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INSPEX/ROT Inspection of Surfaces from Rotational symmetric Parts in Production 12.02.2019

You have quality problems on surfaces of rotary parts after production? Typically, these arise from flitter or chipping in CNC centers which automatically load / unload the devices. Chipping particles can attach to the gripper, which then cause surface imprints on the material. On critical surfaces, these imprints must be detected and sorted out.

For a long time these defects had to be sorted out, which cause the 100% automatic production line to be cost inefficient if it requires extensive visual testing at the end. And the migration to Industry 4.0 standards require 100% automatic control and documentation.

But also the automatic inspection causes trouble. Imprints are rather flat and often invisible in systems with confocal illumination. They also are oriented randomly, which does not justify a single ideal optical setup for all types of defects.

It is worthwhile to follow the inspection method of visual inspectors: He or She will hold the device in various orientations towards the illumination source, causing a variety of light reflections. A Single Orientation is not sufficient!

STV has turned this method into the system concept. The surface is digitized with several illuminations, such as confocal top light, and dark field illumination from the sides, and orientations in between. The combination of all inputs increases the confidence to find a real defect.

For instance, the very bright spots in darkfield light often are dust particles sitting on the surface. But they can as well be cavities in the surface, such as chipping, cracks, or cutouts.

On the other hand, if this specific point moves into the confocal toplight, the dust particles are almost invisible, whereas defects in the surface remain.

Altogether this results in a significant suppression of artefacts, or false rejects, and will therefore increase the production yield, or reduce the amount of defects part to throw away.

Clusters is another typical visual defect: A single crack line will often be split into multiple small spots, disconnected. But they all are recognized as a common larger defect. The cluster analysis is capable to test for neighboring conditions: "How many neighbors does my little defect have around me?" If others are close enough and large in numbers, they build up for a single significant defect, although all single defects individually would be insignificant.

How does the inspection work? The test device is placed to the roller surface or rotary table by robot (or manually), the inspection is started, and the camera grabs a series of images while the device is rotated. All images are at fixed frame rates, so the defects move at a specific offset from one image to the next. All image

information is evaluated in real time while the camera grabbing is active. At the end you get the result on display or robot interface. The total cycle time is a few seconds per device, dependent on the device size, complexity and accuracy requirements.

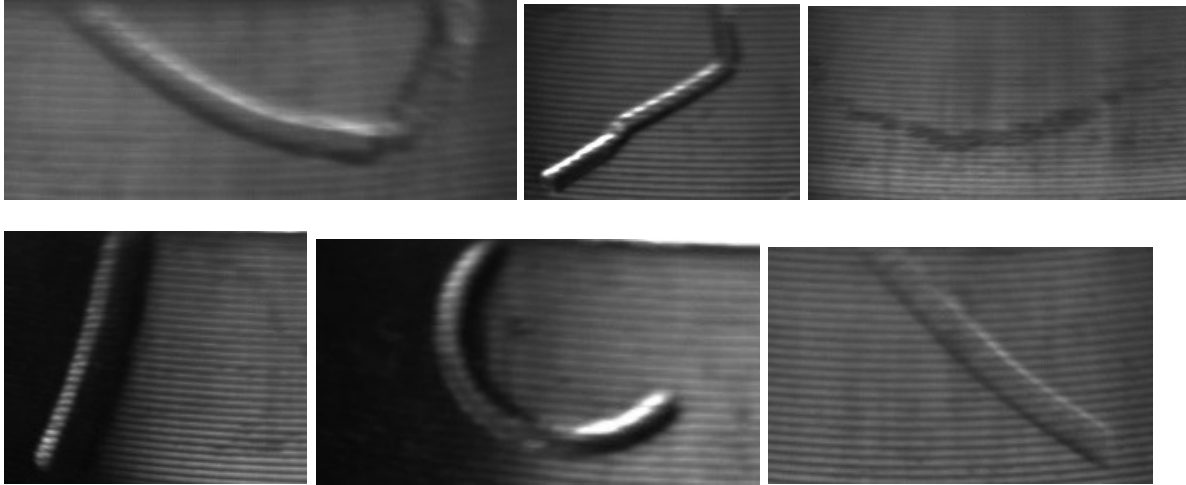
Technical Data

Rotary Table	Mechanics	Measurement for	Max dimension
Type 1 table	Rotation Rollers	For needles, drilled parts	≤ 10 mm diameter
Type 2 table	Rotary table, spindle	Flange, housing	Various dimension ≤ 100 mm
Type 3 table	Large Rollers	Pistons, Cylinders	>20 mm diameter

