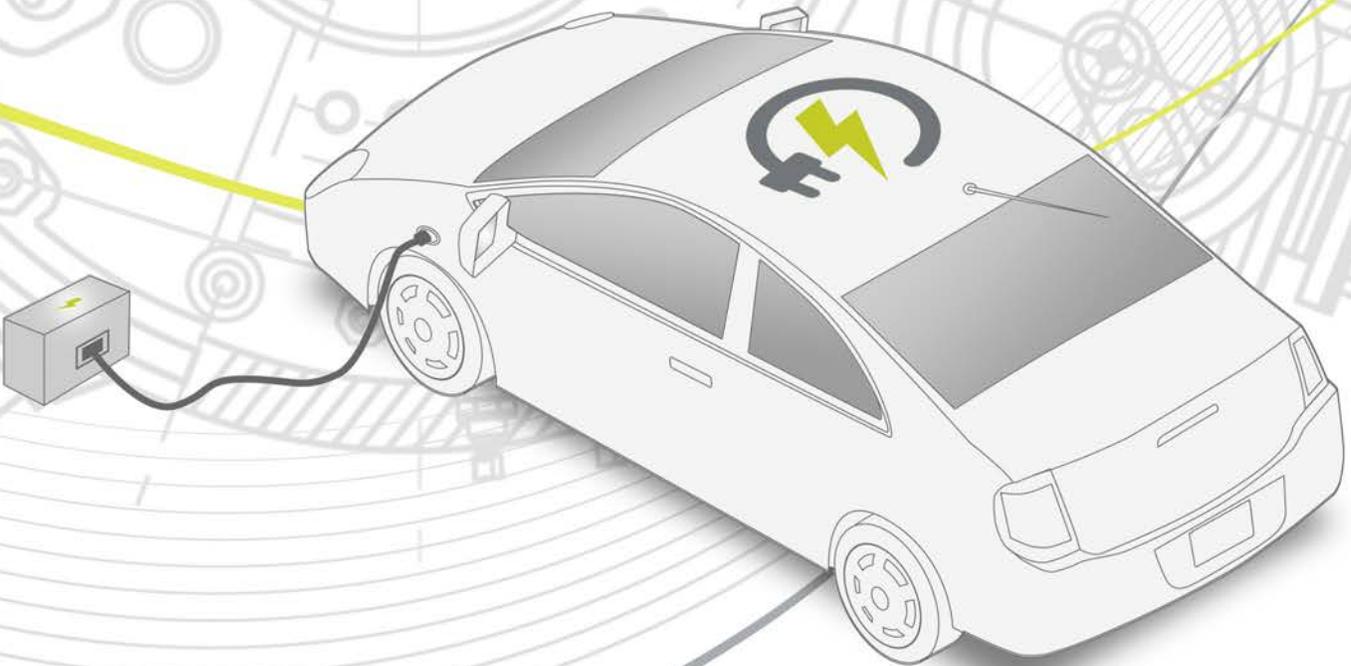


TOTAL PERFORMANCE IN-LINE VALIDATION FOR ELECTRIC VEHICLE MOTORS





CHALLENGE

The motor of an electric vehicle (EV) must follow a thorough validation process. Improper assembly, insulation or alignment of these parts will damage the motor, rendering the car unusable and becoming a liability. To protect their customers as well as their brand, our client needed to develop a multi-bench validation line for a smarter solution through this shift in electric automotive technology.

The client requested the following deliverables for their test setup:

- ▶ Fully automated system with zero operator intervention;
- ▶ Test time reduced and optimized from current state;
- ▶ Able to detect and identify the location of larger vibrations for repair;
- ▶ Automatically label all parts of the subsystem per directives;
- ▶ Conserve & re-use energy throughout;
- ▶ Manage all communication of parameters with traceability.





ABOUT THE CUSTOMER

A pioneer in the electrification of cars, our client has developed innovative technologies designed to lower energy consumption and CO₂ emissions.

RELIABILITY DELIVERED FOR A GREENER SOLUTION

With the growth of the hybrid and electric vehicle industry and the fast-moving innovations in the field, reliability and dependability are at the forefront of the e-automotive consumers' minds. While transitioning through this change for a cleaner planet, the product must deliver as promised and maintain its environmental commitment during production. As customers deviate from the old ways, repairs can be costly and dangerous if the final product is not manufactured properly. Our client required an all-in-one End of Line (EOL) performance and validation line, ensuring only quality goods will be sent to market.

RESULTS

WITH FEW ALTERNATIVES ON THE MARKET, AVERNA DEVELOPED A CUSTOM, HANDS-FREE SOLUTION TO TEST, MEASURE AND VALIDATE THE PERFORMANCE OF A SUBSYSTEM THROUGH THE ASSEMBLY PROCESS ACTING AS BOTH AN EV MOTOR AND AS A GENERATOR TO CHARGE THE CAR'S BATTERY.

