



THE HIGHEST QUALITY TESTING FOR SPACE EXPLORATION

Together, Element and NTS are the global leader in end-to-end solutions for space with testing services for satellites, rockets and spacecraft for civil, commercial and military use. Together, we have participated in every major space program since the inception of human space exploration. Our expertise has helped launch every rocket in history into space, enabled satellites in low Earth orbit, and is currently guiding the mission to go to Mars. We deliver:

- Unparalleled delivery time for projects of any size, duration or location
- Peace of mind with our robust program management and seamless communication and support plans
- Test results with unmatched levels of accuracy and quality
- Direct access to top engineering experts for technical guidance
- Built-in redundancies in capacity that de-risk your development cycle, resulting in a more resilient supply chain
- Unmatched quality performance with the most expansive breadth of capabilities and unparalleled capacity and experts to accelerate your mission into space
- State-of-the-art testing from engines to propellant bottles, fasteners to 3D printed materials and composites, panels to spacecraft structure
- Product qualifications in all environments
- Simulation of pre-launch, launch, and space environments
- Expertise in R&D, material allowables, material selection, and ongoing production support
- Lower cost, faster development cycles possible with digital modeling services that validate designs before production
- Large scale testing and custom programs, saving you both time and money
- Confidence that testing plans fit your specific needs, reducing the risk of costly delays and retests

PROOF OF CONCEPT

R&D consulting/advisory services
Digital modeling & simulation
Early stage design optimization

DIGITAL ENGINEERING

Applied Science & Engineering
Software engineering services
Data Science and Machine Learning
Digital Twin Solutions
Digital technology Solutions

MATERIALS TESTING & SELECTION

NDT
Mechanical
Chemical
Corrosion
Coatings
Fracture & fatigue
Metallurgical
Thermal

DESIGN

Guidance on specs to right test platform
Develop or edit test plan/procedures to show compliance
Digital modeling & simulation

FABRICATE, INTEGRATE AND TEST

Climatics
Environmental simulation
Hydraulic & pneumatic simulation
EMI
Dynamics
Lightning
Fire & flammability
Fluids and fuel

PRODUCTION / MANUFACTURING SUPPORT

NDT
Mechanical
Chemical
Corrosion
Coatings
Fracture & fatigue
Metallurgical
Thermal

LAUNCH AND ORBITING SIMULATIONS

Pre-launch, launch and space extreme environmental testing
Failure analysis & evaluation
Thermal vacuum testing
Cold space testing
Infrared radiation testing

NASA AWARD WINNER

Element is a recipient of the prestigious Space Flight Awareness Supplier Award. Nominated by Boeing Corporation and Lockheed Martin, Element is the only independent test laboratory to receive the honor from NASA.

According to NASA, the award “honors outstanding performance” among suppliers who demonstrate “production of high-quality products, excellent technical and cost performance, and adherence to schedules.”

ENGINES

- Astronautics and Propulsion Testing
- Outgassing Analysis
- Extreme Environmental Testing
- High Pressure, High Flow Pneumatic Tests at Temperature
- Advanced EMI/EMC Testing
- Pyroshock
- High Level Vibration Testing
- NDT & Destructive Testing
- Fracture Toughness & Fatigue



ROCKETS

- Rocket Thrust Stand and Exhaust Duct Testing
- Outgassing Analysis
- Extreme Environmental Testing
- Direct and Indirect Lightning
- High Pressure, High Flow Pneumatic Tests at Temperature
- Aerodynamic Heating for Simulated Hypersonic Flight
- Advanced EMI/EMC Testing
- Pyroshock
- High Level Vibration Testing
- NDT & Destructive Testing
- Fracture Toughness & Fatigue