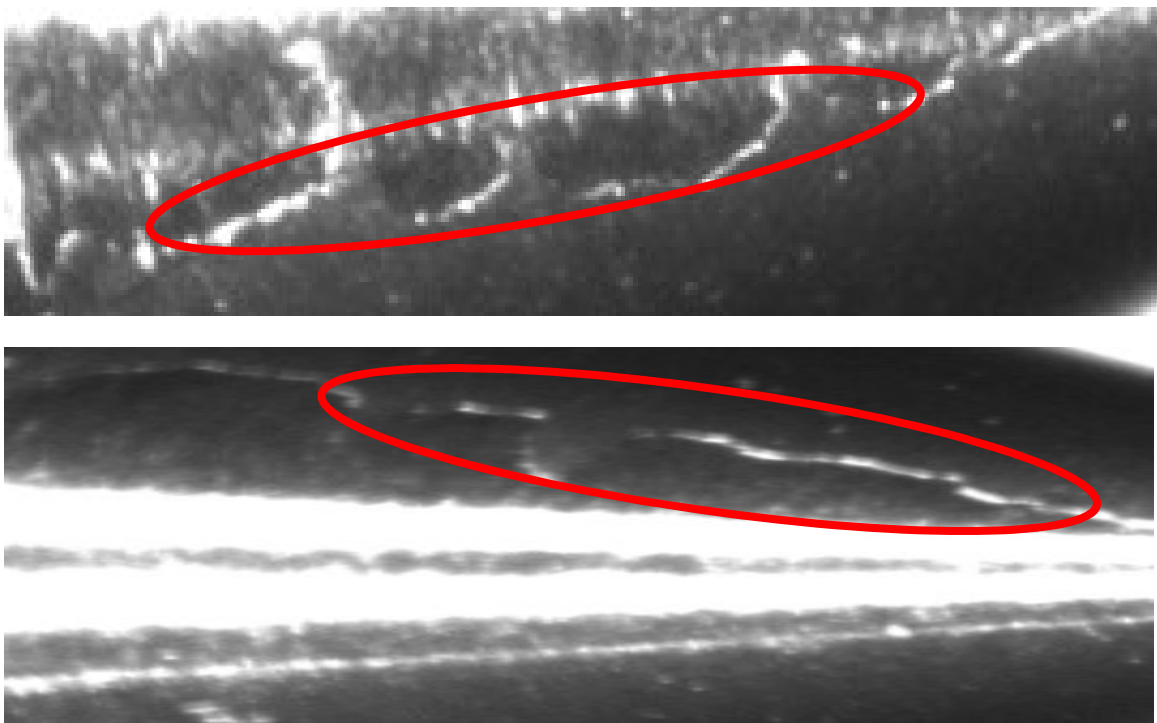
Camera Type	Standard HDTV	Medium	High resolution	
Camera Image Format	1900x1200	2500x2000	4100x2100	Pixel
Grabbing Speed	50	25	14	Images /sec
Image Size	12x7.6	12x10	8x4.2	Mm
Pixel	6.3	4.8	2.0	Micron
Optics				
Contour Shape Check	+ - 4	+ - 2	+ - 1	Micron
Defect Size	12	8	4	Micron
Position Measurement	+ - 3	+ - 2	+ - 1	Micron
Scratch Width min	≥ 8	≥ 5	≥ 3	Micron
Discoloration	10	10	10	Gray values
	35	24	24	Micron
Max # images / device	100	100	100	Images
Cycle Time	2	3	4	Sec
Robot Interface	24V PLC			
Industrial PC	Win10-64	Win10-64	Win10-64	
Illumination	LED	LED	LED	

