

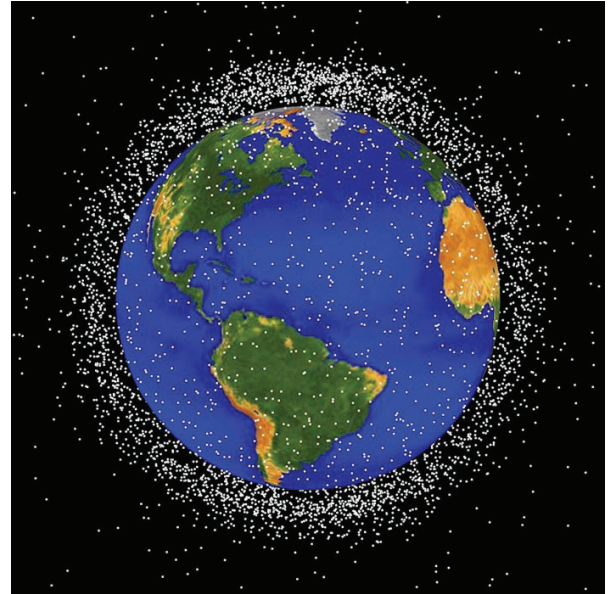
Global Space Launch Business

FORWARD

The space launch industry continues to grow rapidly, driven by satellite constellations, national security programs, lunar exploration, and lower launch costs. Market forecasts project strong growth through the 2030s, with reusable rockets remaining the dominant trend.

SPACE LAUNCH COMPANIES

SpaceX and Blue Origin were the first of the private companies to enter the space launch business. Now there are many smaller companies and startups in this business and who are striving to claim to a special share of the market. As more startups come on board, we find the missions and goals are diverse and also very noble. Their websites provide insights to their missions and goals.



Commercial Market Trends

- LEO satellite constellations remain the largest source of launch demand, including broadband, Earth observation, and defense systems.
- Rideshare launches continue growing because they reduce costs for smaller satellite operators.
- Government and defense spending is increasing in the U.S., Europe, and Asia, supporting long-term launch demand.
- Heavy-lift competition is intensifying among SpaceX, Blue Origin, Arianespace, and emerging providers such as RocketLab and Firefly Aerospace.

What This Means for Aerospace Suppliers

For companies supplying aerospace components, sensors, fiber-optic instrumentation, test equipment, and launch-support hardware, the strongest opportunities are currently:

- Launch vehicles and propulsion systems
- Satellite manufacturing
- Defense-space programs
- Lunar exploration infrastructure
- Ground-test and qualification systems

Fiber Optic Sensor Applications

1. LIQUID FUELED ROCKET ENGINE TURBOPUMPS
2. SATELLITE PROPULSION SYSTEMS

ROCKET ENGINES for Large Liquid Fueled Rockets

Philtec sensors monitor turbopump rotor speed (D Models) plus radial and axial rotor displacements (RC Models).

Custom probe casings are required to support exposure to pressurized cryogenic fluids.

Special casings are designed by the customer.

Some customers provide the casings.

Otherwise, Philtec has the casings machined from the customer's 2D pdf and 3D stp production files.

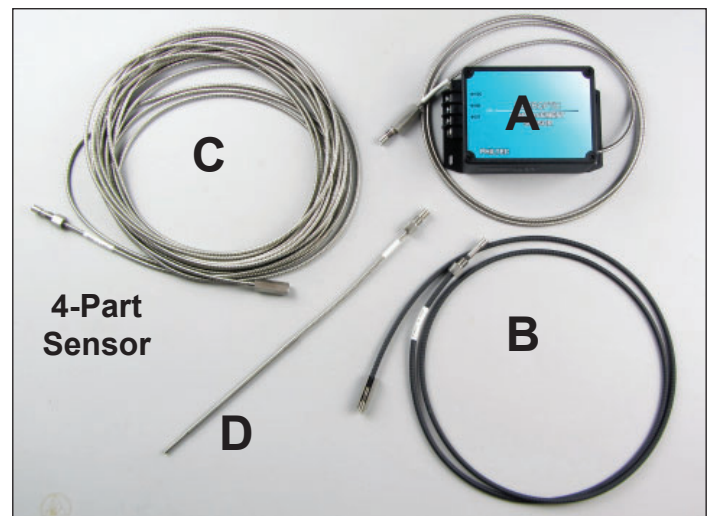
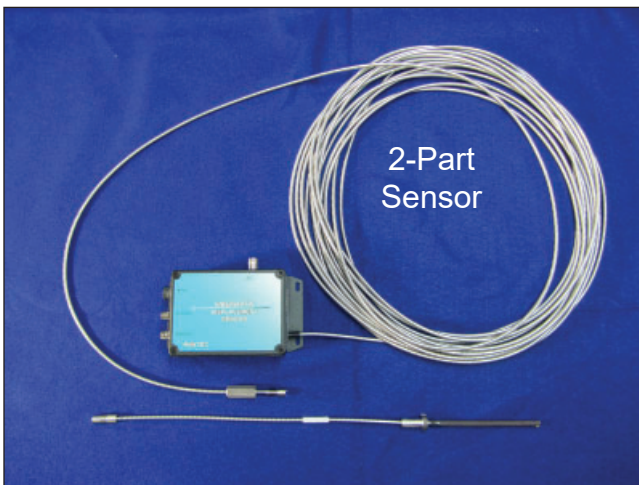
Monel K500 metal is usually specified when the media is liquid oxygen.



