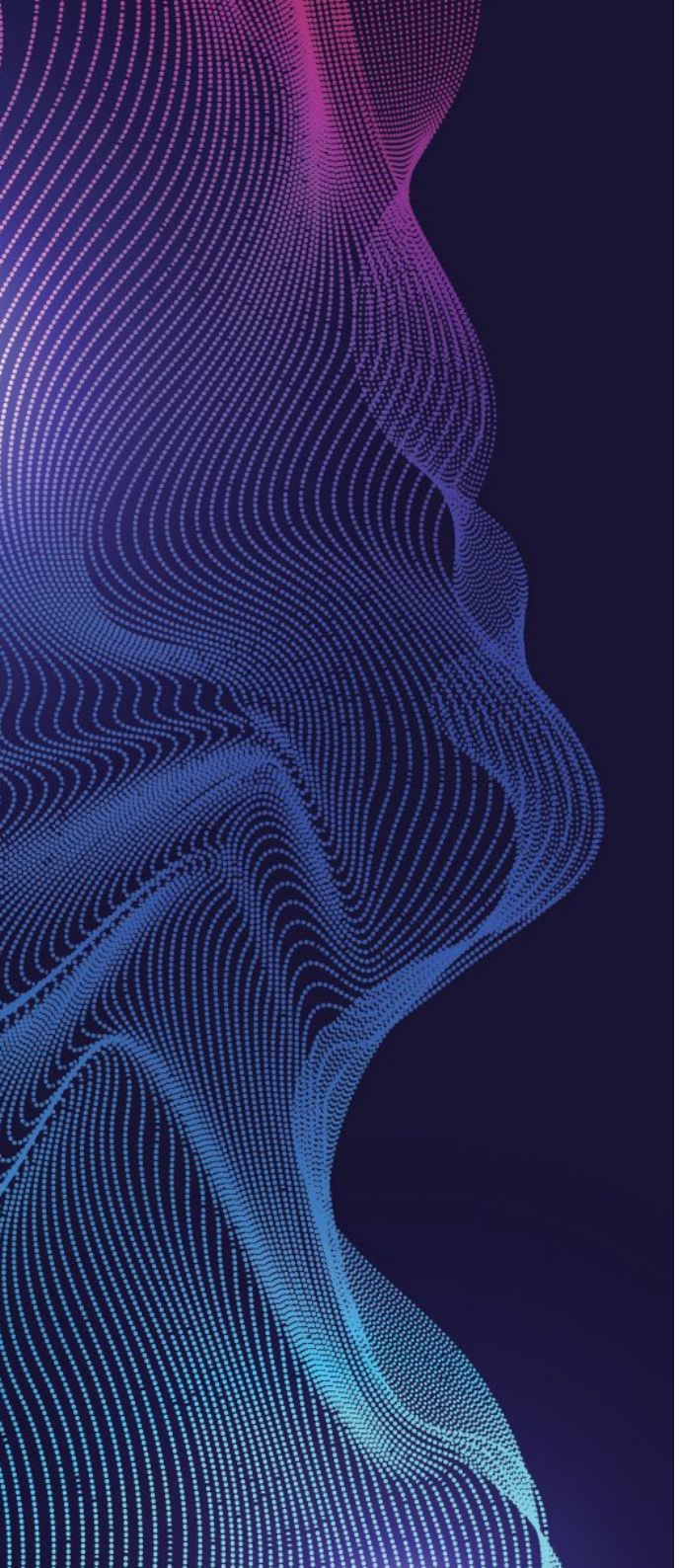
MSIAC
Munitions Safety Information Analysis Center

TOOLS

https://www.msiac.nato.int/tools/



Contents

Introduction to MSIAC Tools

Since establishment as a NATO project in 1991, MSIAC has developed a suite of tools to support our member nations' efforts to design, develop, procure, and use safer munitions. During this time our tools have evolved and grown with both the needs of the community and advances in technology.

We remain focused on providing member nations with a set of tools that are not only useful to their munition safety activities, but also easy and intuitive to use.

