Standardization for Defence Procurement – European Handbook

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Recommendations issued by Expert Group 7 “Electromagnetic environment” on their selection of standards

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EUROPEAN COMMITTEE FOR STANDARDISATION (CEN)
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Report of the CEN WS 10 EG7 "Electromagnetic environment"

CEN: European Committee for Standardisation
Workshop 10: Standardisation for Defence Procurement
EG7: Expert Group 7: Electromagnetic Environment

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Summary

The European Commission (EC), DG Enterprise, endeavours the competitiveness of the European Defence Industry. The plethora of (national) standards, more than 10.000, are recognised by the EC as a major constraint and cost driver.
Electromagnetic Compatibility (EMC) or Electromagnetic Environmental Effects (EEE) areconsidered by the EC as a major topic, with 7 other topics such as environmental engineering, energetic materials, batteries, electrical interfaces.
An EMC expert group with representatives from industry, including Aerotech Telub, Intellect, EADS, Ericsson Microwave, Fincantieri, MBDA, Thales, and national MoDs rationalized in 2004 a list of 329 EEE standards, implicitly abandoning national, including American, standards, and develop guidelines for the procurement process.
A limited number of widely accepted and cost effective standards, suitable for use by MoD's (acquisition) and industry (product development), has been defined after making comparisons. Comparisons were carried out on some standards against STANAG 4370 AECTP 500. The Expert Group agreed;

- That no one standard is better or worse than another in achieving an end goal
- Differences are not sufficient to prevent the use of AECTP 500
- There are sufficient similarities to AECTP 500 to adopt this as the fundamental replacement standard.

There was sufficient agreement on NATO-, IEC- and EN-produced standards to make worthwhile agreement to use a number of standards as replacement for some (or some parts) of existing National Standards.
This document gives recommendations on the use of the standards, the scope and limitations. It also emphasizes the constraints with respect to the standardisation process of National MoD's, NATO, Industry and EN/IEC.

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1. Introduction

The European Commission requested the European Committee for Standardisation (CEN) to establish Workshop 10 to improve the efficiency and enhance competitiveness of the European defence industry (see Appendix A). Eight Expert Groups (EG) have been established in the beginning of 2004. EG 7 is for Electromagnetic Environmental Effects (EEE, EMC in IEC terms).

EG 7 has selected the EEE standards used within the member states of the European Union, approximately 430, and made a preference list. The database with standards has been published in 2004.

This document gives recommendations on the use of EEE standards. The scope and limitations of those standards are given in Section 2. The standards for electromagnetic environmental effects are described in Section 3. The reduction process and the rationale for the comparison of standards are given in Section 4. The recommendations for best practice are given in Section 5. The results could be used in the acquisition process (by MoD) and development process (by industry) such that systems will be built faster, better and cheaper. Recommendations on the EEE standardisation process has been discussed in Section 6. Conclusion are given in Section 7.

2. Scope and limitations

The task of WS10-EG7 was to develop the European handbook of preferred EEE standards for defence applications. EG7 acknowledges that responsibility for further development of the chosen ‘prefered standards’ resides with the respective authority.

The military environment is sometimes more severe than the civilian, hence civilian EEE standards are not always appropriate for defence procurement. The handbook contains a mixture of military and civilan standards to be called upon as applicable.

EEE specifications are a compromise, a balance between cost and performance. In a highly complex system, it may prove impossible to achieve and proof total compatibility. In this case, the customer must decide which other compromises must be made.

Military organisations have prepared their specifications over many years, typically with limited, or no, consultation with industry. While all Nations could use the same specification if starting again with a zero base line, military equipment in service, and that already in design, will not necessarily be compatible with equipment designed to meet the "Handbook".

The time to design and develop military equipment and the in-service life give a combined total of up to 35 years. From this, it can be seen that the change from National Standard to European Handbook could have implications that extend for considerable number of years. That is, if the handbook is accepted today, the last piece of equipment manufactured under some other specification would finally be replaced in 35 years time.

For this reason, the military users need to manage the changeover so that any problems are minimised. However both military and the defence industry would like a quick transition to a common EEE requirement and a near future move to common test formats, preferably based on IEC basic standards to further reduce costs.

Overlap:
Expert group 7 has considered the electromagnetic environmental effects standards. A strong link in program management exists with EG 8, environmental engineering. In all other area’s links are possible. For example, radiation hazards with respect to fuel (HERF). This application is a so-called vertical standard, implying that EG 7 is responsible for the basic requirement, procedure and levels, while the actual vertical application is responsible for the typical use. No serious constraints in overlapping standards were observed.

Electromagnetic effects covered:
The electromagnetic effects covered are listed in Section 3.

