



November 2023

Bulletin

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PM'S PERSPECTIVE

2023 has been a busy year for MSIAC and 2024 is expected to be just as busy.

This year, we saw the departure of Dr Ernie Baker, our Warheads TSO, and we recently launched the recruitment process for the Munition Systems and Propulsion Technology TSO positions. We added two new members to our staff: Jakob Breiner as our new Warheads TSO and Evelyn Verstraete as our new Information Analyst & Data Manager. And finally, I am due to depart at the end of 2024 and we have started the recruitment process for the Project Manager position.

Despite all of our staffing activities, we kept up with the program of work. We continued to provide our normal support to the AC/326 activities within the various subgroups and we also provided support to activities within AC/327 WG/6 regarding Life Cycle Environmental Profile (LCEP) environments/testing (mechanical, climatic and electromagnetic effects), the E3 RADHAZ WG for HERO, and the AC/305 Logistics Committee for Explosives Safety Munitions Risk Management (ESMRM).

We saw our usual number of technical questions and we continue to focus on answering these for our member nations. We also continued our interaction with the technical community and our member nations, providing a number of country visits, participating in country specific technical meetings, and supporting international seminars and conferences. MSIAC also provided seven AASTP-1 & -5 courses in 2023 and the schedule for 2024 will see another seven courses with a possible eighth course for thirty Ukrainian students.

2023 also saw the addition of a number of new work elements to our work plan to include:

Flow Synthesis - Investigates the use of flow synthesis techniques for the manufacture of energetic materials and other ingredients used for energetic formulations.

Surrogate Materials – Deals with the use of surrogate materials in the development of energetic materials processing and in the qualification of munitions.

Loitering Munitions - Highlights the various challenges associated with the S3 assessment of loitering munitions and make recommendations as to areas which warrant particular attention.

Electromagnetic Environmental Effects & Munition Safety – Supports the development of STANAGs, risk management activities, the understanding of the environmental profile for HERO, interacting with the technical community, developing technical reports, and developing a HERO webinar.

Small Scale Testing of Energetic Materials - Provides guidance on the considerations for electrostatic discharge (ESD) and impact testing in the future.

Review of Cost Benefit Models - Directly links to the IMEMG where we will be comparing the IMEMG tool to the MSIAC CBAM tool.

Work in these areas will continue in 2024.



MSIAC continued to host student interns in 2023. We had two student interns: Alexane Esposito (FRA) finished her project on *Impact Sensitivity of Energetic Materials* (joint MSIAC/RMA project) in August and Léo Tinchon (FRA) finished his project on *Property Mixing Rules for Energetic Material Formulations* in September.

In addition, Mr. Drew Klesat (USA/Naval Surface Warfare Center Dahlgren Division) started his Stokes Fellowship in September 2023 and is due to finish before the end of the year. He is working on a project *New Concerns for Hazards of Electromagnetic Radiation to Ordnance (HERO) Qualification Efforts* to address the challenges of the new extreme environmental profile for HERO, RF effects on energetic material, pulse width effects on EIDs and the left-hand side of the HERO curve. He is also assisting in answering a number of technical questions regarding HERO.

And to assist our efforts at MSIAC, we have also welcomed LEUT Lachlan Bourke (AUS) at MSIAC as an intern for six months.

Looking ahead, 2024 is expected to be another busy year. In addition to our normal activities, we have already added two new work elements. They are:

- **“Pushing the Limits” 2024 MSIAC Workshop.** The work element will support the planned MSIAC workshop near Eglin AFB on the 9th through the 13th of September 2024. The workshop will focus on addressing the recent trend where research in energetic materials and munition technologies is transitioning from improving safety (at limited performance cost) to improving the performance and lethality of our weapon systems. The goal of the workshop is to bring the technical community together to ensure performance improvements do not decrease safety. This workshop will discuss how we can improve our munitions performance while maintaining, and ideally improving, our current levels of safety.