Examples: Outer Surface Inspection

Imprints, Flitter



Micro Cracks

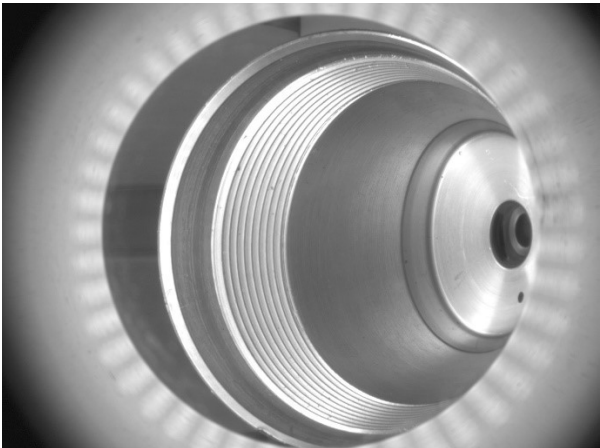


Examples: Inner Surface Test

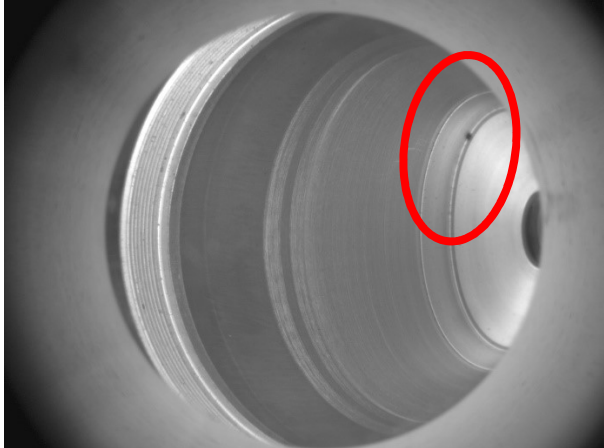
(dynamic test)

Material - Steel

OK Part

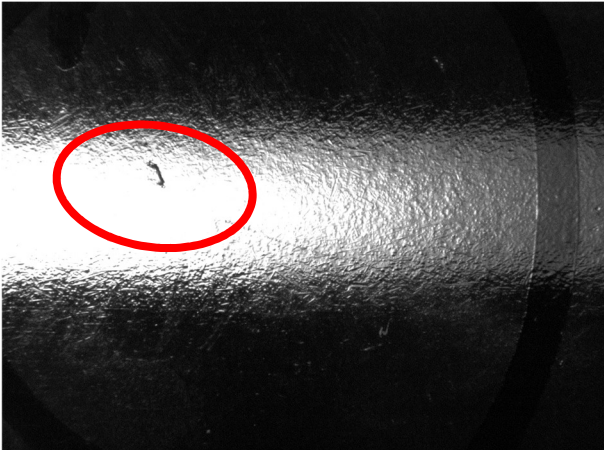


Lunker in Bottom Surface

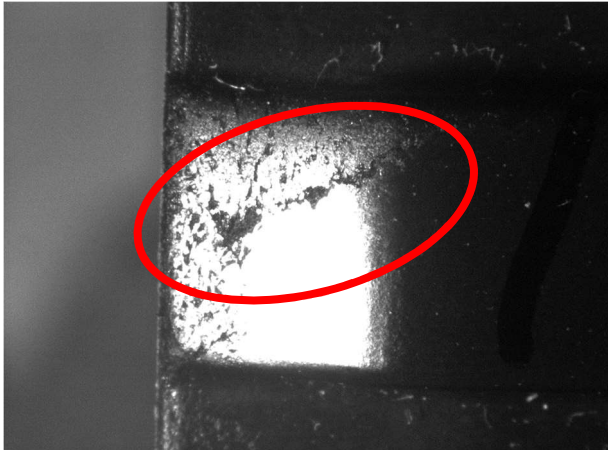


Material – Plastic

Defect inner Surface



Casting Defect, Lunker



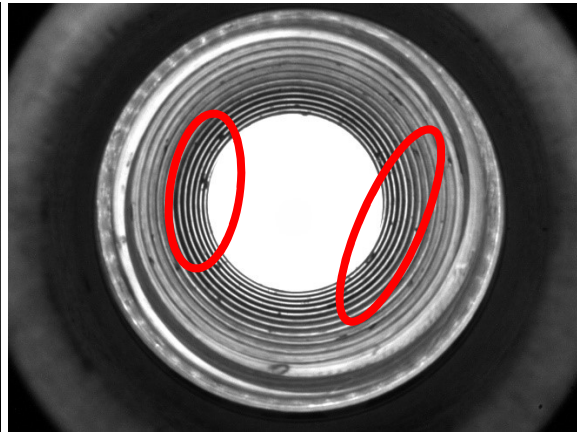
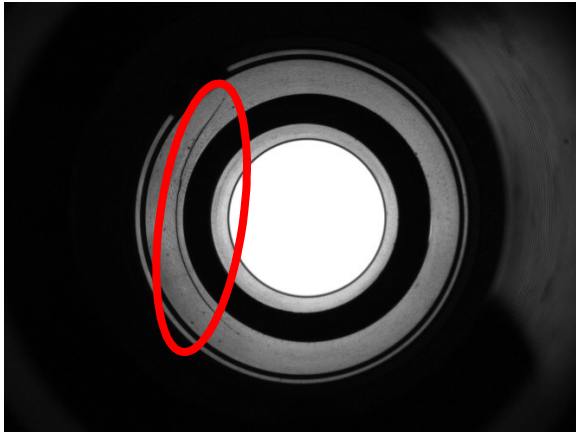
Example: Drill Hole Inspection
(static test)

Piston, Piston bolts

**Thread check, Double line trapezoid thread
D=8**

Process Scratch, Cut

Chips and Particles



Fitting inside DrillHoles

Good sample

