



**ESL
LABS**

TESTING YOUR LIMITS®

WHY TEST?

Building Reliability from Design to Deployment

An Environmental Testing Primer from ESL Labs





WHAT'S INSIDE

Every product tells a story - of design brilliance, of innovation, and, sometimes, of the hidden weaknesses that surface only after launch. Qualification and compliance testing ensures that story ends well.

This guide from ESL Labs, a division of J-Squared, explores why rigorous testing at each product space stage—from concept to deployment — pays measurable dividends. Moving beyond basic evaluation, comprehensive qualification programs that uncover weaknesses early, cutting redesign costs and preventing schedule delays. By integrating environmental, EMC/EMI and power quality standards into a single compliance strategy, reliability is built into the DNA of a product. This holistic approach helps companies meet strict regulatory standards and ensures durability before broad-scale production begins.

From shipboard shock to desert sand and dust, lightning strikes to extreme electromagnetic threats, ESL Labs replicates the world's most unforgiving operating environments. Our state-of-the-art facility reveals how equipment will perform when it matters most.

For more than 35 years, ESL Labs has helped organizations in defense, marine, aerospace, oil & gas, transportation, and industrial markets build safer, longer lasting, and more competitive products. We provide the data-driven confidence required to deploy in any theater of operation. This eBook explains not just how qualification testing works, but why it's one of the smartest investments an engineering team can make.



WHY TEST? BUILDING RELIABILITY FROM DESIGN TO DEPLOYMENT.

THE COST OF SKIPPING TESTING

In the race to deliver new products, testing often appears as a line item to trim or skip altogether in an effort to recover costs or time. Yet history repeatedly proves the opposite: testing early and often is a revenue protector, not a cost center.

When products fail in the field — whether a defence-grade controller malfunctioning due to electromagnetic interference (EMI), an industrial controller corroding offshore, or a system shuttering during a lightning transient — the consequences are severe. Beyond warranty claims and lost contracts, failure leads to brand damage and even safety risks that can include serious injury. Qualification and compliance testing prevents these surprises by exposing weak points under controlled yet real-world simulated conditions, not live deployments.

SHORT-TERM VS. LONG TERM VALUE

IMMEDIATE BENEFITS

- Faster certification & fewer schedule slips
- Reduced rework & redesign costs
- Verified EMC/EMI & Power Quality compliance
- Early detection of non-compliant components
- Smoother stakeholder & regulatory sign-off

ENDURING ADVANTAGES

- Increased lifecycle reliability & DNA toughness
- Fewer in-field failures and warranty claims
- Resilience against lightning & electrical power interrupt/ failures
- Stronger brand reputation & customer confidence
- Sustained competitive advantage in harsh markets

“Finding the fault in the lab is always cheaper than finding it in the field.”



WHY TEST? BUILDING RELIABILITY FROM DESIGN TO DEPLOYMENT.

THE LIFECYCLE ADVANTAGE: WHY TEST EARLY, TEST OFTEN.

Testing isn't a final checkbox. It's a continuous process that strengthens every phase of the product lifecycle.

CONCEPT & DESIGN

Early testing of materials, components and shielding effectiveness validates design assumptions. For instance, ESL Labs' MTS Tension/Compression Machine subjects metals, plastics and composites to fatigue until failure - helping engineers choose materials that will endure real-world stress.

BENEFIT: Catching weaknesses non-compliance risks before tooling or production begins saves months of redesign and tens of thousands of dollars.

PROTOTYPE & INTEGRATION

At this stage, pre-compliance testing identifies risk hot spots. Using tailored tests – vibration, temperature, EMI or power transients – teams can isolate design flaws long before certification, saving time and money.