Accessing MSIAC Tools

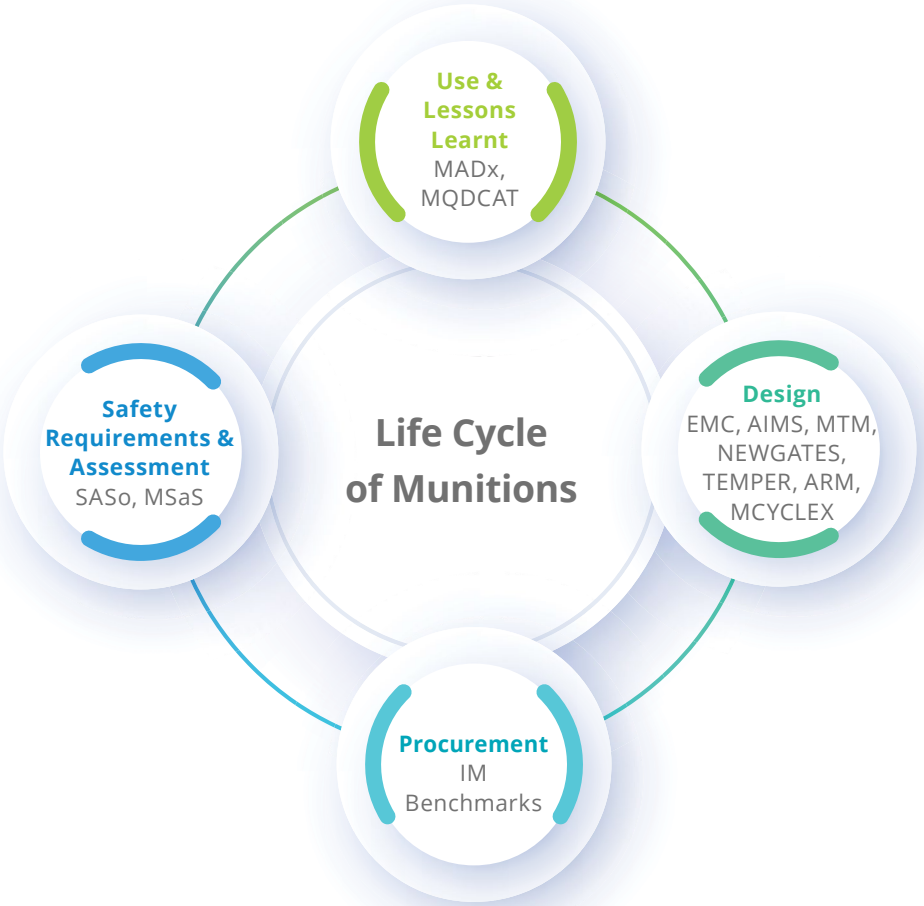
All MSIAC tools are accessed through the MSIAC website: https://www.msiac.nato.int/tools/

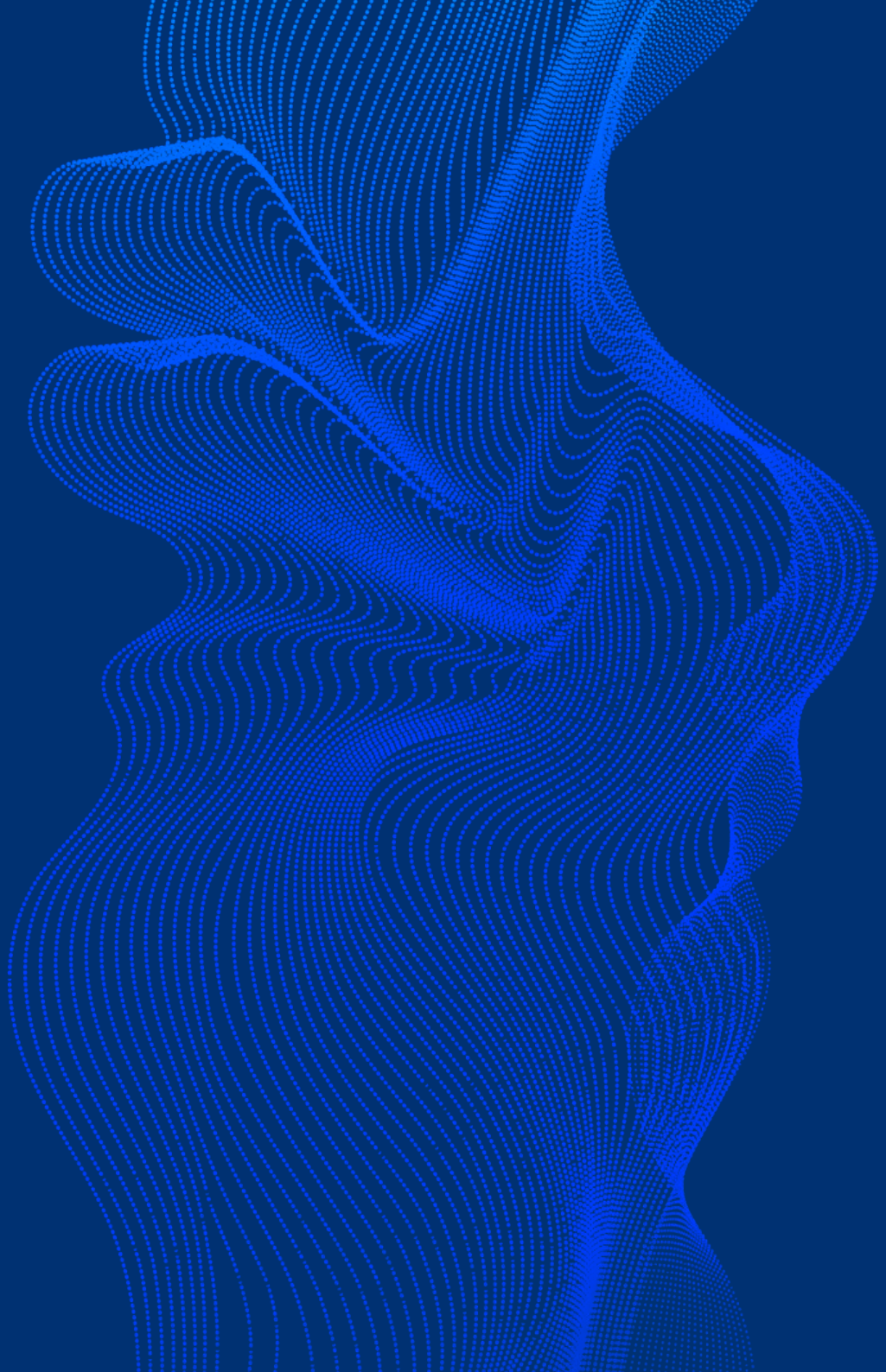
Most of the MSIAC tools are browser-based, and can be used directly in your web browser without the need to download or install any software. A small number must be downloaded before use; we are actively working to replace these tools with browser-based versions.

