



INSIGHTS ON STATE-OF-THE-ART QUALITY CONTROL

Learn how optimized and automated processes create fast and reliable results for a surface hardened steering rack.

By Lars Hagsted Rasmussen MSc,
Application Specialist, Struers

STEERING RACK

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, analyze and ensure the highest quality of raw and processed solid materials in the manufacturing process.

In this materialographic report, we describe the procedure used to test the hardness of six surface hardened parts of a steering rack. We will also describe how highly-automated equipment and customised accessories help to reduce time consumption and maximise reliability within quality assurance.



Lars Hagsted Rasmussen
MSc, Application Specialist, Struers

THE FIELD OF STUDY

Quality control on steering racks involves hardness testing. In this process, we tested the hardness of six parts of a surface hardened steering rack.

We used customized accessories to auto feed and clamp the steering rack during the cutting process – eliminating manual sample handling. Further, we used a customized specimen holder to hold the six differently-shaped parts simultaneously while grinding and polishing. All enabling us to shorten leadtime for hardness testing.



Exhibit 1: A final result of hardness testing using an automated Case Hardness Depth (CHD) process

Solution



EFFICIENT HARDNESS TESTING OF A SURFACE HARDENED STEERING RACK VIA AUTOMATED EQUIPMENT AND CUSTOMIZED ACCESSORIES

Cutting:



- Equipment: Axitom-5
- Cut-off wheel: 50A35
- Feed-rate: 0.7 mm/s

For the cutting process, we used the [Struers Axitom-5](#) with a 50A35 cut-off wheel and feed-rate of 0.7 mm/s.

We used an auto-feed system to automatically clamp, unclamp, and re-clamp each part. This system also allow for infinite x-table movement. Instead of re-clamping manually, the feeding system will automatically perform the task.

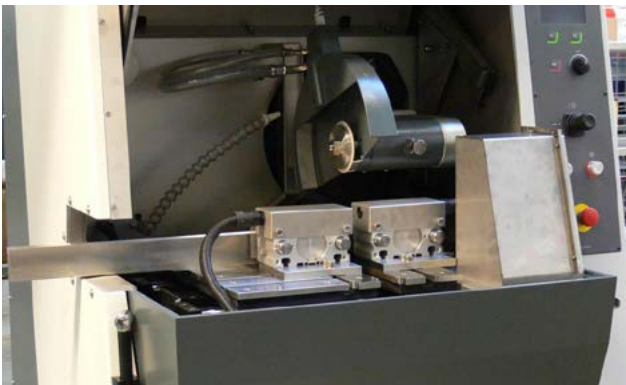


Exhibit 2: An Axitom with autofeed clamping system.

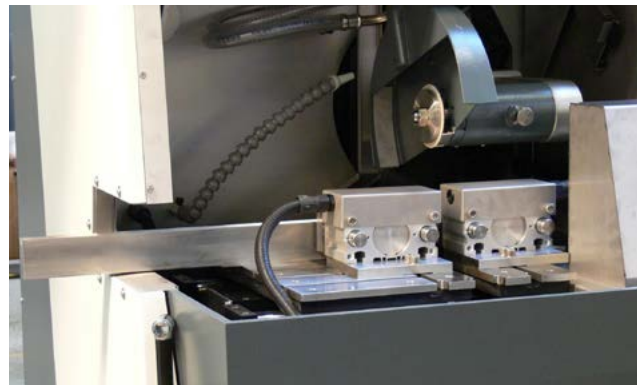


Exhibit 3: Close up of the autofeed system.



Exhibit 4: The cutting equipment is modified with an auto-feed system that eliminate manual clamping procedures and results in a tact time of 1 minute per cross sectioning

Grinding and Polishing:



- Equipment: AbraPlan-30 and AbraPol-30
- Disc diameter: 350 mm / 14"
- Specimen holder: 02606916 - MAXCY

For the grinding and polishing process, we used the [Struers AbraPlan-30](#) and the [Struers AbraPol-30](#), both with disc-diameters of 350 mm / 14".

A customised specimen holder was used to hold the differently-shaped specimens in place during grinding and polishing. This allowed six parts to be held simultaneously.

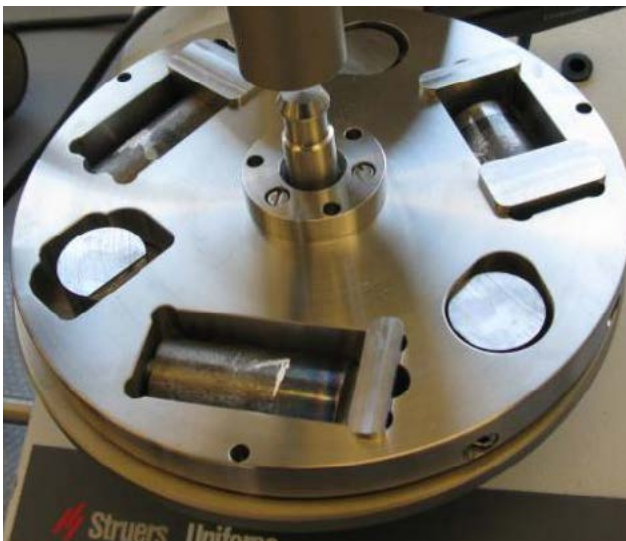


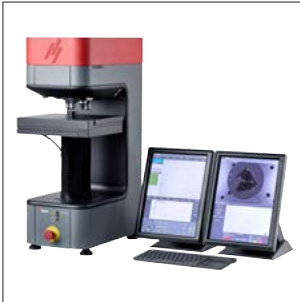
Exhibit 5: A customised specimen holder for grinding and polishing 6 differently-shaped specimens is applied.

