

Automotive OEM establishes a sensor-based End-of-Line quality control solution for compressors

Background

Large automotive supplier released a new electric compressor product line for high-end electric vehicles. They discovered that some of these units excessively vibrated under certain operating conditions, impacting compressor performance. To identify these early, they added specialized test equipment and subjective human-audible testing to their manufacturing process, in order to maintain the expected quality of products shipped to customers.

These tests were time consuming, labor intensive and did not support high volume production.

They needed a reliable, fast, and scalable end-of-line quality control solution in order to more optimally identify compressors of subpar quality.



Challenge

Rapidly isolate substandard compressors during production line testing

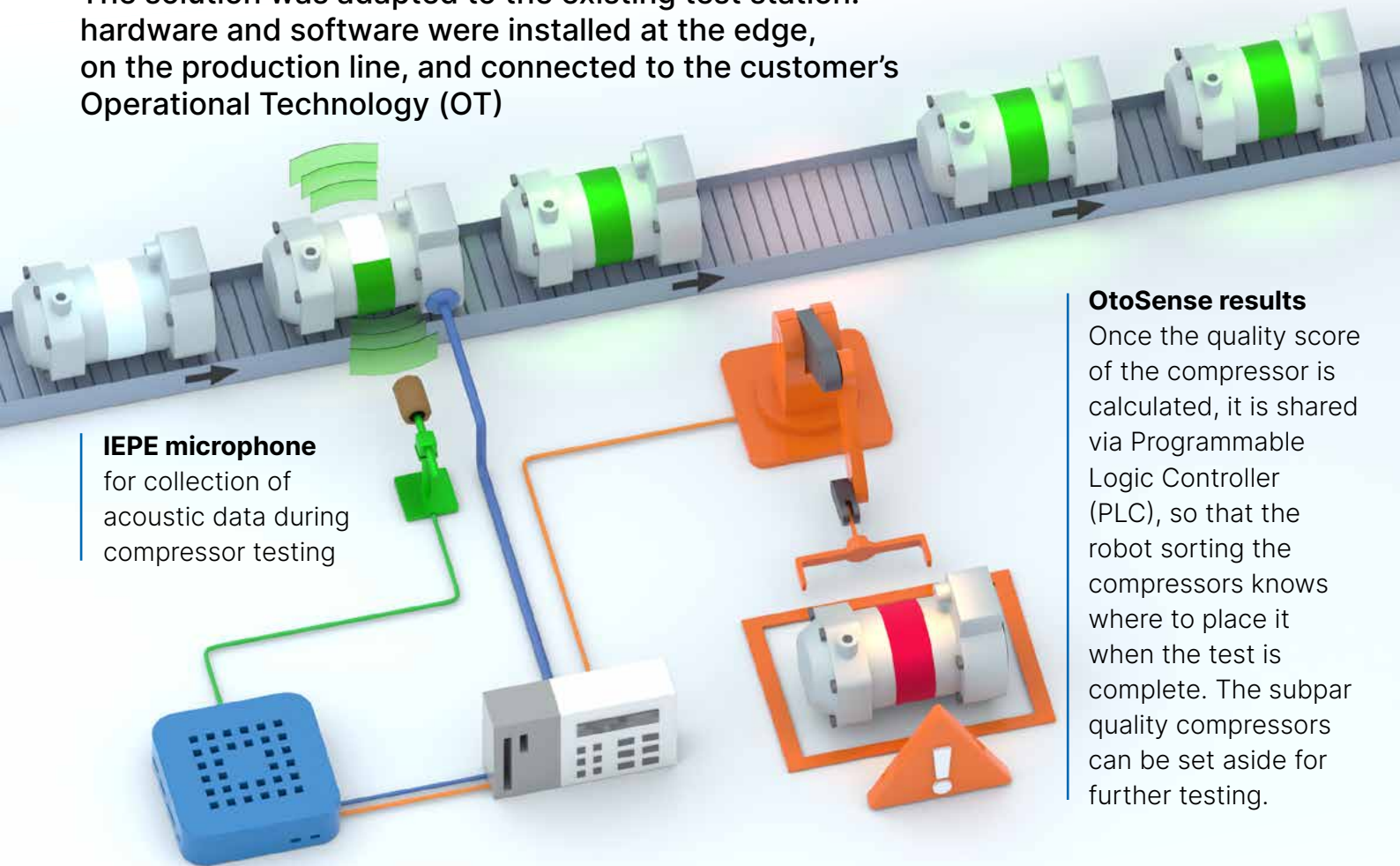
The testing solution must:

- Support high volume production
- Quickly and accurately identify substandard units without impact on production throughput
- Scale to test compressor model variants across multiple production lines

Solution implementation

A first trial was conducted using samples of audio data collected with the aid of a microphone. Some of the data was labeled to indicate samples from good and bad compressors in order to train the anomaly detection model. Then the unlabeled data was used to test OtoSense AI performance. The results were so promising that the customer decided to quickly install OtoSense Quality Control in their lab to confirm these results, and then in their factory, for a full deployment.

