



10 Steps To Successful Automotive EMC Testing



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Complete EMC & Environmental Stress Testing

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Automotive EMC Testing

Automotive EMC testing measures the radio frequency (RF) emissions emanating from vehicle electrical systems and evaluates their susceptibility to RF signals generated by other devices on the vehicle as well as from off-vehicle sources.

EMC testing also extends to evaluating the device performance while exposed to vehicle steady state and electrical transient conditions and electro-static discharge.

An average passenger car today relies on between 50 to 75 embedded electronic modules to monitor and control nearly all aspects of vehicle operations. These functions include steering and braking, tail-pipe emission controls, safety, as well as entertainment and comfort enhancements, to name just a few.

To ensure safe and reliable operations of these systems, a rigorous test and validation process is often performed as part of new product development. All vehicle original equipment manufacturers (OEMs) and most component suppliers prescribe corporate tests to validate the electrical performance and electromagnetic compatibility (EMC) of their devices. Government regulations also stipulate testing and compliance for certain vehicle types and electronic subassemblies.

To help manufacturers prepare for automotive EMC and electrical testing Elite has outlined the following 10 steps to set in motion a smooth and successful test and validation effort. After reviewing these key steps, contact Elite to discuss the specific details and unique needs for your test and validation program. Let's begin with Step 1...



1 Define Your Target Market

Download Elite guides to learn more about regulatory compliance processes:

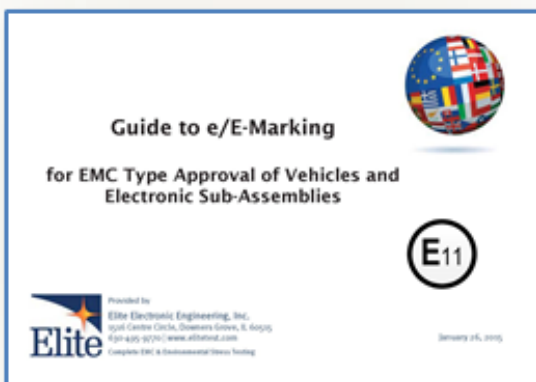
- E-marking
- FCC Certification
- CE Mark

The first key step in automotive EMC test and validation is to define your target markets. Is your device being sold to a vehicle OEM or is it an aftermarket product? Will it be used in North America, Europe, or Asia? Can it be fitted on a passenger, truck or construction machine, or potentially multiple platforms? Does it include wireless connectivity?

If an electronic subassembly is sold to a vehicle OEM, then the OEM will typically issue a design specification that lists their EMC and electrical requirements. Often the OEM design specification will identify the applicable regulatory requirements for the markets being targeted. Plus, in many cases the OEM's testing standards incorporate the regulatory requirements within their procedures and test limits.

If the product is strictly an aftermarket electronic subassembly then the focus shifts to complying with the regulatory requirements of the country where the product is used. Some government regulations can be met by the manufacturer performing tests to published harmonized standards and then self-declaring compliance, but other regulations require testing then certification by a third party.

Elite can provide step-by-step guidance for either OEM validation testing or global regulatory conformity assessment.



FMC 1278 Test Plan Template 18 May, 2016

Component / Subsystem EMC Test Plan Title Page

Product Name:	
Product Supplier Name:	Ford Recognized EMC Test Facility(s) used: <i>Include Lab Manager Name(s)</i>
Product Part Number(s): <i>List all product part numbers that this test plan is applicable to. (May be listed on separate page)</i>	Vehicles & Model Year using this product: If multiple part numbers, identify which vehicle numbers are used. <i>(May be listed on separate page with part numbers)</i>
Product Printed Circuit Board(PCB) Number(s): <i>List all PCB numbers that this test plan is applicable to.</i>	
Product Manufacturing Location(s) <i>Where will this product be produced?</i>	EMC Specification Used: <i>Identify specification and revision number being used</i>

I certify that the information contained in this test plan is factual including description of the product operation, correct function classifications, and acceptance criteria. I understand and agree that any subsequent changes to this test plan prior to design testing shall be communicated to the FMC EMC department. Any changes or revisions to this test plan after test completion, a written technical justification and approval by the same EMC department. I understand that failure to follow this process may result in acceptance of the product's EMC test data by the FMC EMC department. I also understand and acknowledge that requirements via this test plan are relevant only to the specific vehicles that the product is to be fitted to. Use of the product on other vehicles may require additional EMC performance requirements, which will necessitate additional verification testing of the product. I certify that the product samples submitted for EMC testing are of a production representative design. I authorize the EMC test laboratory summary report directly to the FMC EMC department no later than five (5) business days following completion of testing. I also authorize forwarding a copy of the EMC test laboratory's detailed test report directly to the FMC EMC department within thirty (30) business days following completion of testing. I certify to perform all tests in a Ford recognized laboratory.