Focus:
Numerous EEE standards exist and a detailed comparison is impossible. This activity was driven by economic arguments and therefore EG7 focused on standards enabling free trade. This has been discussed in detail in Section 4.

3. Standards for electromagnetic environmental effects

A survey on the economic impact of standards used has been carried out. The results showed that the most common EEE standards in use are:

1. US MIL-STD
2. National military standards in Europe: Def-Stan, VG and GAM
3. European Standards: EN, ETSI
4. STANAG and AP
5. International Electrotechnical Standards: IEC

Based on this survey the listing of most important phenomena and standards is given below:

Standards for equipment and subsystems:

Electromagnetic interference requirements and tests at equipment and (sub)system level:

- conducted phenomena (low frequency conducted, harmonics and inter-harmonics, voltage fluctuation, unbalance, dips and short supply interruptions, power frequency variation, DC components, transients, high frequency, ESD)
- radiated phenomena:
  - emission
  - susceptibility
  - transients (ESD)
  - DC magnetic field

Radiation hazards

- HERF
- HERO
- HERP

HIRF

Lightning

Lightning and nuclear EMP

Spectrum (emission) control (spurious, harmonics)

Power quality

Standards which are not yet mature:

System level

Engineering and guidance docs

Management, including system life cycle.

Classified standards (and not discussed) on:

Tempest

No standards on

High Power Microwaves (HPM)

Ultra Wide Band (UWB)

4. Reduction Process

Each Nation represented declared that, after National Standards, much of the defence industry finds that it is using United States MIL standards. This would be an obvious point of convergence for most, if not all, industry. However these are produced and maintained by the US and not by the European community. However, NATO Standards (STANAG) are a close representation of the MIL Standards and were agreeable to all present at the initial EG7 meeting.

Existing IEC based standards would allow more free trade at lower costs. However, such standards are changed and upgraded continuously via a 'democratic' voting structure and as such are not (yet) appropriate for professional equipment for military applications.
The scope of these IEC (EN) standards could be improved to cover the whole frequency spectrum. If a coherent framework of these standards, including emission standards, is effective, then military standards could be based on the same basic standards.
Until the structure and coverage of IEC (EN) standards has been improved, dedicated military standards must be in place and therefore NATO STANAGs have been taken as the basis for comparison against other standards, see Appendix B.

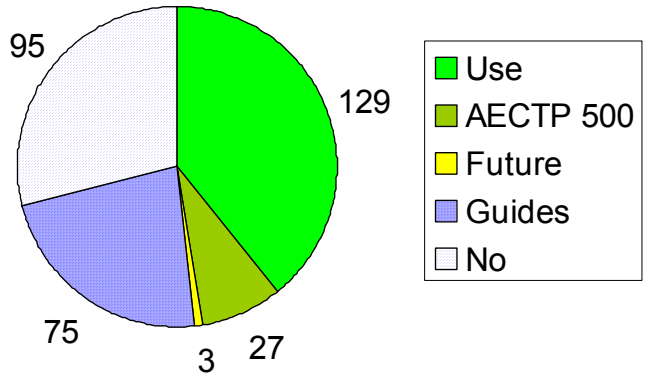
All EMC Standards are a matter of compromise between emissions and immunity requirements, size, weight, technical performance etc. The levels of performance required have been developed empirically, based on experience and so use a different basis for compromise. For this reason standards cannot withstand an in depth comparison against each other. Therefore the comparison is based on a first, high level, assessment.

The EEE standards from the initial handbook have been selected and two columns have been added:
Recommendation: with keywords

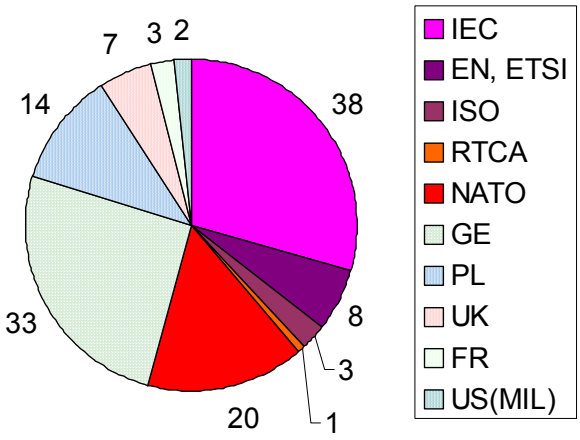
- AECTP 500: when the AECTP 500 has been published then it can be used instead of this standard.
- Use: recommended standard
- Guide: document can be used for guidance
- No: not recommended standard, obsolete
- Future: standards that we have confidence that are being produced, but are not published yet.

Comments: This gives additional information.

The reduction of EEE standards is depicted below



The number of Use standards are shown below.



The comparison of standards has been described in detail in Appendix C.

