



# MSIAC

Munitions Safety Information Analysis Center  
Supporting Member Nations in the Enhancement of their Munitions Life Cycle Safety



# Bulletin

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### Issue 2 - 2020

#### CONTACT INFORMATION

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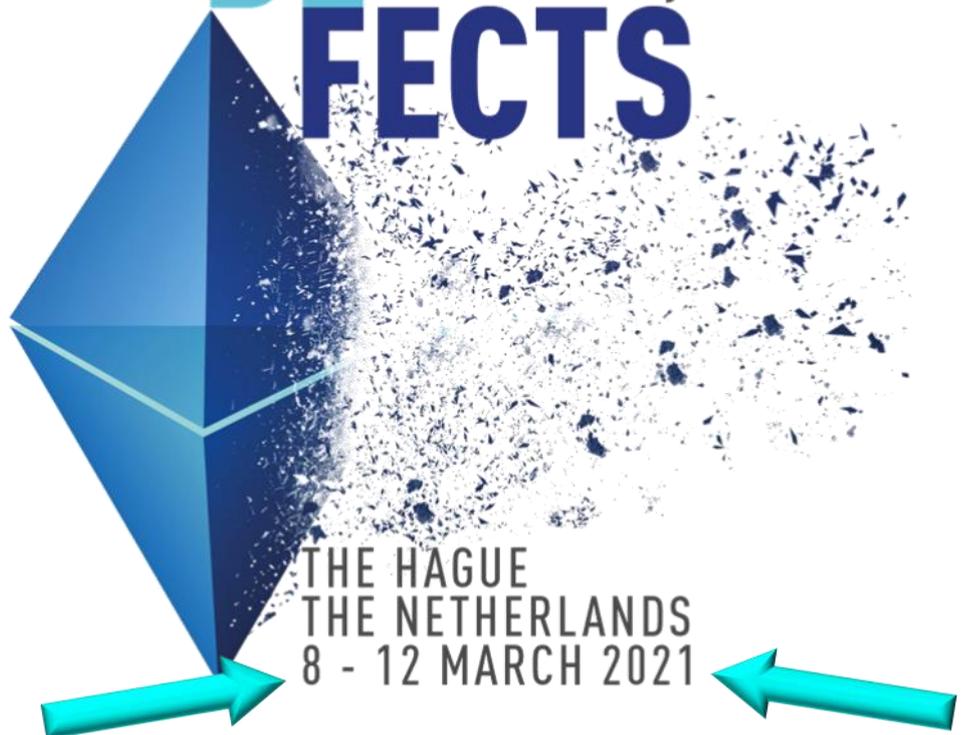
🌐 <http://www.msiac.nato.int>  
✉ [info@msiac.nato.int](mailto:info@msiac.nato.int)

# 2021 Workshop

## Register Now

# DEFECTS

causes classification and criticality



THE HAGUE  
THE NETHERLANDS  
8 - 12 MARCH 2021



As you are no doubt aware, many international conferences have been cancelled or postponed due to the global COVID-19 situation; unfortunately this includes the **MSIAC Workshop “Defects – Causes, Classification and Criticality”**, which was originally planned to take place in June 2020. We believe this decision to have been in the best interests of realising the objectives of the workshop and, more importantly, the health and wellbeing of the MSIAC community.

However, we are pleased to announce that we have secured a new date for the workshop, which will now take place from **8<sup>th</sup> – 12<sup>th</sup> March 2021** in The Hague, The Netherlands.

**Registration** for the workshop is now open, and can be completed at the following website:



<https://www.msiac.nato.int/defects>

In addition, we are now accepting abstract submissions for presentations and/or technical papers to be delivered at the workshop. Participation of attendees through the exchange of information is key to the success of the workshop, and we therefore encourage the early submission of abstracts and technical information prior to your formal approval to attend the workshop. Please submit abstracts by emailing them to:

[defects@msiac.nato.int](mailto:defects@msiac.nato.int)

The workshop is free of charge to MSIAC member nations, and includes a hosted reception and dinner. However, delegates will be responsible for meeting the cost of their own travel, accommodation and expenses for the workshop.

Please also note that the MSIAC Steering Committee members and/or National Focal Point Officers will make the final decision on attendance for their respective nations. **We therefore advise you to not make any travel arrangements until your attendance has been confirmed.**

A general discussion of the workshop goals, structure and background work can be found in **MSIAC Open Report O-214**; supporting this is more detailed information on the development of a Defect Taxonomy (**MSIAC Limited Report L-256**) and a Defect Lexicon (**MSIAC Limited Report L-258 – to be issued**), both of which will provide a common basis for discussion at the workshop and are recommended pre-reading.