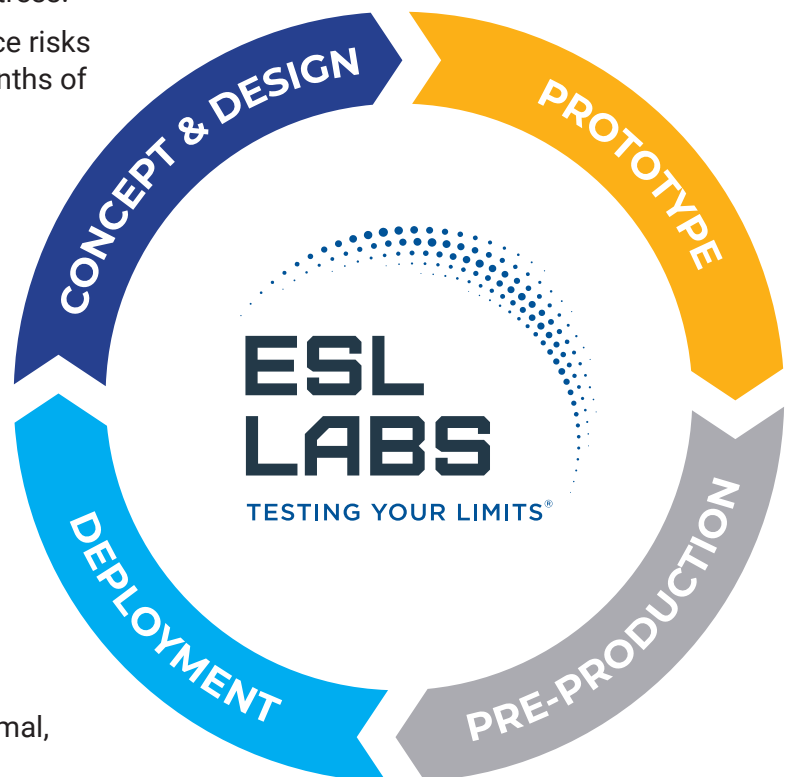
PRE-PRODUCTION & QUALIFICATION

This is where the product proves itself. Full-scale environmental and EMI/EMC testing ensures compliance with military, marine, and commercial standards. ESL Labs' multi-disciplinary expertise allows mechanical, thermal, and electromagnetic testing under one roof.

DEPLOYMENT & IN-SERVICE SUPPORT

Testing doesn't end after shipment. Accelerated-aging and failure-analysis programs simulate years of real-world service in weeks, enabling proactive maintenance strategies and longer product lifespans.

BENEFIT: Lower total cost of ownership and stronger customer trust.



WHY TEST? BUILDING RELIABILITY FROM DESIGN TO DEPLOYMENT.

PROVEN IN THE LAB. TESTED IN THE FIELD.

ESL Labs' state-of-the-art facility reveals how equipment will perform when it matters most utilizing:

MECHANICAL CLIMATIC SUITES

Featuring the Medium Weight Shock Machine (one of only 19 in the world), Large Base Motion Simulators, and Salt Fog/Blowing Sand and Dust chambers for physical ruggedization.

ELECTROMAGNETIC COMPATIBILITY

Full EMC/EMI compliance testing alongside specialized High-Intensity Radiated Fields (HIRF) and Electromagnetic Pulse (EMP) testing to ensure seamless operation in contested or high -threat signal environments.

ELECTRICAL RESILIENCE

Specialized Lightning Induction and Power Quality testing to protect mission-critical systems from indirect strikes, voltage spikes, and transient surges.

A Testing Snapshot for products and solutions used across land, sea and air military environments, as well as marine, oil & gas and industrial settings.

THERMAL SHOCK CHAMBER	Rapidly transitions from -65 °C to +150 °C in three seconds. Validates performance across extreme temperature swings – ideal for avionics or outdoor electronics.
AGREE™ TEMPERATURE & HUMIDITY CHAMBER	Combines temperature, humidity, and vibration to replicate real operating conditions. Crucial for aerospace, medical, and transportation systems.
HYDROSTATIC PRESSURE VESSELS & IP TESTING	Two vessels simulate depths to 32,000 ft (15,000 psi) for underwater products such as hydrophones or subsea beacons.
ALTITUDE TEMPERATURE HUMIDITY CHAMBER	Tests functionality at altitudes up to 80,000 ft under controlled thermal/ humidity cycles.
THREE-METER SEMI-ANECHOIC CHAMBER	For electromagnetic emissions and immunity testing – ensuring devices meet MIL-STD-461 and RTCA DO-160 requirements.