GM WORLDWIDE ENGINEERING STANDARDS		GMW3103	
Table A1: Component EMC Test Plan			
Device Under Test (no abbreviations):	GM Approval Number:	Release Date:	Revision:
DUT Part Number(s):	DUT Manufacturer:		
Prepared by (Supplier):	Approved by Vehicle Manufacturers Responsible Engineer:		
Approved by (Supplier):	Approved by Vehicle Manufacturers/EMC:		

2 Develop a Test Plan

Contact Elite for assistance on test plan preparation

Test plan templates are available from most automotive OEMs

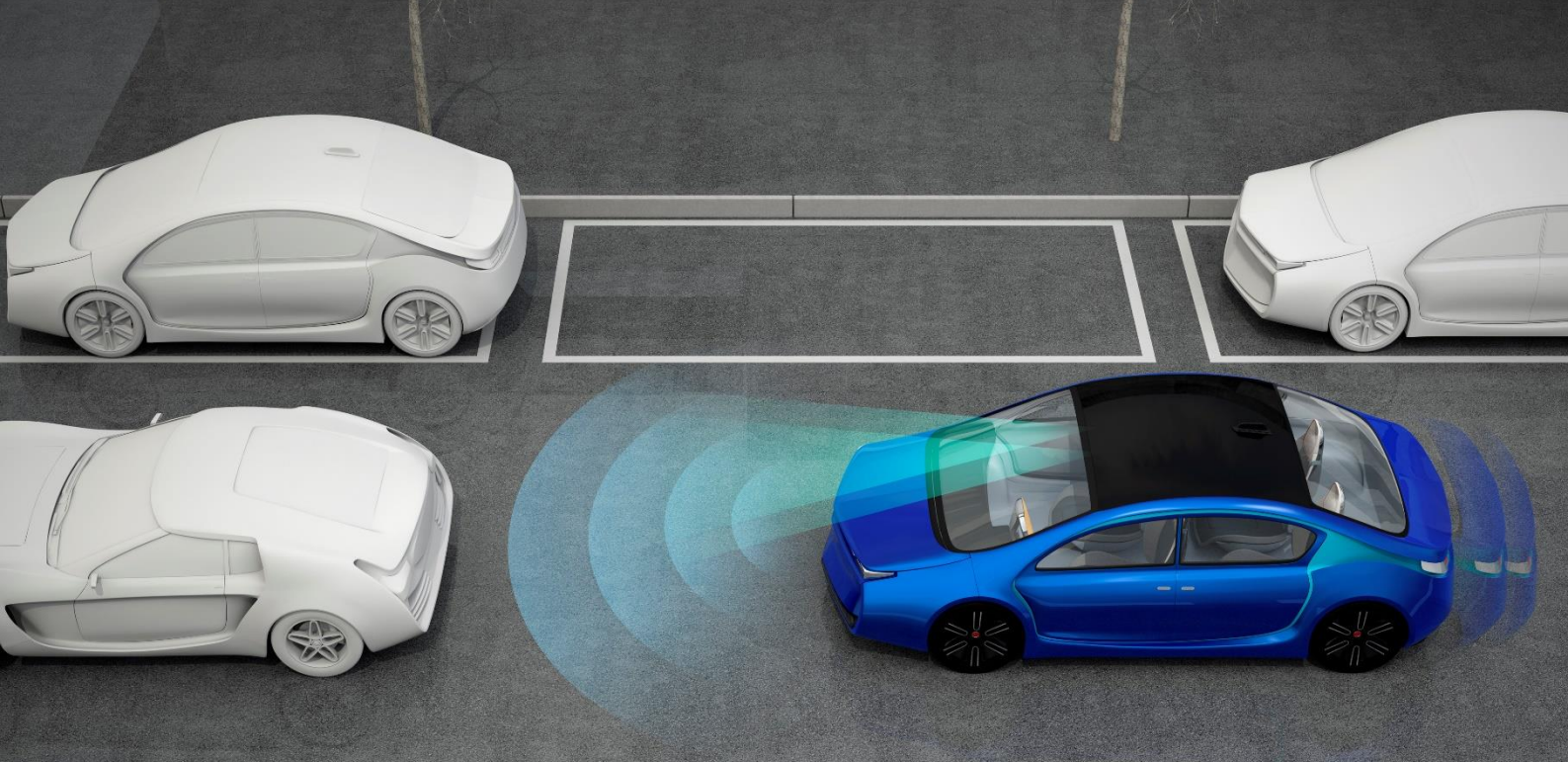
Certain regulatory standards include test plan templates

A well written test plan is essential to a successful EMC validation program. Most vehicle OEMs require an EMC Test Plan be completed by the supplier and approved by the OEM EMC engineer assigned to the project.