Finally, there are still some rooms available at the workshop venue, at the agreed rate of €132 per night. To book a room, please contact Mrs Simone Robbers at [simone.robbers@leonardo-hotels.nl](mailto:simone.robbers@leonardo-hotels.nl) or via telephone +31(0)70 3511711 and use the reference “**NATO-MSIAC March 2021**”.

Matt Ferran  
Munition Systems TSO

Chuck Denham  
Project Manager

Do you want to know what's going on in AC/326 and its SUB-GROUPS? Check it out [here!](#)

You can find all Technical PUBLICATIONS via this [hyperlink](#) .

## PM'S PERSPECTIVE

As we begin to enter into the summer, I would like to take this opportunity to say that I hope everyone is healthy and getting back into a careful and more normal routine.

The year started out very busy and fizzled as the COVID-19 spread across the world and impacted daily life, work and travel. The months of February through May took its toll on the MSIAC work plans for the year as numerous international conferences, technical working groups, and country visits were postponed and/or cancelled. In addition, our DEFECTS workshop that was scheduled for June in the Netherlands was postponed until March of 2021. And while we were forced to shift from an office to a telework environment, MSIAC was successful in hosting its spring Steering Committee meeting (virtually) and successfully hosted an intern and Stokes Fellow.

Despite the fact that the COVID-19 situation impacted a number of our work elements, the MSIAC team managed to stay busy and continue to support its member nations' explosive safety endeavors as we shifted our focus to working on technical reports, answering technical questions and working on the web site and web applications (tools). In 2019, we saw a significant increase in the number of technical questions submitted to MSIAC (100) and it is expected that in 2020 we will again receive a large number of technical questions.

That said, I would like to remind everyone that, through the submission of technical questions, MSIAC is a valuable resource of information and technical expertise that is available to assist with projects and efforts related to research and development, policy and planning, materiel procurement and sustainment, and all technical aspects within the explosive safety domain and I encourage you to utilize this resource.

The summer of 2020 will also see the departure and arrival of some of our MSIAC staff as Dr. Matt Andrews will be departing MSIAC after 7 years of outstanding service and Mr. Chris Hollands will be assuming the Energetic Materials TSO post. Matt was a valuable part of the MSIAC team and he will be missed personally and professionally and we wish him all the best in his future endeavors. And our congratulations go out to Chris and we welcome him and his family to the MSIAC team.

Certainly 2020 has proven to be a challenging year so far and it is my goal to ensure that MSIAC continues to provide our member nations the products and services that have been promised and to ensure that we stay engaged with the technical community. And as we return to our normal life and work routines, and travel restrictions are lifted, I would like to say that MSIAC team looks forward to supporting your explosive safety efforts and seeing you again in the near future.



# UPDATE TO AOP-15

## REQUEST FOR INPUT TO SURVEY

A Custodial Working Group (CWG) has been formed under AC/326 SG/B to develop a new edition of AOP-15 (*Guidance on the Assessment of the Safety and Suitability for Service of Non-Nuclear Munitions for NATO Armed Forces*). MSIAC are pleased to be providing support to AC/326 SG/B in the effort to update the standard that is the cornerstone of NATO's approach to Safety and Suitability for Service (S3) assessment.

MSIAC have released a survey to inform the development of the new edition of AOP-15. The purpose of the survey is to determine:

- ⊕ How AOP-15 is currently used by the Nations, and how it fits into their S3 assessment processes;
- ⊕ What the nations believe the scope and content of AOP-15 ought to be.

The survey can be found on the MSIAC website at the following link: <https://www.msiac.nato.int/aop-15-survey>. We encourage all those involved in the S3 assessment of munitions to contribute! Timing: In order to allow time for analysis of results before the Fall 2020 AC/326 SG/B meeting, it is requested that responses to this survey are provided **by 31st August 2020**.

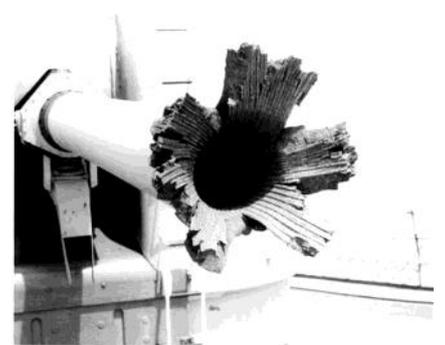
Any question regarding this survey, or related comments, can be directed to Matt Ferran (MSIAC TSO Munition Systems): [m.ferran@msiac.nato.int](mailto:m.ferran@msiac.nato.int).

**Matt Ferran**  
Munition Systems TSO

## ARTILLERY PROJECTILE PREMATURES HISTORICAL REVIEW (EDITION 1)

The MSIAC report O-218: Artillery Projectile Prematures Historical Review, Edition 1 was published in June 2020 and is now available through the MSIAC web site Weblink (<https://weblink.msiac.nato.int/weblink/>) at MSIAC>MSIAC Member Nations>MSIAC Open Reports.