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ENVIRONMENTAL TESTING IN ACTION

TEST IN FOCUS #1

MEDIUM WEIGHT SHOCK MACHINE (MWSM)

This signature system, **one of only two in Canada and 19 worldwide**, delivers controlled, repeatable shocks up to 7,000 lb payloads — replicating the explosive shock loadings shipboard systems might experience from nearby detonations.

- **PURPOSE:** Verifies operational integrity and ensures equipment doesn't become a hazard during severe shock.
- **APPLICATIONS:** Shipboard machinery, naval control and combat systems, heavy enclosures.
- **STANDARDS:** MIL-DTL-901E (US), CFTO D-03-003-007/SG-000 (CAN).



REAL-WORLD EXAMPLE

A defence-sector client identified a housing enclosure design issue during compliance testing on ESL Labs' MWSM (Medium Weight Shock Machine). Uncovering this issue allowed for implementation of an alternative solution before commissioning, avoiding potential equipment damage and injury to personnel at sea.



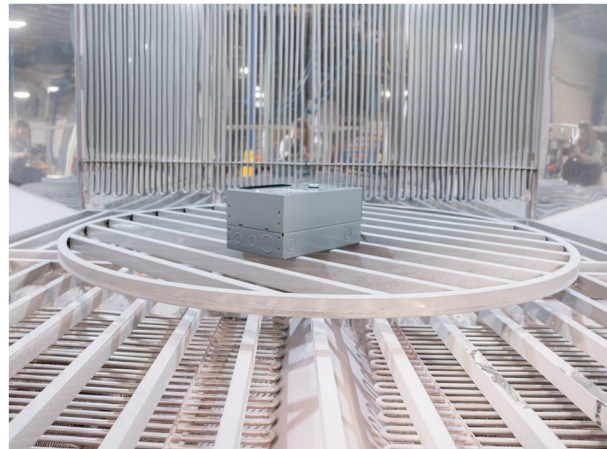
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NEW AT ESL LABS

Canada's largest sand & dust test chamber, supporting military and industrial programs from coastal naval bases to desert deployments.

ENVIRONMENTAL TESTING IN ACTION



TEST IN FOCUS #2

BLOWING SAND & DUST CHAMBER

Desert conditions are brutal on electronics and seals. ESL Labs' chamber generates wind speeds up to 54 m/s, using precisely graded MIL-STD sand to test ingress protection and operational durability.

- **PURPOSE:** Evaluate resistance to dust and sand particle intrusion.
- **APPLICATIONS:** Land-based vehicles, aircraft avionics, above-deck naval equipment and communications gear.
- **STANDARDS:** MIL-STD-810 Method 510, DO-160 Sec 12.



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ENVIRONMENTAL TESTING IN ACTION

TEST IN FOCUS #3

LARGE BASE MOTION SIMULATOR

This six-degree-of-freedom platform replicates the complex movement of a ship at sea up to 45° pitch, simulating Sea State 6 (4–6 m waves).

- **PURPOSE:** Validate system operation under continuous motion and multi-axis stress
- **APPLICATIONS:** Maritime radar arrays, control cabinets, sensor pods and other deck or superstructure-mounted equipment.
- **STANDARDS:** Ship Motion Pitch/Roll/Heel & Trim profiles.

“If it still works here, it’ll work anywhere.”



ENVIRONMENTAL TESTING IN ACTION



TEST IN FOCUS #4

SALT & FOG CHAMBER

Corrosion is the silent killer of metal assemblies and coatings. ESL Labs' modernized chamber can alternate between salt fog and sulfur-dioxide (SO₂) environments to accelerate corrosion testing.

- **PURPOSE:** Determine material or coating resilience to marine and industrial atmospheres.
- **APPLICATIONS:** Above-deck naval components, offshore rigs, transportation structures.
- **STANDARDS:** MIL-STD-810 Methods 509 & 518, DO-160 Sec 14, ASTM B117, G87.

