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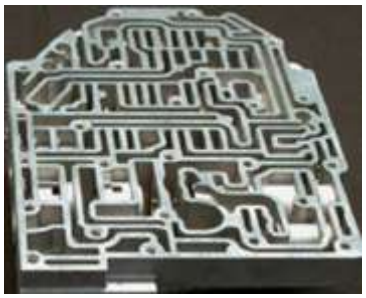
High-Definition Metrology and Vision Application Note #09-05

Detection of an Incoming Part Casting Defect - a *ShaPix* Case Study

The Powertrain Challenge



In a transmission plant of a *Coherix* OEM customer, ("**OEM2**"), a *ShaPix* being used to audit machined parts detected a small area that was much lower at a particular point on the machined surface separating two fluid channels ("worm trails") near the center of the part. The lower area was in the same location on all parts that failed tests in this way. When *ShaPix* detected an area that was much lower than the surrounding area, it rejected the part for global and zone flatness. The CMM had passed the part. Upon visual examination of the parts, no low area was apparent at that location.

The Metrology Need

The valve body machining production line was stopped. The location and cause of the discrepancy between the few thousand CMM measurement points and ShaPix's million or more high-definition complete-surface-coverage measurement points was initially unknown. The number of already-machined parts for which this discrepancy existed was also unknown given the receiving part audit inspection sampling rate.

The Measurement Requirements

To ensure that measurements consider each part surface's complete shape, high-definition measurement both surfaces was required to 1 micron accuracy. Measurement of the entire part surface was needed to determine the impact and root cause of the ShaPix-detected part surface discrepancy, so the effects on potential transmission performance and leakage could be assessed.

The Coherix Solution

ShaPix directly provided a visual image clearly highlighting the small surface area causing the measurement discrepancy. The *ShaPix* part mask defines what points in the field of view are relevant to the surface flatness. For a valve body it is important to measure all worm trails surface areas and omit other non-milled surface areas. The *ShaPix* part mask in the area of interest was straight, but the part being measured was curved, leaving a small notched section that *ShaPix* was measuring, but did not exist between two of the failed parts' "worm trails". This small section that the *ShaPix* expected to see but did not exist was the cause of the failures. The *ShaPix* image from the original reference part that was used to make the part mask was examined to determine if the area of interest was curved or straight when the part surface was set up. It was straight.

An archived part used in long term reference testing of the *ShaPix* was retrieved and compared to the part being measured. There was a difference in the castings of the parts in the area of interest. Further checking of parts in the production area determined that the die used for casting them was different than all other dies used to cast parts. It had a notched surface between the "worm trails" in the area of interest and all others had a straight trail.

The *ShaPix* Results

Machining was halted on the valve bodies. Investigation by production personnel discovered the problem on castings with two specific die identifiers. The casting supplier and product engineering was notified of the problem. **OEM2** production management then rejected all castings from those dies. They were purged from the system including assembly and returned to supplier. No rejected parts made it into saleable transmissions.

The casting supplier uses “jigsaw puzzle” type die inserts. Small sections of these dies can be replaced to produce different worm trail configurations. This transmission is produced by both another original Equipment Manufacturer OEM (“**OEM1**”) and **OEM2**, and the supplier provides castings for both companies. **OEM1** had made a small change in the worm trail design for their version of the transmission. But the casting supplier had failed to change two dies to the **OEM2** configuration before casting parts for them. So it incorrectly shipped many **OEM1** castings to **OEM2**. No outgoing testing at the supplier or incoming testing at **OEM2** was in to place verify that the correct parts were produced and shipped.

The Powertrain Value Delivered

The *ShaPix* system detected a defect in incoming castings that no other system could have detected the problem. As a result approximately 580 incorrect valve body castings that had been shipped to **OEM2** were prevented from being machined or assembled into transmissions that would have performed poorly and production cost and warranty maintenance costs were averted.