The Benefits of Harmonising Airworthiness Certification Criteria to Achieve Recognition of Certification (EMACC, UASs STANAGs)

Lt.Col. GArn Alessio GRASSO
Italian MoD - DAA Vice Technical Direction
Alessio.grasso@am.difesa.it
+39 06 4986 6812

Larnaca (Cyprus), 27 September 2012
To provide examples of successful harmonisation activities in the field of airworthiness

To “Socialize” these products that some of you may not be aware of
Harmonisation processes in the field of military airworthiness

Case Studies

- EMACC
- STANAG 4761, 4702, 4703
The Concept of Harmonisation in the field of Airworthiness of Military Aircrafts
The operational environment and the mission profiles are limited and almost always the same

Airworthiness is regulated by law e.g. CS 25 / FAR 25
Military aircrafts are characterized by great variety of:
- operational environments
- mission profiles
- new technology (evolving rapidly)

Performance requirements are in the CONTRACT
Airworthiness is done by the same CONTRACT setting performance requirements

The mission requirements are as important as airworthiness when providing the requested military capability.

The benefits for the State are related both to military aircrafts performances as well as their safety.
INTRODUCTION

Performance and airworthiness requirements are intercorrelated

=> TAILORING IS THE BEST PROCESS IN MILITARY WORLD
INTRODUCTION

MILITARY AUTHORITIES PROCESSES

CIVIL AUTHORITIES PROCESSES

HARMONISE WHEN APPLICABLE

MILITARY TECHNOLOGIES
Military background in airworthiness

CIVIL TECHNOLOGIES
Civil background in airworthiness

Potential advantage not only for Authorities but also for Aerospace Industry
In the field of military airworthiness, a lot of resources are being spent in harmonisation initiatives within EU (EDA), NATO and US Services.

**! SHARE EXPERIENCE AND HARMONIZE !**
(trying to avoid redundances when feasible)

Potential advantage not only for Authorities but also for Aerospace Industry
THE EXAMPLE
OF
EMACC
(European Military Airworthiness Certification Criteria)
Under MAWA, a specific Task Force (TF4) is established to produce harmonised European Military Airworthiness Certification Criteria (EMACC).

EMACC is an European handbook detailing technical military airworthiness certification criteria, intended to be used to tailor the airworthiness basis for Military Type Certification activity.
EMAAC is NOT intended to be a Certification Specification containing the specific quantitative REQUIREMENTs to which the product is to be certified.

EMACC provides
1. a complete set of airworthiness criteria to be considered (like an airworthiness checklist)
2. a complete sources list of state of the art rules and standards applicable to each criterion
3. an expanded text harmonized among previous standards to help in the tailoring process of defining quantitative airworthiness requirements
THE EXAMPLE OF EMACC

MILITARY USAGE

MISSION

CRITERIA

TAILORING PROCESS

NEW MILITARY AIRCRAFT
(Tailoring using criteria from within EMACC handbook, e.g. Harmonised text, STANAG, DEFSTAN, JSSG)

EMACC

LEGACY AIRCRAFT
(Tailoring based on existing certification basis, with equivalence across national standards captured by harmonised text in EMACC handbook)

NEW CIVIL DERIVATIVE AIRCRAFT
(Tailoring using criteria from within EMACC handbook, e.g. EASA CS + Military specific harmonised text)

REQUIREMENT

CERTIFICATION BASIS

Step 0

Step 1

Step 2

Step 3
Approach in two steps

- Starting point:
  MIL-HDBK-516B Change 1

- DOORs database with existing 516B criteria, US DoD/Mil and FAA cross-references

STEP 1

- Adding cross-references to European and NATO documents where equivalence is deemed possible:
  - Def Stan 00-970
  - STANAGs
  - EASA CSs
STEP 2: Harmonisation among different standards
### 5.4. DAMAGE TOLERANCE AND DURABILITY (FATIGUE).

5.4.1 Verify that all safety-of-flight (SOF) structure, including dynamic components, have adequate safe life or damage tolerance capability (depending on certification authority) for the required service life.