- **Catalogue of Member Nation Munition Safety Training.** This project will establish a catalogue of courses that are provided by our member nations that are also open to external attendees.

In addition, MSIAC will be adding four more work elements to the 2024 work plan once we have developed the objectives, milestones and deliverables to include:

- ⊕ **Weapon Integration Challenges**
- ⊕ **Safety Software**
- ⊕ **Applicability of Frangible Buildings to Ship Design**
- ⊕ **Demil: End of Life Safety**

In addition to our planned changes to the 2024 work plan, I would also like to note a coming change to our TSO structure. We will be adding a E3 / HERO TSO in 2024 to address our growing efforts related to HERO, ESD, and lightning. MSIAC will begin to recruit a new TSO for E3 in the spring of 2024.

As always, I would like to encourage you to get involved in our program of work during 2024 and the MSIAC staff hopes of seeing you soon. Please feel free to send us an e-mail requesting more information or to be kept informed on or involved with any of our work elements.

Chuck Denham
MSIAC Project Manager

MSIAC TECHNICAL MEETING ON NON-DESTRUCTIVE TESTING OF MUNITIONS



13 MAY 2024

Alongside the upcoming EMTWG (formerly known as IMEMTS), a specialists' technical meeting is being organized by MSIAC on Monday 13th May 2024 on Non-Destructive Testing (NDT) of Munitions. This technical meeting follows the MSIAC workshop on Defects – Causes, Classification and Criticality that was held virtually in March 2021. Several topics have been proposed for further discussion that have been phrased as questions.

We need your help in deciding which questions to discuss!

The proposed topics are:

- ⊕ Best Practices in the Detection of Defects,
- ⊕ Emerging Technology in NDT,
- ⊕ Limitations & Capability Gaps in NDT,
- ⊕ Calibration and Standards,
- ⊕ Standardisation of Acceptance Criteria, and
- ⊕ Consideration of Risk and Consequence.

There are too many topics to discuss for a one day meeting. To help with the selection, please read the information describing these topics at <https://www.msiac.nato.int/workshop/technical-meeting-ndt/> and then follow the link to the survey. You can provide two topics of that are your highest priority and then two topics that are your lowest priority. You can also provide comments and suggestions which are always welcome! Please provide your responses by 8 December.

This technical meeting offers the opportunity to a limited audience of subject matter experts to exchange information on current issues related to the NDT of munitions. Registration for the technical meeting is now open – follow the links on the main page. <https://www.msiac.nato.int/workshop/technical-meeting-ndt/>

Kevin Jaansalu
TSO Materials Technology

MSIAC's UPDATED INSENSITIVE MUNITIONS TUTORIAL: BALANCING SAFETY AND LEARNING



At MSIAC, we are pleased to introduce our refreshed Inensitive Munitions tutorial. This new version builds upon the existing presentation, providing professionals with the essential knowledge and tools to enhance munitions' safety and performance in today's landscape.

Highlights

This four-hour tutorial is structured into four core sections:

1. **Introduction:** Gain a solid understanding of the importance of Inensitive Munitions (IM) in modern munitions development.
2. **IM Technology:** Explore the latest technologies and innovations designed to reduce a munition's sensitivity

to various stimuli, ensuring safer handling and storage.

- 3. Energetics and Explosives:** Dive into the science behind the energetic materials used in munitions, and learn how IM principles contribute to their stability.
- 4. Safety Arming and Functioning Systems:** Understand the intricacies of munition arming and functioning systems and how they can be designed for maximum safety.

Flexible Learning

We understand that every learner has unique preferences, which is why the Insensitive Munitions tutorial can be delivered as either an on-site presentation or a webinar. You have the freedom to choose the mode of learning that best suits your needs.

Global Engagement

Our commitment to safety extends globally. The first group of 14 professionals from Norway and one MSIAC Stokes Fellow participated in this tutorial on September 26th 2023, and their positive feedback demonstrates the tutorial's practical value. Next, a group of Australian professionals will undergo the same tutorial at the end of November.