The solution was adapted to the existing test station: hardware and software were installed at the edge, on the production line, and connected to the customer's Operational Technology (OT)



IEPE microphone
for collection of acoustic data during compressor testing

Edge device hosting the OtoSense software locally (WebDAQ 504), processing data locally and making the result immediately available

Contextual information

Via PLC, OtoSense collects:

- the compressor's ID to know what model of compressor it will test in order to apply the appropriate anomaly detection AI model
- the commands sent to the compressor to start the analysis once the right operating condition starts

OtoSense results

Once the quality score of the compressor is calculated, it is shared via Programmable Logic Controller (PLC), so that the robot sorting the compressors knows where to place it when the test is complete. The subpar quality compressors can be set aside for further testing.

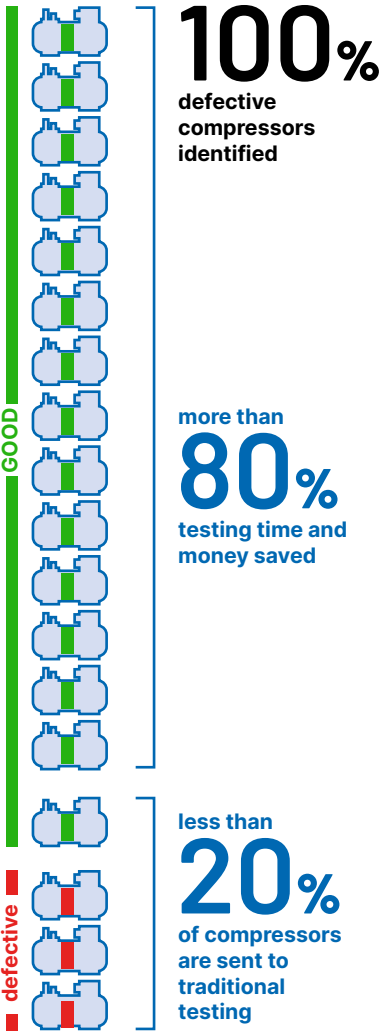
Electric compressors importance in automotive applications is growing to not only provide cooling to cabins and to ensure a comfortable ride but also cooling of the batteries responsible for powering the automobile. Subpar quality compressors create excessive noise and can impact the automobile's ability to operate effectively if the batteries run at a higher than nominal temperature. Therefore the manufacturer's goal to detect 100% of sub-optimal units, not only to avoid warranty and replacement costs, but more importantly to maintain a leading position in the competitive and growing electric vehicle market.

Outcome:

83% of the compressors can confidently be shipped without further testing

Reducing testing costs by a factor of **200**

Furthermore, improving performance and part traceability are key initiatives with the customer's digitization and industry 4.0 process. OtoSense Quality Control allows you to keep track of each unit, storing raw sensing data and insights attached to a serial number. It becomes a tool to help improve designs.



After initial training, the OtoSense AI model was tested with data coming from over a hundred compressors, among which a few were overly vibrating. OtoSense AI detected 100% of these subpar quality compressors during production testing, with only a small percentage requiring additional testing to confirm quality.

Result:

Instead of performing a full test on all compressors, the manufacturer can now test only about 20%, which represents huge savings

Conclusion

By quickly detecting the defective compressors directly on the production line, ADI OtoSense Quality Control (QC) supports the customer's growing market position as a top tier supplier to the fast-growing electric vehicle market. It enables them to reduce the compressors testing time and its associated costs to deliver the highest quality and highest performing compressors to their customers, securing their industry reputation.

The solution is...



Adaptive

OtoSense Quality Control seamlessly adapts its AI model to each compressor type and variant, based on PLC inputs.



Fast

OtoSense Quality Control only needs 3 seconds to identify the defective units and share its diagnosis.



Automated

The pass/fail results are sent via the customer's PLC system so that an immediate action can be taken: the robot knows where to move the compressors depending on their condition.



Evolutive

OtoSense Quality Control is an AI-driven solution: the more it learns, the better it performs. In addition, OtoSense quality control is able to detect anomalies that had previously gone unnoticed.



Repeatable

Any OtoSense installation can be easily replicated across production lines and production sites.