

UK Defence Standard 59-411 on Electromagnetic Compatibility

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Ministry of Defence, Def Stan 59-411 Issue 1 on Electromagnetic Compatibility (EMC) was published in January 2007 and supersedes Def Stan 59-41 and other EMC-related Def Stans. The new Def Stan 59-411 is a result of three years work by the UK MoD sponsor and industry to update and consolidate seven EMC-related Defence Standards into a single new standard – Def Stan 59-411.

Def Stan 59-411 is sponsored by Defence Equipment & Support (DE&S), Defence Electromagnetic Environment Effects Authority (DE3A), EMC Policy Section and issued on the DSTAN website.

The document is organised into five Parts shown in Figure 1, which also shows the relationship to the previous Def Stan 59-41.

Part	Def Stan 59-41	New Def Stan 59-411
Part 1	Introduction & Guide	Part 1 Management & Planning
Part 2	Management & Planning	Part 2 Electromagnetic Environments
Part 3	Section 1 Man Worn, Man Portable Section 2 Military Support Equipment (Withdrawn) Section 3 LRU & Sub-Systems	Part 3 Test Methods & Limits for Sub-Systems
Part 4	Large Equipment	Part 4 Platform & System Test & Trials
Part 5	Specialised Test Equipment	Part 5 Code of Practice for Tri-Service Design & Installation
Part 6	Vehicle Installation Guidelines	
Part 7	Ships Installation Guidelines	

Figure 1 – The New Def Stan 59-411

TÜV Product Service has been a member of the Working Group set up by the UK MoD sponsor to update the standards and was lead author for Parts 1 and 4.

Part 1 ‘Management and Planning’

Part 1 addresses EMC throughout the project lifecycle.

Guidance is provided to assist Project Managers and Contractors select appropriate EMC activities, dependent on project size and complexity. The increasing use of COTS or MOTS (commercial/military off-the-shelf) equipment in military environments has introduced an additional risk of shortfalls in EMC performance. A new COTS/MOTS risk assessment procedure is defined as shown in Figure 2, requiring electromagnetic environment definition, evaluation of EMC compliance evidence (e.g. by gap analysis), determination of functional criticality of the equipment and platform and, mitigation of unacceptable risks by remedial design, installation methods and retest.

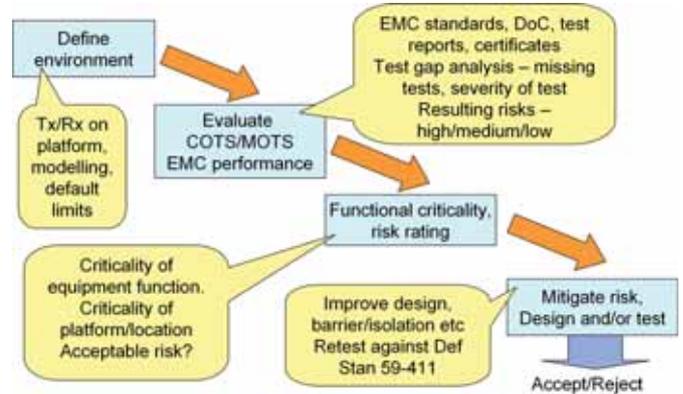


Figure 2 – COTS/MOTS risk assessment

The manufacturer or supplier of military equipment needs to comply with applicable UK regulations implementing EU Directives including EMC. The MoD policy on ‘CE Marking’ military equipment is under review, due to the latest UK EMC regulations (SI 2006 No.3418) implementing EMC Directive 2004/108/EC and the re-examination by the European Commission of Article 296 of the Treaty of the European Community – the so-called ‘military exemption’. The expected outcome is that MoD procurement contracts will require compliance with applicable EU directives, unless a specific exemption is granted, due to essential national security interests.

Applying EU directives to defence projects can lead to duplication of test programmes and additional costs. However, testing can be minimised by establishing Technical Documentation to demonstrate that Def Stan 59-411 satisfies the majority of the EMC directive requirements and that the remaining unsatisfied requirements are addressed by testing in accordance with commercial standards. The manufacturer or supplier then makes a Declaration of Conformity and applies CE Marking. Assistance in this process can be obtained from an EMC Notified Body such as TÜV Product Service.

Def Stan 59-411 is not a safety standard, but recognises that controlling EMC plays an important role in safety management; therefore, the Part 1 includes guidance on EMC and functional safety and Part 4 provides trials for platform safety clearance.

EMC requirements are now specified for support equipment that is not being used in frontline environments and draws upon commercial EMC standards used for CE Marking where possible.

Part 2 ‘The Electric, Magnetic and Electromagnetic Environment’

Part 2 defines military EM scenarios and incorporates and replaces Def Stan 08-46. The environments specified in Part 2 are ‘worst case’ and are used to derive the default test limits in

Part 3 and Part 4, which address the majority of equipment deployments, but do not necessarily equate directly with the Part 2 environment levels.

Part 3 ‘Test Methods and Limits for Equipment and Subsystems’

Part 3 incorporates the previous Def Stan 59-41 Part 3 and addresses equipment testing. The test methods and limits in Part 3 have been updated in response to changes in the military environment, due to the introduction of new systems such as BOWMAN. A new section has been included to provide the rationale behind the tests. Radiated emission test limits (DRE01/DRE03) have changed for air and land service. Radiated susceptibility test limits (DRS02) have also changed for:

- Ship above decks limits increased from 200V/m to 400V/m, 1 to 4 GHz, due to new radars
- Land service limits 30 MHz to 100 MHz increased up to 200V/m, due to BOWMAN
- Land service Class C & D pulse modulated test limit introduced up to 200V/m, 200 MHz to 18GHz (field radars)
- Land service Class A & B pulse modulated limits reduced from 500V/m to 200V/m, 4 GHz to 10 GHz

The test methods and limits are arranged in two annexes: Annex A for Man Worn and Man Portable equipment, and Annex B for LRU and Subsystem Equipment. These relate to the previous Def Stan 59-41 Part 3 Section 1 and Section 3. The previous Def Stan 59-41 Part 3 Section 2 for ‘Military Support Equipment for use in a Civilian Environment’ has been discontinued since it was not widely adopted in contracts.