Feel free to reach out to us if you have any questions or if you're interested in bringing this tutorial to your nation. We are here to provide more information, address your questions, and explore opportunities to tailor our Insensitive Munitions tutorial to meet the specific needs of your organization or region. Your input and engagement are valuable to us, and we look forward to assisting you on your mission to enhance munitions safety.

Jakob Breiner, Christelle Collet & Chris Hollands
TSOs Warhead Technology, Propulsion Technology
and Energetic Materials

MSIAC LOITERING MUNITIONS SAFETY SURVEY: REPORT L-297 COMING SOON



Introduction

The Munitions Safety Information Analysis Center (MSIAC) is conducting a survey to assess the safety and suitability (S3) of loitering munitions. Loitering munitions are autonomous or semi-autonomous guided munitions that can linger over an area before engaging a target. As this relatively new type of munitions creates multiple challenges in the area of safety & suitability for service, the aim of this survey is to collect and evaluate the individual status and thoughts within the MSIAC nations.

Survey Overview

The survey comprises 11 questions around the safety & suitability for service topic of loitering munitions, taking less than 10 minutes to complete. It does not request classified or restricted data, ensuring all responses are unclassified.

Your Participation Matters

The loitering munitions S3 survey is an important initiative to ensure the safe, reliable, and efficient use of these innovative weapons. We kindly invite all experts and managers working on related projects to participate in the survey and share their point of view.

Report L-297

The limited report L-297 will present the findings of the MSIAC survey and an assessment on the S3 challenges of this munition type. It will offer essential insights into the classification, deployment, safety, and standards of loitering munitions. This information will be valuable for military decision-makers, procurement agencies and defense professionals, contributing to safe, reliable and effective loitering munition operation of MSIAC & NATO nations defense forces.

Thank you for your support!

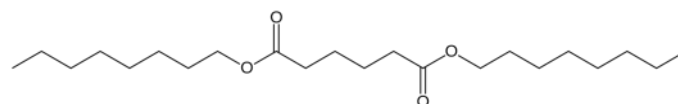
Link: <https://forms.Office.com/e/hiDhUpC51i>



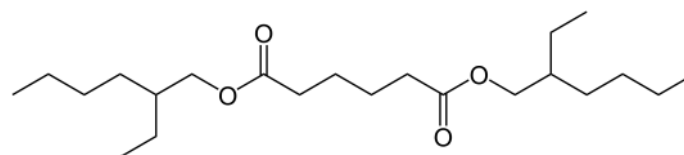
Jakob Breiner
TSO Warhead
Technology

WHAT'S IN A NAME, PART II: IS IT REALLY DOA?

After receiving a question on commonly used plasticizers in energetic formulations, I was looking up the formula for DOA, or dioctyl adipate. From the name, dioctyl adipate would have two carbon chains, each consisting of 8 carbon atoms, at each end of a central adipate structure:



This structure has been assigned the CAS number 123-79-5. However! DOA, as used in the plasticizer industry (and energetics community), has the CAS number 103-23-1. The structure is:



From a chemical naming point of view, the structure above is bis(2-ethylhexyl) adipate or more simply diethyl hexyl adipate, DEHA. Both substances have the same formula, $C_{22}H_{42}O_4$, and molar mass, $370.57 \text{ g mol}^{-1}$, but due to the difference in structure, considerably different properties. Of the two, DEHA has a lower density and a much lower melting point which are useful for a plasticizer.

	DOA	DEHA
Density (g cm ⁻³)	0.98	0.93
Melting point (°C)	-7.48	-67.8
Boiling point (°C)	404.84	417

The use of the term DOA to describe what is structurally DEHA is very common as seen in the long list of product names tabulated on the EU REACH website. The mis-use of names was even encountered in a patent from 1960! So this 'misnomer' is very well established, one could say in common practice, and extends even to MSIAC's Energetic Materials Compendium. The EMC does list the proper chemical name of DEHA and refers to the CAS number 103-23-1. The common use of the term DOA will remain common for quite some time.