This document describes the results of an international historical review of artillery projectile premature explosions. The purpose of this review is to document artillery gun launch incidents that were potentially caused by projectile explosive fill issues. This supports the NATO AC/326 Subgroup A (Energetic Materials) Gun Launch Setback Ignition Study Working Group, which is currently developing a new STANREC and associated AOP: Suitability of Energetic Material Survivability under Setback Loading. Additionally, it is hoped that such a document will provide a history of potential causes of gun launch premature explosions in order to support guidance provided by the new STANREC. The high acceleration environment and projectile filling issues are a major concern as the potential cause of gun launch prematures. It is envisioned that this document will be updated to further editions as more artillery prematures information becomes available.



*Artillery projectile gun launch and barrel damage as a result of prematures*

**Dr Ernie Baker**  
Warheads Technology TSO



# L-250 DEFECT DETECTION AND CHARACTERIZATION CAPABILITY STUDY FOR ENERGETIC MATERIALS

Published in May 2020, this limited report is a survey of Non-Destructive Testing (NDT) techniques and their application to the detection of defects in energetic materials or munitions. This report also serves as background to the upcoming Defects Workshop in March 2021. Defects in energetic materials or munitions can alter the safety and performance characteristics, potentially leading to failure and causing serious damage to military equipment and injury to service personnel and the public. It is important to be able to inspect munition systems to detect any possible defects inside them and therefore assess their safety.

The detection process can be a destructive one, like cutting the material in two pieces, but since the end of WWII significant advances have been made in the domain of NDT, and various non-destructive methods of detecting defects now exist. This report aims to explain the different approaches to inspecting items, and also aims to establish what techniques fit best at detecting some specific categories of energetic material defects.

Ultrasonic testing and eddy current testing can detect some defects well but since their penetration power is low their results are relatively more difficult to interpret, thus they are not the prominent techniques. The best and most prominent technique is X-ray computed tomography which naturally leads to further automation. The very detailed results that can be provided by neutron techniques might lead to more widespread adoption in the industry, but for now they are still very expensive.

**Rodrigue Barlerin, Dr Kevin Jaansalu, Dr Matthew Andrews, Matthew Ferran**  
MSIAC trainee, Materials Technology, Energetic Materials and Munition Systems TSOs

## L-257 LIFE CYCLE COST METHOD AND EXAMPLES FOR MUNITION HEALTH MONITORING

This limited report was published in March 2020 and documents the MSIAC poster presented at the AVT-292 panel Collaborative Demonstration of Technology on “Innovative Solutions for Munition Health Management (MHM)” held in the Agora of NATO HQ in October 2019.

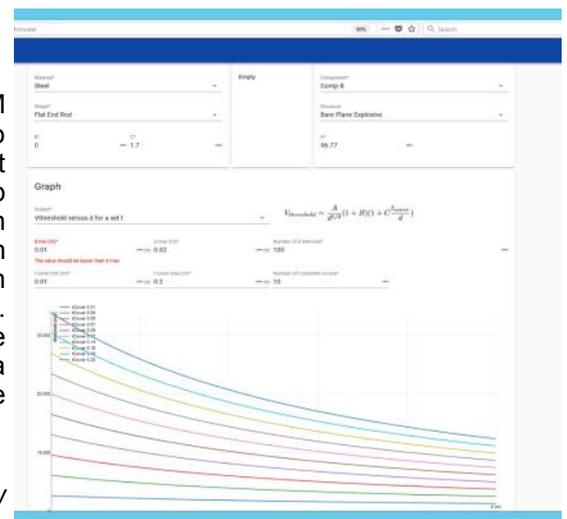
Within the NATO context, a cost benefit analysis (CBA) is a valuable support tool for economic analysis for defence programs. A major part of any CBA is a sound life cycle cost analysis of all options. Steps for a CBA are outlined, within which different perspectives for life cycle costing are described. In developing the life cycle cost model, the two important factors are the methods for determining input costs and accounting for the variability of these costs. The NATO recommended practice is to incorporate Monte Carlo simulations to account for this cost variability. Case studies are presented that reflect the nature of the decisions about munition health management: should munition health management be used; should an existing munition health management scheme be continued; and which of two (or more) munition health management programs should be selected. In three of the four case studies, the implementation of an appropriately sized munition health management can be justified on a cost basis alone, regardless of any other benefit in terms of safety.