A final 3 μ m diamond polishing on a soft cloth gave a fine and shallow scratch pattern, which allowed for subsequent hardness testing.

Step	1	2	3
 Disc / Cloth	4A36 #150	MD-Piano 500	MD-Plus
Speed [rpm]	300	150	150
Dressing [μm]			
 Cooling			
 Suspension			DiaPro Plus 3 μm
Pre-dosing			
Dosing			
 Lubricant	Water	Water	
Pre-dosing			
Dosing			
 Force [N] Single/Holder	/ 320	/ 240	/ 200
Holder speed	150	150	150
 Rotation direction	>>	>>	>>
Holder offset			
 Time [min]	0:30	2:00	2:00
Stock removal [μm]	500		
Pause between steps	No	No	No

Exhibit 6: The settings of the equipment allowed for a 3-step grinding and polishing process with a full completion time of only 4.5 minutes.

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.

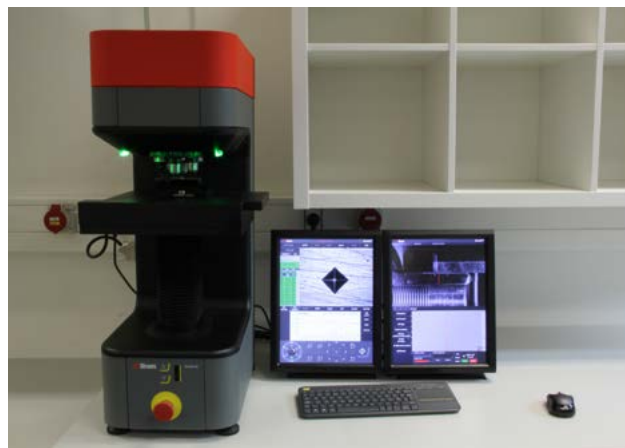


Exhibit 7: The sample was hardness tested using equipment allowing for series of 15 automated indentions into the sample

RESULT AND OVERVIEW

Steering rack hardness testing via automated equipment and customised accessories eliminates the need for re-clamping during the cutting process and reduces time spent on grinding and cutting.

This creates a more efficient method for hardness testing and improves hardness testing processes in the automotive industry.

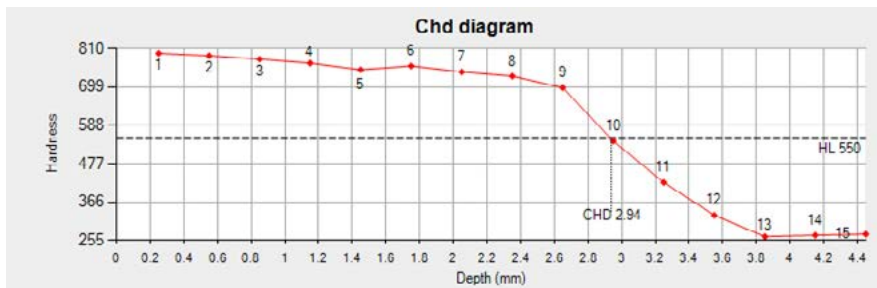
The cutting process has a tact time of only one minute per cross-section when cutting with a modified Axitom-5 using an automatic feed and a drop box.



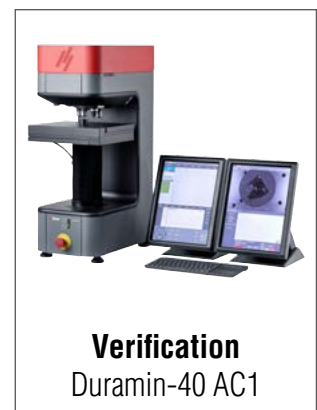
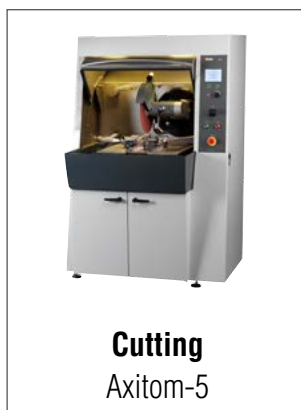
Exhibit 8: Hardened surface with indents.

The grinding and polishing process also allows six samples to be prepared for hardness testing in just five minutes using an automated three-step method in a customized specimen holder.

Results of the automated hardness testing process are instantly delivered as CHD measurements via an informative report.



Solution



REACH OUT TO LEARN MORE

Concerned about Quality Control in the automotive industry?

[Feel free to reach out to me or other application specialists](#) for more information about this particular report or other quality control themes that might concern you.

[Visit us here](#) for more information about Struers and quality control in the automotive industry.



APPLICATION SPECIALISTS

Based on years of experience and expertise from a wide variety of industries, the Struers Applications Specialists team enables our customers all over the world to discover new opportunities for enhancing quality control, failure analysis and productivity, and to develop new applications and methods in order to meet evolving needs.