Energetic Materials Standards – Fundamental Data Supporting the Munition Life-Cycle Safety Assessment

Dr Irmeli Tuukkanen
AC/326-SG/A(EMT) Chairwoman

Dr Richard Bouma
AC/326-SG/A(EMT) Vice-Chairman
Outline

• Introduction
• The Core Area of SG/A(EMT)
• Methods of Work
• Promotion of Common Language
• SG/A(EMT) Portfolio
• Ingredients
• Hazard and Sensitivity Testing
• Summary
Introduction

CNAD AC/326 – SG/A(EMT) on Energetic Materials

Terminology Management Team
Subgroup/A
Energetic Materials & Initiation Systems
Subgroup/B
Ammunition Systems Design and Assessment
Subgroup/C
In-service & Operational Safety Management

CASN Main Group
CNAD Ammunition Safety Group

MSIAC
NATO project

CLASSIFICATION: None (Public)
AC/326 CASG Publications:

- STANdardization AGreements – STANAGs
- STANdard RECommendations – STANRECs
- Allied Publications - APs
SG/A(EMT)

- develops and maintains standards that provide fundamental information and guidance for the design, assessment and qualification of energetic materials.

- provides internationally recognized standards.

- supports Nations to build their technical capability at each stage of the life cycle of energetic materials and components.

- provides fundamental understanding to specify requirements for energetic materials, which important to act as an Intelligent Customer or a Smart Buyer.
• AC/326 CASG is theTasking Authorityto SG/A(EMT)
• SG/A(EMT) Programme of Work
  • Must be aware of tasks in relation to NATO/CNAD/National Priorities
• Custodian
  • A Nation responsible for managing the development of a standardization task
  • Providing support to SG/A(EMT) in the maintenance of the life cycle of the standard
• Temporary non-entitled Working Groups
  • Assisting the work of SG/A(EMT) on a specific document
  • SG/A(EMT) is the Tasking Authority
  • SG/A(EMT) monitors the progress of work
• Defence Investment Portal DI-Portal
• Virtual Study Group – Working Group
• Document Management
  • Traceability and Transparency of changes proposed to document
  • Technical Note
    • Applies to the document in its development and update phase
    • Records technical information at appropriate level of details, provides any deviation from the standard procedure or parameters used in measurements
    • Supports the tracking of changes and proposed and background information related to the document
The SG/A(EMT) Portfolio covers the following areas:

- Qualification of Energetic Materials
- NATO Catalogue of Qualified Energetic Materials
- Chemical Compatibility
- In-Service Surveillance
- Ingredients
- Hazard Testing
- Stability/Reactivity Testing
- Mechanical Analysis
- Performance Testing
• STANAG 4170 is the overarching document.
• There are a number of STANAGs directly supporting STANAG 4170 by defining test methods.
• The ingredient standards support interoperability by defining the energetic material formulations used in ammunition and ammunition components.
• The test methods break down further into hazard, stability/reactivity, mechanical and performance properties.
• Many methods appear in the category Qualification and In-Service Surveillance.
• Some of the stability/reactivity documents are also associated with In-Service Surveillance.
**STANAG 4170, AOP-7, Principles and Methodology for the of Qualification of Energetic Materials for Military Use**

**Chemical Compatibility**

**In-Service Surveillance of Energetic Materials**
Part of SG/B ISS-Document Package

**NATO Catalogue of Qualified Explosives**

**Performance Testing**
Solid Propellant Burn Rate

**Hazard Testing**
Friction
Shock
Impact
Electric Spark
Thermal Tests

**Stability/Reactivity**
NC Propellant Stability
NC Stability by HFC
Vacuum Stability
Ageing of Composite Propellants
Ageing of PBX
Thermal Analysis

**Mechanical Analysis**
Compression
Tensile
Stress Relaxation
TMA
DMA

Ingredients
- TNT,
- RDX, HMX, Cl-20,
- AN, AP, NTO,
- NQ, NC, GUDN,
- HNS, TEGDN, Bu-NENA, ...

**CLASSIFICATION**: None (Public)
Standards
- new ingredients that are important to many nations
- updates to incorporate improved characterization methods, overcome the variety of industry specs. and national standards, reduced sensitivity variants of energetic materials

Requirements
Compendium of test methods
Precision of methods

purity
melting point
granulation acidity
particle density
thermal stability
volatile content
inorganic matter
specific surface
Example of activities:
Reduced Sensitivity RDX Round Robin

- STANAG with updated methods
- Aim to find characterization method at crystal level that is the indicator of shock sensitivity at PBX level
- Comparison of results inter-laboratory testing ➔ required precision of methods
- Follow-ups in international R&D arena
Typical activities / discussion topics

- UN Test series 7 – SG/A(EMT) analogues
- Pressure and energy fluence threshold in gap tests
- Improvement to VCCT
- Spreadsheets at DI portal
- Setback sensitivity
- Nano-sized particles in energetic formulations
The SG/A(EMT) activities include

- Standardization efforts on energetic materials
- State of the Art
  - Developments on energetic materials
  - Latest information on the health and environmental aspects

Mature energetic materials for applications and test methods are accepted as standardization tasks.

- SG/A(EMT) does not conduct research or development of energetic materials or test methods.
The SG/A(EMT) Portfolio provides fundamental information on the properties and behaviour of energetic materials that is relevant/crucial for all the life cycle phases of ammunition/weapon systems.

The AC/326 CASG Portfolio supports
• The development of methodologies and tools for risk analysis, as well as, management on explosives/ammunition/weapon systems.
• The development and maintenance of national methodologies and instructions on explosive and ammunition safety.
• The expertise on the key factors connected to the management of material capabilities and explosives safety.

The AC/326 activities allow Nations to build a common language and safety culture in terms of interoperability and interchangeability.