The test plan approval process is an absolute requirement for certain OEMs (i.e. Ford, GM, and FCA) and any delays in its submittal by the supplier to the OEM can impact test start/completion dates. A test plan that is not properly signed by the OEM is at risk of invalidating the test report. We recommend clients forward their test plan to Elite where our experts can review it to confirm the necessary signatures and laboratory identification are present.

For certain vehicles and aftermarket products a test plan is not always required but we highly recommend one still be generated. A test plan builds confidence between the supplier and vehicle OEM and end user. It's also an important document to include in a technical compliance file and is used to support a manufacturer's due diligence in assessing compliance for a regulatory conformity assessment.

A generic test plan can be developed if a specific template does not exist. The regulatory compliance limits associated with the product's end use application or test levels and limits can be listed in the test plan or a manufacturer can draw from recommendations in CISPR, ISO, and SAE standards.



3 Specify Function & Expected Performance

Test Plan Basic Information

- *Number of samples*
- *Test methods*
- *Immunity test levels and emissions limits*
- *Operating mode(s) during tests*
- *How the operation will be monitored during immunity tests*
- *Expected performance of monitored parameters (with tolerances)*
- *Pass/Fail criteria (including tolerances)*
- *Input power requirements and grounding*
- *Signal lines loading*
- *Communications bus (ie CAN) configuration*

The test plan should capture all the information that the test engineer will need to accurately complete the project. It should also consider modes of operation and other conditions that an end user would want to see evaluated when the final test report is delivered. What is the function of the device? Is it a convenience item or a safety critical device?

If the device is a convenience item, then it may be allowed to respond during certain immunity tests as long as it returns back to normal operation after the threat is removed and the response does not distract the driver. The immunity test levels for a convenience item will also usually be less severe since convenience products are not critical to the safe operation of the vehicle.

A safety critical device will usually need to operate without any sign of upset from the immunity threat being applied. In addition, the immunity test levels of a safety critical device will usually be much higher than the requirements of a convenience item.



4 Design for Compatibility

By understanding the EMC and electrical environment and requirements, a manufacturer can design for compliance and compatibility.

The process of EMC and electrical testing is to confirm that a device will operate properly in the presence of its own interference as well as from other devices that may be nearby or connected to the same power and communications bus.

If the product is being designed for a particular vehicle OEM, then the corporate EMC standards typically set the benchmark for test and performance requirements. If the product is an aftermarket device, then the regulatory requirements are key. As a minimum, government imposed EMC regulations stipulate emissions limits for the protection of off-board receivers through standards like CISPR 12. Some regulations also set requirements for the protection of on-board receivers applying CISPR 25 as the test method and limit. For electric vehicles, CISPR 22 may apply for emissions through the AC mains connection. In addition, the electronic subassemblies that have functions related to the safe operation of the vehicle are tested for RF and conducted transient immunity and ESD.



5 Confirm Design with Development Testing

Development testing should be performed during the product design and prior to validation testing. Although development testing adds up-front costs to the project, this testing can greatly improve the odds for successful validation testing.

Development testing is an important step in a product design process. A full series of tests is usually not required for development testing. A subset of the tests that evaluate emissions and immunity are often enough to give a high level of confidence to the product design. Check with Elite experts for a recommendation on test applicability.

If possible, use the same EMC test lab for both development and validation testing. This will ensure familiarity with the product and associated support equipment. It may also save travel costs for the validation tests. Since the lab will use the same test methods and techniques during both tests, testing at the same lab will eliminate surprises (due to lab differences) during the validation tests.

If development tests are performed at the supplier's "in-house" or local "development" lab, then make sure the development testing will correlate with the validation lab.



6 Communicate with the End User

Communication is the key to success of any business. Whenever possible, the Vehicle OEM should be consulted and made aware of any potential issues.

If an unforeseen issue occurs during the test, communicate the findings with the vehicle OEM. Often the OEM will work with the supplier to mitigate the issue or resolve problems by accepting results based on analysis, test conditions, risk, or other testing circumstances.

The vehicle OEM usually has EMC experts on staff and they often support the supplier with engineering assistance to expedite design issue resolution.