5. Recommendations for best practice

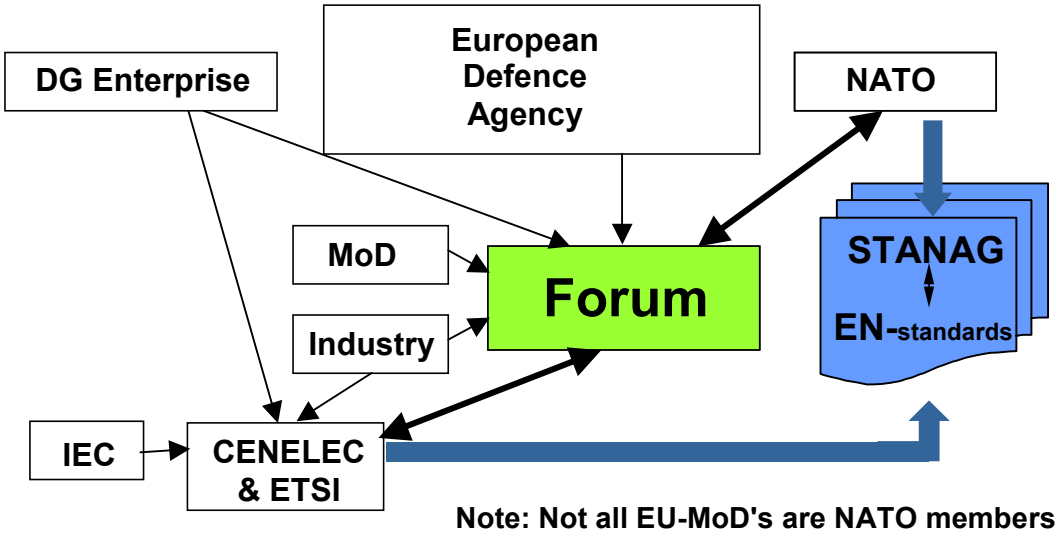
EG7 recommends the use of the prefered standards Electromagnetic Environmental Effects as listed in the Handbook, see Appendix D.

The use of international standards, STANAG included, shall be encouraged, while the use of national standards shall be discouraged.

6. Recommendations for standardisation process

EG7 recommends the following:

- Early publication of STANAG 4370 AECTP500 ed. 2
- The development of NATO STANAGs, to replace national standards.
- Extension of STANAG 4370 AECTP500 with the identified shortfalls
- Extension of STANAG 4370 AECTP500 with system level requirements
- Cooperation with European industry and non-NATO nations.
- WS10 should encourage the formation of the necessary forum to improve the cooperation with national MoDs and industry for greater harmonisation. A possible structure has been shown below.



- All standards must be freely available -preferably by the Internet- to end user.
- National Authorities take a pro-active approach to manage interference issues in co-operation with Spectrum Management activities (ITU and others) and a good working relationship with industry to provide economic solutions.

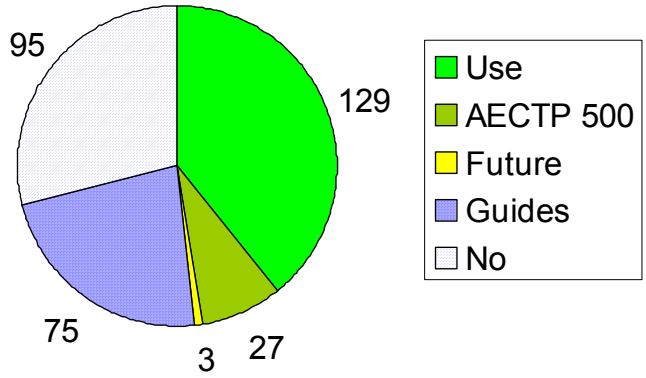
7. Conclusions

To achieve common European EMC standards, instead of the plethora of national standards, is a significant undertaking and will take some years to finalise. EG7 has accomplished significant steps towards this but continued improvements are dependant on other forums and authorities, see Section 6.

329 standards with relevance for the work of EG7 were found in the initial handbook and added references.

- A number of standards can be replaced by the recommended STANAG 4370 AECTP 500.
- Of the 'Use' category a significant number could be eliminated if the recommendations of this report are followed and are successful.
- Many standards are not recommended for use.
- Many standards are mostly for guidance.

as shown below



EG7 conclude that

- The scope and quality of IEC (based) standards is insufficent for military purposes except in environments similar to domestic or industrial.
- STANAGs must be used as the basis of harmonization of military standards. The low acceptance level of the STANAGs is a threat to this process. Guidance and support from WS10 is therefore needed and appreciated.

Agreements could be made regarding some vital areas of standardisation, see chapter 6.

