

Working together

Protean Electric partners with Centrateq to overcome vibration testing challenges

Protean Electric is a world leader of in-wheel motor (IWM) technology for passenger cars, light commercial vehicles, future transport solutions and more. Their IWMs are designed to deliver high levels of performance, efficiency, and sustainability for myriad solutions. Protean's motors deliver a host of benefits including creative freedom for original equipment manufacturers (OEMs) and driving benefits for the consumer allowing increased interior space as well as more packaging for battery, increasing range.

The development of this pioneering technology does not come without challenges. The use of in-wheel motors can alter the operational conditions that a product must withstand. Compared to a conventional central electric drivetrain, being positioned inside the wheel means that IWMs must continue to operate reliably while being subjected to much harsher environmental conditions. An electric motor located on the un-sprung side of the vehicle suspension will experience much higher levels of shock and vibration from potholes and other road surface defects than a central drivetrain located on the sprung chassis.

Moreover, IWMs are subject to unique stresses that are not experienced by central drivetrains, such as lateral cornering loads, suspension travel-induced cable movement, and potential impacts with kerbs. Given their location on the vehicle, IWMs are relatively complex and costly components, with a higher value compared to the wheel, brakes, or basic suspension parts surrounding

them. While end-users may be willing to replace a damaged wheel, the same cannot be said for an IWM. Therefore, IWMs must surpass the durability of the components usually found in this exposed area of the vehicle to ensure their reliability and avoid costly replacements.

With no existing automotive industry standard test program for in-wheel motors, Protean Electric have their own proprietary design validation system. To do this they have collated national and regional legislative requirements from across the globe, along with individual manufacturers' standards and guidelines. These tests are extremely robust, and include extensive vibration testing.

However, they had been experiencing occasional failures in their vibration system due to the high forces being generated by the fixture arrangement. In search of a more reliable solution, Protean Electric contacted Centrateq, a renowned provider of custom-designed fixtures and vibration testing solutions.

Centrateq worked closely with Protean Electric's engineers to design and manufacture a fixture that would help Protean Electric overcome their vibration testing challenges and achieve greater efficiency in their product development cycle.

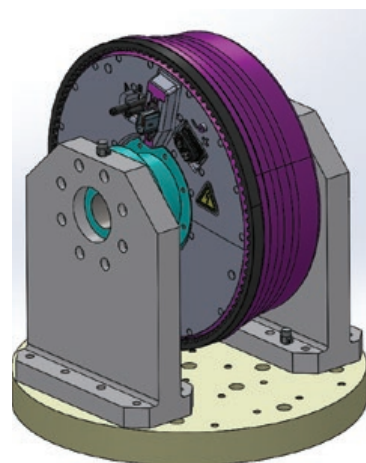
The brief requested a custom-designed fixture that could fully support the payload during a random vibration test while operating within the specified boundaries of the shaker. The fixture would need to provide stability and support for the test item in both the X and Y axes, while also operating within the parameters of a frequency bandwidth

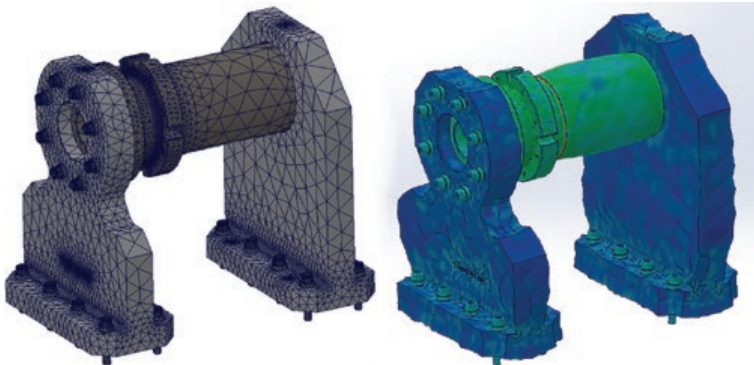
of 20Hz to 2000Hz and an acceleration level of 10.95 G rms.

In addition, the fixture would need to be capable of withstanding temperature variations of -40° C to +90° C for test durations of up to 32 hours. It was also important for the fixture to be designed within a certain weight limit to ensure compatibility with Protean Electric's existing vibration testing system.

Centrateq's custom fixture design team worked closely with Protean Electric's engineers to develop a tailored solution that met all these specific requirements. The team provided Protean Electric with an initial design concept, which comprised a "H" fixture with side supports made from anodised aluminium and a center shaft made from stainless steel.

