Presentation of the CEN WS 10 EG7 ([1]) recommendations for "Electromagnetic environment" standardisation

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Abstract
The European Commission (EC) seek to reach the competitiveness of the European Defence Industry. The fullness of (national) standards, more than 10.000, is recognised by EC as a major constraint and cost driver.
Electromagnetic Compatibility (EMC) and more generally Electromagnetic Environmental Effects (E3) have been considered by EC as a major topic, with 7 other topics such as NBC detectors, energetic materials, fuels and lubricants, batteries, packaging, electrical and mechanical interfaces, and environmental testing.
An E3 expert group (called Expert group 7 or EG7) with representatives from industry and national Ministries of Defence rationalised in 2004 a list of 329 E3 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 E3 Expert Group (EG7) concluded;
- that no one standard is better or worse than another in achieving the end goal
- differences are not sufficient to prevent the use of STANAG 4370 (AECTP 500)
- there are sufficient similarities to AECTP 500 to adopt this as the fundamental replacement standard.
- there is 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 paper, based on the reference (1) report, presents the work conducted by EG7 focusing on its recommendations on the use of E3 standards, and on the constraints with respect to the standardisation process of National MoD's, NATO, Industry and EN/IEC.

Table of content

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

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. Eight Expert Groups (EG) have been established in 2004 and EG 7 addresses the Electromagnetic Environmental Effects (E3).

EG 7 ([2]) has selected the E3 standards used within the member states of the European Union, approximately 430, and made a preference list. This database with standards has been published in 2004.

This paper presents and summarises the results of the work conducted by EG7 and the main recommendations of this group for the use of E3 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 E3 standardisation process has been discussed in Section 6. Conclusions are given in Section 7.

2. SCOPE AND LIMITATIONS OF THE EG 7 TASK

The task of WS10-EG7 was to develop the European handbook of preferred EEE standards for defence applications but the responsibility for further development of the chosen 'preferred 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 civilian standards to be called upon as applicable.

E3 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.
The electromagnetic effects covered by EG7 are listed in the following Section 3.

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-Stand (UK) , VG (GE) and GAM (FR)
3. European Standards: EN, ETSI
4. STANAG and AP
5. International Electrotechnical Standards: IEC

[2] The member list of EG 7 is given in annex C.

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

a) <u>Standards for equipment and subsystems</u>
- Electromagnetic interference requirements and tests at equipment and sub-system level:
  - conducted phenomena [3];
  - radiated phenomena (emission, susceptibility, transients (ESD), DC magnetic field)
- Radiation hazards (HERF, HERO, HERP)
- HIRF
- Lightning and nuclear EMP
- Spectrum (emission) control (spurious, harmonics)
- Power quality

b) <u>Standards which are not yet mature</u>
- System level
- Engineering and guidance documents
- Management, including system life cycle.

c) <u>No standards[4] on</u>
High Power Microwaves (HPM)
Ultra Wide Band (UWB)

4. REDUCTION PROCESS

Each Nation represented in EG7 agreed that, after National Standards, much of the defence industry uses United States MIL standards. This would be an obvious point of convergence for most, if not all, for 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 many EG7 experts.

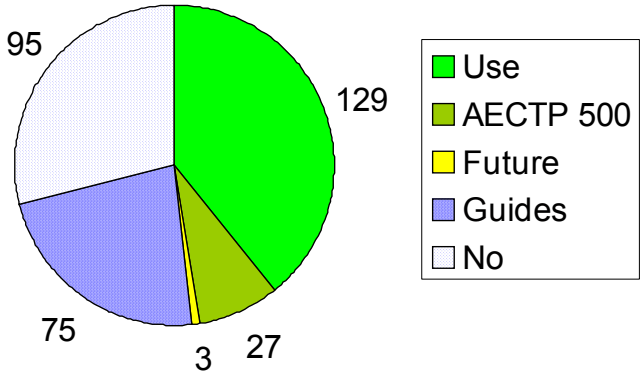
Existing IEC based standards would allow more free trade at lower costs. However, such standards are changed and upgraded continuously via a 'democratic' voting structure and as such are not (yet) appropriate for professional equipment for military applications.
The scope of these IEC (EN) standards 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 STANAGs have been taken as the basis for comparison against other standards, see Annex A.