Appendix A: Background information on EC activity since 1996

The European Commission (EC) published in 1996 a Communication on 'The Challenges Facing the European Defence-Related Industry, A Contribution for Action at European Level', and in 1997 on 'Implementing European Union Strategy on Defence-Related Industries', advocating the need for an urgent restructuring of the European defence industries and the creation of a single market for defence products. To support the implementation of this strategy the EC has launched an Action Plan for the defence-related industries. The Plan put forward by the Commission in that Communication describes fourteen areas in which immediate EU action is deemed necessary. Standardisation is one of these 14 areas for EU action. Then the EC awarded in 1998 a study to the University of Sussex to produce a comprehensive report on standardisation systems in the defence industries of the EU and the US. The Report describes the changing institutional framework of defence procurement and of defence and civil standardisation, evaluates US defence standards reform, and examines European requirements in defence standardisation. It identified problem areas and policy options to promote and facilitate the linking of civil and defence standardisation regimes. It stated '….We recommend that the Commission and the other relevant bodies undertake a bold initiative endorsed at the level of the Ministers of Defence in the Member States. We propose that the initiative should be a collaborative project to develop a European Handbook of Defence Standards and Standardisation Procedures - a 'living' document (preferably in electronic form) updated at regular intervals that sets out according to a common scheme all details of national defence standards regimes in Europe and their relationships to the defence procurement regimes of the Member States. The project should be co-ordinated by the Commission and WEAG (the Western European Armaments Group), with contributions from each country assembled under the supervision of the national armaments directors. We recommend also that as the handbook project progresses, close liaison be maintained with industry and the civil Standards Development Organizations, by including representatives from these constituencies on a project management board. The Handbook will be a crucial tool in achieving administrative transparency and in promoting the development of harmonised best practice…..'

The EC organized then in 2000 a conference on 'European Defence Procurement in the 21st Century: Improving Efficiency and Enhancing Competitiveness; the Role of Standardisation', recognising that standardisation is one of the facets to improve the competitiveness of the European Defence Industry. The conclusion of the University of Sussex report, the European Handbook of Defence Standards and Procedures was discussed.

The EC asked the European Committee for Standardisation (CEN) to facilitate this activity, and in 2001 the BT Working Group 125 (BT/WG 125 'Standardisation for Defence Procurement') was established. BT/WG 125 endorsed the setting up of CEN Workshop 10: Standardisation for Defence Procurement - European Handbook. This activity is sponsored by the EC.

(BT/WG 125 has recently endorsed the setting up of a new CEN Workshop on 'Network Enabled Abilities'. Information on this activity is attached to this message).

European Commissioner Erki Liikanen, from DG Enterprise, stated in his speech 'Remarks at the European Parliament on Defence Policy and Industry' to the European Parliament in april 2002, that:

'In the foreseeable future, two on-going processes make us feel confident that efficient solutions may soon be within reach:

- progress on ESDP(European Security and Defence Policy) paving the way for harmonising the demand in Europe for defence equipment and in parallel;

- the gradual recognition of the need to harmonise the rules and regulations which affect the competitiveness of the industries, once restructured'

The Commission's communication of 3 november 2003 on 'European Defence - industrial and market issues - Towards an EU Defence Equipment Policy', stressed the urgency and importance of action in standardisation:

'…..the EC Communication therefore proposes action in the following fields: (such as)

• Standardisation: Stakeholders recognise the need for harmonised European approach to defence standardisation. The Commission is working on this issue with CEN to assist co-operation between Ministries of Defence and industry to develop, by the end of 2004, a handbook cataloguing standards commonly used for defence procurement.
...

While work on standardisation of defence equipment is largely a technical matter, it is an important precondition for the opening-up of national markets and the gradual establishment of a single European market. Both manufacturers and public authorities (Ministries of Defence - MoDs) will benefit from a common reference regarding standards elaborated in consistency with NATO works. It will help to enhance cost efficiency and interoperability. That necessity has been recognised by all those stakeholders who are participating on a voluntary basis in the development of a "Defence Standardisation Handbook". It will contain references to standards and standard-like specifications commonly used to support defence procurement contracts as well as guidelines on the optimum selection of such standards.

The action currently under way with the participation of the MoDs and industry and with the assistance of CEN is funded under the framework contract for standardisation of 1998. The Commission will ensure that the European Handbook is ready in its initial phase by the end of 2003 and in a first operational version around the end of 2004.

The next phase should be to give formal status to the Handbook so that, once approved in terms of content, its use will be systematic in defence procurement contracts. The Commission would then propose appropriate complementary measures to ensure the upkeep of the Handbook and its use…….'

Appendix B: Limitations of EN and IEC standards with respect to military applications

The world-wide International Electrotechnical Committee (IEC) is structured in technical product committees (TCs). CENELEC TC's are mirror groups of IEC TC's.
The European Union's EMC Directive of 1989, has led to many new European (EN) standards which are derived from IEC standards.
The structure is described in CENELEC Guide number. 24, and should be

- Basic EMC standards
  Definition, description of phenomenon, detailed test and measurement method (often table top and floor standing EUT), test instrumentation and basic test set up
- Generic EMC standards
  A set of precise EMC requirements, including limits, to indicate which basic tests are applicable to those products intended to be used in a given environment. Only 2 environments are given: residential and industry. The generic standards were seen as an interim measure, because product committees expect that only product standards would exist in the future. They forgot that rapid technology changes outpace the production of product standards.
- Product and product family standards
  Similar as generic, but typical product-specific elements are added. Some TCs however generate complete other EMC standards…

Type	Contents	Aims
BASIC (*)	- Measurement and test methods - Instrumentation - Test set-up - Ranges of test levels (immunity) - No limits/No performance criteria	- Reference documents - No conformance testing of products (Not published in the OJEC list)
GENERIC	- Precise and essential requirements (limits) for all products intended for use in each environment i.e. residential, commercial, light industry and industry -Refer to basic standards for measurement/test methods (no repetition) - General performance criteria	- Conformance testing of products (Published in the OJEC list) - Co-ordination tool for product (family) standards
PRODUCT-FAMILY	- EMC requirements for product-families - More detailed performance criteria - Specific test set-up etc. - Refer to basic standards for measurements/tests (no repetition)	- Conformance testing of products (Published in the OJEC list). - Precedence over generic standards but to be co-ordinated with them.
DEDICATED PRODUCT	- Same as for product-family but more specific.	- Same as for product-family but more specific. - Generally not needed for emission

Due to lack of time (or slow standardisation process) this failed partly; For example, the basic standard for residential environments was taken from the ITE equipment emission standard.

The product committees continue in creating standards not related to the EMC directive structure, making use of the confusion and their power by generating product standards. Note that IEC/CENELEC is organised in technical product committees.
Examples:

- TC72, control equipment:
  IEC 60730, several, such as for water valves, energy regulators, sensors
- TC.., medical equipment
  EMC standards on Hearing aids, Surgical equipment, X-ray equipment, Etc.

Table 1
(Non exhaustive table)

Families of products	Standards covering the protection EMC requirements			
	Emission			Immunity
	Harmonics	Voltage fluctuations	Radio-interference	(All aspects)
1) Household appliances and portable tools (motor-driven such as vacuum cleaners, washing machines etc; heating and cooking appliances, etc.)	EN 61000-3-2	EN 61000-3-3	EN 55014-1 (1)	EN 55014-2
2) Lighting equipment	EN 61000-3-2	EN 61000-3-3	EN 55015	EN 61547
3) TV receivers and audio equipment	EN 61000-3-2	EN 61000-3-3	EN 55013	EN 55020
4) Professional audio, video and entertainment lighting control equipment	EN 55103 (ref to EN 61000-3-2)	EN 55103 (ref to EN 61000-3-3)	EN 55103-1	EN 55103-2
5) Information Technology (I.T.) equipment	EN 61000-3-2 (2)	EN 61000-3-3 (2)	EN 55022	EN 55024
6) Mains signalling equipment	-	-	EN 50065-1	EN 50082-1 (3)
7) ISM equipment	EN 61000-3-2 (2)	EN 61000-3-3 (2)	EN 55011	EN 50082-2
8) Industrial equipment in general	- (4)	- (4)	EN 50081-2 (8)	EN 50082-2
9) Static watt-hour meters (Cl. 1 and 2)	-	-	EN 61036	EN 61036
10) Static watt-hour meters (Cl. 0,2 and 0,5)	-	-	EN 60687	EN 60687
11) Electronic ripple control receivers	-	-	EN 61037	EN 61037
12) Time switches for tariff and load control	-	-	EN 61038	EN 61038
13) Marine navigational equipment	-	-	EN 60945	EN 60945
14) Automatic electrical controls for household and similar use (7)	EN 61000-3-2	EN 61000-3-3	EN 60730-1 **and -x** (5)	EN 60730-1 **and -x** (5)
15) Household electronic switches for fixed installations (7)	EN 60669-2-1 (ref. to EN 61000-3-2)	EN 60669-2-1 (ref. to EN 61000-3-3)	EN 60669-2-1	EN 60669-2-1
16) Induction watt-hour meters	-	-	-	EN 60521
17) Programmable controllers (industry)	-	-	EN 50081-2 (8)	EN 61131-2
18) Low-voltage switchgear and controlgear (7)	-	-	EN 60947-1 **and-x** (6)	EN 60947-1 **and-x** (6)
20) Alarm systems	EN 61000-3-2-	EN 61000-3-3-	EN 50081-1	EN 50130-4
21) Uninterruptible power systems (UPS)	EN 50091-2 (ref. to EN 61000-3-2)	EN 50091-2 (ref. to EN 61000-3-3)	EN 50091-2	EN 50091-2
22) Arc welding equipment	EN 50199 (ref. to EN 61000-3-2)	EN 50199 (ref. to EN 61000-3-3)	EN 50199	EN 50199
23) Residual current operated protective devices for household use	-	-	EN 61543	EN 61543
24) Adjustable speed power drives	EN 61800-3 (ref. to EN 61000-3-2) (4)	EN 61800-3 (ref. to EN 61000-3 3)- (4)	EN 61800-3	EN 61800-3
25) Radio-communication equipment	EN61000-3-2 (2)	EN 61000-3-3 (2)	See ETSI relevant standards	See ETSI relevant standards

Another source of EMC standards is <u>product</u> directives such as automotive, toys, agricultural machines that include EMC requirements.

Actually a Framework is needed where

- Basic (test) standards are related to the electromagnetic phenomenon
- Generic standards related to environments (application area)

i.e. a horizontal approach
This is the case for immunity (susceptibility) standards, but not (yet) for emission standards.

The structure for the immunity standards is given below:

IEC 1000 structure	
Part 1: General	General considerations (introduction, fundamental principles)
	Definitions, terminology
Part 2: Environment	Description of the environment
	Classification of the environment
	Compatibility levels
Part 3: Limits	Emission limits
	Susceptibility limits
Part 4: Testing and measurement techniques	Measurement techniques
	Testing techniques
Part 5: Installation and mitigation guidelines	Installation guidelines
	Mitigation methods and devices
Part 9: Miscellaneous	

At present, relevant reference standards for the following environmental phenomena exist:

	IEC
Electrostatic discharge (ESD)	IEC 61000-4-2
Radio-frequency electromagnetic field	IEC 61000-4-3
Electrical fast transients/burst	IEC 61000-4-4
Surges	IEC 61000-4-5
Conducted high frequency disturbances	IEC 61000-4-6
Power-frequency magnetic fields	IEC 61000-4-8
Pulse magnetic fields	IEC 61000-4-9
Damped oscillatory magnetic fields	IEC 61000-4-10
Voltage variations, dips and interruptions	IEC 61000-4-11
Oscillatory waves	IEC 61000-4-12
Voltage fluctuations	IEC 61000-4-14
Conducted low-frequency disturbances	IEC 61000-4-16
Low-frequency disturbances	
TEM cell testing	IEC 61000-4-20
Reverberation chamber testing	IEC 61000-4-21

environments \ **products**	**Television and audio**	**Alarm systems**	**Handheld tools**	**Lighting**	**ITE**	**Frequency converters**	**X-ray equipment**	**Sensors**	**Hearing aids**	**Surgical equipment**	**Energy meters**	**Professional audio**	**Water valves**	**Alarm systems**	**Arc welding**	**Supplies**	**Program. controllers**	**etc.**	**etc.**
landbased	**in national MIL standards, in STANAG**																		
air																			
naval																			
space																			
office	**In EMC Directive: generic (environment based) and many product standards**																		
home																			
light industry																			
heavy industry																			
hospital	**partly in medical devices directive**																		
automotive	**in automotive directive**																		
air (civil)	**in RTCA-DO**																		
railway																			
(N)power plant																			
etcetera																			

Appendix C: Comparison of standards

The following STANAGs are selected by EG7 as reference standards:

- STANAG 4370: AECTP 200 series, for description of environments
- STANAG 4370, AECTP 500 series, for equipment level testing
- STANAG 1397 for RadHaz classification of munitions and weapons
- STANAG 4236/4327, for lightning and weapon systems
- STANAG 4560 & AOP43, for EEDs

The rationale for this selection has been given in the report.

Comparison for EMI test standards

The STANAG 4370 AECTP500 is the most important standard for equipment requirements. A comparison with national equipment level testing standards is given in the Table below.