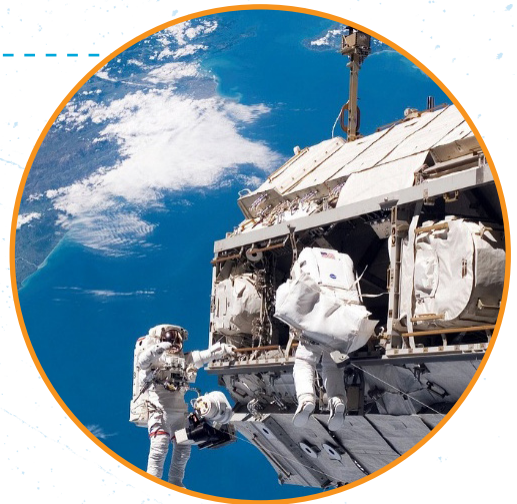
SATELLITE

- Thermal Shock and Cryogenic Component and Subsystem Testing
- Outgassing Analysis
- Extreme Environmental Testing
- Precision Cleaning
- Advanced EMI/EMC Testing
- Pyroshock
- High Level Vibration Testing
- NDT & Destructive Testing
- Fracture Toughness & Fatigue
- Radiated Aging & Effects



SPACE STATIONS

- Space Simulation/Thermal Vacuum Cycling
- Outgassing Analysis
- Extreme Environmental Testing
- Precision Cleaning
- Advanced EMI/EMC Testing
- NDT & Destructive Testing
- Fracture Toughness & Fatigue
- Radiated Aging & Effects



CONNECT WITH AN EXPERT

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WHO WE ARE

We are Element, one of the world's leading independent providers of testing, inspection and certification services to a diverse range of industries, where failure "in service" is simply not an option. Everything we do is aligned to deliver one thing for our customers - Certainty.

We exist to help all of our customers make certain that the materials and products that they make are safe, quality compliant and ultimately fit for purpose using our 200 years of testing experience and our global testing capabilities.

That is the Certainty of Element.

OVERVIEW

SUPPORT AT EVERY STAGE

The heavier an aircraft, spacecraft, automobile, or other vehicle, the more it costs to drive or fly it from point A to point B. Newer, lighter materials are replacing heavier traditional materials to reduce energy costs. Graphite Fiber reinforced resins, for example, are more than ten times stronger and five times stiffer per pound than steel or aluminium. Vehicles can be manufactured at half the weight with the same structural integrity by using composites.

Our clients are among the leaders in the development of new and emerging polymers, adhesives, thermoplastics, elastomers, ceramics, and foam products. We support their efforts in manufacturing, designing, and engineering the world's newest materials with comprehensive testing and analysis.

ACCREDITED QUALITY SUPPORT

Element Materials Technology's quality program meets the ISO/IEC Guide 17025 standards (equivalent to the relevant laboratory requirements of the ISO 9002 series of standards).

SUPPORTING CAPABILITIES

INDUSTRIES SERVED

- . Aerospace & defense
- . Airframe structures
- . Automotive
- . Biomedical
- . Building & industrial construction
- . Chemical & petrochemical
- . Coatings & paints manufacturing
- . Commercial vehicles
- . Containers & packaging
- . Durable goods manufacturing
- . Engineering & supply chain
- . Fastener manufacturing
- . Ground support equipment
- . Power generation & alternative energy
- . Medical device
- . Plastics & polymers manufacturing
- . Rail & light rail
- . Satellites & spacecraft

SERVICES OFFERED

- . 3A-FDA-CFR examinations
- . Accelerated aging studies
- . Chemical analysis
- . Composites testing
- . Corrosion testing & consulting
- . Corrosion evaluation
- . Deformulations
- . Destructive testing
- . Experimental mechanics
- . Expert Witness services
- . Failure Analysis
- . Finite Element Analysis (FEA)
- . Physical properties testing
- . Polymer testing & analysis
- . Restricted substance analysis
- . Salt Fog & Salt Spray testing
- . Thermal analysis
- . UV exposure & weathering



SPACE AND SATELLITE TESTING

Element Los Angeles (104th Street) offers extensive capabilities to support the space industry, providing space and satellite testing in Southern California. Our facility and expert staff of highly experienced engineers and technicians provide a full range of qualification, compliance, and reliability testing. We support a wide range of industries including aerospace, military, and defense.