<table>
<thead>
<tr>
<th>Comm1 Doc:</th>
<th>US Cross References</th>
<th>European Cross References</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoD/MIL Doc:</td>
<td>JSSG-2009: A.3.12 Damage Tolerance, pg 398</td>
<td>Def-Stan 00-970 Reference:</td>
</tr>
<tr>
<td></td>
<td>JSSG-2009: A 4.12 Damage Tolerance, pg 400 (for compliance development)</td>
<td>00-970 3.2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>00-970 Part 1 Sec 3.3.2.2</td>
</tr>
<tr>
<td>STANAG Reference:</td>
<td></td>
<td>00-970 Part 1 Sec 3.3.2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>00-970 Part 1 Sec 3.3.2.9</td>
</tr>
<tr>
<td>FAA Doc:</td>
<td>14CFR reference:</td>
<td>00-970 Part 1 Sec 3.3.2.10</td>
</tr>
<tr>
<td></td>
<td>23.571, 23.572, 23.573; 25.571; 27.571; 29.571;</td>
<td>00-970 Part 1 Sec 3.3.2.11</td>
</tr>
<tr>
<td>Harmonised Text:</td>
<td>The airframe structure and associated components, whose failure would be catastrophic, must be shown by analysis supported by test evidence and, if available, service experience, to meet the fatigue requirements of a damage tolerant or, if not applicable a safe life design methodology over the design service life of the aircraft. The fatigue evaluation must include the requirements of subparagraph (1), (2), and (3) and also must include a determination of the probable locations and modes of damage caused by fatigue, considering environmental effects, intrinsic/discrete flaws, or accidental damage.</td>
<td>00-970 Part 1 Sec 3.3.2.12</td>
</tr>
<tr>
<td></td>
<td>CS 23.571</td>
<td>00-970 Part 1 Sec 3.3.2.13</td>
</tr>
<tr>
<td></td>
<td>CS 23.572</td>
<td>4671 305</td>
</tr>
<tr>
<td></td>
<td>CS 23.573</td>
<td>4671 570</td>
</tr>
<tr>
<td></td>
<td>CS 23.575</td>
<td>4671 572</td>
</tr>
<tr>
<td></td>
<td>CS 25.571</td>
<td>4671 573</td>
</tr>
<tr>
<td></td>
<td>CS 27.571</td>
<td>4671 575</td>
</tr>
<tr>
<td></td>
<td>CS 29.571</td>
<td></td>
</tr>
</tbody>
</table>
EMACC will be ready by the beginning of 2013

EMACC Custodian Support activity for next years

Refinement based upon changes within information sources

Potential future TF4 opportunity: Harmonisation with US process (MIL HDBK 516B team)
International rules to integrate a military aircraft in the airspace

THE EXAMPLEs of STANAG 4671, 4702, 4703

Harmonization of airworthiness requirements for UASs in NATO
THE EXAMPLE OF STANAGs

**Derived from CS23**

- Added specific sections for UASs (e.g., Data Link, Ground Station)
- Included a lot of experience from various NATO Nations

**STANAG 4671 (Ed2)**

- Fixed Wing UAS from 150 to 20,000 kg

Ed 1 ratified
Ed 2 non ratifiable is the last version
Ed 3 will start ratification in fall 2013

Cross walk exercise with MIL-HDBK-516
Identified gaps not covered by a CS23 derived STANAG (e.g., in the Vehicle Control Functions field)

A lot of effort is being dedicated to harmonize safety requirements for Edition 3 => above a weight breakpoint safety will be increased of an order of magnitude
THE EXAMPLE OF STANAGs

**Derived from CS27**

- Added specific sections for UASs (e.g., Data Link, Ground Station), taken from STANAG 4671
- Included a lot of experience from various NATO Nations

**STANAG 4702 (Ed1)**

Rotary Wing UAS from 150 to 3750 kg

**Ed 1 started ratification this year**
THE EXAMPLE OF STANAGs

**Invented from the Essential Requirements of Airworthiness**

- Contribution from previous certification programs of light UASs and form all participant Nations
- Harmonized Military Essential Requirements are used as starting point to develop new STANAG 4703
  - + CS_VLA + CS_22 + ASTM F2245-06
  - + STANAG_4671 + DEF_STAN_00_56
  - + EN_9100
- EDA adopted the Military Essential Requirements in the Basic Framework Document

**STANAG 4703 (Ed1)**
- Fixed Wing UAS below 150 kg Reciprocating/Electrical/Turbine engines

**Ed 1 started ratification this year**

- EU Regulation (EC) N°216/2008 defines Essential Requirements for Airworthiness of civil aircrafts
- OCCAR Procedure for Airworthiness finalized in 2009 included Military version of Essential Requirements for Airworthiness (harmonized also with industry - ASD)

**EXCELLENT EXAMPLE OF HARMONIZATION**

- Contribution from previous certification programs of light UASs and form all participant Nations
- Harmonized Military Essential Requirements are used as starting point to develop new STANAG 4703
  - + CS_VLA + CS_22 + ASTM F2245-06
  - + STANAG_4671 + DEF_STAN_00_56
  - + EN_9100
- EDA adopted the Military Essential Requirements in the Basic Framework Document

- EU Regulation (EC) N°216/2008 defines Essential Requirements for Airworthiness of civil aircrafts
- OCCAR Procedure for Airworthiness finalized in 2009 included Military version of Essential Requirements for Airworthiness (harmonized also with industry - ASD)
AIMs

- The amount of certification evidences required should be as LIGHT as possible.

- USAR-LIGHT must be RIGOROUS and COMPLETE in addressing those design attributes which may endanger safety.

- Being FLEXIBLE and not prescriptive, in order not to limit the Manufacturers design solutions.
AIMs

- as light as possible
- rigorous and complete in addressing all design attributes
- flexible and not prescriptive

A single complete set of Airworthiness Codes cannot be flexible enough to consider all the variety of configurations in this UAS category.