**Dr Kevin Jaansalu & Christelle Collet**  
Materials & Propulsion Technology TSOs

**Dr Giuseppe Tussiwand (Haptica s.r.l.), Ms Rada Feraco (Department of National Defence, CAN),  
Mr Pieter Jansen and Mr Michail Bozoudis (NCIA)**

## NEW ARM RELEASE

The second version of the MSIAC Analytic Response Models (ARM v2.0) has been released. It is a web based tool being developed to replace and augment the Toolbox of Engineering Models to Predict Explosive Reactions (TEMPER). It is now available on the MSIAC Web Portal and includes significant improvements and advancements. An implementation of the MSIAC modified Jacobs-Roslund impact initiation model is now available in ARM. It allows the detonation initiation modeling of thicker explosive cover plates and conical impactors. TEMPER v2.3 will remain available; as it includes significantly more capability than ARM. TEMPER is a software package that utilizes a library of empirical or semi-empirical models dedicated to insensitive munitions (IM) assessment.



ARM Main Window



TEMPER was programmed in Microsoft Visual Basic 6.0 (VB6). The final release of VB6 was in 1998 and Microsoft no longer supports it. As a result, it is not possible to continue supporting TEMPER into the future. ARM is not being developed to fully replicate the capabilities within TEMPER, but rather focus development on current Insensitive Munitions response modeling prioritized by the MSIAC member nations.

**Dr Ernie Baker**  
**Warheads Technology TSO**

## AN ENERGETIC FAREWELL

I joined MSIAC in the summer of 2013 and it has been a pleasure to have worked here during a very dynamic and exciting period of the project's existence.

- ⊕ In 2016, MSIAC celebrated its 25<sup>th</sup> anniversary and is marching on to its 30<sup>th</sup> anniversary in 2021;
- ⊕ Membership of MSIAC increased from thirteen to fifteen nations; Belgium, Poland and the Republic of Korea (2019);
- ⊕ The team also increased from five to six technical specialist officers after the creation of the Materials Technology post;
- ⊕ In 2018 MSIAC moved its office to join Defence Investment in the new NATO headquarters.

MSIAC's success is its ability to gather, analyse, share and disseminate munition safety-related information with its members. This, of course, is only possible if the team of people are driven and passionate about MSIAC's mission. The steering committee provides us with the direction of the project and it's been a pleasure to have received guidance from all the national representatives over the last seven years.

I have worked under three project managers, all of whom have provided me with enough freedom to follow my research interests while still achieving the aims of the project. I have enjoyed facilitating the transition between project managers and leave the helm in the safe hands of Chuck Denham.

I have also worked along side eleven, talented technical specialist officers, all of whom are subject matter experts in their fields. I have learnt so much from them and will miss the regular hallway discussions. To the current crew, Christelle, Ernie, Kevin, Matt and Martijn, it is always a school day at the office!

The engine room of the project is the office staff, without whom I would not have been able to carry out my job. Diane who has always ensured I'm going in the right direction, Angy and her ability to find that essential report/document to provide the best response and Dimitris who has provided IT services wherever I have been in the world.

I have been fortunate in having visited all fifteen MSIAC countries and thoroughly enjoyed promoting MSIAC, meeting so many talented subject matter experts and discussing research and advances in energetic materials.

MSIAC is known for its workshops that bring national experts together on a mutual topic of interest. I've been

directly involved in three of these and led the 2016 Science of Cookoff Workshop, of which I'm proud of its success and impact to the community.

After seven years in Belgium I will return to the UK to continue working in the field. I leave MSIAC with a wealth of knowledge but yet so much more still to learn. I'll be leaving behind multi-lingual friends and colleagues, the Belgian weather, awesome cycling terrain, its cuisine and of course Belgian beverages, and European culture...thankfully the UK is very similar to Belgium!

I will not say **adieu** but **au revoir /tot ziens** and hope to see you all in the future.



**Dr Matt Andrews**  
**Energetic Materials TSO (2013-2020)**

## MSIAC SAYS "SEE YOU SOON" TO DR MATT ANDREWS

**Dr Michael Sharp, former Project Manager of MSIAC:**

"I had the pleasure of working with Matt during his time at MSIAC. With his impending departure I just wanted to say a few words to thank him for his considerable contributions in helping nations address munition safety issues. Let me first recognise that Matt is an excellent chemist with a real passion for his field of energetic materials. As a consequence, he was always diligent in everything he did making sure that the best possible outcome was obtained. The workshop on Cook-off was a good example of where his hard work and preparation were instrumental in making this the success it was. I have no doubt that he will be equally as successful in to his future endeavours. Working with Matt over the years was a lot of fun - what a great sense of humor. I certainly will not forget the workshop ties he designed! Nor the Christmas Santa suit he wore to work (as you can see below)!"



*Matt doing what he does best – sharing his knowledge and having fun at the same time (RSC presentation in his own time helping to capture the imagination of the next generation of scientists).*

**Former and current MSIAC staff members also testify about Dr Andrews' memorable years at MSIAC!**

When Dr Matthew Andrews joined the MSIAC team on 23 July 2013 as the new Energetic Materials TSO, he looked like he was hardly old enough to have a PhD, let alone a wife and a child! But things have changed since then...



