INEA INSPECT

Case study

Input quality control: detection of optical leaks in DPFs

canning process

Company profile

Industry
Automotive industry, corporation known for its innovative solutions in ride performance, clean air systems, and aftermarket products.

Product portfolio
A diverse array of products including shock absorbers, struts, noise control systems, and performance suspension components, alongside advanced clean air technologies that cater to emission control needs, such as catalytic converters and diesel particulate filters.

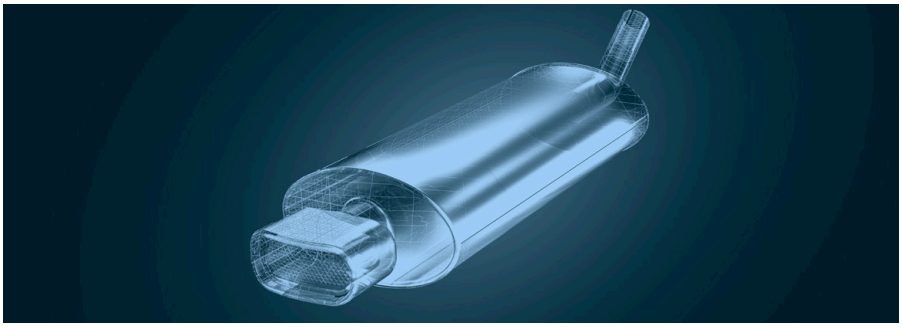
Location
Global presence with operations in approximately 24 countries, maintaining a network of manufacturing sites, technology centres, and administrative offices worldwide.

"Industrial vision system set the bar for quality inspection very high. Especially the part handling of fragile substrates and the traceability systems, the precision of inspection methods, and integration with the existing production."

- Global Core Competency Team Leader, Manufacturing Engineering Technology

Leveraging visual inspection and image processing technologies, the company implemented an in-line, non-destructive inspection system of every single component. By ensuring faulty components are detected and removed early in the process, the system prevents defective clean air systems from reaching vehicles.

The system is specifically focused on the precise detection of optical leaks in DPFs. By accommodating varying component geometries and sizes, this solution seamlessly integrates into the existing production line, enhancing production process efficiency and reducing cycle times by 30%.



Challenge

To comply with environmental standards and regulations, the customer required a 100% quality assessment system capable of precisely detecting defects that could cause optical leaks in Diesel Particulate Filters (DPFs). Optical leaks were a critical concern, as they could allow harmful particles to bypass the filter and enter the atmosphere, leading to product rejection by end customers.

The production line handled three types of components: a combined catalytic converter and diesel particulate filter (which required canning together) and a standalone catalytic converter, all in varying dimensions. The visual inspection solution needed to accurately identify and adapt to these different dimensions to ensure optimal quality assessment according to specific parameters.

The solution needed to be integrated as an input control at the start of the production line to ensure defect-free input and early detection of any issues, while also aiming to improve the existing cycle time of 31 seconds per finished product.

Key features

Speed and precision

With conveyors running at 450 mm/s, our system inspects 160,000 cells per piece. The fast cycle time and flexibility enable inspection of multiple product types, allowing a single machine to efficiently support two or three different canning lines

Diverse geometries and sizes

Featuring servo-driven components, the system dynamically adjusts to the height of varying substrate dimensions, ensuring thorough inspection coverage across diverse geometries on a single production line.

Non-destructive quality control

By integrating industrial cameras, collimated lighting, and X-ray technology, the quality of all products is now thoroughly assessed, effectively replacing the outdated practice of destructive testing on selected samples.

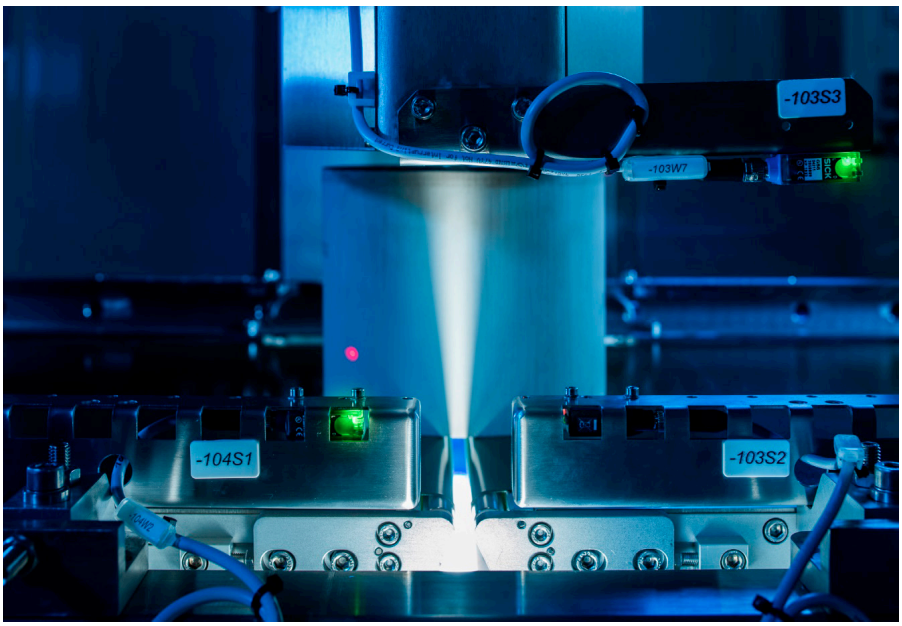
Solution

We developed and integrated an advanced visual quality inspection system at the beginning of the customer's production line for the canning process of catalytic converters and diesel particulate filters. This system is engineered for 100% in-line, non-destructive inspections using cutting-edge technologies.