Def Stan 59-411 Part 3 Annex C corresponds to the old Def Stan 59-41 Part 5 ‘Specialised Test equipment’. The Def Stan 59-411 Annex C introduces a revised method for verifying the screened room anechoic damping performance using a continuous noise emitter (CNE) as a calibrated test source for use on a ground-conducting bench. Test laboratories wishing to test in accordance with Def Stan 59-411 will need to undertake measurements within their screened rooms to verify that the results are within the permitted tolerances that address the frequency range 30 MHz to 1 GHz; an example result is shown in Figure 3.

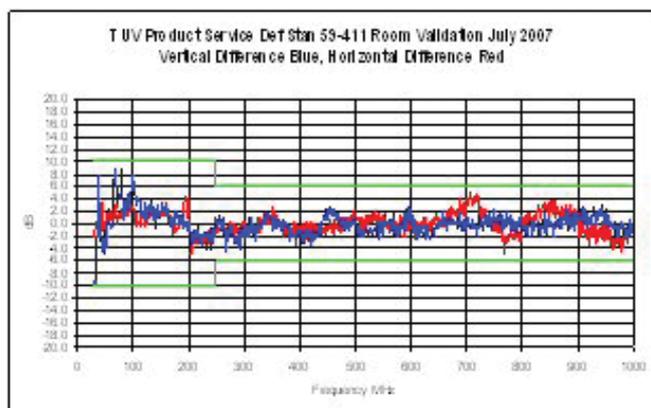


Figure 3 – Def Stan 59-411 Example Screened Room Anechoic Verification Result with Ground Conducting Bench

Part 4 ‘Platform and System Tests and Trials’

Part 4 applies to whole platform and large system test and trials. Platform trials were not specified in detail in the previous Def Stan 59-41; therefore, this new Part 4 incorporates a range of other Defence Standards and industry best practice to provide a definitive set of requirements.

Procedures for whole aircraft EMC trials assess the aircraft compatibility with the external EM environment and with on-board EM sources. As there was no existing Defence Standard for aircraft EMC trials, the procedures are based on the aerospace industry best practice.

Military land vehicles trials incorporate Def Stan 58-06 EMC for Mobile Communications Installations. The trials ensure that communications performance is maintained when installed on the vehicle and while on the move as well as ensuring that vehicle safety is not compromised by high-power radio transmissions. The principle of assessing vehicle safety via a mutual interference trial is shown in Figure 4.

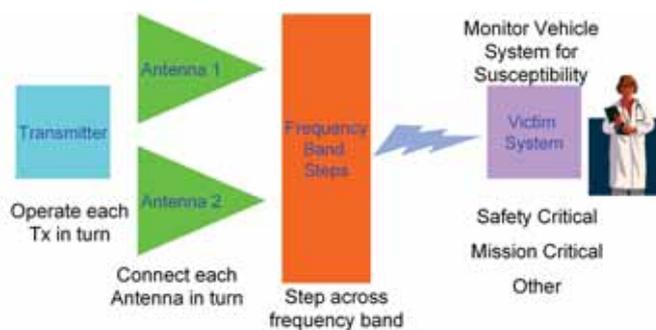


Figure 4 – Platform Mutual Interference Trial

Ships and submarines undergo mutual interference trials to ensure they are safe to proceed to sea and that sensors, communications and navigation systems operate compatibly. Part 4 incorporates Def Stan 08-112 for submarine trials. The ship and submarine trials include the requirement for the weapon electronic mutual interference trial (WEMIT). Modified test procedures are given for *in situ* testing of equipment on platforms or during commissioning.

Part 5 Code of Practice for Tri-Service Design and Installation

Part 5 provides design guidance with sections to cover air, land and sea applications, and addresses EMC fundamentals, equipment and platform design.

Future Development

These five Parts of the new Def Stan 59-411 provide the foundation for ensuring electromagnetic compatibility in defence procurement. Work continues to revise the standard with Amendment 1 due in autumn 2007. This amendment will correct errors and provide new material including: a project manager’s checklist with default contract requirements; and, the MoD view of the application of the EU EMC Directive to military equipment.

In the longer term Def Stan 59-411 will be updated to address the following objectives:

Improved testing methodologies to make tests more cost-effective and resolve technical issues, such as the validity of radiated measurements using the 41" rod antenna, and a suitable replacement for test DRE03 (tuned antenna), which currently uses the obsolete HF CLANSMAN service equipment.

Test limits will be revised to ensure that they reflect the EM environment definitions in Part 2 and specific issues resolved such as the limits for test DRS02 for equipment under Submarine casings and Airside.

New defence technologies will impact the EM environment and therefore require the test methods and limits to be updated. These technologies include all electric ships, frequency hopping radios, electric armour, electronic counter measures (ECM) and unmanned airborne vehicles (UAV).

The need to ensure platforms and equipment remain safe means that the role of EMC and functional safety will be a priority. The future harmonisation of Def Stan 59-411 with NATO standards AECPT 250/500, US standard MIL-STD-461 and EU defence procurement requirements remains a long-term goal.

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