NATO	France	Germany	Poland			United Kingdom	United States	IEC/EN
AECTP 500	GAM EG13	VG 95373	NO-06-A200:1998	NO-06-A500:1998	PN-V-8410:2002	DEF-STAN 59-41	MIL-STD 461E	Various
NCE01	62C1	LA01	KCE-01	PCE-01	NCE01	DCE01.3	CE101	EN 61000-3-2, but NC
NCE02	62C2	LA02	KCE-02	PCE-02	NCE02	DCE01.3	CE102	EN 55022 etc, NC
NCE03	NE	NE	KCE-03	PCE-03	NE	NE	= CE106	ETSI product standards
NCE04	NE	LA03	NE	NE	NE	= DCE03.3	NE	NE
NCE05	62C3	LA01	NE	NE	NE	= DCE02.3	NE	EN 55022, absorbing clamp, etc., NC
NCS01	63C1	LF01	KCS-01	PCS-01	NCS01	DSC01.3	= CS101	61000-4-11 etc, NC
NCS02	63C2	LF02	KCS-02	PCS-02	NCS02	= DSC03.3	NE	
NCS03	NE	NE	KCS-03	PCS-03	NCS03	NE	= CS103	ETSI product standards
NCS04	NE	NE	KCS-04	PCS-04	NCS04	NE	= CS104	ETSI product standards
NCS05	NE	NE	KCS-05	PCS-05	NE	NE	= CS105	ETSI product standards
NCS06	NE	LF06	KCS-06	PCS-06	NE	NE	= CS109	
NCS07	63C3	LF06	KCS-07	PCS-07	NE	check	= CS114	EN 61000-4-6, differences
NCS08	63C4	LF03, LF04	KCS-08	PCS-08	NE	check	= CS115	
NCS09	NE	NE	NE	NE	NE	check	= CS116	
NCS10	NE	NE	NE	NE	NE	= DSC09.3	NE	
NCS11	NE	NE	NE	NE	NE	= DCS12.3	NE	
NCS12	NE	LF05	NE	NE	NE	= DCS10.3	NE	IEC 61000-4-2
NRE01	62R1	SA01	KRE-01	PKE-01	NRE01	~ DRE02.3	= RE101	IEC-CISPR15, NC
	62R2	SA02	NE	NE	NE			
NRE02	62R3	SA03, SA04, SA05	KRE-02	PRE-02	NRE02	~ DRE01.3	= RE102	EN 61000-6-4 > EN 55011, NC
NRE03	NE	NE	KRE-03	PRE-03	NE	NE	= RE103	NE
NRS01	63R1	SF01	KRS-01	PRS-01	NRS01	DRS01.3	= RS101	EN 61000-6-1 > EN 61000-4-8, 9, 10, NC
	63R2	SF02						
NRS02	63R3	SF03, SF04, SF05	KRS-02	PRS-02	NRS02	DRS02.3	= RS103	EN 61000-6-1 > EN 61000-4-3, EN 61000-4-6, NC
NRS03	national adaptions	NE	KRS-03	PRS-03	NE	national adaptions	= RS105	IEC 61000-4-25, but not equal
NRS04	NE	NE	NE	NE	NE	= DRS03.3	= 1399 070/2036A	EN 61000-6-1 > EN 61000-4-8, NC

NE: No Equivalent
NC: Not Comparable (IEC)

Brief comparison between the STANAG 4370, AECTP 500, and MIL-STD 461E:
Test added for Conducted emission test for signal & power lines up to 150 MHz
Test added for Conducted emission transient test
Test added for LF conducted susceptibility test
Test added for ESD (susceptibility) test
Test added for Aircraft equipment susceptibility test for lightning.
Test added for Ship/sub system susceptibility test for transients.
Test added for Ship magnetic field test for degaussing fields.

Comparison for electrostatic discharge

The comparison is given in the table below.

Comparison of STANAG 4239/ 4235; AOP 24; AECTP 500; EN61000 -4-2 ; and VG 95378/11 Other standards (e.g. IEC, MIL) are not considered, because of their limited use.					
	VG 95378/11 Prove of immunity to disturbance towards EED against ESD	STANAG 4239 Munition Test Procedure, Limits are defined in STANAG 4235	AOP 24 Test Procedure, STANAG 4239 refers to AOP 24	AECTP 500 NSC12 For Munitions testing the test levels and methods in STANAGs 4235 and 4239 shall be applied.	EN 61000-4-2 (IEC) Testing and Measurement technique – ESD Test
Voltage	25 kV	25 kV, 300 kV, see table 2 20, 15, 10, 5; 250, 200, 150, 100, 50, 25		2, 4, 6, 8, 15 kV	2, 4, 6, 8, 15, XkV
Capacitor	500 pF ± 5%	500 pF ± 5%; 1000 pF ± 5%	500 pF ± 5%; 1000 pF ± 5%	150 pF ± 10%	150 pF
Discharge Resistor	5 kΩ ± 5%	500 Ω; 5 kΩ ± 5%, 1 Ω	500 Ω; 5 kΩ ± 5%, 1 Ω	330 Ω ± 10%	330 Ω
Discharge inductance	Defined by pulse shape calibration	< 5 µH; < 20 µH	< 5 µH; < 20 µH		Defined by pulse shape calibration
Measure adapter	2 Ω ± 2 %	1 Ω	1 Ω	2 Ω ± 2 %	2 Ω
Test	Pin to case and both pins shortened and to case	Air and contact discharge	Air and contact discharge	Air and contact discharge	Air and contact discharge
Polarity	Positive and negative	Positive and negative	Positive and negative	Positive and negative	Positive and negative
Record bridge resistance	Record bridge resistance, before and after test			-	
Number of Samples/ EED	10	See AOP 24	Confidence level defined	See AOP 24	N/A
Number of Test pulses/ Test sequences	5 per Connection	20		20	10
Data Acquisition	75 MHz	100 MHz	100 MHz	1 GHZ	1 GHZ
Calibration	before, during, after	before and after	before and after	Before	periodic