Matt has worked ... a lot:

- ⊕ he published 24 limited and 11 open reports;
- ⊕ answered 104 technical questions;
- ⊕ organized the very successful Science of Cook off workshop in Atlanta, in 2016;
- ⊕ updated and enhanced the MSIAC Energetic Materials Compendium (EMC);
- ⊕ and was always available to help out colleagues.

But it was not all work, there was also play. Besides becoming a father to a second son, he also managed to find time to have quite a bit of fun...!



He had the privilege to meet Alfred Nobel (one of his idols), a well-known cow in Sevilla and Dasher, Dancer and Prancer, the reindeer... who will never be pulling Santa's sleigh again!



We all know that such fun can only be accomplished and upheld if one is in excellent shape. And our friend has shown over and over again during his years at MSIAC that he is indeed in great condition. He completed a number of races in Brussels and proudly finished the marathon of Rotterdam in April 2019.



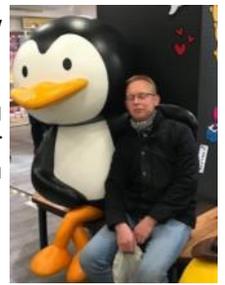
And of course, we will always remember his inimitable clothing choices, most notably his famous Christmas suit and remarkable hats!



After seven years at MSIAC, Matt now deserves to have some rest... at last!

Farewell, Matt, we will all miss you dearly. We wish you all the best in your new position, and hope to see you again in the future.

The MSIAC team



## ACCIDENT REPORTING

We have compiled a new batch of accidents from open sources within the period June 2019 – April 2020. Notable ones are the ammunition depot blasts in Kazakhstan (24 June 2019) and the Krasnoyarsk region in Russia (5 August 2019). <https://www.msiac.nato.int/news/accident-reportings>

Two new accident posters were compiled: <https://www.msiac.nato.int/products-services/accident-posters!>

The first involved fire and explosions in the port of Bombay in 1944 (now Mumbai). This accident took the lives of 1,000 to 1,500 firefighters and civilians and caused devastating damage.

A second poster deals with explosions in an underground ammunition storage facility in Mitholz (Switzerland).



As there are still a lot of buried munitions, it was recently concluded that the Mitholz site cannot be used for further development. TSO Martijn van der Voort visited a workshop in Bern on the 12<sup>th</sup> and 13<sup>th</sup> of February to discuss future scenarios.

**Martijn van der Voort**  
Munitions Transport and Storage Safety TSO

## MSIAC COURSES

We started the year with an ambitious course program. A pilot course on Explosives Safety and Munitions Risk Management (ESMRM) was organized at the Royal Military Academy in Brussels, 4-7 February.

We thank Lt.Col Katrien d'Hert for hosting the course, and all participants for their input during the exercises and their feedback afterwards. Comments will be addressed in future iterations of this course.

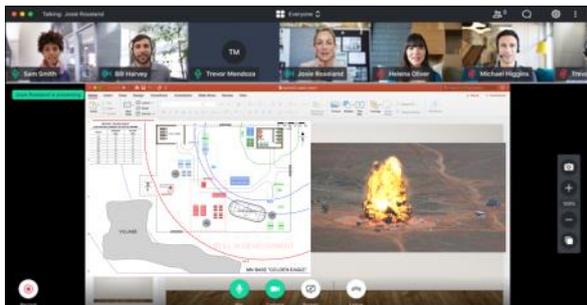




Soon after the ESMRM course, the course program came to a halt due to the Corona virus. AASTP-1 and AASTP-5 courses in Versailles, Brussels, Erfurt, and Albuquerque had to be cancelled or postponed. Remaining AASTP-1 and 5 courses for this year are:

- ⊕ Erfurt, Germany, 9-13 November 2020
- ⊕ Wroclaw, Poland, 16-20 November 2020
- ⊕ Brussels, Belgium, 30 November – 4 December 2020

In order to present students an alternative, and to be more resilient in the future, we are currently developing a webinar for the AASTP-1 and 5 course. The total run time of this event will be shorter because of less time spent on exercises and interaction between students and the instructors. The webinar will still take 5 days but with less hours per day to allow people from different time zones to participate.



The dates set for the webinar are currently:  
**AASTP-1 and 5 Webinar: 12-16 October 2020**

The final time schedule will be determined based on participation. Please let us know if you or colleagues have an interest to join the webinar, and register under this link. Registered participants will receive a "gotomeeting" link two weeks prior to the webinar.  
<https://www.msiac.nato.int/webinars>

**Martijn van der Voort**  
**Munitions Transport and Storage Safety TSO**

## FOLLOW-ON WORK FROM THE IEMRM WORKSHOP

It has been nearly two years since MSIAC organized the Improved Explosives and Munition Risk Management (IEMRM) workshop in Granada. After the workshop, activities were defined to address the recommendations, and these have now resulted in a number of reports available to MSIAC members.