Kevin Jaansalu
TSO Materials Technology

33RD INTERNATIONAL SYMPOSIUM ON BALLISTICS

From October 16th to 20th, Kevin Jaansalu and Christelle Collet travelled to Bruges to attend the 33rd International Symposium on Ballistics.

There were dedicated oral and poster sessions on Interior Ballistics, Exterior Ballistics, Terminal Ballistics, Launch Dynamics and Emerging Technologies, Vulnerability and Survivability, and Explosion and Warhead Mechanics.

Kevin presented two posters, "Simple Models of Setback Stresses during Gun Launch" and "Gurney and Mott Constants of Black Powder". The accompanying papers are published in the proceedings of the symposium, and were made possible from the technical work performed by MSIAC staff on behalf of our Member Nations.

This symposium was ably hosted by the Department of Weapon Systems and Ballistics of the Royal Military Academy of Belgium, and was chaired by LtCol. IMM Dr Ir Frederik Coghe. The 34th ISB will be held 18th – 24th May 2025 in Jacksonville Florida.

Kevin Jaansalu
TSO Materials Technology



Kevin Jaansalu and Christelle Collet at the 33rd ISB, Bruges.

ANNOUNCING AN STO AVT LECTURE SERIES ON «MUNITIONS HEALTH MANAGEMENT: IMPLEMENTATION CHANGES»



In January 2022, the development of the STO AVT Lecture Series on "Munition Health Management: Implementation Challenges" started. Currently, a large group of committed experts from several NATO countries is working on the structure and the content of the lectures.

The Lecture Series will be held in 2024 and is aiming at decision makers, quality & safety people, logistic people, management and end users of munitions at the NATO MoD's.

The Lecture Series will cover two full days and consists of lectures introducing the chapters of AOP-4844 mixed with lectures from companies, MoD's and institutes already working with MHM.

In the past few months, the dates and locations for the three editions of the Munition Health Management Lecture Series have been fixed. The program is identical for each of the locations. If you are interested by this opportunity, we invite you to save the dates of the Lecture Series in the location that suits you best, based on your own schedule, your country of origin or other travel-related aspects:

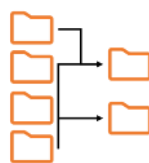
- Ankara, Türkiye, June 5 and 6, 2024
- Bristol, UK, June 26 and 27, 2024
- Washington DC, USA, September 10 and 11, 2024

In case you have any questions concerning the Lecture Series, please don't hesitate to send us a private message through [LinkedIn](#), or by sending an email to: Christelle Collet (c.collet@msiac.nato.int) or Peter Hooijmeijer (peter.hooijmeijer@tno.nl)

Christelle Collet (MSIAC) & Peter Hooijmeijer (TNO)

WHAT'S NEW IN 2024?

As of the 3rd of Jan 2024, Laserfiche folders will receive a small update. Currently, when you access Laserfiche, you see a couple of folders, depending on your access rights. Starting 2024, we will be grouping folders to increase findability using the search functions of Laserfiche Cloud.



When opening the MSIAC Repository, you will encounter only 1 or 2 folders, depending on your access rights. You can click through and find the folders you know and love!

Note that links will not be impacted by this change! This also means that no impact is expected on the functioning of our tools.