MSIAC tools can only be accessed by users with an active MSIAC account, approved by their national MSIAC representative. To apply for an account complete the form on our website: https://www.msiac.nato.int/contact-access/request-secure-website-access

Application of MSIAC Tools

The MSIAC tools can be used at different stages in the life cycle of munitions, as shown in the image below.





Browser-based Tools

The following tools can be accessed and used directly in your web browser

AIMS - Advanced Insensitive Munitions Search

Advanced Insensitive Munitions Search (AIMS) is a fully searchable database of IM test results. It is intended to support munitions designers, test centres, IM boards, program managers and munitions suppliers.

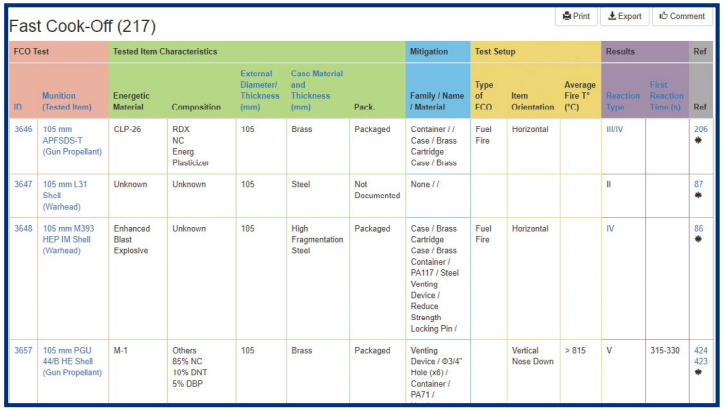
AIMS provides access to IM test results for munitions and generic test units for each threat defined by the NATO IM policy: fast heating, slow heating, bullet impact, fragment impact, sympathetic reaction and shaped charge jet impact.

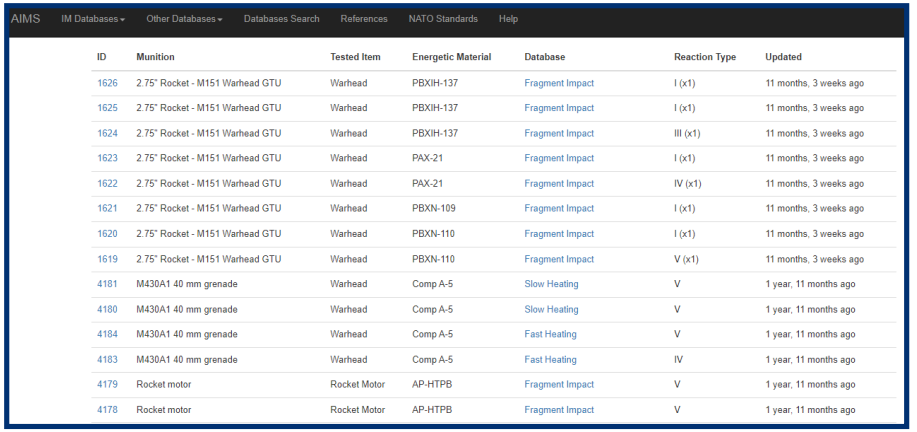
Each test result is fully referenced, searchable and in certain cases access is granted directly to the source material. The information is displayed in a table that provides the munition's name, its main characteristics (energetic material, caliber, case material, packaging), mitigation, test set-up and test results. A detailed view provides additional information on the munition and the test itself, and when available, a picture of the test is included.