In this article we'll give you a preview of reports related to instrumentation techniques for Insensitive Munitions (IM) & Hazard Classification (HC) tests, collation and analysis of IM & HC test data, and also about a review of HC in various MSIAC member nations.

### INSTRUMENTATION TECHNIQUES FOR IM & HC TESTS

This activity started in January 2019. The aim was to review the different techniques required in IM & HC tests, in order to collect best practices and lessons learned. The results from a survey sent early 2019 showed that the community was interested in (by priority) blast pressure (65%), high speed video (52%), velocity of detonation (43%), heat flux and temperature measurements (43%).

During 2019, the efforts were then focused on the collation and analysis of relevant documentation on the measurement of blast and velocity of detonation (VoD), this latter covering high speed visualization techniques. Lucas Caylar, a summer intern from ENSTA Bretagne, greatly contributed last year to this documentary search (see newsletter 02 and 03-2019). It is now time to advertise the first outputs from this MSIAC activity: the limited reports L-253 and L-255 on instrumentation techniques for blast and VoD, respectively. These reports are now available to the member nations in the MSIAC secure website. They hopefully provide useful information to improve the measurement of blast and VoD characteristics as requested in IM and HC tests. Work is currently ongoing to complete this series with instrumentation techniques for temperature and heat flux measurements.

The ultimate goal of this series of reports is to provide recommendations for improved and harmonized test procedures as well as recommendations for the characterization of munition responses, whatever their reaction type, and their use for safety distances and risk analysis.

**Christelle Collet**  
**Propulsion Technology TSO**



[http://ffden-2.phys.uaf.edu/webproj/212\\_spring\\_2017/Steve\\_Gabrielsen/gabrielsen\\_project/Slide4.htm](http://ffden-2.phys.uaf.edu/webproj/212_spring_2017/Steve_Gabrielsen/gabrielsen_project/Slide4.htm)

### COLLATION AND ANALYSIS OF IM TEST DATA

This activity started in January 2019. The aim was to identify how blast and fragmentation measurements conducted in IM tests can be used to inform safety distances, as well as consequence and risk analysis. An important issue is the variability in the observed munition response, which may not always be clear as typically only one or very few tests are carried out. In report L-248 we present various aspects and examples of variability in munitions testing.

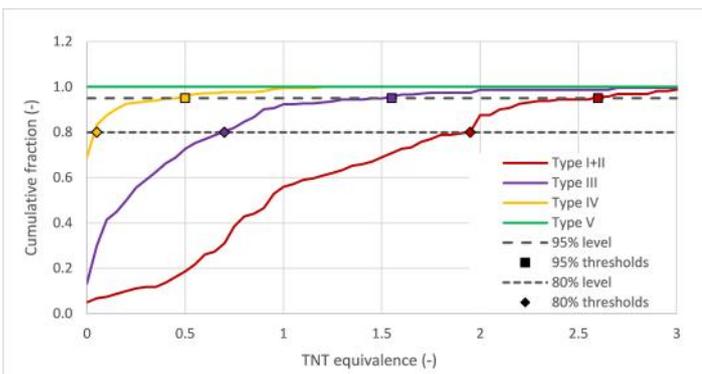
The highlight of the report is an analysis of the assigned munition response in a large number of IM tests conducted by the US Navy and the French DGA. Based



on blast measurements, a correlation was established between the assigned response type and TNT equivalence for any desired confidence level.

Florian Djédis, a summer intern from ENSTA Bretagne, performed groundwork for this by developing the IM TNT tool for calculation of TNT equivalence including a measure of uncertainty, based on peak overpressures and positive phase impulses measured in the test arena. This tool is available for MSIAC members upon request.

We would like to thank Bill Smith and Ken Tomasello from NOSSA for sharing their abundant dataset and analysis. This comprised 225 IM tests on 37 individual weapon systems, with multiple blast measurements per test. The analysis can be summarized in the following graph, which gives the cumulative fraction of measurements versus TNT equivalency for a given response type, ranging from detonation (I), partial detonation (II), explosion (III), deflagration (IV), to burn (V). This graph gives a consistent increase of TNT equivalency with severity of the response, but also shows a very wide distribution for each of the response types. The results can be used to determine scenario probabilities in risk analysis.



Further work was identified with respect to Sympathetic Reaction (SR) tests, where it is not always clear how to distinguish the acceptor blast from the donor blast signal. We encourage more test centers to share their test data with MSIAC so that further analysis can be conducted.