TESTING FOR SATELLITES, REFLECTORS, SOLAR ARRAYS AND OPTICAL PAYLOADS

We're considered a leader in testing for the space industry, with the internal capabilities to custom-engineer chambers and design- fixtures to conduct a complete range of space-related testing, including:

- Spacecraft and spacecraft subsystems
- Fuel cells and solar panels
- Composite antennas and batteries
- Full qualification and acceptance testing of propellant tanks
- Various mechanical and electronic devices



TV-25: 15' DIAMETER BY 25' DEEP THERMAL VACUUM SYSTEM

This state-of-the-art system is the largest TVAC system within the Element organization. TV25 is equipped with a fully automated 500kVA, 3 phase emergency backup power generator. The pumping system includes four (4) roughing pumps, two (2) blowers, four (4) 52" cryopumps along with a 10" turbo pump. This allows quick pump down capabilities to the 10⁻⁷ Torr range. This system has a 3-ton crane located in a class 100,000 (ISO 8) high bay cleanroom area for product unpacking. Facility has an air bearing ride system for safe product transport from high bay to class 10,000 (ISO 7) room located in front of thermal vacuum system.

DELIVERING INNOVATIVE PRODUCT TESTING AND CERTIFICATION SOLUTIONS

ENVIRONMENTAL & DYNAMIC TESTING AT ELEMENT LA (104TH ST)

The Element Los Angeles (104th Street) Team are experts in environmental, thermal, shock, vibration, proof, leak and precision cleaning. We have a large selection of temperature, thermal shock, thermal vacuum and overpressure chambers as well as electrodynamic shakers for sine, random, sine on random and shock testing.

Other services include:

- Vacuum Bake-out with TQCM outgassing measurements, FTIR (Fourier-transform infrared spectroscopy and NVR (Non-Volatile Residue) analysis
- Proof Testing hydraulically to 60,000Psig and pneumatically to 20,000Psig
- Helium Leak Testing with a range from 10⁻⁵ SCCS/Helium to 10⁻⁹ SCCS/Helium
- Nitric and citric acid passivation, hydrofluoric acid pickle/etching and aluminum deoxidation
- Primary specifications include MIL-STD 810, MIL-STD 202, RTCA DO160, ISTA, ASTM and NEMA

PRECISION CLEANING CAPABILITIES AT ELEMENT LOS ANGELES (104TH ST)

As the preferred precision cleaning supplier for many of our nation's aerospace and defense contractors, Element is an active participant in Space, National Security and Homeland Defense Programs. These programs require the strict process and cleanliness controls that only a company with over 50 years' experience can provide.

Working closely with our client partners, we developed and implemented the cleaning processes necessary to meet the demanding level of process control and system cleanliness required for mission success. We continue to develop processes and techniques as new commercial space programs grow. The need to reduce costs and deliver products that meet stringent requirements on time, every time is now more important than ever.

Element Los Angeles (104th St) performs precision cleaning and testing for in-process parts and finished products including:

- Valves and related items
- Piping and tubing
- Tanks and cylinders
- Heat exchangers
- Gauges and instruments
- Fittings and fasteners
- Transducers and sensors
- Fuel and oxidizer ducts
- Cryogenic and vacuum jacketed piping
- Cleaning Capabilities
- Propellant systems (fuel and oxidizer)
- Hydraulic components and systems
- Purge panels
- Cryogenic components and systems
- Breathing air systems
- Hydrogen peroxide components and systems
- Nitric and citric acid passivation
- Nitric and hydrofluoric acid pickle
- Hydrofluoric acid etching
- Aluminum deoxidation
- NASA, AMS, SAE, ARP, ASTM NAS and IEST; Industrial cleaning and compressed gas association.



