

## CASE STUDY

# ENGINEERING ANALYSIS REDUCES DEVELOPMENT COST AND TIME TO MARKET

## PROJECT HIGHLIGHTS

Meeting Federal Requirements while bringing innovation to the marketplace can be a time-intensive and difficult endeavor. One of our long-time Modus™ customers (specializing in heavy-duty agricultural equipment) experienced months of frustration while trying to do just that.

Coupled with a deadline to introduce their new diesel version at the World Ag Expo, the customer was under the gun.

To stay competitive, our customer developed a diesel version of the gas-powered work-horse they've had in production for over four years. Knowing the proven reliability of the gas-powered version—coupled with the customer confidence they have experienced with this product—it seemed like converting to a diesel engine, with minimal re-engineering, would be straightforward.

A big challenge was to meet Federal Tier 4 Diesel Engine Standards, applied to diesel engines manufactured or re-manufactured after January 1, 2014. The Tier 4 Standard requires makers of off-road diesel-powered equipment to meet strict exhaust emissions to reduce particulate matter (PM) - unburned hydrocarbons, and nitrates of oxygen (NOx) - a primary ingredient of smog, defined by the Diesel Technology Forum.



The requirement is to bring these emissions to near zero levels. In order to certify the diesel engine meets Tier 4, a list of criteria must be successfully tested with the engine installed in the finished product. This testing must be performed by the engine manufacturer or certified 3rd party testing firm before the engine can be approved for use.

## CHALLENGES

Installing the same LORD Corporation Vibration Isolators as used on their gas powered version seemed like a reasonable starting point. However, early testing by a certified expert showed the isolation system resulted in unacceptable levels of vibration.



Because the OEM had an inventory of similar LORD mounts used on other equipment, it made sense to try those mounts as well. Trial-and-error testing not only required re-engineering the engine mounting system, but it also resulted in a multiweek time delay each time they called upon the 3rd party tester. Although the testing was getting closer to acceptable system vibration limits, it was not sufficient to meet the engine manufacturer's specification, and therefore a no-go.

## SOLVING THE VIBRATION REQUIREMENTS

When reaching out to Modus Advanced, Inc., Modus™ quickly responded and rallied with its long-standing partner, LORD Corporation. As the leading expert when it comes to compact, high-load and high-capacity vibration isolators, LORD vibration isolators were at the forefront as the natural solution to meet the stringent vibration requirements.

However, LORD's fully accredited test lab and extensive design and analysis software offer capabilities well beyond technical solutions. LORD applications engineers worked with the customer to collect the following data, which ultimately determined the appropriate mounts being selected for the application:

- We = Engine Weight (Wet, Including Accessories)
- Wt = Transmission Weight (Wet)

- He = Engine C.G. Height Above CSCL
- NI = Engine Speed - Idle
- NO = Engine Speed - Operating Number of Cylinders and Arrangement (I-6, 90° V-8, etc.)

In addition to accessory load, operating range and performance requirements, the LORD engineering team quickly produced the XYZ roll, pitch and yaw analysis listing the corresponding mount required for the vibration signature.

## THE RESULTS

With Modus' initiation and LORD's capability to solve difficult vibration and shock problems, the appropriate mounts were selected and sent overnight to the customer for testing. The accredited 3rd party testing firm was once again called upon to perform this, by now, extremely time-critical test.

Testing revealed our customer was able to realize 98% vibration isolation using the new mounts and successfully met the engine manufacturer's specifications. The diesel engine manufacturer requires 150 hours of continuous operation with no component failure or cracks. They also require durability assessments performed on the after-treatment unit as well.

Passing all testing with flying colors, our customer was able to introduce their new diesel powered model at the World Ag Expo and achieve their goal as a major force in the diesel powered market.

## ONE DAY MATTERS

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