**Martijn van der Voort**  
Munitions Transport and Storage Safety TSO

### A REVIEW OF INTERNATIONAL HC

You may be aware that MSIAC maintains a HC database for ammunition and explosives with 16 contributing nations. An activity was defined to analyse and compare the data in detail to identify any differences or inconsistencies. Adrien Leroy, a summer intern from ENSTA Bretagne, started this work already in 2017, but report L-215 was in April this year.

It appeared that all nations register the Hazard Division (HD) and the Compatibility Group (CG), but Storage sub Divisions (SsD), NATO Stock Number (NSN) and UN identification code are not registered by all nations. Sensitivity Group (SG) and Maximum Credible Event (MCE) are only registered by the US. The new dividing line between SsD1.2.1 and SsD1.2.2 of 0.136 kg applicable HE content per round is not yet consistently implemented by all nations. Furthermore, there are differences in terminology related to Net Explosive Quantity (NEQ), as well as in the packaging description.

We have described a number of cases with the same

munition classified differently in various nations. There are examples of differences in relation to HD, CG and NEQ. Especially for Small Arms Ammunition (SAA) there seem to be significant differences between the nations.

A future automated MSIAC HC Database Exchange (MHCDx) will enable more efficient searching in HC data, and has the advantage that nations can easily compare each other's classifications and identify differences. The report gives various recommendations for future improvements.

**Martijn van der Voort**  
Munitions Transport and Storage Safety TSO

## MSIAC QD CONSEQUENCE ANALYSIS TOOL

During recent courses on AASTP-1 & 5 and Explosives and Munitions Risk Management (ESMRM), it appeared that the Ammunition Safety & Logistics communities have a need for a Consequence Analysis Tool (CAT) when AASTP-1 Quantity Distances (QD) cannot be met.

A CAT already exists for field storage (AASTP-5) but this has limitations:

- ⊕ Typical Potential Explosion Sites (PES) and Exposed Sites (ES) for field storage, e.g. ISO containers
- ⊕ All Hazard Divisions are aggregated as HD 1.1.
- ⊕ For NEQ below 4,000 kg

Some nations have their own national tools, but they are often complex and time-consuming to use.

As a result MSIAC started the development of the MSIAC Quantity Distance Consequence Analysis Tool (MQDCAT). This is an extension of the current MQD tool with consequence calculations. It will be easy to use, based on available test data, and consistent with the upcoming new version of AASTP-1 (EdC V1). This means that it can be used for storage of all hazard divisions, PES types and NEQs.

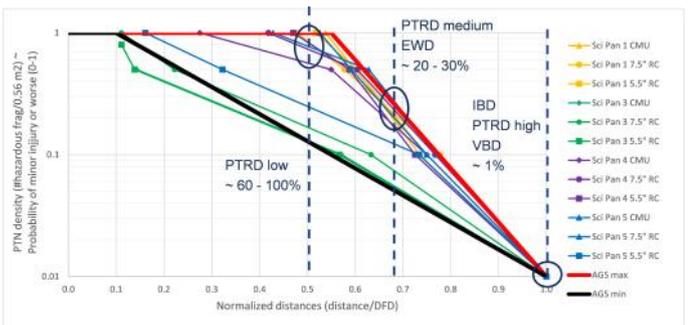
MQDCAT will allow a user to specify the details of a Potential Explosion Site (PES), and those of a number of Exposed Site (ES). Based on models for blast, debris and fragment and thermal damage, the number of fatalities and injuries in the various ES will be predicted.

A lot of attention has been given to develop appropriate debris and fragment fatality and injury models, as this is typically a big driver for consequences and risk. To guarantee consistency with QD, it was set as a boundary condition that these models should yield a 1% probability of minor injury or worse at the AASTP-1 EdC V1 Debris and Fragment Distances (DFD). We revisited the original test reports to also determine the higher probabilities of fatality and injury for smaller distances. Such information is deduced from debris pick-up data that is collected after full scale trials.

A very well documented test series is SciPan (Anderson et al), which entailed the detonation of various quantities in Reinforced Concrete structures. The following figure shows the probability of a minor injury or worse for the various tests as a function of normalized distance (distance divided by DFD). This means that all data



coincide in the lower right corner of the graph. This test series leads to the conclusion that at the Public Traffic Route Distance (PTRD) the probability of minor injury or worse is typically between 20 to 30%. For PTRD with low traffic density this can even run up to 100%.



In a similar fashion, test series were analysed for Earth Covered Magazines (ECM), Hardened Aircraft Shelters (HAS), ISO containers, and brick structures.

MQDCAT is expected to be ready for testing in early fall 2020. Please let us know if you have an interest in providing feedback on the trial version.

