# Using accurate torque measurement for building ultra-high-performance motors

MADE IN BRITAIN

*Image ©Equipmake*

## Background

An ever-growing demand for electric vehicles, coupled with 65% of the electrical energy used in the industry consumed by electric motors, pressured the governments around the world to introduce MEPS (Minimum Energy Performance Standards), setting mandatory minimum efficiency levels for electric motors.

In response, motor designers are looking to reduce losses in their machines to boost efficiency and thus limit CO2 emissions through developing high-performance electric motors of high energy efficiency and low weight.

When it comes to assessing the performance of motors, measuring torque, speed, and calculating the power quality characteristics are of utmost importance. These measurements can not only give a direct insight into the performance and health of the motor, they can ensure reliable operation over time, predict failures and help minimise downtime.

**Improving the accuracy of torque and power measurement data for design, prototyping and verification of ultra-high-performance motors**

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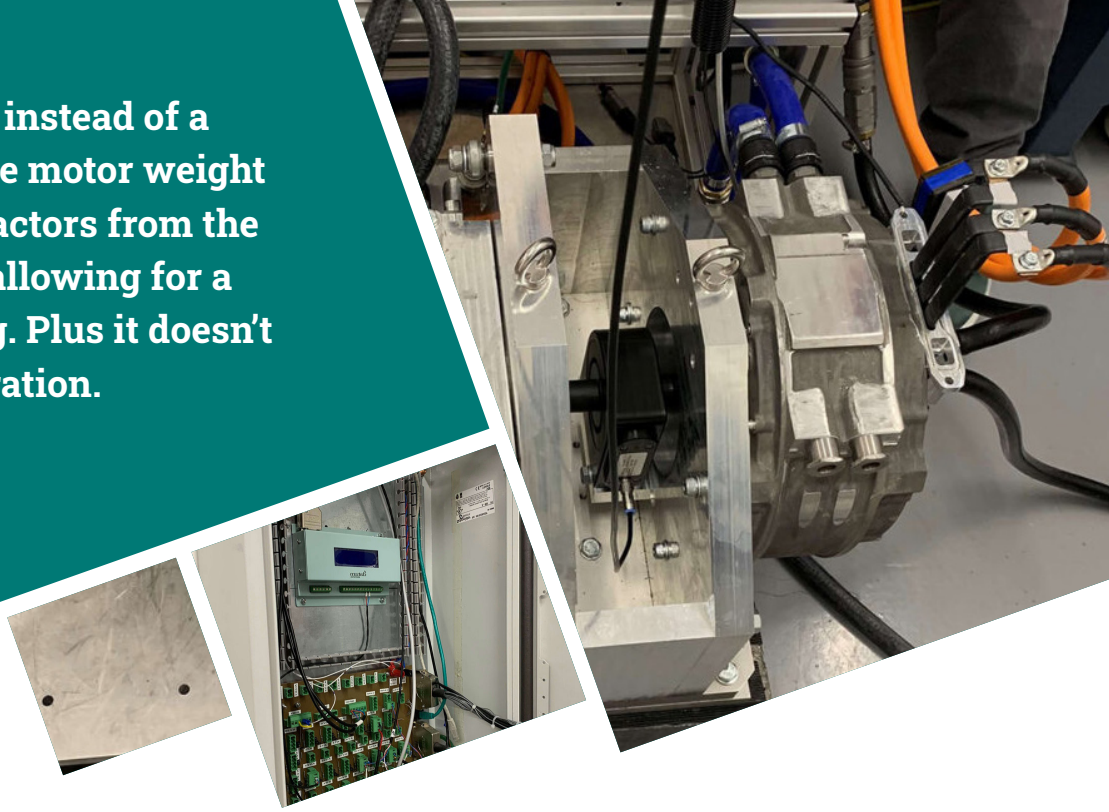
**Using a torque sensor instead of a load cell eliminates the motor weight and bearing friction factors from the torque measurement allowing for a more accurate reading. Plus it doesn't need frequent recalibration.**



## The Client

We were recently approached by Equipmake, a UK-based leader in developing ultra-compact, lightweight high-performance motors. Using this expertise, Equipmake has completed multiple impressive projects under their belt, including an electric bus and Ariel's upcoming HIPERCAR high-performance range-extended electric sports car.

Equipmake-Building-Electrics-Motor-Manufacturer
Headed by Ian Foley, who has vast experience in global motorsport events, like Le Mans and F1, Equipmake's team of expert engineers have been delivering projects from initial specifications through modelling, simulation, design, prototyping, and testing to production in industry-leading timescales.

Currently, the company is working on the world's most power-dense permanent magnet electric motor – 3D printed motor Ampere, aiming to give a power to weight ratio of 5 times more than a conventional motor.

## The Challenge

Motor torque is the single most critical variable that characterizes instantaneous mechanical performance. Previously, Equipmake used load cells to measure the force at a given moment arm. This would have a different zero error offset after almost every test and required frequent re-calibration. This method would also measure the force applied by the non-symmetrical weight of the motor mounted to the rig, which was far from ideal.

To correctly measure only the torque applied to the driveshaft by the device under test, the company decided to invest into an accurate torque sensor solution, that doesn't need frequent recalibration.

Using a torque sensor instead of a load cell, would also eliminate the motor weight and bearing friction factors from the torque measurement allowing for a more accurate reading.

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## Solution

After looking at project specifications, Datum Electronics team determined that a custom RS425 torque sensor would be a perfect solution for the project at hand.

Benefitting from a compact design and completely separate rotor and stator, an RS425 torque sensor can fit in limited spaces, where most of the torque measurement systems can't. It also offers zero bearing friction, making it a perfect choice for high speed and high torque applications.

Another benefit of an RS425 torque sensor is that we could take a free issued shaft from Equipmake's driveline and directly fit our torque sensor solution on it. This saved Equipmake from cutting the driveline and fitting a sensor inline, not to mention saving on cost, downtime, weight/space and eliminating further error due to additional parts. It also made for a smooth re-install on site.

Having Datum Universal Interface display allowed Equipmake to have a local read out with live torque and power data. Also, with the wide range of both digital and analogue outputs, the integration process was extremely simple.

## Impact

Improving the efficiency of electric motors and the equipment they drive can save energy, reduce operating costs, and improve productivity. For these reasons, Equipmake made their mission to bring high-performance but yet cost-effective advanced electric motors to the market and their customers.

By using a rotary torque sensor, Equipmake team was able to significantly reduce zeroing/calibration errors during the testing phase and increase their confidence in torque measurement data at higher speeds.

Even though they were using the same torque sensor for different driveshafts, they didn't need to worry about the accuracy of the torque readings after switching over, focusing their time on other parts of the project.

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