Waygate Technologies
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Enable in-line metrology for complex automotive injection molded parts using inspection

How new advancements in industrial CT technology provide dimensional measurement and help assure quality.

Technology's role in automotive design is a modern-day marvel. It provides capabilities such as predictive maintenance, fuel efficiency, and personalized driving experiences. One silent but powerful technological competency that is changing the landscape of automotive possibilities is injection molding technology.

Complex injection molded parts in automotive manufacturing

In automotive manufacturing, injection molding technology has spurred tremendous innovation and novel design capabilities. Injection molding allows for lower cost, rapid turn-around parts, bolstering its' foothold in automotive designs. New automotive features, for example built-in screen displays and rearview cameras, require plastic molded parts. Additionally, lighter plastic-molded parts have replaced parts previously made of metal, such as bumpers and inside door panels, helping to improve automotive fuel efficiency.

As technology advances and automotive requirements increase, injection molded parts for automobiles are becoming progressively more complex – and more broadly used. Injection molding often involves multiple-part integration, necessitating parts with complicated curves and intricate shapes.

Thus, the precise geometry of complex injection molding has become an increasingly crucial – and simultaneously challenging – step in automotive production. It is crucial because accurate, fast metrology is required for optimal productivity, minimal scrap and related loss reduction. It is challenging because molded parts with complicated geometries and more sub-surface details are increasingly difficult to measure and inspect.

The rising importance – and simultaneous challenge – of metrology

Frequent metrological inspections are essential for complex injection molded automotive parts to ensure quality, boost safety, speed up the injection molding process and improve cost effectiveness. In the automotive industry, maintaining speed and cost effectiveness are two foundational competencies required for sustained manufacturing viability.

Conventionally, optical scanners, destructive testing and CMMs (coordinate measuring machines) have been employed to measure complex injection molded parts and connectors. However, with advancements in part design there is an escalating need for higher speed in-line inspections employing NDT (non-destructive testing) and metrology. As a result, conventional metrology solutions, which are inherently slow and unable to handle complex geometries, are becoming less and less effective.

New requirements

Quality inspection competencies for complex injection molded parts in automotive manufacturing stem from two key trends: 1) elevated usage in automotive and 2) increasingly complex designs. The characteristics of design complexities include

+ Intricate geometries
+ Complicated curves
+ Integrated designs
+ More sub-surface areas

Conventional approaches

To-date, automotive quality and metrology inspection techniques for complex injection molded parts have been limited. Conventional approaches include:

1. **Destructive testing** which cuts open the part and destroys it. This means that only periodic samples are tested, and the part used in end-use application is not the part tested; thus it is an extrapolation of quality, leaving potential gaps in manufacturing awareness that can lead to increased scrap and associated losses.
2. **Optical inspections**, which only view visible surfaces, make it an ineffective method for complex injection molded parts.
3. **CMMs (Coordinate Measuring Machines)** have long been employed to measure complex injection molded parts and connectors. However, with advancements in part design there is an escalating need for higher speed, in-line inspections employing NDT (non-destructive testing) that do not require the part to be moved and potentially compromised.

The effectiveness of conventional metrology solutions, inherently slow and unable to handle complex geometries, continues to decrease for inspections of complex injection molded automotive parts.

The steep and hidden costs of limitations

Conventional inspection and metrology approaches leave potential blind spots of vulnerability in complex automotive injection molded parts and performance. Blind spots and hidden losses, although obscured, carry real, tangible costs. As such, they can hinder quality and productivity while increasing vulnerabilities and risks – unnecessarily.

In complex injection molded parts, the steep and hidden costs of limitations can be significant. When compared to 3D industrial CT inspections, which provide comprehensive quality inspection capabilities, the total cost of ownership numbers can look like this:

+ The initial cost of conventional inspection is about **40% less than industrial CT solutions**. However, conventional inspection tests for a mere 20% of potential failures, incurring costly risks of scrap, downtime and ultimately, public safety.
+ In other automotive applications and adjacent industries, a 10% scrap rate generates an estimated manufacturing **scrap cost of $50-100M USD** per each facility with multiple lines.
+ In other automotive applications and adjacent industries, 3D industrial CT technology is estimated to reduce manufacturing **scrap rates by 30-50%** over conventional inspection methods.

What's new:
game-changing advancements in metrology and inspection

Next gen metrology and inspection solutions have outpaced conventional approaches. Today's automated, in-line metrology inspection solutions, based on industrial CT technology, provides adequate cycle time, uptime, image resolution and measurement accuracy. Furthermore, industrial CT solutions handle complex geometries, view sub-surface structures, generate holistic part images and handle highly integrated parts. And, their capabilities are ideally suited for the high volume, high speed, and margin-sensitive requirements of automotive manufacturing.

In automotive manufacturing and the inspection of complex injection molded parts, industrial CT technology operates at appropriate in-line inspection speeds that sustain high volume output. By enhancing productivity, improving manufacturing accuracy and minimizing scrap and its' related costs, the feasibility of a positive industrial CT technology ROI justification is high.

Advantages of industrial CT inspection for complex injection molded automotive parts

+ Automates in-line metrology
+ Provides adequate cycle time
+ Maximizes uptime
+ Optimizes image resolution
+ Improves measurement accuracy
+ Handles complex geometries
+ Views sub-surface structures
+ Generates holistic imagery
+ Handles highly integrated part
+ Ideally suited to operating requirements of automotive plants

Summary and next steps

To select the proper industrial CT inspection solution for complex molded injection automotive parts and connectors, you need a partner not a product. Leverage an experienced, industrially minded partner with deep, proven expertise in high resolution radiography solutions that understands the unique requirements of injected part metrology and inspection.

The use of complex injection molded parts in automotive designs is on the rise, enabling lower cost, rapid turn-around parts. As a result, fast, accurate metrology and inspection in complex automotive molded part production is increasingly essential. By adopting apt, state-of-the-art industrial CT inspection solutions, automotive manufacturers can help to ensure quality, enhance productivity, and lower costs.

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