FORCE MEASUREMENT SOLUTIONS

CASE STUDY

LAUNCHING INTO ORBIT WITH INTERFACE




Customer Need and Challenge

Space organizations play a critical role in allowing humanity to re-imagine the realm of existence—and no one understands this better than NASA. NASA's latest efforts have been centered around human deep space exploration, opening new possibilities for scientific missions to places like the Moon, Mars, Saturn and Jupiter.

Getting a rocket and its payload beyond earth's orbit is no easy task. There's nothing more important than structural integrity, and achieving it on a rocket is incredibly difficult. The gravity on Earth produces a force that pull objects towards each other, but when a rocket gets to space, forces want to pull it apart. It's easy to prevent against either pushing or pulling, but to protect against both at the same time requires deep expertise of how forces interact.

The degree of accuracy and reliability required for the testing of rockets is equally critical, leaving no room for error. If a launch mission is unsuccessful, the billions of dollars invested in the rocket and its payload is suddenly lost. The amount of time, money and resources needed for space exploration makes the testing of the launch structure too critical to fail.

Faced with these challenges, NASA turned to Interface in the development of its Space Launch System (SLS) to replace its Saturn 5 rocket. NASA needed to verify the structural performance of the core stage of the SLS under simulated launch conditions.

Interface is well-known in the industry for manufacturing load cells, many of which have been used regularly for structural testing on rockets and a variety of other aerospace and spacecraft applications.

1200 Standard Precision LowProfile® Load Cell

AxialTQ™ Wireless Rotary Torque Transducer

9890 Strain Gage, Load Cell, & mV/V Indicator

GS-SYS03 Gold Standard® Portable Load Cell Calibration System

Interface Solution

Due to the massive size of the rocket, Interface provided NASA with two different models of custom load cells that ranged from 100,000 to 2,000,000 pounds in capacity to accurately measure the forces the SLS will experience during its use. A typical load cell ranges from 100-5,000 pounds, so working with one million pound plus load cells is rare for most companies, but not Interface.

Interface also fulfilled NASA's extremely high accuracy requirements for force measurements by using finite element analysis to revitalize its existing 2000 series load cell design. With this technique, Interface achieved accuracies that were as much as four times better than its standard product and eight times better than its competition's products. Interface created custom strain gages for the refreshed 2000 series and used its in-house precision machine shop to optimize the basic load cell for extremely tight tolerances that would allow for higher accuracy than a standard off-the-shelf solution would provide.

Results

Marshall Space Flight Center in Huntsville, Alabama, built a 215-foot twin tower static test stand to test the 185-foot hydrogen tank of the SLS. A second 85-foot test stand was built to test oxygen tank and forward skirt. The test stands contained hydraulic cylinders placed at strategic locations to push, pull or twist the structure to produce the required loads calculated by the test engineers to simulate actual launch conditions.

Multiple Interface 1200 series and high accuracy 2000 series load cells of up to 2 million pounds-force were attached to hydraulic cylinders at different points along the test stand to measure the load produced by each cylinder within 0.05 percent. The load cell outputs were fed back to the control system to monitor the cylinder forces. The Interface manufactured temperature-compensated strain gages within each load cell reduced temperature related errors to less than 0.0008%/°F (0.0015%/°C). Custom strain gages were also bonded to the surface of the rocket structure and connected to a data acquisition system for stress analysis.

With Interface's custom high precision load cells, engineers were able to evaluate loads applied to different areas of the rocket structure, allowing them to accurately verify the structural performance under simulated launch conditions.

About Interface

Interface is the world's trusted leader in technology, design, and manufacturing of force measurement solutions. We guarantee the highest quality performance of load cells, torque transducers, multi-axis sensors, wireless telemetry, instrumentation, and calibration. We empower engineers around the world to measure force and performance at the highest degree. Our clients are the who's who in aerospace, automotive and vehicle, medical devices, energy, test and measurement, and industrial manufacturing.

Interface, Inc., was founded in 1968 and is a US-based, women-owned technology manufacturing company headquartered in Arizona.

For more information on how Interface can help solve your space and rocket test and measurement challenges, please visit www.interfaceforce.com and also check out this application use for rocket structural testing: https://www.interfaceforce.com/solutions/aerospace/rocket-structural-testing/.