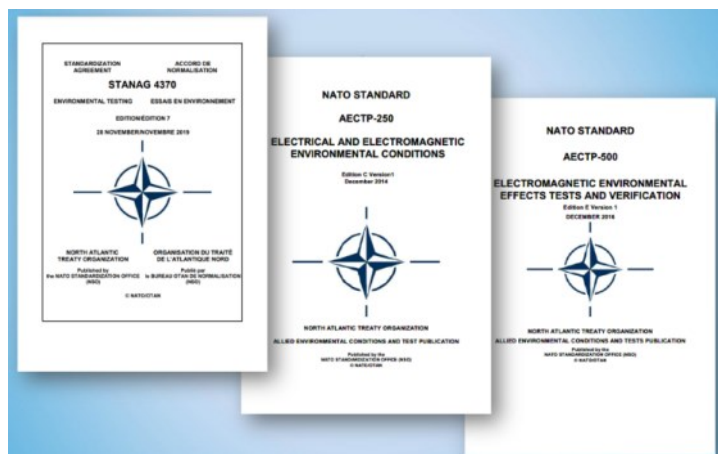
Should you encounter any issues in finding documents, or have trouble accessing the platform, please feel free to reach out to Evelyn (e.verstraete@msiac.nato.int)!

NATO AC/327 WG/6

ELECTROMAGNETIC ENVIRONMENTAL EFFECTS ACTION TEAM (E3AT): AN INTRODUCTION

Hello MSIAC! Chuck Denham (MSIAC PM) has kindly offered our group some space in the newsletter, so without further ado I'd like to introduce the NATO AC/327 WG/6 E3AT to you all – and provide some background on the groups activities and how it fits in with the wider MSIAC community.

To give us our full title, the NATO CNAD Lifecycle Management Group (AC/327), Working Group 6 on Environmental Engineering & Testing (WG6) Electromagnetic Environmental Effects Action Team (E3AT) exists to co-ordinate and harmonise environments and test methods related to E3 across the alliance and partner nations. We have an active membership, including regular participation from nations outside of the alliance such as Australia and Sweden.



Our flagship document, and one that we spend most of our time on, is STANAG 4370 – Environmental Testing, and more specifically AECTP-250 and AECTP-500. These documents set out the electrical and electromagnetic environments and test methods which are used to assess all NATO materiel – from aircraft carriers to cruise missiles and handheld radios.

In the near future, STANAG 4370 is going to be split up into four separate documents to allow for better timeliness of updates and remove interdependencies with our colleagues in the Mechanical and Climatic Action Team (MCAT). In this brave new world, STANAG 4868 will be the home of all things E3 so keep an eye out on the NSO website for that!

Now that MSIAC has a formalised work element regarding Electromagnetic Environmental Effects & Munition Safety, we are very keen as a group to forge closer links with the community. MSIAC have been supporting us and the NATO E3 RADHAZ Working Group for some time now, including the creation of the MSTRAD tool which you may have noticed in the portal. Work is ongoing to mature this, and the aspiration is that it will allow us to make operational management of transmitters (typically powerful radios and radars) and receivers (munitions of all shapes and sizes) easier for nations on NATO deployments.

MSIAC have also completed a number of reports related to E3 technical questions in recent years, and I would recommend the following to you to give a flavour of how radio frequency hazards might affect munitions in ways not normally considered:

- ⊕ L-263: Effects of Electromagnetic Radiation on Munitions Part 1: Microwave and Terahertz Radiation
- ⊕ L-265: Effects of Electromagnetic Radiation on Munitions Part 3: Hazards of Portable Electronic Devices to Munitions
- ⊕ O-210: Non-HERO Microwave Hazards to Munitions

Our focus going forward is the further harmonisation of national documents into the AECTP series, as we want it to be an alliance-wide one stop shop for all things E3, so if you know of anyone in your nations that may want to contribute please do not hesitate to put them in touch with us.



The following gives an idea of ongoing and future work by the E3AT that may be of interest to MSIAC members:

- ⊕ Refinements and improvements to HERO test instrumentation, including appropriate techniques for pulsed tests.
- ⊕ Characterisation of reverberant spaces used for storage/handling of munitions, and the impact of wireless communications within these areas.
- ⊕ Computational modelling of munition responses to electromagnetic radiation.

On behalf of the E3AT, we very much look forward to working more closely with the MSIAC community, and please do not hesitate to reach out to us for any E3 related questions you might have!