REAL-WORLD CASE STUDY

A defence customer compared 30 coatings for durability under combined salt-fog and SO₂ exposure. Corrosion isn't just "surface rust"; it can lead to pitting and stress corrosion cracking, which eats into the core of metals used in load-bearing components and to house sensitive electronics. So determining the level of corrosive resilience is critical. ESL Labs' accelerated cycles helped them eliminate under-performing finishes, saving time and ensuring fleet readiness.



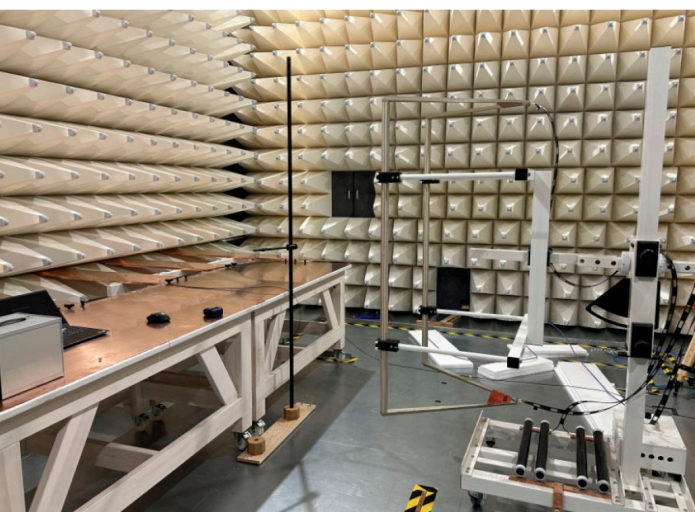
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EMI & EMC TESTING FOR COMPLIANCE AND RELIABILITY

Comprehensive EMI and EMC test services are vital to ensuring products meet international electromagnetic compatibility (EMC) and interference (EMI) standards. We make compliance testing straightforward and reliable — so your innovations perform flawlessly in the real world.

A Frankonia semi-anechoic EMI chamber facilitates testing for conducted emissions, conducted susceptibility, radiated emissions, radiated susceptibility, and pre-compliance testing for diverse applications. The chamber measures 9.68 m (L) x 6.53 m (W) x 6.00 m (H) with a 2m diameter turntable and 2000 kg capacity so it can perform MIL-STD-461G testing on a wide range of product sizes. Its anechoic cones and ferrite tiles absorb electromagnetic radiation and to prevent any reflections from the walls, ceiling, or floor to create a perfectly isolated qualification environment.

Common testing instrumentation includes EMI receivers, signal generators, high-power RF amplifier racks, low frequency test sets, and high bandwidth digital oscilloscopes.



CASE STUDY

THREE-METER SEMI-ANECHOIC CHAMBER

Emissions testing for a defence customer uncovered a power supply emitting energy that could interfere with sensitive peripheral equipment. ESL Labs experts not only discovered the issue, but leveraged in-house expertise and experience to design a special filter that was incorporated in the design that mitigated the issue.



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J-SQUARED TESTS TO RECOGNIZED STANDARDS

REPRESENTATIVE STANDARDIZED TEST LIST

MILITARY STANDARDS (MIL-SPEC) – DEFENSE AND MISSION-CRITICAL HARDWARE	
MIL-STD-810 (G/H)	Environmental Engineering (Temperature, Humidity, Altitude, Sand/Dust, Rain, etc.).
MIL-STD-461 (D to G)	Electromagnetic Interference (EMI) and Compatibility (EMC)
MIL-DTL-901E	High-Impact Shock (Navy/Shipboard machinery)
MIL-STD-167	Mechanical Vibrations of Shipboard Equipment
MIL-STD-1275	Characteristics of 28V DC Electrical Systems in Military Vehicles
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-1399	Interface Standard for Shipboard Systems
MIL-STD-108	Enclosures for Electric and Electronic Equipment
MIL-STD-2164	Environmental Stress Screening (ESS) for Electronic Equipment
MIL-STD-464D	Electromagnetic Environmental Effects Requirements for Systems
DOD-STD-1399	Electric Power, Alternating Current

