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USING AI TO DETECT INDENTATIONS IN THE FINE-LAMELLAR PEARLITE MICROSTRUCTURE

Objective:

Detecting hardness indentations in fine-lamellar pearlite is difficult, as complex microstructures, low contrast and surface irregularities obscure the contours and complicate the evaluation. Manual assessments are also subjective and time-consuming. QATM's AI-based QAI software enables precise, automatic detection even under difficult conditions. It reduces operator influence, increases reproducibility and improves measurement accuracy. This makes the testing process more efficient, reliable and significantly faster. In this report, you will learn how the detection of indentations in normalized cold-work steel can be carried out simply and reliably using QAI.

Sample in as-received condition





Precision cut-off machine
Qcut 150 A

CUTTING

Device	Qcut 150 A	
Cut-off wheel	Aluminum oxide resin-bonded	Item no.: 92004159
Coolant and anti-corrosion agent	ATM-CoolCut	Item no.: 95004146
Clamping tool	- Clamping arm L	Item no.: Z1870031
	- Double parallel vice	Item no.: Z1870056
Cutting method	Vertical cut (Y-axis)	
Parameters	- Feeding speed	0.2 mm/s
	- Pulse setting	Without pulse
	- Rotational speed of cut-off wheel	3000 rpm

Notes



The clamping set-up in the
cut-off machine Qcut 150 A

HOT MOUNTING



Hot mounting press Qpress 40

Device	Qpress 40
Mounting material	Thermoplast BIO
Heating time	5:00 min
Temperature	190 °C
Pressure	250 bar
Cooling time	3:30 min
Additional consumables	-
Heat set up	100%
Pressure mode	One-step mode
Cooling set up	100%
Mould Assembly	Ø 40 mm
Notes	



Sample on the mounting piston
and after mounting



Automatic grinding and polishing
machine Qpol 300 AI Eco+

GRINDING/POLISHING

Device	Qpol 300 AI Eco+	
Sample holder	6 x Ø 40 mm	Item no.: Z5445025
Pressure	Single pressure	

STEP	MEDIUM		 rpm	 rpm	 Single pressure N	 min
 Grinding	SiC Paper P320 (self-adhesive) + X-Tap	H ₂ O	200	150 ►► Synchronous Rotation	25	1:00
 Grinding	SiC Paper P1200 (self-adhesive) + X-Tap	H ₂ O	200	150 ►► Synchronous Rotation	25	1:00
 Polishing	GAMMA	Dia-COMLETE Poly, 3 µm	150	100 ►► Synchronous Rotation	30	6:00
 Polishing	ZETA	Dia-COMLETE Poly, 1 µm	150	100 ►► Synchronous Rotation	22	3:00
 Etching (chem.)	Alcoholic nitric acid, 3% Nital					0:02

Notes

- Pre-dosing for 3 µm and 1 µm: 3 s
- Dosing interval and dosing duration for diamond suspension 3µm, 1µm: Every 30 s for 1,3 s
- During etching, have a container of ethanol ready so that you can immediately immerse the sample in it after etching to stop the reaction.

The microstructure containing perlite and secondary cementite after etching- 200:1



The microstructure containing perlite and secondary cementite after etching- 500:1



HARDNESS TESTING

Hardness testing of cold-work steel in the normalized condition is a crucial step in ensuring the desired material properties, particularly with regard to wear resistance and tool life. Due to the complex microstructure and the high hardness that can be achieved, a precise and reproducible testing method is essential. The use of modern testing systems such as the QNESS 60 A+ EVO enables a significant improvement in test quality and efficiency. The fully automated execution of test series minimizes operator influence whilst achieving a high measurement density. This is particularly advantageous when analyzing hardness profiles or examining individual microstructural components. In addition, the integrated QAI image analysis ensures objective and rapid determination of hardness values. Overall, automation offers not only time savings but also increased process reliability. The QNESS 60 A+ EVO thus represents a future-oriented solution for industrial materials testing.

QAI, an AI-supported object recognition system from QATM, facilitates hardness testing in the etched state by using AI-based image analysis to reliably detect hardness indentations. Despite microstructural features and etching artefacts, indentation diagonals are determined automatically. This reduces manual effort, making the evaluation more reproducible and faster. Overall, QAI improves accuracy and significantly simplifies the entire testing process, particularly for challenging materials such as cold-work steel.

Average hardness: 239 HV 0.1.
Using AI to detect hardness indentations in
fine-lamellar pearlite



OUR PRODUCT OF THE MONTH

HARDNESS TEST BLOCKS

Calibrated and certified hardness test blocks fulfill the requirements for testing according to following standards:

- | Rockwell (EN ISO 6508-3 & ASTM E18)
- | Brinell (EN ISO 6506-3 & ASTM E10)
- | Vickers (EN ISO 6507-3 & ASTM E92)
- | Knoop (EN ISO 4545-3 & ASTM E92)



Find out more at
www.qatm.com