

Engineering Capabilities



LASP's engineering capabilities are similar to those of a small aerospace company; we rely on a cutting-edge mix of on-site facilities, skilled personnel, and close collaboration with scientists to build, test, and calibrate spacecraft, instruments, and components.

The LASP Engineering Division conceives and develops space instruments and components, which are manufactured, assembled, tested, and calibrated on-site in the LASP Space Technology Building.

The development of a LASP-engineered instrument typically starts when a scientist poses a question that can be answered by a specific type of data. The scientist discusses the necessary data with the engineering group, which recommends the best type of detector to collect the data. Next, mechanical and materials engineers design the detector so that it can withstand its intended environment—for example, the intense shaking of launch, specific radiation levels, and temperature extremes. Electrical and parts engineers work on the detector design and develop appropriate computer systems for the detector, and software engineers create the software that will drive the instrument.

Once the detector's materials, parts, and overall design meet the instrument requirements, LASP begins instrument production. Frequently, production involves procuring materials with precise specifications and building components from these materials on-site. We also work closely with trusted vendors that supply some components. As the instrument is integrated, components and the finished product go through extensive calibration and testing to be sure that all aspects of the piece are performing to specifications.

Our Quality Assurance personnel oversee the development and production of the instrument, ensuring that we meet all the necessary standards and safety precautions throughout the process.

Calibration & Test

The Calibration & Test group at LASP serves as a bridge between the science realm and the engineering realm; the group is often the first stop on the way to instrument development. The group functions by conceptually pulling together the mechanical, optical, and electronic needs of detector systems, while working closely with LASP scientists and other engineering disciplines to understand what data is needed and how they can best be taken. The detector systems are at the core of the science and drive the rest of the instrument design. The "Cal Group" works in collaboration with each of the other disciplines to optimize the detector systems to meet science requirements while staying within constraints such as mass, power, volume, cost, and schedule.

Mechanical/Materials Engineering & Procurement

LASP mechanical engineers design space science instruments to meet requirements developed with scientists; our in-house expertise in design, analysis, fabrication, assembly, and testing ensures robust instrument hardware. Mechanical engineers design instruments that are optimized to balance contractual requirements and in-house best practices.

Materials engineers consider the type of material used and its potential effects on its surrounding environment, and ways to shield detectors from radiation, temperature fluctuations, or other

potentially harmful effects.

Finally, our procurement specialists ensure the use of certified and stringently documented materials in our instrument development at LASP. For example, if our materials engineers have specified a specific grade of aluminum, our procurement specialists can select an appropriate vendor, communicate the requirements to that vendor, and ensure that appropriate documentation accompanies the aluminum before it goes into our instrument builds.

Electrical/Parts Engineering

Our team of electrical engineers comprises a wide range of technical experience, including digital and analog experts. The engineers work together to ensure that the physical measurements desired by scientists are collected, converted, and transmitted accurately, and that flexibility is built into the measurement systems so adjustments can be made in response to in-flight observations.

Parts engineers ensure that the electrical, electromechanical, and electronic parts of an instrument meet program and Institute of Electrical and Electronics Engineers (IEEE) requirements during development.

Systems Engineering

Systems Engineering at LASP links scientific objectives to engineering implementation. System engineers develop and manage requirements from initial concept through on-orbit operation, aiding cohesion within the technical team. They optimize functional and physical compatibility of interfaces by carefully balancing developmental design trades against available technical resources such as mass, power, volume, and data bandwidth.

Successful flight programs share the core systems engineering principles of identifying, defining, and mitigating technical risk, and establishing verification and validation paths for all system elements such as hardware, software, facilities, personnel, and data.

Flight Software

The software that runs a scientific instrument controls components and mechanisms, such as doors and filters, and coordinates instrument activities among science components. Flight software is responsible for communication between the spacecraft and ground operators, receiving and executing commands to change configurations and transmitting science, engineering, and housekeeping information to ground operators. Operators then monitor the health of the instrument and scientists perform their analysis. Flight software also receives alerts from the spacecraft. If unsafe situations develop, the flight software responds to these alerts by placing the instrument in safe configuration mode.

Production

LASP production engineers turn the theory of a designed component or instrument into a tangible finished product. Frequently one-of-a-kind, our products reflect craftsmanship, expertise, and quality. Production engineers are involved in every aspect of instrument assembly, including crafting, evaluating, cleaning, and inspecting parts.



(Courtesy LASP)

Attention to detail is a requirement for the successful production of high-performing, structurally sound space instruments.

Mechanical parts that we build in-house begin in the machine shop, where our machinists craft complex parts to design specifications in a wide variety of materials. Next, our metrology experts evaluate the parts—either built in-house or acquired from a vendor—to verify that they meet specifications.

A cleaning process removes oils from fabrication, fingerprints, and other minute impurities that could damage the finished part. Our experts also use bake-out chambers to ensure that materials have properly out-gassed. We finalize our efforts with inspections to make sure that the part meets all necessary standards.

Quality Assurance & Safety

The Quality Assurance group at LASP works to ensure that an instrument's engineering and production meet stringent program requirements. Quality Assurance personnel check procurement documentation, inspect the parts and materials that we buy from vendors, handle any nonconformance issues, inspect in-process assembly for conformance-to-design requirements, and provide an internal "check and balance" system for our work.

To read more about Engineering Capabilities at LASP, visit: <http://lasp.colorado.edu/home/engineering/eng-capabilities>.

The Laboratory for Atmospheric and Space Physics (LASP) combines all aspects of space exploration through our expertise in science, engineering, mission operations, and data management. As an institute at the University of Colorado Boulder, LASP includes students throughout our activities. Learn more at <http://lasp.colorado.edu>.