HIGH PRESSURE/HIGH FLOW FLUID & ROCKET ENGINE TESTING

Element San Bernardino Rocket and Fluids test laboratory provides specialized fluids testing with high-level expertise in space applications, including high pressure/high flow fluid and rocket engine static test capabilities. This facility supports the strictest testing requirements of aerospace, renewable energy, oil and gas and Navy Nuclear, high pressure/high flow.

ELEMENT SAN BERNARDINO — WORLD-CLASS HIGH PRESSURE/HIGH FLOW FLUID AND ROCKET ENGINE TESTING

Element San Bernardino Rocket and Fluids test laboratory provides specialized fluids testing with high-level expertise in space applications, including high pressure/high flow fluid and rocket engine static test capabilities. Located at the San Bernardino International Airport, this facility supports the strictest testing requirements of aerospace, renewable energy, oil and gas and Navy Nuclear, high pressure/high flow.

We are a robust ground test facility for aerospace propulsion development testing; staffed by experienced managers, engineers and technicians. In more than 50 years of operation, we've maintained a superior performance record and an excellent safety record. Our premier facility hosts specialized test equipment and offers unique test capabilities for high pressure fluids. The team philosophy is to apply professional approaches to achieve superior test results while operating in full compliance to all regulatory requirements and environmental responsibilities.

Our facility is designed in accordance with API and ASME power piping codes, and all pressure vessels are ASME coded and commissioned for use in California. In addition, we are in full compliance with all federal, state and local agency requirements, including the South Coast Air Quality Management District.

ROCKET TESTING: THRUST STAND AND EXHAUST DUCT

The thrust measuring system (TMS) can measure to 50,000-lbf thrust and 8,000-lbf side or asymmetric loads. Test articles are fired into a water-cooled duct designed to handle a 20k-lbf thrust rocket engine. With this duct, we can operate larger engines while mitigating sound levels. The TMS utilizes electric motors to remotely check load cell calibration prior to hot fire testing. Our data acquisition system resolves the forces and bending movements for all three axes and logs them as calculated data channels.

FLUID FLOW: HYDROGEN — 7 LBS/SEC (GH₂), 700 GPM (LH₂); OXYGEN — 3.2 LBS/SEC (GOX), 5000 GPM (LOX); NITROGEN — 60 LBS/SEC (GN₂), 5000 GPM (LN₂)

Our specialized large run tanks and pressure vessels, valves and components have been augmented by 18 additional pressure vessels from the former Boeing Rocketdyne Santa Susana Field Lab (SSFL). Many of the large pressure vessels are cryogenic storage tanks, steam blowdown vessels or pressurized run tanks. These unique, heavy-walled ASME coded vessels range in MAWP from 2,500 to 5,500 psia.

DELIVERING INNOVATIVE PRODUCT TESTING AND CERTIFICATION SOLUTIONS

CRYOGENIC TO 6000 PSI HELIUM, HYDROGEN, OXYGEN, NITROGEN, METHANE, CARBON DIOXIDE

Our cryogenic fluid storage area consists of three 13,000 gallon liquid nitrogen tanks, one 13,000 gallon liquid oxygen tank and one 9,000 gallon liquid hydrogen storage tank. The tanks can be selectively filled to support independent testing activities or feed liquid to high pressure positive displacement pumps and vaporizers. The vaporizers are ASME-coded for use at a liquid hydrogen temperature of -423°F.

All pressure piping conforms to ASME B31.3 code design and is installed by certified welders with post-weld X-ray inspection as required. This site has the capability to store LH₂, LO₂, LN₂, liquid CO₂ and liquid methane as well as pump and vaporize cryo fluids up to 12 lbs. per second.

HIGH TEMPERATURE AT HIGH PRESSURE (+1500 F AT 2500 PSI)

Our collection of three vacuum jacketed stainless steel propellant run tanks in 2,500, 3,000 and 5,000 gallons allow the capability to support many different propellant combinations. They are equipped with both remote and local tanker truck fill ports, and a high-flow GN₂ pressurization system for tank blowdown. The tanks feature both DP and resistive type tank level indicators that output to displays, data acquisition and control systems.