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. To make the selection two columns of the E3 Standards handbook have been selected in order to give recommendations with the following keywords:

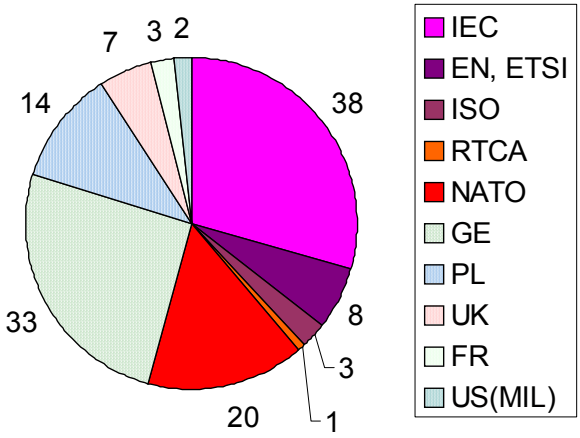
- AECTP 500: *when published then it may be used instead of the indicated standard.*
- Use: *recommended standard*
- Guide: *document which may be used for guidance*
- No: *not recommended standard, obsolete*
- Future: standards that EG7 have confidence that are being produced, but are not published yet.

The reduction of E3 standards is depicted below

[3] Low frequency conducted, harmonics and inter-harmonics, voltage fluctuation, unbalance, dips and short supply interruptions, power frequency variation, DC components, transients, high frequency, ESD.
[4] TEMPEST Standards have not been addressed because they are classified.



The number of Use standards, and AECTP500, are shown below.



The comparison of standards has been described in detail in annex B.

5. RECOMMENDATIONS OF EG7 FOR BEST PRACTICE

EG7 recommends the use of the preferred standards Electromagnetic Environmental Effects as listed in the European Handbook (EG7 April 2005 version file). This EXCEL file (reference 2) may be acceded through the AFNOR website (**http://comelec.afnor.fr/cen/ws_def_proc**) after compliance with authorisation access (login and password needed and have to be required to AFNOR). The first table lines of this file are presented in annex D. This handbook contains 63 pages.

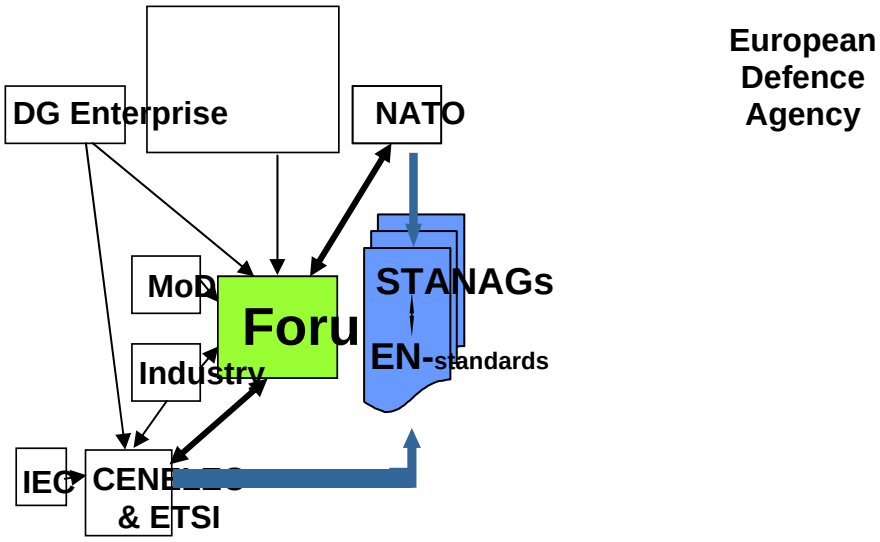
The use of international standards, STANAG included, shall be encouraged, while the use of national standards shall be discouraged.

6. RECOMMENDATIONS FOR STANDARDISATION PROCESS

EG7 recommends the following :

- early publication of STANAG 4370 AECTP 500 ed. 2
- development of STANAGs, to replace national standards.
- extension of STANAG 4370 AECTP 500 with the identified shortfalls
- extension of STANAG 4370 AECTP 500 with system level requirements

- been 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 harmonization. A possible structure has shown below.



Note : Not all EU-MoD's are NATO members

- 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.

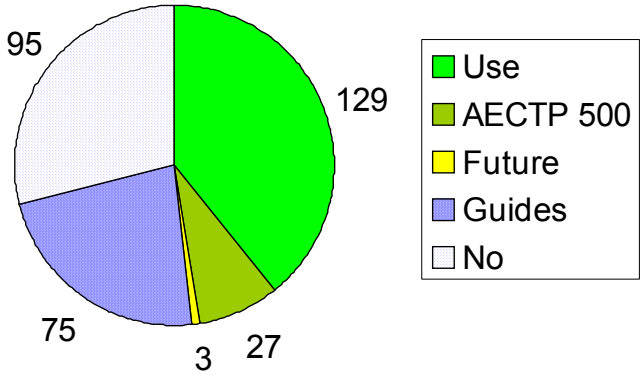
7. CONCLUSIONS

a) 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 defined in Section 6.

b) 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.
- a significant number of standards could be eliminated from the 'Use' category if the recommendations of this report were followed.
- many standards are not recommended for use.
- many standards are mostly for guidance.

as shown below :



c) EG7 conclude that :

- the scope and quality of IEC (based) standards is insufficient 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 STANAGs is a threat to this process. Guidance and support from WS10 therefore needed and appreciated.
- agreements could be made regarding some vital areas of standardisation, as described in § 6.

