces avoid pinching on the cut-off wheel. A four-step automated grinding and polishing process using surfaces ensures edge retention and a specimen surface ready for hardness testing.

Automated CHD-measurements result in an instant report.

Overall, the process can be used to conduct reproducible quality control on the surface hardening of mass-produced components.



Solution



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