Fiber Optic Cables

Depending upon customer needs, FO cable systems may comprise 2, 3 or 4 parts.

- 40 - 60 Ft long fiber optic cables put the electronics away from heat and vibration at the rocket test stand.
- Vibration proof connector hardware is used.

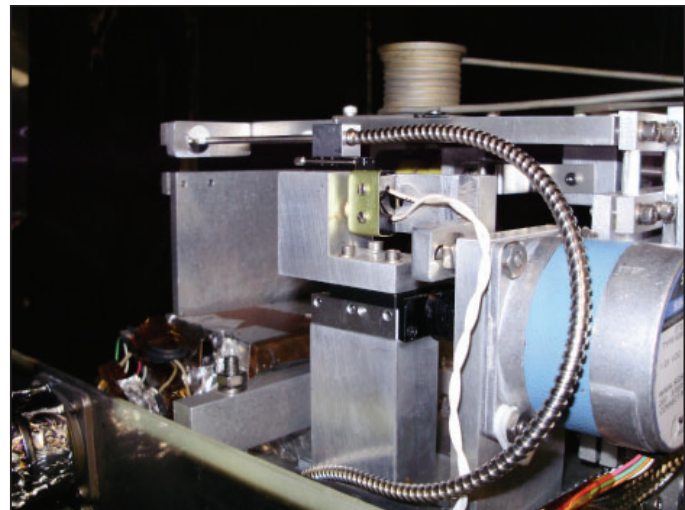
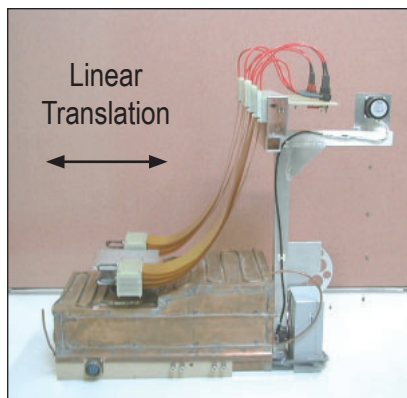


PHILTEC®

Fiber Optic Sensor Applications

SATELLITE PROPULSION SYSTEMS

Philtec's D Model Sensors are used to measure displacements of thruster assemblies. Companies developing new satellite propulsion systems perform these measurements via custom-built thrust stands. Thruster performance is gauged by directly measuring the linear force output. Two major requirements are accuracy and complete resistance to stray electrical noise. By equating the applied thrust with the linear displacement via Philtec D models, the force output can be measured precisely and noise free.



Philtec Probe Inside Thrust Stand

Note: Philtec produces FO compatible vacuum passthru flanges for a variety of vacuum levels.

Typical Sensor System with Vacuum Passthru Flange



PHILTEC®

www.philtec.com

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SMALLSAT THRUSTERS

Small satellites (CubeSats, nanosats, and microsats) increasingly require propulsion for orbit raising, station keeping, collision avoidance, formation flying, and end-of-life deorbiting. Electric propulsion is becoming the dominant technology because of its high efficiency, while chemical and cold-gas systems remain important where simplicity or higher thrust is required.

Leading SmallSat Propulsion Companies

VACCO Industries

Strong in CubeSat propulsion.

Offers cold gas, warm gas, and green monopropellant systems.

Flight heritage includes NASA and JPL MarCO CubeSat missions.

Busek Co. Inc.

Pioneer in electric propulsion for small satellites.

Hall thrusters, ion thrusters, electro spray systems, and green monopropellant technologies.

Widely used in government and commercial programs.

Phase Four Space

RF electric propulsion.

Focused on constellation satellites and scalable propulsion systems.

Current Industry Trends

1. **Electric propulsion** dominates new designs because it greatly reduces propellant mass and extends mission life.
2. **Green propellants** are replacing hydrazine in many small spacecraft due to easier handling and lower toxicity.
3. **Iodine propulsion** is gaining traction because iodine is dense, inexpensive, and easier to store than xenon.
4. **Dual-mode systems** combining chemical and electric propulsion are emerging, potentially offering both high thrust and high efficiency from a single propellant.