

# Engineering Production Facilities



(Courtesy LASP)

*LASP engineering production facilities are co-located with our scientific and technical resources. This collaborative environment enables dynamic interaction, problem-solving, and the exchange of ideas.*

Having the facilities to develop and test spacecraft on-site is a key factor to LASP's success. Our broad production services capabilities allow our in-house engineers direct access to the production technicians working on their designs to ensure good communication of requirements and fast turnaround should the need arise during test or assembly.

Our in-house facilities include:

- A fully equipped machine shop for mechanical parts fabrication
- A metrology laboratory for mechanical inspection and verification
- A NASA-qualified electrical laboratory for electronics and harness/cable fabrication
- A NASA-qualified polymerics laboratory including a spray booth
- A cleaning laboratory for ensuring parts and assemblies are free of contaminants
- Multiple Class 10,000 clean rooms for final instrument assembly

## Machine Shop and Metrology Lab

The LASP Machine Shop creates instrument components using a variety of metals, such as aluminum, magnesium, stainless steel, and titanium, as well as a variety of ceramics and plastics. Our shop regularly achieves close tolerances of 0.0005 of an inch or better. LASP instrument makers work from prints, sketches, and 3-D solid models, translating that information using master computer aided machining (MasterCAM) software to program

our machining centers. We have four-axis computer numerically controlled (CNC) milling capability, CNC lathe, and numerous manual lathes and milling machines for secondary operations.

The LASP Metrology Lab allows precision measurement and verification of mechanical parts made both internally by LASP instrument makers and by external machining partners. The equipment also enables LASP engineers to make measurements and comparisons of assemblies during the build process to ensure as expected tolerance stack or alignments. Laser part marking capability allows LASP to uniquely designate each part by serial number and/or assembly information.

Metrology Lab equipment includes:

- Zeiss coordinate measuring machine
- Deltronic video comparator
- Brown and Sharpe Micro-Hite
- RMI laser engraving system

## Production Laboratories

LASP production laboratory facilities allow our engineering staff to take the fabricated parts and other components and assemble, test, clean, and calibrate the assemblies and instruments. All of our laboratory facilities are temperature and humidity controlled with ESD precautions and monitoring in place for all work spaces. Work benches are all Class 100 flow benches mounted with overhead ionizers. More specifically, LASP has the following labs.

## Electrical Assembly Lab

LASP has five electronic assembly workstations set up for hand soldering and assembly of circuit boards, cabling, and harnesses. LASP assembly technicians are all certified to the NASA Standard 8739.2-4 for board and harness assembly. They bring experience in a wide variety of electrical components from small 0705 surface mount components, to terminals, to large 352 pin FPGAs.

Specialized equipment helps to ensure that LASP can handle a broad range of design requirements. Examples are a Fancort lead form and trim system to reconfigure flat-packs into gull-wing style components for better bonding to the printed wire board and the Electromatic motorized crimp pull tester to verify harness connections.



(Courtesy LASP)

*On-site production services enable direct interactions between designers, fabricators, and assemblers.*

## Polymeric Laboratory

The LASP Polymeric Laboratory is where certified personnel mix and apply bonding materials, conformal coatings, encapsulants, and other polymeric materials. A spray booth allows for an even application of coatings and paints. Multiple ovens ensure that cures can be done at a temperature appropriate for assembly, including an ambient filtered cabinet for slow cures.

To ensure that boards are free from potential ionic contamination, the polymeric lab also includes an SCS 1500M Ionograph Tester. Boards are tested prior to the application of conformal coat since contaminants can cause loss of adhesion and the tell-tale “fish-eye.”

## Cleaning Lab

The LASP Cleaning Lab is equipped with a variety of cleaning tools to ensure that all materials going into an assembly are free from contaminants. Ultrasonic tanks for agitation cleaning, fume hoods for more caustic cleaning agents, and a de-ionized water rinsing station for clean rinses are just some of the devices used in over 25 different cleaning protocols employed by LASP for the diverse selection of materials in LASP instruments.

To further verify that parts are clean, LASP has a vacuum bake-out tank facility with residual gas analyze (RGA) and thermal quartz crystal microbalance (TQCM) with multiple tanks to accommodate concurrent runs at different temperatures and duration.

## Cleanrooms

Environmental pollutants, such as dust, particles, and vapors, are an important consideration during the development of space instruments and components; a stray dust particle or fingerprint could disrupt or disable a scientific instrument. NASA and other agencies have strict guidelines concerning the level of allowable contamination for space-bound products. LASP’s four on-site cleanrooms—special rooms with controlled and restricted levels of pollutants—allow LASP to meet those rigid specifications.

Cleanroom standards are federally and internationally regulated and designated by class, which is an indication of the size and number of particles allowed per volume. For example, a Federal Standard Class 10,000 cleanroom has at most 10,000 particles bigger than half a micron per cubic foot.

While the main LASP cleanrooms used for instrument assembly are rated as Class 10,000, LASP takes extra precautions as if they were Class 1000. All entrants don special protective clothing including coveralls, shoe covers, face masks, gloves, hair nets, and goggles. Equipment inside the cleanrooms is also controlled so that it does not generate air or particulate contamination.

## Tracking

To track the multitude of work order requests flowing through the production areas, LASP employs a business process management software configured for the LASP process. Business rules help guide the requests to their appropriate next step and ensure that required information is logged when needed. And interested parties within LASP can follow the requests real-time through online access to the status and data for each.

To read more about Engineering Production Facilities at LASP, visit <http://lasp.colorado.edu/home/engineering/facilities>, call Jennifer Methlie at 303-492-6124, or email [jennifer.methlie@lasp.colorado.edu](mailto:jennifer.methlie@lasp.colorado.edu).

*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>.*