Ultimately, project success is more likely achieved if the end user is involved during the entire design process including EMC testing. Open communications will build the relationship between the supplier and the vehicle OEM and will greatly improve the potential for a successful program.



7 Schedule Well in Advance

Communicate your schedule needs well in advance of your test date. By establishing an early channel of communication, a lab can usually achieve the desired test start and completion dates.

At Elite, we strive for quick access to laboratory services. However, manufacturers should anticipate a schedule backlog for automotive validation testing from (several) weeks up to months. Be sure to contact Elite well in advance of the date the product will be ready for testing.

Begin by contacting the Elite sales team with your requirements. We can provide the expertise you need for selecting the appropriate OEM test standards and test methods. Elite experts can also help identify the regulatory requirements and outline the process for conformity assessment.

Once a proposal is generated, Elite will schedule all services based on the required time and lab resources. By establishing an early channel of communication with Elite's lab scheduler we can usually achieve the desired test start and completion dates. Typically a purchase order is not required to hold a scheduled test date, but a PO will be required to start testing.

Certain regulatory tests for European Union vehicle and agricultural tractors and their electronic sub assemblies require an "E" marking type approval through a European Notified Body. These services are processed directly between the Notified Body and the equipment manufacturer. Elite can provide the contacts for notified body services and we work closely with the Notified Body and client to coordinate test scheduling.



8 Prepare for Validation Testing

Communicate with the lab scheduler early and often regarding your readiness for testing.

With sufficient notice, the test lab can easily shift your start dates.

Prepare for testing by configuring a fully functional system that can be delivered to the test laboratory on the scheduled start date. Be sure to add time to make sure all of the wiring harnesses, support equipment, etc. are ready for the project start date. As a minimum the lab will need the following items:

- *A properly approved test plan for OEM validation*
- *Device(s) to be tested*
- *Wiring harnesses*
- *Load box and support equipment to properly simulate the systems that interface with the test item*
- *Laptop computer with communication (CAN) bus simulator*
- *Monitoring equipment*
- *Instructions for operating the equipment*

Certain specialized support equipment can be provided by Elite. However, clients should identify their needs early on so we can provide the necessary resources at the start of your testing. Examples of equipment available through Elite (upon advanced request):

- *Fiber Optic Transceivers*
- *Laptop PCs, Oscilloscopes, Audio Analyzers,*
- *Communication Simulator (CMW500)*
- *Mechanical fixturing, tooling, and test automation*



9 Be Available When Testing Begins

Elite provides a daily email summary of testing progress.

More significant issues and testing problems are communicated by phone contact.

Elite business hours typically run from 8:00am to 4:30pm so plan to arrive shortly before 8:00am on the first day scheduled for your testing. For special shifts or extended hours testing contact Elite at the earliest phase of the test project.

Elite clients are always welcome to be present for testing. In many cases we encourage clients to attend the initial setup and for the first few test operations. However, many of our clients ship their equipment along with setup and operating instructions to Elite. Our engineers then configure the unit for testing and run the tests while monitoring the performance of the device. If the client is not present for testing, then we need a responsive technical support contact that can be reached quickly to help with setup and resolve testing issues. Also, to ensure a more efficient test process, we recommend the client provide spare test samples if possible.



10 Respond Quickly to Project Delays

It's not uncommon for projects to run into delays. For this reason it is important to keep the laboratory informed of potential project delays for planning purposes.

For project delays that occur in advance of the test start date we request that clients notify Elite as soon as possible so the reserved lab time can be reallocated to others and a new start date reassigned for the delayed project.

When problems occur during testing our engineers work quickly and closely with the client to resolve all issues. This includes working through test item setup complications, test item non-compliance, or Elite equipment faults. For clients not present at Elite during testing, we rely on our client contact being readily available by phone to support our troubleshooting efforts. For these cases we request email and mobile phone contact information for key support personnel.



Contact Elite today!

Our Experts, Your Timing, Best Value

Let us know how we can help you succeed with your product development.

Why Trust Elite?

- *60+ years of EMC testing experience*
- *20+ automotive EMC test engineers and iNARTE organizational certification*
- *15+ years of continuous laboratory recognition from Ford, GM, and Fiat-Chrysler*
- *Only independent test laboratory fully recognized for all Ford, GM, and Fiat-Chrysler EMC test methods*

Automotive EMC testing can be a challenging process, but with the support of Elite engineers you can rest assured that you're working with the most knowledgeable, best equipped, and best value service provider in the industry. Contact the following Elite personnel to get your project started on the right path.

Elite phone number: 630-495-9770

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