**Reference**

Anderson, M.A., Conway, R.T., Tatom, J.W., Cotton, L.A., SciPan 5 Program Description and Data Summary, TR-NAVFAC EXWC-CI-1507, September 2015

**Martijn van der Voort**  
Munitions Transport and Storage Safety TSO

**MSIAC STOKES FELLOW**  
**MORGAN BOLTON**

I am a Defence Engineering & Support (DE&S) employee in the UK MOD. I attended Aston University, UK where I earned a BSc in Chemistry and developed an interest in organic chemistry. I then progressed to the Defence Engineering and Science Group (DESG) graduate scheme within DE&S.



During my time on the scheme, I attended Cranfield University at the Defence Academy of the United Kingdom where I earned an MSc in Explosive Ordnance Engineering. My interest in chemistry and materials, as opposed to munitions and systems, led to choosing a thesis topic on the development of new inert and energetic binders from natural sources.

After completing the MSc, I joined Defence Ordnance Safety Group (DOSG) for a 6 month placement and I am now carrying out the Stokes fellowship with MSIAC. The fellowship provides an opportunity to enhance my knowledge of energetic materials through exposure to the international energetics community. At the end of the fellowship I shall be returning to DOSG for the next stage in my career.

As part of the Stokes fellowship, I am working on the project 'the influence of mechanical properties on the explosiveness of energetic materials' under the supervision of Dr Kevin Jaansalu and Dr Matthew

Andrews. The aim of the project is to find out about the types of damage that a polymer bonded explosive (PBX) may experience from mechanical and thermal sources, gain awareness of the characterisation of damage, and how this affects the response of the material in an accident or incident.

The planned output for the project is to review available data and literature on mechanical damage to PBX materials to determine whether there are any trends in changes, and what influence damage has over the response to small scale, sub-scale and full-scale Insensitive Munitions (IM) tests. This will extend to a comparison of the results obtained from single and realistically defined combined aggressions. An end goal would be to answer the question, 'can we define the safe operating envelope for a system based upon the energetic materials' mechanical and physical properties'.

Due to the current global pandemic, my time in Brussels at NATO HQ was short lived, and I am now managing the fellowship project remotely from the UK.

**Morgan Bolton**  
MSIAC Stokes Fellow

**THE FRENCH CHRONICLE**

Recently at NATO, a remembrance of the Auschwitz camp liberation was organized at NATO HQ.

For this event, a piece of art was displayed in the Agora, made of barbed wires on which yellow flowers were arranged (see picture).

It turns out that the yellow flowers are dandelions and during the speech, a note was made on the origin of this word which comes from the French "dent de lion", meaning lion's tooth.

However, the French translation, "pissenlit", has nothing to do with a lion nor a tooth. Indeed, it is pronounced the same way as "pisse en lit" (literally meaning "pee in the bed") and it is on purpose as it is due to its diuretic properties! Still related to this flower is the French saying "manger des pissenlits par la racine" which is the equivalent of the English saying "to push up daisies", an allusion to one having been buried, with daisies growing over one's burial plot. And if we all remember, hopefully no other Holocaust will contribute to the growing of daisies and dandelions in the future.



**Christelle Collet**  
Propulsion Technology TSO



# RECENT CHANGES TO THE MSIAC WEBSITE

You may have already noticed some discrete but useful changes in the MSIAC website if you are familiar with it. Here are the main changes that occurred recently:

- There is a new location for the button to access the secure website. This allows more space for the titles in the menu bar. It was then possible to rename the “Workshops” menu to “Workshops & Technical Meetings”, which improves the clarity as to where to find MSIAC hosted technical meetings.



Secure Website

Products & Services Tools About MSIAC Areas of Expertise News Contact & Access Workshops & Technical Meetings

- With the constantly increasing number of published reports, a search engine became necessary to find relevant MSIAC publications. This is now possible with the recently implemented searching tool which allows a search by key words, dates, titles, authors and publication area.

Home » Products & Services » Publications (Technical Reports)

## Publications (Technical Reports)

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### PUBLICATION AREAS

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Other Support Activities

PM's Overview

Propulsion Technology

Warhead Technology

- It is now possible to upload a document when submitting a technical question via the MSIAC online form (<https://www.msiac.nato.int/products-services/msiac-technical-question-form>), thanks to a recently added uploading functionality placed just before the “Submit” button.

Upload a file

If you wish to upload a file related to your question, please use the upload functionality below.

Choose File No file chosen

Upload

Files must be less than 2 MB.

Allowed file types: gif jpeg png txt pdf doc docx ppt pptx xls xlsx rar tar zip.

Submit

Some other cosmetic changes were made to improve the readability and the clarity of certain pages, or to fix minor bugs. We are curious to know if you have spotted them and if so, please let us know!

Obviously, the MSIAC website is not intended to please or serve the MSIAC staff; it is for YOU and only YOU. So, if you are not happy with the organization, or if you have difficulty finding the information you are looking for, do not hesitate to share your ideas by sending an e-mail to [info@msiac.nato.int](mailto:info@msiac.nato.int).

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