

# Opto Engineering PCHI023 lens inspects inner surface of engine rings

## Introduction

As most automotive parts, engine rings are simple yet very critical components: even the tiniest surface defects can seriously impact component efficiency and shorten the whole system lifetime or, in the worst case, lead to early failure. Defects of such critical components must be identified as early as possible in the manufacturing process both to raise quality and cut costs: this is where machine vision plays a fundamental role.

## Company profile

Puffin Automation is an automation and vision solutions provider based in Minnesota, USA, that specializes in designing and implementing innovative, turn-key inspection systems.



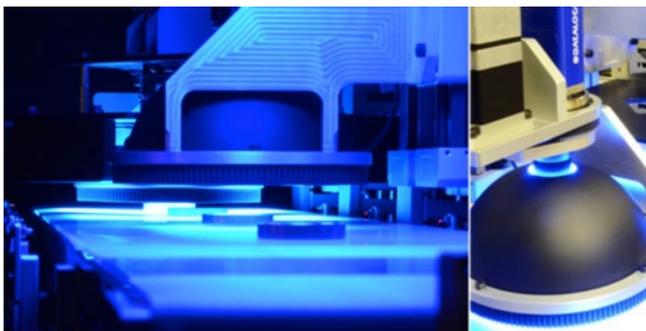
## The case

Our customer was asked to design an inspection system capable of detecting surface defects of engine rings of different sizes, especially including defects positioned onto inside surfaces. The rings range from approximately 25 mm to 76 mm in diameter and 4 mm to 20 mm in height. Defects could be small cracks or voids in the material as small as 200  $\mu\text{m}$  and located anywhere on the inner diameter of the engine rings.

The whole system must inspect the top, bottom, inner and outer surfaces of over 1500 different parts.

The existing inspection system was based on line scan cameras where each part had to be rotated resulting in a time consuming and non cost-effective solution.

## The solution



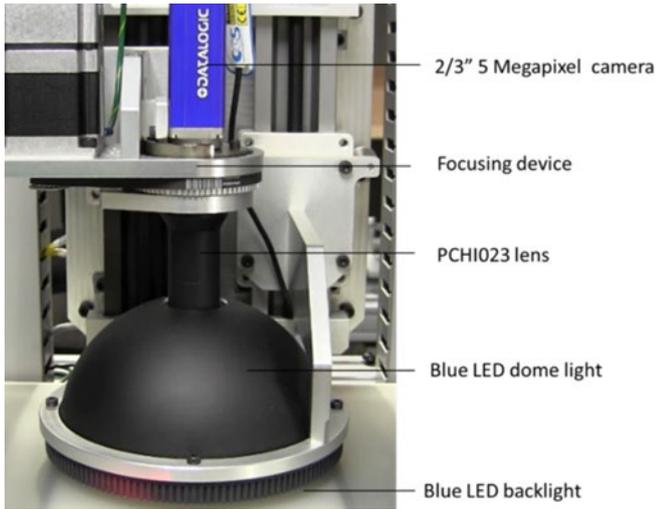
Engine rings being inspected while moving on the conveyor belt and inspection station for the inner surface.

The system developed by Puffin Automation is based on several different preset configurations so that cameras, lighting and optics are automatically positioned for each unique inspection step.

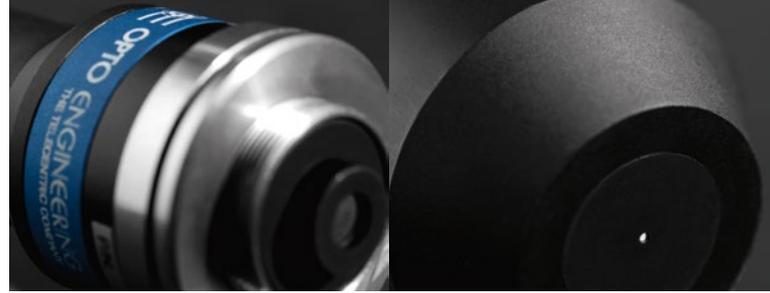
Once a particular configuration is loaded, cameras, lights, focusing and part positioning are all automatically adjusted to ensure that the best image is captured for each part. There are more than 120 parameters associated with each part, including light position and intensity, camera position, exposure, regions of Interest (ROI) location and size, etc.

The whole system consists of six vision stations that check for defects on the internal surface, on the outside surface, on the top surface, the concentricity of the part and (after the part is flipped) also on the bottom surface.

For the inspection of the inner surface Puffin Automation selected Opto Engineering PCHI023 hole inspection optics for 2/3" detectors and 360° inside view in perfect focus. Thanks to the large view angle ( $>82^\circ$ ) and innovative optical design, PCHI023 is in fact compatible with a wide range of hole diameters (from approximately 10 mm to 120 mm) such as cylinders, cones, holes, bottles or threaded objects.



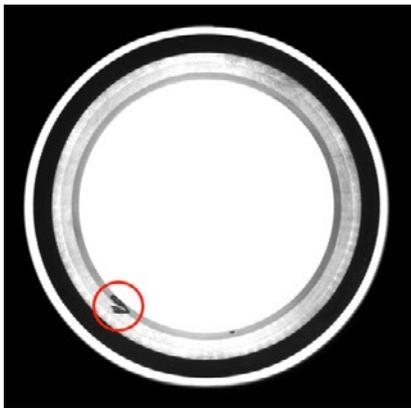
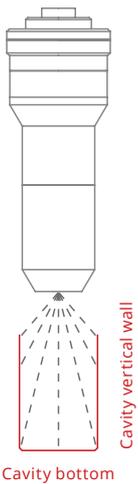
Inner surface inspection station, system set-up. PCHI023 lens is used in combination with a 5MP camera and blue dome and backlight to check the for defects on the inner surface of engine rings.



For this specific inspection task, PCHI023 is used together with a 5 Megapixel monochrome camera (2448 x 2050) and with two different lights to properly illuminate the parts: a backlight positioned underneath the conveyor belt and a dome light positioned over the top of the part.

Both lights were selected in blue color because short wavelengths are scattered more easily than longer ones (such as red) and are therefore more suited for scratch and surface inspection where they provide better contrast, as in this case with metal engine rings.

#### Hole inspection optics



PCHI023 lens field of view (FOV) schematics and image acquired by Puffin Automation with PCHI023 lens and a 5MP camera showing a defect on the inner surface of an engine ring.

Since the system has to check over 1500 parts of different sizes, Puffin Automation developed a motorized focusing device designed to ensure that parts with different internal diameters are all viewed in perfect focus by the PCHI023 lens.

The focusing device integrates a stepper motor and is deployed to thread the PCHI023 lens in or out of the camera body by adjusting the lens back focal distance to accurately focus on rings with different internal diameters. This process only needs to be done when a product change occurs and a different system configuration is loaded.

#### The benefits



PCHI023 lens

In the previous inspection system, line scan cameras were employed to inspect the inner and outer surfaces of the part: each part had to be rotated in front of line scan cameras using large, costly and time consuming rotary disks.

Opto Engineering PCHI lens eliminated the need for part rotation speeding up the whole process. Additionally PCHI provided the largest viewing angle (> 82°) when inspecting inside the part diameter so that defects were clearly focused and identified. Thanks to PCHI lens, parts could be inspected continuously without having to actuate a probe inside the part to find defects and stop the conveyor belt.