High-speed infeed and outfeed conveyors manage product flow without disrupting cycle times. Positioning registration sensors accurately track substrate locations and dimensions, relaying crucial details (such as shape and size) to the vision inspection system.

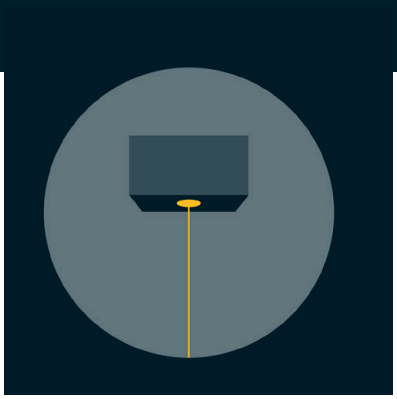
The visual inspection system features a 4K/8K industrial line scan camera mounted on an adjustable linear module, accommodating various part heights as communicated by the tracking system. Paired with collimated LED backlighting, the camera ensures optimal visibility by illuminating parts from below.

After image acquisition, sophisticated image processing software analyses and detects anomalies in real-time, leveraging advanced algorithms to identify deviations based on light transmission or reflection. The system then determines the pass or fail status of each substrate, and a diverter precisely directs them accordingly.



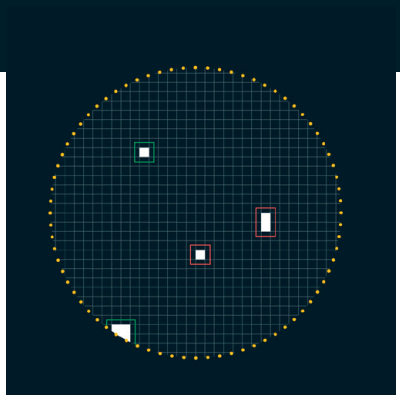
The entire inspection process, including data acquisition, analysis, raw data storage, and communication, is completed within 7 seconds per part—achieving a 30% reduction in cycle time due to fully automated handling and control. Despite the high throughput, the system ensures that all operations are finalized before the next part arrives. All inspection data, including images and parameters, are systematically stored, with automated reports generated to streamline documentation and quality assurance.

Fully integrated with the SCADA system, the inspect for CATs/DPFs provides comprehensive control over both the inspection process and peripheral devices. The vision software interface is designed for user-friendly setup, ensuring seamless integration and minimizing downtime during installation and commissioning.



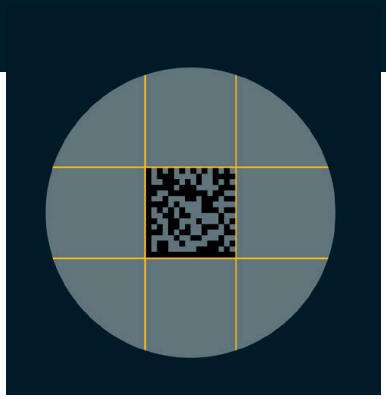
Line scan camera and collimated LED backlight

The catalytic honeycomb undergoes inspection with high-resolution line scan cameras paired with a strategically placed LED backlight, enhanced by collimated optics to emphasize cell details and identify even the smallest defects. The honeycomb is illuminated from beneath, allowing the line scan camera, fitted with telecentric optics, to capture highly detailed images at a 16K pixel cell resolution. While area scan cameras are commonly used for quality assessments, line scan cameras provide a more compact design, facilitating smooth integration into production lines without sacrificing image quality.



Advanced image processing algorithms

After image acquisition, the analysis and detection of anomalies are performed directly on the production line using advanced image processing algorithms. The inSpect system adjusts for variations in light transmission and reflection, precisely identifying structural irregularities based on predefined parameters. The algorithm evaluates the number of cells with optical leaks on both the outer edge and inner sections of the DPF, determining if all parameters are within the specified tolerances. It can detect any leaks on the inner section, and leaks smaller than 0,1mm² on the outer edge.



Reliable data tracking with Data Matrix Codes

100% reliable data tracking is ensured by using laser-etched Data Matrix Codes (DMCs). This tracking system supports high-speed in-line inspection where system transitions between continuous and indexed transit modes to achieve the required cycle time. The system provides immediate responses to recipe selection and setting of the parameters. After the barcode has been read, the system automatically selects the correct recipe, changing detection parameters, the camera exposure time, LED light intensity and camera height.

Results

By integrating automated in-line quality assessment with industrial vision technology, the customer ensured compliance with environmental standards, streamlined result auditing, and enabled real-time rejection of defective components. Eliminating the human factor stabilized the cycle time, reducing it by 30% from 31 seconds to 21 seconds per finished product. This automated quality control system removed subjectivity, improved precision, and significantly enhanced cost management by minimizing the production of defective products and reducing the likelihood of costly market recalls.

Due to the system's effectiveness in detecting defective parts, a leading premium car manufacturer now mandates that all production lines manufacturing their components be equipped with the inSpect system.

100%

products inspected

using non-destructive inspection

66%

reduction in investment costs

with adjustable system for multiple production lines

30%

reduced cycle time

with automated in-line visual inspection

100%

pass rate in audits

by premium car manufacturers

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