

Measurement in Series Cycle

Acoustic parameters without time delay in serial production

In order to meet the specified quality standards for your assemblies and deliver consistently high production quality, measurement is essential. How can the determination of certain acoustic parameters be automated and integrated into tightly synchronized production processes without delay?

Goal: 100% testing in series production

Together with other project partners, Novicos developed and implemented a concept for an end-of-line (EoL) test bench for the series production of a parking lock actuator for the automotive supplier ZF. The aim was to quickly and reliably determine and evaluate the acoustic quality and individual acoustic effects of all products on a production line. The measurement data should also allow conclusions to be drawn as to which components are causing the noise in rejected parts, in order to improve product quality in the long term.

Since the measurement had to take place directly within the noisy environment of the production hall, direct sound pressure measurement using microphones was not feasible. In addition, the planned 100% inspection required a robust and resilient system capable of continuous operation over multiple shifts.

Proof of concept: manual test station

The first step was to develop a manual test station, which also served as a proof of concept and the basis for the development of the automated in-line test stand. The manual test station uses accelerometers to measure structure-borne noise on the surface of the enclosure. The sound pressure level is then calculated from this data. This required the test station to be decoupled in order to eliminate any influence on the measurement results

To the Point

- Allows for instant inspection in batch/multi-shift operations
- 100% inspection - every product is guaranteed to meet specified criteria
- Robust, durable solution to withstand the rigors of continuous operation
- Adaptable as criteria or product design changes
- Expandable for additional inspection tasks (e.g. detailed root cause analysis)
- Individual test data (per component) is stored and available for future analysis

from possible ambient vibrations. To validate the transfer functions used to calculate the sound pressure levels, Novicos carried out further tests under laboratory conditions. Based on these measurements, the previously determined transfer function was refined to achieve the best possible match. After a development time of only 14 days, the manual test station was ready for productive use at the customer's premises. In addition to general component testing, specific criteria and noise phenomena during actuator movement could be evaluated separately.

However, the manufactured components still had to be manually inserted into the test bench and removed again after testing. A 100% test was possible, but required a relatively long time, which was not compatible with series production.

Further development of the inline test bench

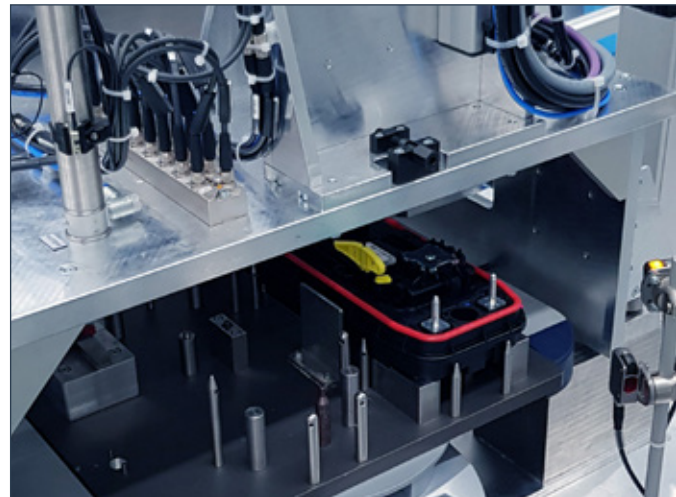
For the development of the inline test bench, further considerations had to be made. Accelerometer measurement, which had proved its worth on the manual test bench, was unlikely to be able to cope with the tight cycle times of 3-shift operation. The continuous high mechanical stress of series production could lead to inaccuracies in the test results and, in the worst case, failure of the test system. In the inline test bench, structure-borne noise is therefore measured without contact using a laser vibrometer. No mechanical forces act on the sensor during the non-contact measurement, making the entire test system more robust and reliable and ensuring long-term operation.

The test station was integrated directly into the customer's production line. Each component produced automatically enters the test station and is decoupled. The test is then performed; the signal is recorded and the data is sent to the evaluation software.

to the test software for evaluation. The entire test sequence is automated and provides results without delay, making it fully compatible with series production. The data obtained from the test sequence is transferred to a database using a specially developed communication protocol and is also available for later analysis. The concept enables the customer to ensure the high quality requirements for each individual product on the production line. The test system is easily modifiable to accommodate any changes to parameters or component adjustments. In addition, functional extensions are possible, e.g. the assignment of different defect causes.



Dr. Sören Keuchel configuring the test rig



EoL test bench in operation with test object