The discharge voltage limits are 2, 4, 6, 8 and 15 kV. For munitions testing the test levels and methods in STANAGs 4235 and 4239 shall be applied. The levels there are 25kV and 300kV. The higher level is only for helicopter borne threat.

AECTP-500(NCS12) Edition 2, is recommended for this purpose, because of it's applicability to military testing and wide coverage.

Comparison for lightning

The result of the discussion is to recommend that the following standards for Lightning effects evaluation on weapon systems be categorized as:

a) first rank standards:
- STANAG 4236 edition 2 : Lightning environment
- STANAG 4327 edition 2 : Lightning, munition assessment and test procedures
- AOP 25 : Rationale and guidance for 4327.
- These standards should have to be in the part "Systems" of AECTP 500 which remains yet to write.

b) second rank standards (for commercial aircraft but very common in the European defense world):
- EUROCAE ED 91: Lightning Zoning
- EUROCAE ED 84: Lightning Environment (as support when STANAG 4236 is deemed too much severe)
- DO 160 SECTION 22 : Lightning Indirect effects testing on equipment
- DO 160 SECTION 23 : Lightning Direct Effects testing

The standards selected for the handbook are for weapon systems and munition. They are not addressing buildings or any installation. For that reason the standards applying to the design of protection of buildings, for example BS 6551, is not included.

Comparison for radiation hazards

HERF
There is not a specific military standard on HERF. Some HERF protection procedures are included in STANAG 1380.

HERO
It was agreed that to day there are several standards for the requirements that are need in the HERO domain.
The main requirements for an HERO standard should be:
- the definition of the environment to comply with
- the definition of the best measurement system to be used in order to avoid disturbances and false results
- the definition of the safety margins
- the definition of the tests to be conducted on EEDs with different electromagnetic waveshapes (Pulse waves for example)
- the definition of the tests to be conducted on the safety electronic systems (arming safety electronic units) associated with EEDs.

The result of the discussion is to recommend that the following standards for HERO evaluation on weapon systems be categorized as:

a) first rank standard now and main standard in the future:
- STANAG 4324: Em radiation hazard assessment and testing of munitions and associated systems
- STANAG 1380 AECP-2 : NATO Naval radio and radar radiation Hazards manual (to be extended to the three services in the future)
- STANAG 4560: EEDs, assessment and test methods for characterization
- AOP 43 EEDs assessment and test methods for characterization; guide for 4560

- STANAG 4238 Munition Design Principles, Electrical/Electromagnetic Environments

The result of the discussion is that, because almost these standards are addressing the safety regulations criteria it seems necessary to keep them as they are and no to include them in AECTP 500 and particularly in the part "Systems " which remains again to write.
Work should have to be conducted later in the future by NATO countries in order to reduce the number of these standards to one or two STANAGS.

b) second rank standards:
   - VG 95 378 : EMC characteristics of EEDs (no fire threshold, thermal time constant,etc..)
   - VG 95 379 : EMC testing of EEDS inside systems
   - GAM DRAM 01: General specification for EEDs and their integration in munitions and weapon systems used in an electromagnetic environment
   - GAM DRAM 02: Safety requirements to implement in electromagnetic environment for systems and munitions embodying EEDs

   It is proposed that European nations use the first rank standards shown above and where there is a need for some specific requirements they may use their own standard (second rank standard) as fall back solution.

HERP
Covered under the European Recommendation from 1999 and the new European Directive from april 2004, and thus a legal issues

Comparison for lightning and nuclear EMP

The difference between lightning and nuclear EMP comes mainly from the shape of the pulse. The N-EMP frequency spectrum is much broader and is going in frequency, upto RF, compared to the L-EMP. The energy of the L-EMP is much higher than the N-EMP. The military N-EMP are classified.

Comparison for HIRF

The maximum levels which may be encountered are collected in STANAG 1307 ed. 2. and MIL-STD 464A. STANAG 4234 gives only EM environment for a design criteria.
MIL-STD 464A gives levels for every environment.
In the future this subject shall be covered by STANAG 4370 AECTP 200

Appendix D: Handbook

See excel database in electronic format