In addition to our propellant run tanks and flow systems, our facility contains eight gaseous nitrogen vessels, each with a volume of approximately 600 cubic feet and a maximum allowed working pressure of 5,500 psig at -20°F to 150°F. Each pressure vessel has 3 inch ANSI Class 2,500 gate valves attached to the outlet, and are manifolded together to enable maximum flow capacity to the various high-flow, dome-loaded regulators.

HIGH-PRESSURE STEAM AND WATER FLOW TEST SYSTEMS (+700 F AT 3100 PSI)

We have a large blow down tank capacity with over 800 feet of ASME-coded vessels rated at 4,475 psig at 700°F. The steam/water tanks can deliver constant test pressure to one of four test pad locations. In addition to the steam system, Element San Bernardino can conduct tests with cryogenic fluids, high-flow gases and water at pressures ranging up to 4,500 psig.

STRUCTURE BORNE AND AIRBORNE NOISE MEASUREMENT CAPABILITY

We've designed, built and verified a quiet technology test facility to MIL-STD-1474 (Appendix E); MIL-STD-740-1 (SH); and MIL-STD-740-2 (SH). The 17.5' x 12' soundproof enclosure is capable of a minimum pressure of 5 psig, minimum flow of 5 SCFM, and a maximum pressure of 5,500 psig with maximum flow of 20,000 SCFM.

The accompanying control room consists of low-level microphones ranging from 15 dB to 140 dB. Data can be acquired up to 24-bit resolution with a sampling rate up to 100 kHz and 8 channels. It is DACS capable of automated sequences with redline control.

DATA ACQUISITION AND CONTROL SYSTEM

Our equipment is designed to give you the best results with regard to data acquisition to help with the detection of leaks and life cycling predictions. Our primary LabView-RT data acquisition and control systems consist of 224 analog input channels, 64 digital inputs and 192 digital output channels, and is based on the National Instruments PXI/SCXI real-time architecture.

Any combination of data channels can be monitored with redline control logic applied to initiate an automatic safe shut-down should customer-defined limits be measured for a prescribed period. We have three other NI LabView control systems to allow setup and test of a total of four simultaneous tests.

VIDEO DATA SYSTEMS

The Element San Bernardino video event recording system can record up to 20 minutes of imagery (640 x 480 resolution) at 200 frames/sec. The system can also capture, compress and record up to two hours of image data from six low speed cameras. It was designed so the images from all 8 cameras can be displayed in real time.

We also utilize IO Industries Streams 5™ to handle all data recording requirements for an application. We can provide simultaneous data recording from a variety of streaming devices; synchronizing the data streams using computer time, GPS time or IRIG-B time. This has been specifically designed for test applications where requirements often extend to recording data from multiple cameras and other instrumentation. Key components of the video recording system include:

- Two high speed Mikrotron 1303 cameras with fiber optic extenders.
- Six Cohu 3695 iView cameras with remote Pan-Tilt-Zoom and 500 feet of power and control cable.
- Dedicated PCI-X computer with Streams 5 Software and 3.2 GHz Intel Xe



MATERIALS TESTING

Element Anaheim is an analysis laboratory with expertise in commercial, aerospace, military aerospace and automotive markets worldwide.

We specialize in electronics and materials conformance, qualification and reliability testing to all levels of the supply chain with an unparalleled reputation for the highest level of customer service and reliable independent test results. The laboratory is a recognized IPC training center.

PRINTED CIRCUIT BOARD (PCB) TESTING

Printed circuit boards are the foundation for any printed circuit assembly. Our highly qualified staff of mechanical and chemical engineers can perform physical, mechanical, electrical, visual/dimensional testing and verification at the bare board level on raw materials and assembled PCBAs. This includes evaluation to both military and commercial standards, including IPC certifications and test methods MIL-STD-810, MIL-PRF-55110, MIL-PRF-31032, MIL-PRF-50884, ASTM and IEC.