A complete set of airworthiness codes would result to be excessively prescriptive to this UAS category Manufacturers.

Nevertheless a minimum set of basic Airworthiness Codes could help both the Applicant and the Authority in performing UAS certification activities.

A set of Airworthiness Codes doesn’t exist for any type of aircraft < 150 kg.

STANAG 4703
1) What are the minimum requirements required by law to be fulfilled in order to recognize a type design as airworthy?

In EU Civil Aviation the minimum Essential Requirements for Airworthiness are established by Regulation (EC) N°216/2008 (Annex 1) of the European Parliament and of the Council. OCCAR-JMAG (BE+DE+FR+IT+SP+UK) agreed among themselves and with ASD (the association of EU Aerospace Industries) a military version of the Essential Requirements adopted then by MAWA as the basis of their regulatory framework.
HARMONIZED:
- Civil-Military
- with Industry (ASD)
- EDA MAWA

HIGH LEVEL ESSENTIAL REQUIREMENTS:
minimum top level AW topics

TOP LEVEL + ESSENTIAL + QUALITATIVE = FLEXIBLE & NOT PRESCRIPTIVE = APPLICABLE TO ALL CONFIGURATIONS
2) How to demonstrate compliance with the Essential Requirements for Airworthiness?

For UAS<150 kg the best proposed solution is a hybrid approach in which compliance with Essential Requirements is demonstrated through detailed arguments made of the following:

- a clear definition of the design usage spectrum
- a minimum set of airworthiness codes
- verification of the design criteria by the Authority
- process evidences (e.g. Safety Management System)
<table>
<thead>
<tr>
<th>MANDATORY AIRWORTHINESS ESSENTIAL REQUIREMENTS</th>
<th>DETAILED ARGUMENTS</th>
<th>MEANS OF EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER.1  Product integrity</td>
<td>Compliance with the Essential Requirements may be shown by the Applicant through these detailed arguments or by any other argument which meets the intent behind them with comparable level of safety to be agreed with the Certifying Authority, wherever a “should” statement appears</td>
<td>Acceptable type of evidence to be presented to the Authority</td>
</tr>
<tr>
<td>ER.1.1 Structures and materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER.1.2 Propulsion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER.1.3 Systems and equipments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER.1.4 Reqs for Continued airworthiness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER.2  Airworthiness aspects of product operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER.3  Organisations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Direct arguments

- STANAG 4671
- CS-22
  (Certification Specifications for Sailplanes And Powered Sailplanes)
- CS-VLA
  (Certification Specifications for Very Light Aeroplanes)
- ASTM F2245-06
  (Standard Specification for Design and Performance of a Light Sport Airplane)

Indirect process arguments

- DEF STAN 00-56
  (Safety Management Requirements for Defence Systems)
- Quality Management System
  + Product Safety declared as an objective in the Quality Policy
  (ISO 9100 + ISO 9004)

+ a certain degree of invention
3) Can some requirements be relaxed for very Light UAS?

- Official medical studies: any vehicle under **25 ft-lb**
- PhD dissertation: any vehicle under **49 ft-lb**

(Very Low Energy threshold that cannot cause fatalities)

... Lethality Threshold of **66J**
A new team has been established to develop a new STANAG, similar in structure to the 4703, applicable to rotary wing UAS < 150kg
START IN SPRING 2013
MILITARY AIRWORTHINESS HARMONISATION IS NOW A NEED UNDER THE WILL OF NATIONS

DUPLICATION OF EFFORT MUST BE AVOIDED (LACK OF NATIONAL SPECIALISTIC RESOURCES)

THERE ARE BENEFITS IN USING A COMMON APPROACH IN THE AIRWORTHINESS

TO PROVIDE MILITARY AIRCRAFTs CAPABLE OF PERFORMING THEIR MISSION SAFELY

THE POTENTIAL SAVINGS IN TIME, COST AND EFFORT FOR BOTH AUTHORITIES AND INDUSTRY.

USE THE SUCCESS OF THE EARLY STAGEs TO ENABLE STRONGER HARMONISATION
• EU EFFORTS TO DEVELOP EMACC SHOULD BE HARMONIZED WITH US PROCESS OF REVISION OF THE MIL-HDBK-516, POSSIBLY SHARING BACKGROUND EXPERIENCES AND KNOW-HOW

• RELEVANT NATIONS AROUND THIS TABLE ARE RECOMMENDED TO CONSIDER NEW STANAGS 4702 AND 4703 FOR CONSIDERATION AND RATIFICATION
The benefits of harmonising
In the field of airworthiness

Any question?

Lt.Col. GArn Alessio GRASSO
Italian MoD - DAA Vice Technical Direction
Alessio.grasso@am.difesa.it
+39 06 4986 6812

Larnaca (Cyprus), 27 September 2012