Best regards,

Hywel Sollis (GBR - E3AT Acting Chair)

MSIAC GERMANY COUNTRY VISIT & 1ST JOINT LOITERING AMMUNITION WORKSHOP

Meppen Proving Group WTD 91 (DEU)
24-26 October 2023

As part of our ongoing program of visits to our member nations, MSIAC staff Matt Ferran, Kevin Jaansalu, Chuck Denham, Jakob Breiner and Lachlan Bourke travelled to WTD 91 in Meppen, Germany. After delivering a number of presentations focused on insensitive munitions and storage challenges, we were given the opportunity to witness first hand their world-class test and evaluation facilities, including the German NATO National Test Center for small arms ammunition qualification.

For the next two days, MSIAC TSOs Matt Ferran and Jakob Breiner attended the NATO Land Battle Decisive Munitions (LBDM) 1st Joint Loitering Ammunition Workshop. This forum brought together a broad range of stakeholders with expertise including loitering munition design, testing, procurement, requirements setting, standardization, human factors, airworthiness, and operational use. Throughout the course of the wide-ranging agenda, a number of actions were identified to be fed back into various NATO working groups, which will allow the Alliance to better achieve its interoperability goals with respect to these novel systems. MSIAC staff look forward to continued contributions to this forum.



We would like to extend our thanks to hosts Dr Thomas Malysz (MSIAC Steering Committee member for Germany) and Manfred Gerweler (Loitering Munition workshop organizer).

Matt Ferran
TSO Munitions Systems

NEW FACES AT MSIAC



In early July, MSIAC welcomed a new face to the team.

Evelyn Verstraete joined as **Information Analyst and Data Manager**.

Prior to joining MSIAC, she worked in the Belgian pharmaceutical sector for 8 years in a variety of posts, with emphasis on quality assurance, validation and project management. Evelyn likes to

improve process efficiency, and couldn't pass up on the opportunity to revamp the Technical Question workflow. She's interested in automations and AI, and bringing a fresh perspective to MSIAC.

In case you have any questions about MSIAC document databases, feel free to reach out to her: either via email e.verstraete@msiac.nato.int or phone: +32 2 707 39 47.

At the beginning of September, MSIAC had the pleasure to welcome another new face to the team.

Jakob Breiner joined as TSO - **Warhead Technology**, replacing Dr. Ernie Baker.



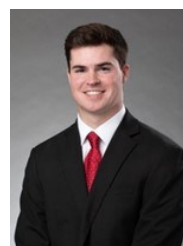
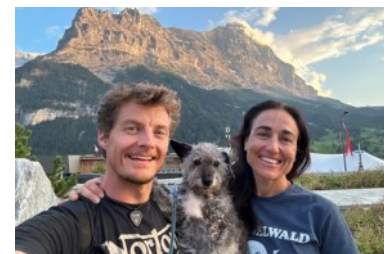
Jakob has spent the last 6 years of his career at TDW Warhead Systems and MBDA Germany. He enhances the MSIAC knowledge base not only in the areas of warhead design, initiation, and shock physics but also in simulation/modeling and fuzing systems.

In case of questions in these domains, feel free to reach out to him at via the following contact details: either via email j.breiner@msiac.nato.int or phone: +32 2 707 38 44.

But it did not end there! MSIAC also welcomed 2 temporary staff members.

Lieutenant Lachlan Bourke joined the Royal Australian Navy in 2010, and served as a Weapons Electrical Engineering Officer on HMAS Canberra and HMAS Sydney, both with deployments in the Pacific. Lachlan has also worked in shore positions as an Integration Engineer for the ESSM Block 2 missile into Australia's ANZAC Class ships, and also as a sustainment engineer for Australia's new DDGs. Having recently completed an MSc (Explosive Ordnance Engineering) at Shrivenham in the U.K., Lachlan is currently consolidating his knowledge as an **intern** at MSIAC, and familiarizing himself with the organization prior to returning to Australia as the NFPO in early 2024.

