



Guide to e/E-Marking

for EMC Type Approval of Vehicles and Electronic Sub-Assemblies



Provided by

Elite Electronic Engineering, Inc.
1516 Centre Circle, Downers Grove, IL 60515
630-495-9770 | www.elitetest.com

Complete EMC & Environmental Stress Testing

March 2016

Table of Contents

- 1 European Union Compliance Overview CE Mark, E-Mark, and e-Mark**
Page 3
- 2 Regulatory Requirements for Vehicles, Tractors, Machines, and ESA**
Page 6
- 3 EMC Testing, Vehicles, Tractors, and ESAs**
Page 10
- 4 Step by Step Overview to Compliance**
Page 13

1 European Union Compliance

Manufactured goods sold in the European Union must comply with community health and safety regulations before they can enter the EU market. Because of the diverse range of product types, an equally wide-ranging set of EU regulatory requirements exist to ensure consumer products and materials are safe and effective for use by European citizens.

A large percentage of these manufactured goods are assessed for regulatory compliance with Europe's New Approach Directives and are CE Marked. However, passenger cars, trucks, buses, along with agricultural tractors are a special class of products and they are not CE Marked, instead they are assessed according to requirements tailored to their unique hazards and environmental concerns associated with their use. Once certified they are e/E-Marked rather than CE marked.

In addition, certain electronic subassemblies (ESAs) that are placed on-vehicle after the vehicle is type approval may also need to comply with e/E-marking regulations. Plus, in some circumstances these ESAs will need to meet both the e/E-mark and CE mark sets of regulations. The processes associated with CE and e-marking are administered differently and it's the manufacturer's responsibility to be aware of all possible compliance obligations associated with their products and to meet the requirements in full.

Whole vehicle regulations cover a broad scope of systems and attributes, including brakes, turn signals, safety restraints, tailpipe emissions, and electromagnetic compatibility (EMC). This guide narrows the focus to regulations for electromagnetic compatibility and describes the EMC compliance steps for road vehicles and tractors along with electronic subassemblies that are integrated onto type approved whole vehicles.



1 European Union Compliance

A properly CE and e/E-Marked product is granted unrestricted access to the EU market and can nearly always be used without further testing, assessment, or other conformity marks*. In addition, the value of an e/E-mark or CE Mark can extend beyond Europe since many countries model their own compliance requirements to those of the European Union and many accept CE or e/E-Mark reports as suitable proof of compliance.

In fact, the desire for globally harmonized requirements has led to the development of two sets of regulations in Europe. The first was initially developed through the European Commission (EC) with the primary objective of having a common set of vehicle regulations for all EU member states. Vehicles that are evaluated and type approved to the European EC directives and regulations are marked with the lower-case “e”.

The other set of parallel vehicle regulations have been created through the United Nations Economic Commission for Europe (UNECE). Many of the UN regulations cover nearly identical requirements but they have the objective of being more globally applicable rather than simply being simply in place for the EU. Products certified to the UNECE regulations are marked with an upper-case “E”.

For years, manufactures selling cars, trucks, buses in Europe had to choose between these nearly identical EC and UNECE regulations and in some cases manufacturers elected to have both certifications. However, over the past several years the European Commission has simplified vehicle approvals by acceding its own community wide regulations to those of the UNECE. Now only a single EMC type approval for vehicles and vehicle ESAs is required for all of Europe. This single type approval for EMC is in accordance with the UNECE regulations and is denoted by having the upper-case “E”-mark placed on the vehicle or ESA.

* Note: Some legislation may be more stringent per county such as lower limits for maximum weight of trailers.



The European Union New Approach Directives apply the CE Mark to compliant products.



Ag/Forestry tractors and legacy vehicle products are labeled with the lower-case “e-Mark”. New vehicles and ESAs must be type approved for EMC to the UNECE regulations and labeled with the “E” Mark.



Products that meet the UNECE Whole Vehicle Type Approval EMC regulations are labeled with the upper-case “E-Mark”.

1 European Union Compliance

Determining the correct EMC compliance regulations and which regulatory mark to apply depends on the type of vehicle, tractor, machine, and/or ESA. Generally speaking cars, trucks, buses, trailers and other road traveling vehicles, including vehicle mounted ESAs must now comply with UNECE Regulation 10 for electromagnetic compatibility. Systems that are type-approved certified in accordance with UNECE Regulation 10 for EMC are E-marked with the upper-case “E”.

Agricultural and forestry tractors along with ESAs mounted on these systems are type approved for EMC to the requirements in European Commission Regulation 2015/208. Because this regulation is developed by the European Commission (EC) and since the EC has not acceded its tractor EMC requirements to the UNECE, type approved tractors or ESAs mounted on tractors are still marked with a lower-case “e”.

All other types of machines that do not fit the definitions for vehicles or tractors in the type approval directives will need to comply with the CE marking New Approach Directives. Common examples of these types of wheeled or tracked machines include farm equipment, construction machines, fork lift trucks, and earth moving equipment.

For CE Mark compliance, a machine must meet the requirements of all applicable New Approach Directives such as electromagnetic compatibility, machine safety, and others. CE marked machines are typically self-declared by the manufacturer to be compliant and do not require a third party type approval.

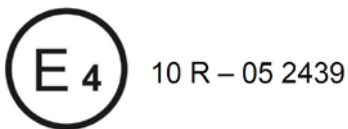
The technical details for the requirements are not specified in the actual CE directives, instead they are initially created by standards development organizations then published as Euronorm harmonized standards. A product that is evaluated against a harmonized standard and found to be compliant is afforded the presumption of conformity and issued at declaration of conformity by the manufacturer. The manufacturer can then apply the CE Mark and the product can be sold into the EU without any restrictions.



2 Regulatory Compliance for Vehicles

The full scope of European motor vehicle regulations are outlined in the European Commission framework directive 2007/46/EC, where the definitions, requirements, application, and type-approval process are described at a high level. The framework directive lists the various categories of vehicles and those machines which are exempt and covered by the New Approach CE Mark requirements or other type approval directives. The framework directive also lists the vehicle systems and performance attributes that are regulated and the associated regulations that apply (for example, tail pipe emissions, safety restraints, EMC, and others). Until recently the EMC regulations referenced by the framework document were according to 2004/104/EC and its amendments. However, as of December 2014 the European Commission has acceded its requirements for EMC to the UNECE requirements in UNECE Regulation 10.

For vehicles and ESAs mounted on vehicles the applicable EMC requirements are listed in UNECE Regulation 10 Revision 5 and type-approved certified system will be labeled with upper-case E-mark.



Typical UNECE marking for
UNECE Regulation 10.5 EMC

Vehicles

- Self-propelled
- At least four wheels
- Complete or incomplete
- Speed >25 km/h



Trailers

- Non-self propelled
- Wheeled
- Towed by a motor vehicle



Exempted Vehicles

- Ag & Forestry Tractors
- Quadricycles
- Tracked Vehicles

(Optional) Vehicles

- Used exclusively at construction sites, quarries, ports, airports
- Armed services, civil defense, fire, public service
- Mobile machinery

2 Regulatory Compliance for Ag and Forestry Tractors

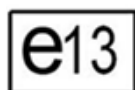
The product specific framework regulation for agricultural and forestry tractors is the EC Regulation No. 167/2013. It includes definitions, administrative processes and technical requirements at a high level. It also identifies the application specific regulations covering the unique operations and systems on a tractor.

Tractors are segmented into various categories and types depending on their construction and capabilities. The required vehicle level conformity assessment may vary depending on the tractor type.

The tractor manufacturer should review the European Commission framework regulation No 167/2013 and consider the definitions listed for tractors along with excluded equipment. The manufacturer can consult with the notified body or test laboratory and determine if their equipment falls within the scope of the ag and forestry tractor directive.

Both whole vehicles and electronic subassemblies used on tractors are assessed to the new tractor requirements listed in the EU framework regulation 167/2013. This regulations specifies that EMC is evaluated in accordance with EC Regulation No. 2015/208. This new regulations is applicable starting January 2016.

Since the assessment will be in accordance with the European EC requirements, the certified system will be labeled with lower-case e-mark.



Agricultural and Forestry Tractors

- Main function is applying tractive power to pull, push, and carry Ag/Forestry equipment.
- Speed >6 km/h
- Motorized, wheeled or tracked
- At least two axles
- Complete or incomplete

Annex II Vehicle Categories and Types

- Category T— Wheeled Tractors
- Category C— Track-laying Tractors
- Category R— Trailers
- Category S— Interchangeable Towed Machinery

Exempted Tractors/Machines

- Machinery specifically designed for forestry use
- Forestry machinery based on earthmoving equipment
- Interchangeable machinery that is fully raised from the ground when the tractor is on a road.

2 Regulatory Compliance for Mobile Machinery

Mobile machinery such as bulldozers, agricultural harvesters, or vehicles designed for low speeds are excluded from the vehicle and ag tractor directives. Since there is not a specific type-approval directive to apply for their conformity assessment, the regulations for mobile machinery are covered in the New Approach Directives which means these systems and their ESAs are CE Marked.

Machinery OEMs need to comply with all the essential health and safety requirements that apply for their systems. In general these include the Machine Safety Directive 2006/42/EC, the EMC Directive 2004/108/EC, and possibly others.

For the most part, the CE Mark is issued by the manufacturers as a self-declaration, though some machinery functions may require the intervention of a European Union Notified Body. The manufacturer is required to ensure products remain compliant with the directives while being sold in the EU. They must re-evaluate for compliance if changes are made to their equipment or as the requirements evolve. The applicable harmonized standards along with start/obsolete dates are posted in the Official Journal (OJ) of the European Union and manufacturers should monitor the OJ for updates for significant changes.

In some instances, an ESA can be used on several types of vehicles or applications. For multi-purpose devices the conformity assessment will need to cover the standards for all types of vehicles and machines where the part is used. The DoC will also need to include each standard. Contact Elite for assistance on which standard applies for your product.



Mobile Machinery

- Typical qualifying details vs. vehicles
- Self-propelled
- Specifically designed to do work
- Not suited for passengers
- Not for transporting goods



Requirements for Mobile Machinery

EMC Directive 2004/108/EC (replaced by 2014/30/EU April 2016)

Harmonized EMC Standards

EN 14982- Agricultural and Forestry Machinery

EN 13309- Construction Equipment

EN 12895- Industrial Fork Trucks

ISO 13766- Earthmoving equipment (applicable through the Machine Safety Directive)

2 Regulatory Compliance for Electronic Subassemblies

Electronic subassemblies (ESAs) are e/E-Mark type approved or CE marked separately. Any ESA mechanically fastened to a type approved vehicle (or tractor) having active digital circuitry with an “immunity function” and which is operational while the vehicle is in motion is required to be type approved and e/E-Marked.

The separate type approval of component may be required when a manufacturer or integrator chooses to type approve a vehicle in multiple stages rather than as a single integrated vehicle having all electronics incorporated at the time of assessment. Separate ESA type approvals are also necessary when new or modified electronic equipment is added to an already type approved vehicle.

A manufacturer is responsible for determining if an ESA falls within the scope of the vehicle directive, tractor directive, or if it is required to be CE Marked.

- ESAs that are sold as aftermarket equipment and intended for installation in vehicles must be type approved if they have an *immunity related function*. The directives and regulations provide definitions for immunity related functions.
- ESAs which do not have an immunity related function are not required to be type approved, rather they are CE Marked per the EMC Directive 2004/108/EC (replaced by 2014/30/EU as of April 2016).

An ESA having an immunity related function (i.e, data bus connectivity) plus other features which are not covered by the vehicle framework directive will need to be E-marked and CE Marked. For example, a vehicle mounted car stereo system with Bluetooth and CAN bus connectivity will need to be E-Marked to cover the vehicle immunity related functions through the data bus and CE Marked to comply with the R&TTE Directive requirements for the effective use of spectrum, EMC, and safety.



UNECE Regulation 10.5 Section 2.12

Immunity related functions are those:

- affecting the direct control of the vehicle,
- relating to driver, passenger, or other road users' protections, liable to cause confusion to the driver or other road users,
- for vehicle data bus functionality
- affecting vehicle statutory data, or
- for vehicle RESS charging

3 EMC Testing for Vehicles

UN Regulation 10 Revision 5 is the current EMC requirement for both vehicles and vehicle mounted ESAs. Within Regulation 10, the emissions limits and the test methods are specified for broadband and narrowband emissions. Vehicle tests are performed per CISPR 12 over the frequency range of 30 to 1000MHz. Broadband tests are performed with the engine running along with all equipment capable of generating broadband interference, i.e. motors or fans are switched on. Narrowband tests are performed (per CISPR 12 or 25) with the ignition switch on but the engine not operating. All digital electronic systems with internal oscillators operating at clock frequencies greater than 9kHz and capable of being switched on by passengers are set to operate in their normal mode.

Vehicle radiated RF immunity testing is performed to ISO11451-2 over the range 20-2000MHz. Radiating antennas are typically positioned at the vehicle hood. However, since each vehicle may be configured differently, the number and location of antenna radiating positions should be determined based on input from the vehicle manufacturer, the EMC laboratory, and Notified Body.

Bulk current injection immunity testing per ISO 11451-4 is an option, but it's typically limited to large vehicles. In addition, BCI immunity testing is inefficient at coupling RF energy at high frequencies and may not identify all potential susceptibilities. Since modern vehicles have many ESAs onboard with most having immunity functions, vehicle BCI immunity testing is an option but can require a comprehensive effort resulting in a lengthy and costly process.



Vehicle EMC Requirements per UNECE Regulation 10.5

3 EMC Testing for Tractors

The EC Regulation Number 2015/208 is the EMC test method and requirements for both tractors and tractor mounted ESAs.

Within Regulation 2015/208, limits and test methods are specified for broadband and narrowband emissions are specified and are measured as described in the regulation from 30 to 1000MHz. Vehicle radiated emissions are measured on an open test site at 3 or 10 meters from the machine. Broadband tests are performed with the engine running along with all equipment capable of generating broadband interference, i.e. motors or fans are switched on. Narrowband tests are performed with the ignition switch on but the engine not operating. All digital electronic systems with internal oscillators operating at clock frequencies greater than 9kHz and capable of being switched on by passengers are set to operate in their normal mode.

Vehicle radiated RF immunity testing is performed per Regulation 2015/208 but the regulation provides for the option to follow UNECE Reg 10.5 over 20-2000MHz. Radiating antennas are positioned at locations where the electronics and vehicle harnesses are concentrated. Since each vehicle may be configured differently, the number and location of antenna radiating positions should be determined based on input from the vehicle manufacturer, the EMC laboratory, and Notified Body.

The technical limits for emissions and RF immunity levels are nearly identical for vehicles and tractors, but slight differences between regulations should be discussed with the regulatory team before proceeding. A well written test plan is always recommended to describe the test procedures, limits, test levels, modes of operation, and pass/fail criteria.



Tractor EMC Requirements per Regulation No 2015/208

Note: Contact Elite to review technical differences between UNECE Reg 10.5 and Tractor Regulation No 2015/208.

3 EMC Testing for ESAs

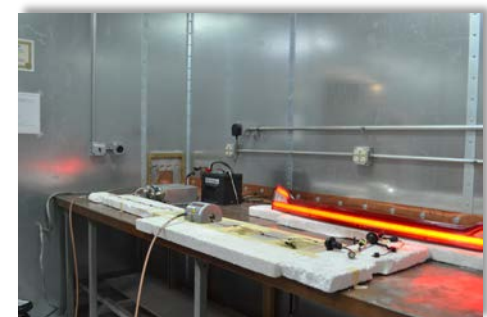
ESA's that fall under the scope of "road vehicles" are type approved per UNECE Reg 10. ESAs that are used exclusively for tractors are type approved per the tractor regulation EC 2015/208, and all other ESAs are CE Marked.

For ESA emissions testing, the requirements follow CISPR 25 for broadband and narrowband emissions over the range 30 to 1000MHz. There are no requirements for conducted RF emissions.

For ESA immunity testing, UN Reg 10 and 2015/208 provides a choice of different methods to cover the frequency range 20MHz to 2000MHz. Best practices suggest the use of BCI from 20MHz to 200MHz and free field radiated immunity from 200MHz to 2000MHz.

In UN Reg 10.5 ESAs are evaluated for conducted transient emissions and immunity per ISO 7637-2. The immunity pulses include 1, 2a/b, 3a/b and 4. Conducted transients are applied only to the power leads. Similarly, transient emissions are measured only at power leads. ESAs that are not switched, contain no switches, or do not include inductive loads are not tested for conducted transient emissions. The tractor EMC requirements in 2015/208 do not include conducted transient tests. Finally, there are no requirement for ESD testing for vehicles or components in either UN Reg 10 or EC 2015/208. However, the CE Marking harmonized standards do include conducted transient immunity and ESD testing.

For ESAs with multipurpose applications, contact Elite for a test plan that will envelope compliance testing covering the full range of vehicle, tractor, or machinery platforms planned for the device.



4 Steps to Compliance

What are the type approval steps?

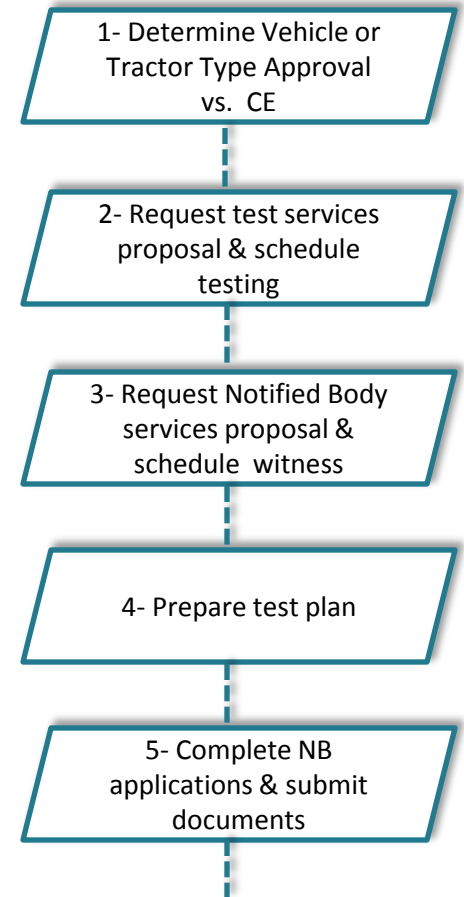
A successful type approval requires a Notified Body and an experienced EMC test laboratory. The following steps illustrate the process for European Union vehicle and tractor approvals.

Step 1- Contact Elite and/or the Notified Body at the early phases of development to conduct an initial review of the product and its range of applications. Determine if the device falls within the scope of the vehicle EMC regulations of UNECE Reg 10, or the tractor requirements from No 2015/208 . At this phase it will also be important to determine if other directives and requirements apply.

For example, an ESA that includes a wireless transmitter and connects through its CAN bus will require a vehicle type approval and an assessment for the R&TTE Directive 1999/5/EC. This type of product will be labeled with both the E-Mark and the CE Mark.

Similarly, a vehicle such as a waste hauling truck incorporating moving machinery will be evaluated and labeled with the E-Mark for those aspects of the machine safety associated with its road operation, but also a CE Mark to note compliance with the Machine Safety Directive 2006/42/EC for the hydraulics and moving assemblies, ie. the trash can lifts.

Step 2- Contact Elite to request a proposal and for scheduling a test start date. Elite will coordinate the start date with the Notified Body. Typically, anticipate 4-6 weeks advance notice to schedule component tests and witness services. For vehicle testing, plan for 8-10 weeks for test scheduling.



4 Steps to Compliance

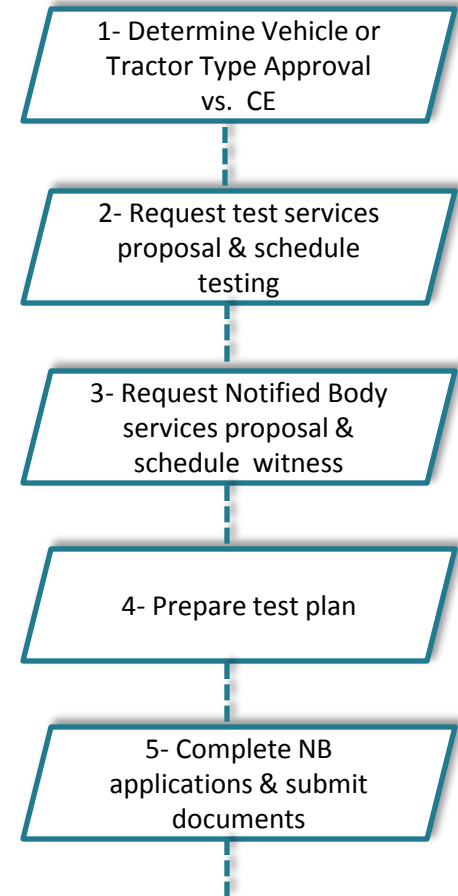
Step 3- Contact the Notified Body to request a proposal for test witnessing, conformity of production, and certification services.