8. REFERENCES

(1) CEN/ WS 10/EG7/N051 June 2005 Report from the WS10 Expert Group 7
(2) N050_EG7_EMC Hdbk final (electronic file containing the list of preferred standards with comments and recommendations of EG7)

Annex A

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[5].

[5] Note that IEC/CENELEC is organised in technical product committees. For example:
- TC72, control equipment (IEC 60730, several, such as for water valves, energy regulators, sensors)
- TCXY, 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

Other source of EMC standards are product 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																			

Annex B

Comparison of standards

The following STANAGs have been 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 AECTP 500 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 categorised as:

a) **first rank standards**:
- STANAG 4236 edition 2 : Lightning environment
- STANAG 4327 edition 2 : Lightning, munitions 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) sec**ond rank standards** (for commercial aircraft but very common in the European defence 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 munitions. 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 wave shapes (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 categorised 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 characterisation
- AOP 43 EEDs assessment and test methods for characterisation; guide for 4560
- STANAG 4238 Munitions 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 95378: EMC characteristics of EEDs (no fire threshold, thermal time constant)
- VG 95379 : 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, up to 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 250

Annex C

List of the WS10 Expert Group 7 members

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Annex D

PRESENTATION OF THE 11 FIRST LINES OF THE EUROPEAN HDBK TABLE (only for example)

ID	Comments	Recommendation	Nation	Standard reference	Title (original language)	Title (English)	Keywords
1	Guide	No	NATO	AEP-09 3 - VOL V	NATO MANUAL OF SIMULATORS OF NUCLEAR WEAPONS EFFECTS - SIMULATORS OF ELECTROMAGNETIC PULSE (EMP) EFFECTS	NATO MANUAL OF SIMULATORS OF NUCLEAR WEAPONS EFFECTS - SIMULATORS OF ELECTROMAGNETIC PULSE (EMP) EFFECTS	
3	Guide	No	NATO	STANAG 3856 and AEP 29	PROTECTION OF AIRCRAFT, CREW AND SUB-SYSTEMS IN FLIGHT AGAINST THE EFFECTS OF ELECTROSTATIC CHARGES	PROTECTION OF AIRCRAFT, CREW AND SUB-SYSTEMS IN FLIGHT AGAINST THE EFFECTS OF ELECTROSTATIC CHARGES	
4	GUIDE OBSOLETE Replaced by SDIP29	No	NATO	AMSG 719	Installation of Electrical Equipment for the Processing of Classified Information	Installation of Electrical Equipment for the Processing of Classified Information	
5	OBSOLETE Replaced by SDIP27 - Equivalent to BTR/01/204(4)	No	NATO	AMSG 720	Compromising Emanations Laboratory Test Standard	Compromising Emanations Laboratory Test Standard	
6	OBSOLETE Replaced by SDIP27 - Equivalent to BTR/01/204(2)	No	NATO	AMSG 784 Vol 1	Laboratory Test Standard for Tactical Mobile Equipment Systems	Laboratory Test Standard for Tactical Mobile Equipment Systems	
7	OBSOLETE Replaced by SDIP27	No	NATO	AMSG 784 Vol 2	Test procedures for Tactical Mobile Platforms	Test procedures for Tactical Mobile Platforms	
8	OBSOLETE Replaced by SDIP27 - Equivalent to BTR/01/210	No	NATO	AMSG 788	Compromising Emanations Laboratory Test Standard for Protected Facility Equipment	Compromising Emanations Laboratory Test Standard for Protected Facility Equipment	
9		Guide	NATO	ANEP-45 Ed 1	ELECTRO-MAGNETIC COMPATIBILITY (EMC) IN GLASS REINFORCED PLASTIC (GRP) VESSELS	ELECTRO-MAGNETIC COMPATIBILITY (EMC) IN GLASS REINFORCED PLASTIC (GRP) VESSELS	
10	GUIDE Has never existed	No	NATO	AOP-23	DESIGN GUIDELINES AND ASSESSMENT PROCEDURES FOR HARDENING MUNITIONS AGAINST ELECTROMAGNETIC ENVIRONMENT	DESIGN GUIDELINES AND ASSESSMENT PROCEDURES FOR HARDENING MUNITIONS AGAINST ELECTROMAGNETIC ENVIRONMENT	
11	GUIDE Limited to lightning definitions STANAG 4236 & 4327	No	NATO	AOP-38	Glossaire de termes et définitions sur la sécurité et l'aptitude au service des munitions, matičres explosives et produits associés	Glossary of terms and definitions concerning the safety and suitability for service of munitions, explosives and related products	
12		Guide	FR	ARINC 609		Design guidance for aircraft electrical power systems	
	Not on AAP4 NATO						