COMMERCIAL & AEROSPACE STANDARDS	
RTCA/DO-160	Environmental Conditions and Test Procedures for Airborne Equipment
ASTM B117	Salt Spray (Fog) Testing
ASTM D4169	Shipping Containers & Systems Performance Testing
ASTM G53	Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type
SAE Standards	Various Automotive and Aerospace Performance Standards
ISTA Standards	Certified for Various Package and Transit Testing (Preshipment Testing)

MILITARY STANDARDS (EUROPEAN)	
DEF-STAN 59-411	Electromagnetic Compatibility Part 3 (Test Methods and Limits for Equipment and Sub Systems)
DEF STAN 00-35	Environmental Handbook for Defence Materiel Part 3 (Environmental Test Methods)



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THE ESL LABS ADVANTAGE: ONE FACILITY. TOTAL CONFIDENCE.

Breadth of Capability

From shock and vibration to EMC, humidity, corrosion, and material fatigue, ESL Labs covers the full spectrum. Few facilities in North America can match this range – fewer still in one location.

Depth of Expertise

Clients rely on decades of combined experience. ESL's senior engineers average 20+ years each, bringing insight that goes beyond compliance to real-world performance assurance.

Efficiency & Speed

With all tests in one place, logistics and scheduling are streamlined. Cross-disciplinary teams collaborate directly, shortening total test cycles.

Customization & Innovation

Not every requirement fits a standard. ESL Labs develops bespoke test profiles – higher vibration amplitudes, unique temperature ramps, or extended corrosion cycles - to meet specialized mission parameters.

Certifications and Standards

ESL Labs is a Canadian Controlled Good cleared Military Spec Lab and maintains a registered AS9100D (2016) Quality Assurance Program (based on ISO 9001:2015),

ESL Labs helps meet stringent product certification, validation and regulatory requirements across different product development stages.

Proven Partnership with J-Squared

As a subsidiary of J-Squared Technologies, ESL Labs integrates seamlessly with advanced electronics and system-design expertise, creating a direct bridge from concept through qualification to fielded performance.

DESIGNING CONFIDENCE INTO EVERY PRODUCT

Testing is more than verification. It's an act of foresight – the difference between a product that merely functions and one that thrives under pressure.

When performed early and intelligently, testing transforms development programs. It empowers teams to make evidence-based design choices, ensures compliance, protects brand integrity, and ultimately wins customer trust.

As industries evolve - with systems becoming smaller, smarter, and more connected – the physical world still has the final word. Temperature, vibration, corrosion, and shock remain the ultimate judges. Testing with ESL Labs ensures your innovations meet those challenges head-on.

“Test early. Test well. Because reliability isn't built by chance, it's built by design.”



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CANADA'S **ONLY** LARGE-FORMAT NEMP-WM NUCLEAR TESTING

Complementing ESL Labs' full range of environmental and EMI/EMC testing, ESL Labs' parent company **J-Squared Technologies** offers one-of-a-kind military testing at its newly expanded headquarters in Kanata, Ontario.

his large custom-engineered indoor chamber is designed to simulate large-scale, short-duration and high-amplitude electromagnetic fields such as nuclear EMP blasts in accordance with MIL-STD-461 and MIL-STD-464. This chamber is the only one of its kind in Canada and is vital for specialized military testing



J-Squared.com

ABOUT ESL LABS

ESL Labs, a division of J-Squared, is North America's most comprehensively equipped environmental and electromagnetic test facility. For over 35 years, ESL Labs has provided mechanical, chemical, and EMI/EMC testing for military, marine, aerospace, oil & gas, transportation, and industrial markets.

A \$10M infrastructure and equipment upgrade completed at ESL Labs in 2025 added even more testing capabilities at the 38,000 sq. ft. facility, enabling even more comprehensive and large-scale testing for military installations including the River Class Destroyer program and other marine and defence products and systems.

With an unparalleled range of test chambers – from shock and vibration to humidity, altitude, and corrosion – and a team of seasoned specialists, ESL Labs ensures that every client's product is proven in the lab before it's trusted in the field. ESL Labs maintains a registered AS9100D Quality Assurance Program and provides both industry-standard testing and highly customized testing, complemented by J-Squared Technologies full product lifecycle support.



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