Lachlan, his wife Ariane, and their dog Sally are thoroughly enjoying their time in Europe, and are looking forward to a cold Christmas whilst simultaneously attempting to drink all of Belgium's beer.



Drew Klesat joined MSIAC in September 2023 as a **Stokes Fellow**. He received a Bachelor of Science in Electrical Engineering from Virginia Tech in 2021.

During his time with MSIAC, Drew will be surveying the member nations on the extent of their hazards of electromagnetic radiation to ordnance (HERO) programs and using that information to help develop a HERO webinar presentation that MSIAC can advertise. He will also be generating a technical report on the *New Electromagnetic Spectrum Concerns for HERO* and taking on a few technical questions related to Electromagnetic Environmental Effects (E3).

Upon concluding his time with MSIAC in December 2023, Drew will return to the Naval Surface Warfare Center Dahlgren Division (NSWCDD) in Dahlgren, VA, where he has worked as an E3 test engineer since 2021. Drew loves sports, plays soccer and golf, and is a huge college (American) football fan.

FEEDBACK FROM THE EUROPYRO

46th IPS Seminar on 11-14th September



In September, MSIAC sailed to the beautiful city of Saint-Malo, on the north coast of Brittany, in France. Unfortunately, it was not for leisure time and we did not go by boat, of course. The purpose of this trip was rather to attend the EUROPYRO / 46th IPS Seminar. The topics covered a broad range of areas, including the synthesis of energetic materials and molecules, new manufacturing processes, insensitive explosives and munitions, applications to solid rocket motors and gas generators, modelling and simulation, testing methodologies, shock waves and detonation phenomena, fireworks, hazard, safety and risk management, friendly environmental design and recycling, and regulations.

MSIAC took this opportunity to present recent work on "Property Estimation of Energetic Composite Materials", by Kevin Jaansalu, and a review of "IM Signatures of Aged Munitions", by Christelle Collet.

This edition was certainly a success in terms of attendance: with 300 participants, it was the most attended one since the first edition of EUROPYRO / IPS in 1987, in Juan les Pins, France.

The other key figures for this edition are the following: 114 papers selected, 31 posters, 19 participating countries, 3 keynotes of which 2 were given by international speakers, and 5 awards.



Christelle Collet, Brian Fuchs, Matt Ferran, and Kevin Jaansalu at EUROPYRO 2023

Christelle Collet, Matt Ferran, Kevin Jaansalu
TSOs Propulsion Technology, Munition Systems,
Materials Technology

THE FRENCH CHRONICLE THE AMMUNITION

If you are familiar with NATO standards, you may have noticed the use of both terms "munition" and "ammunition", sometimes interchangeably. And you may also be aware that for consistency, the term "ammunition" was cancelled in 2009 from the official NATOTerm¹ database, to the benefit of the preferred term "munition" (NATOTerm ID #846) with the definition: "A complete device charged with explosives, propellants, pyrotechnics, initiating composition or chemical, biological, radiological or nuclear material, for use in military operations, including demolitions."

But do you know where the term "ammunition" originally comes from?

Etymologists² agree on that it comes from the faulty separation of the French term for "the munition" -- "la munition" -- which itself comes from the latin "munitionem" meaning "a fortifying". The mistake may have been further influenced by the use of the French term for "the warning" which is "l'admonition", and which pronunciation in French is close to "la munition". And since then, the error has been retained in English dictionaries, with the unetymological double -m- spelling.

Finally, note that the term "munition" has the female gender in French. I let you make your own interpretation!

Christelle Collet
TSO Propulsion Technology

¹ The NATOTerm database is accessible via:
[NATOTermOTAN](https://www.nato.int/nato/t/terms/)

² <https://www.etymonline.com/search?q=ammunition>

Although this may be a bit early,
the MSIAC team already wants
to wish you:

