



smartSCAN 3D quality inspection of gear transmission casings

The company ZF Friedrichshafen AG is a leading manufacturer of gear transmissions in the field of commercial vehicles, developing and producing technologies worldwide for drive-line and chassis technology. The complex gear transmission casings for commercial vehicles are made of aluminum using the method of pressure die-casting.

Based on the casing created in the CAD system, die-casting molds are produced to serve as shaping molds for the casing components. In the actual production process different parameters such as the filling quantity, pressure, temperature conditions, timing and tool design determine the condition of the molding parts. In order to ensure consistent quality of the die-casting parts, the adherence to the pre-defined tolerances has to be continuously verified.

This is when the high resolution 3D measurement and inspection system smartSCAN comes into play. The optical metrology technique of this breuckmann Scanner offers the ideal solution for quality assurance in the areas of first sample inspection or serial production. The application range stretches from laboratory measurements all the way to automated process solutions, thereby ensuring the acquisition of high-precision data even when executed in the factory environment.



—→ 3D scanning of a gear transmission casing



—→ The smartSCAN with a large field of view

Objective and measuring object

The inspection tasks at ZF for gear transmission casings made of aluminum die-cast are versatile: Firstly, in order to make sure of the required quality in the prototype phase, precise three-dimensional data is needed for the first sample inspection. The purpose and objective of the construction is the highest level of rigidity of the casing while using a balanced material input.

During the serial production, precision is of key importance when it comes to maintaining the quality standard. This is when the casing is inspected for contour accuracy and the surface is examined for damages and deformations. A special inspection parameter in this context is the wall thickness, which has to be of optimum proportion with regard to stability and quantity of material used.

Finally, the tools used in the production process have to be regularly inspected in order to make sure that signs of wear and tear are being identified at an early stage, thus avoiding the development of inferior product quality well ahead of time.

All inspection processes can either be carried out manually on a turn table or automated in combination with a robot (serial inspection).

Measuring system and setup

For the first sample inspection, the measuring system smartSCAN with a 250 watt light and a big measuring field is being used. To execute the partially automated data acquisition of the transmission casing, the sensor setup is additionally equipped with the rotation unit turnTABLE-300, which is specifically designed for heavy weight measuring objects.

Workflow

During the scanning process, firstly the individual scans are generated, aligned and then merged into a uniform polygon mesh with the aid of AICON's OPTOCAT software. In a second step, the generated data is imported into the inspection software (in this case PolyWorks | Inspector™ by InnovMetric Software Inc.) in order to assess the geometries of the measuring object.

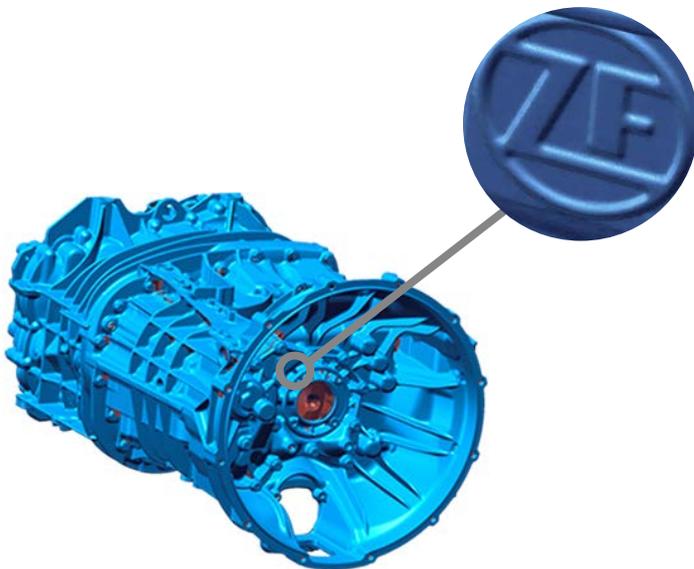
The workflow in detail: Using the standard triangulation angles of area-based scanning systems, deep ridge structures very often cannot be captured with the desired accuracy. Thanks to the flexible sensor configuration of the smartSCAN series, scan processes can be carried out using triangulation angles of 30°, 20° and 10°, thus allowing the generation of highly precise measuring data even of object areas which are usually very difficult to capture using conventional sensors.

1. Measuring setup and digitization

- Setup of sensor, turn table and measuring object
- Sensor calibration and verification (VDI 2634/2) according to a dumbbell artifact
- Measurement of the transmission casing (scanning and visualization)
- Generating the 3D data set (format: STL or PLY)

2. Comparison with CAD data

- Establishing the inspection parameters as per definition (features, cross-sections, scaling)
- Nominal / actual comparison (color deviation comparison with CAD)
- Generation and evaluation of the inspection report
- Optimization of the die-casting mold and adaptation of the production parameters



—→ 3D data with an object detail



—→ The original gear transmission casing

Conclusion

If the CAD tool data is already available, it is directly loaded as reference. Typically, the measured deviations between target and actual status are visualized with the help of a false color map. This way, the measuring results can be easily and directly interpreted and immediately used for the optimization of the die mold tool or the process parameters. This helps the production department to maintain a consistent efficiency even under demanding circumstances and in the end result to ensure the production of high quality gear transmission casings.

In comparison to the conventional coordinate measurement technology, the AICON smartSCAN allows a much easier and faster evaluation of the measuring result, in particular of freeform surfaces. Furthermore, the user is provided with a much more comprehensive data base for subsequent processing, which in the context of the development of the prototype allows a significant reduction of the time to market cycle.

Contact / Link

ZF Friedrichshafen AG, 88046 Friedrichshafen, Germany — www.zf.com

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