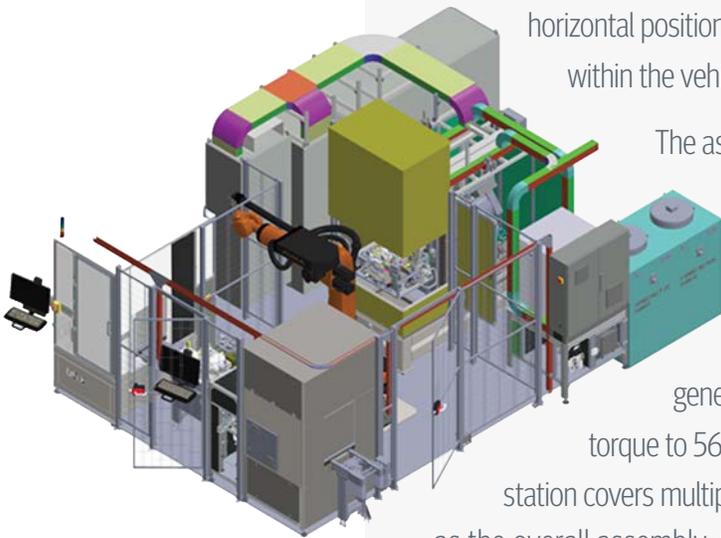
THE AVERNA SOLUTION

Several testbenches are incorporated into the build. The first station performs a series of HV & vibration tests on the motor only, without the inverter. It has been designed for vertical testing with an in-line configuration to optimize time and detect issues in the early stages of assembly. If all tests pass, the motor continues to assembly, otherwise the Unit Under Test (UUT) is sent for rework or repair before continuing down the line. Discrepancies can cause severe consequences due to the high speeds that are generated. The vibration sensors are also used to determine the exact location of heavier vibrations to submit for repair.

Once confirmation is received that the component is fully functional, the subsystem is ready to be assembled. Using the validated motor, it is combined with the inverter and sent to the second HV tester for re-testing as an assembled product. All HV and vibration tests are re-performed and if results conclude that all components are connected per the specifications, the motor is sent for final performance testing.

Using a KUKA robot, the UUT is brought to the final performance testbench to ensure accurate alignment within the component. It must maintain its horizontal position, mimicking the position in which it will be installed within the vehicle.

The assembled subsystem, weighing close to 50 kilos, is placed in the performance test bench by the KUKA robot. By using 90 kW of power the system replicates 2 separate scenarios to test the motor accordingly. The first scenario applies 4750 RPM and generates 166 Nm of torque, followed by decreasing the torque to 56 Nm and replicating 14,000 RPM. By doing this, the station covers multiple bases for validation of the product housing as well as the overall assembly. Measurements are verified for sound, vibration and torque, reducing the risk for any potential damage.



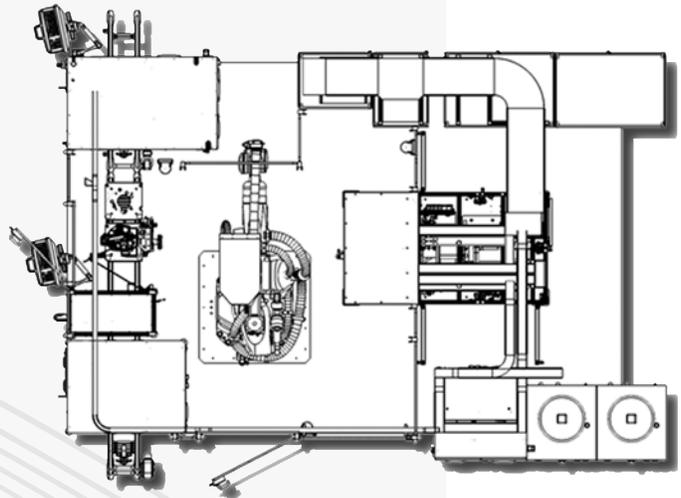
The final performance tester also includes a chiller-based cooling system to control the high temperatures generated from these test sequences as well as an industrial-sized battery simulator.

The battery simulator is essential for this setup, offering many benefits to the product and the user. Acting as a simulator, it also recuperates any over expenditures of energy and reuses it to power the test bench itself. By having the battery simulator, it renders the solution extremely energy efficient, saving the client from high costs and waste. It is also one of the key failsafe features within the test solution in the event the system must be powered off quickly.

Once testing is complete, the motor is returned to the production line, and sent to the laser marking station. Here all designated information such as serial number is characterized within the components and the EV motor is ready for market.

The entire system is managed by combination of PLC controllers and an external PC. The controllers manage the signal handshaking throughout the automated line while the PC commands each UUT to execute the desired speed and torque requirements. The measurements need to be highly accurate and are communicated quickly via Unified Diagnostic Services (UDS). Test results are stored within the internal database, sorted by serial number.

What was once a manual process including communication of all results one serial number at a time, has been completely replaced and fully automated. Operator intervention has been eliminated, test results are more accurate and test time was reduced from 45 minutes to 5 minutes per unit.





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