OVER 35 YEARS' EXPERIENCE IN FAILURE ANALYSIS

Our failure analysis program can provide detailed information about the performance of materials and devices for end-use applications, as well as root-cause analyses. This allows you to identify design, select, test and process deficiencies and take corrective action to enhance product reliability and performance. Our unbiased analysis converts your failure into success, helping you roll out higher quality products.

ROOT CAUSE ANALYSIS

Since failure is rarely due to one single mistake, our multidisciplinary approach includes everything from chemical and environmental analyses to simulation tests and visual inspections. Plus, with our vast testing experience, we run only the necessary tests to efficiently get to the root cause of the failure you want to correct.

ELECTRONIC AND ELECTRICAL TESTING

A core capability, we partner with the electronics and printed circuit board (PCB) industries. Our engineers routinely provide test program insight and development; allowing you the flexibility to enhance and/or structure programs to your specifications.

UL AND PRODUCT SAFETY TESTING

Element Anaheim can assist with UL Testing requirements for Printed Boards, Laminates and Coatings by helping to determine what materials and testing might be required before opening a full test program with UL. Testing the material and product before opening a full program could help understand material performance before submitting for final certification.

MICRO-SECTIONAL ANALYSIS

We offer one of the most proven methods to accurately test for the through-hole integrity of printed circuit boards. Since PCBs are constructed of various materials and layers including glass, fibers, metals, adhesives and epoxies, it is critical to product safety to determine the reliability of PCB microsections. In addition, we offer micro-sectional analysis training, so your staff can perform this testing in-house if you prefer.

DELIVERING INNOVATIVE PRODUCT TESTING AND CERTIFICATION SOLUTIONS

RESEARCH AND DEVELOPMENT

Our Research and Development team has more than 25 years of experience providing R&D test services, analysis and consulting on electronics and materials. Our laboratories are equipped with the most advanced instrumentation to customize a program to best meet your development requirements. A partial list of our R&D capabilities includes:

- Accelerated aging
- Differential Scanning Calorimetry (DSC)
- Failure Analysis (F/A)
- Thermal Conductivity
- Thermal Mechanical Analysis (TMA)
- X-Ray Fluorescence (XRF)

TEST SPECIFICATIONS AND METHODS INCLUDE:

- Accelerated aging
- Adhesion
- Arc resistance
- Ball shear/die sheet
- Ball pressure test
- Bond strength
- Break strength
- Comparative Tracking Index (CTI)
- Compressive strength
- Conductivity
- Conductive anodic filament (CAF)
- Conformance and reliability
- Corrosion
- DC resistance insulating materials
- Dielectric breakdown/strength
- Decapsulation
- Deflection temperature
- Design of experiments (DOE)
- Density determination
- Dielectric breakdown voltage and strength
- Differential scanning calorimetry (DSC)
- Durability
- Electromigration resistance
- Elongation
- Environmental stress screening (ESS)
- Flammability
- Flexibility endurance
- Flexural bend/fatigue/strength
- Fracture evaluation
- Fracture toughness
- Hi-Pot
- High temperature storage
- High-voltage, low current dry arc
- Hot impact test
- Humidity
- Immersion
- Microsectional analysis
- Surface insulation resistance (SIR)
- Volume/surface resistivity
- Lap shear
- Material characterization
- Mechanical properties
- Peel/shear/tensile/terminal strength
- Rework simulation
- Rockwell hardness
- Solderability
- Steam aging
- Temperature aging/cycling
- Tensile impact
- Tension and compression
- Thermal shock/cycling
- Thermal stress
- Thermo gravimetric analysis (TGA)
- UL short-term properties
- UL long-term thermal aging (LTTA)
- Water absorption
- Dielectric withstanding voltage (DWV)
- Wire ignition
- X-Ray fluorescence (XRF)
- Young's Modulus