Step 4- Manufacturer prepares a test plan with guidance from the EMC lab and Notified Body to outline the scope of testing, test conditions, mode(s) of operation, and pass/fail criteria.

Step 5- Complete a formal application for certification with the Notified Body. The manufacturer shall submit the completed type approval application along with product descriptions, quality control information, and related documents as identified by the Notified Body. The information required shall be sufficiently detailed so that the Notified Body can conduct a complete and comprehensive document review .

For information on Notified Body Services, contact:
VCA North America
Livonia, MI 48152
Tel: 734 838 3930
e-mail: general@vcana.com

What are the type approval steps?



4 Steps to Compliance

Step 6- Complete the compliance testing in accordance with the requirements. During the test a representative of the Notified Body will be present to witness the equipment setup, testing, and to evaluate the test outcome.

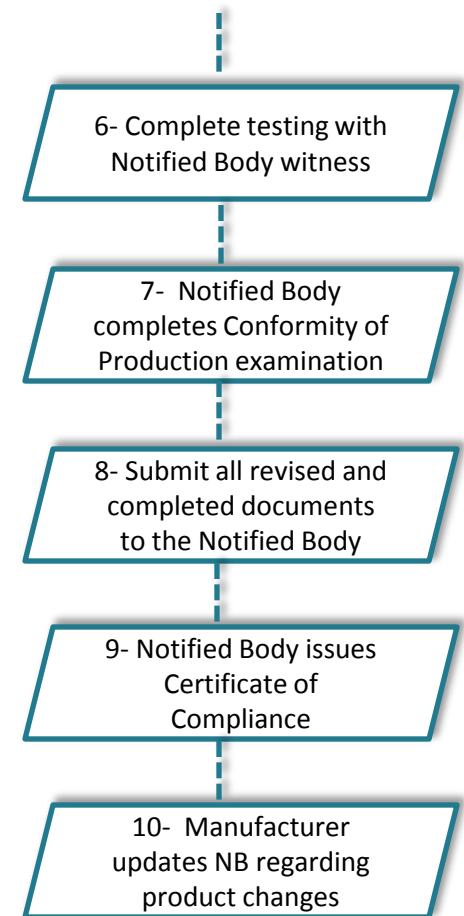
Step 7- The Notified Body will conduct a conformity of production (CoP) review of the manufacturer's quality management system. This review may include an audit of the manufacturing facility.

Step 8- All revised and completed documents including the test report shall be submitted to the Notified Body for final review and approval.

Step 9- The Notified Body shall issue a type approval report and issue the Certificate of Conformity (CoC).

Step 10- As part of the CoP process, the manufacturer is obligated to communicate any changes in the design or production processes that may impact the continued compliance of the type approved device with the regulations.

What are the type approval steps?



4 Final Comments and Resources

Vehicle and ESA type-approval for EMC is an important process for manufacturers and it is required to be in place before entering the European market. From start to finish, a vehicle EMC certification can take 2 to 4 months to complete and ESA type approvals can require weeks to months. But through careful planning and by working with an experienced EMC lab and Notified Body a more timely and successful type approval certification can be assured.

Elite has over 60 years of EMC experience and we've been testing vehicles for nearly as long. We can help vehicle OEMs step through the type approval process and we work with ESA manufacturers for simple devices or multi-purposed ESAs on applications for trucks, cars, tractors, and construction machinery.

Call Elite experts today to learn more about our services.

*For information on Elite's vehicle and ESA type approval services contact Elite Electronic Engineering, Inc.
Steve Laya, Sales & Marketing Manager, 630-495-9770 x 119, sqlaya@elitetest.com*

References:

UNECE Regulation 10.5

Regulation (EU) No. 167/2013

Regulation (EU) 2015/208

http://ec.europa.eu/growth/sectors/automotive/legislation/motor-vehicles-trailers/index_en.htm

http://ec.europa.eu/growth/sectors/automotive/legislation/tractors/index_en.htm

<http://www.dft.gov.uk/vca/vca-north-america/>



Elite Electronic Engineering, Inc.
1516 Centre Circle, Downers Grove, IL 60515
630-495-9770 | www.elitetest.com
Complete EMC & Environmental Stress Testing