By providing a balanced and symmetrical support structure on either end of the test item, the "H" fixture can help to reduce unwanted vibration or movement that could affect the accuracy and reliability of the test results.





After several design reviews, the team finalised the design, which included cut-outs in the side support at one end for cables and connectors. The design also allowed for the payload to be rotated in situ without having to dismantle the assembly, providing greater convenience and efficiency during testing.

To ensure that the fixture would perform as intended, CentraTEQ conducted CAD analysis to simulate the expected response under test conditions. The resulting analysis provided Protean Electric with a clear understanding of the expected behaviour of the fixture and the test item during testing.

Once Protean Electric approved the final design, CentraTEQ had just eight weeks to manufacture and supply the fixture to meet Protean deadlines. Thanks to efficient manufacturing processes and close collaboration between teams, CentraTEQ was able to deliver ahead of schedule.

The final product provided Protean Electric with a stable and secure support structure for the test item during vibration testing, while also operating within the specified frequency and acceleration parameters and withstanding the required temperature variations. Furthermore, the fixture was designed within the required weight limit, allowing for seamless integration with Protean Electric's existing vibration testing system.

After receiving the fixture, Protean Electric successfully ran vibration tests in both orientations. Protean's Product Validation Manager, Mark McDonnell,

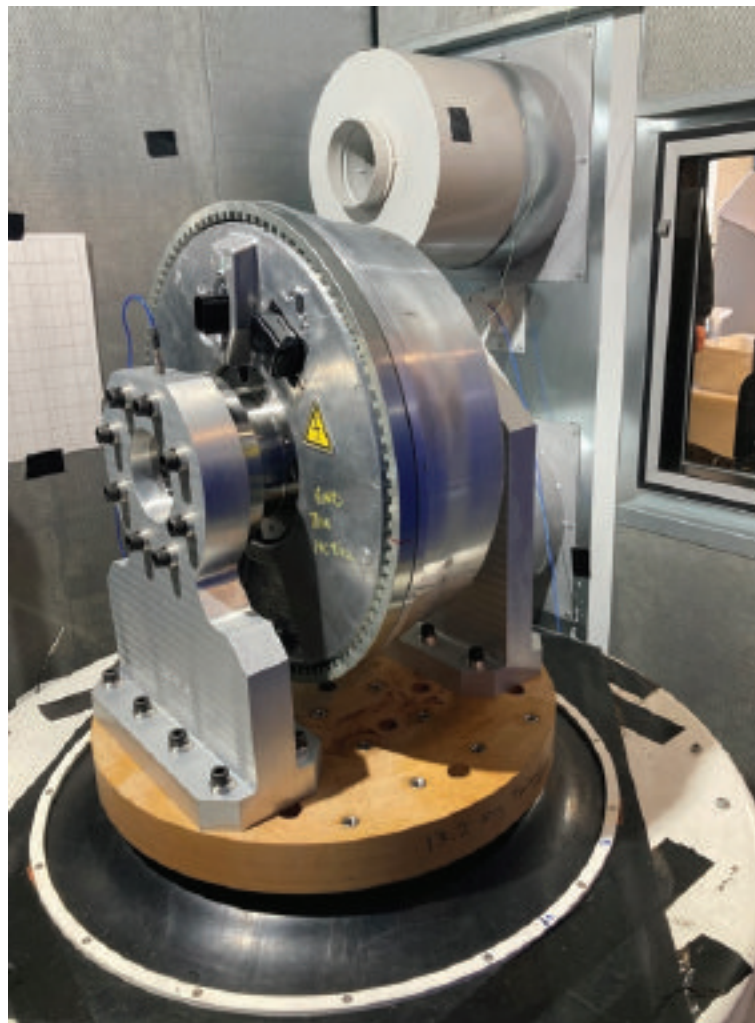
expressed his satisfaction with the outcome of the project, stating, "Just to let you know, we have successfully been running vibration with the new fixture since the middle of last week and it looks like everything is working well, we have used it in both orientations so good news."

Thanks very much for your work on this job. Let me take the opportunity to say the whole experience working with you guys has been a pleasure, your professionalism and technical ability were clear throughout."

Protean Electric's experience with CentraTEQ highlights the importance of custom fixture design in vibration testing. The successful outcome demonstrates the value of working with an experienced partner like CentraTEQ who have a comprehensive understanding of vibration test fixture design, including the properties of the fixture materials used, their resonant frequencies, and how they may impact the testing.

www.centrateq.com

Design Analysis



Finished product under test