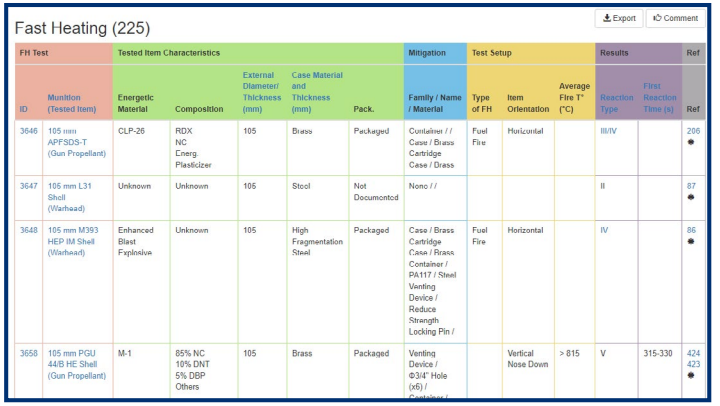
The platform also allows users to search through all the databases at once. The results are displayed per IM threat in separate tabs that reproduces the interfaces of each database. Tests performed with the standardized IM threats can also be sorted in a synthesized table that allows comparison of the munition's IM signatures.

Users can also access the related NATO test standards, the list of references used to populate the database as well as a description of commonly used generic test units and shaped charges.

Responsible TSO:	Warhead Technology and Propulsion Technology
Documents:	O-156 AIMS Advanced Insensitive Munitions Search
Link:	https://aims.msiac.nato.int
Available to:	All approved users







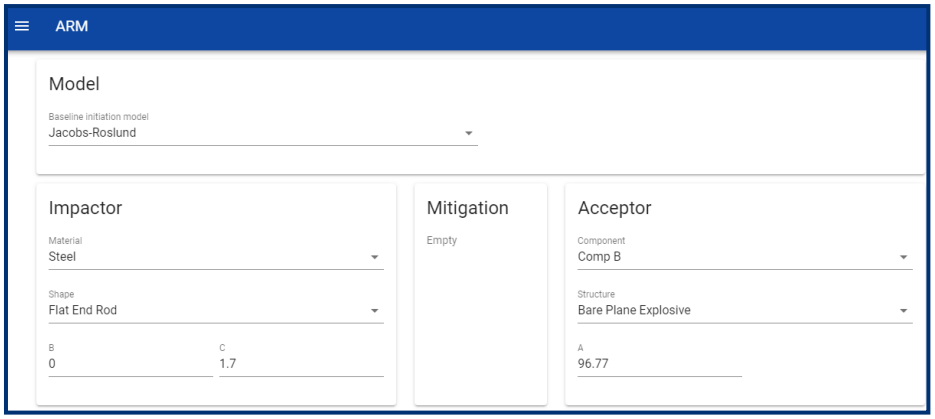
ARM - Analytical Response Models

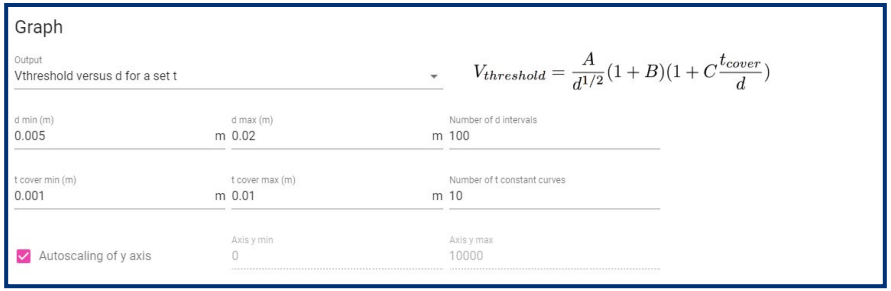
Analytical Response Models (ARM) is a suite of empirical and analytical models used for assessing munition safety, in particular the response to threat environments associated with Insensitive Munitions (IM) requirements.

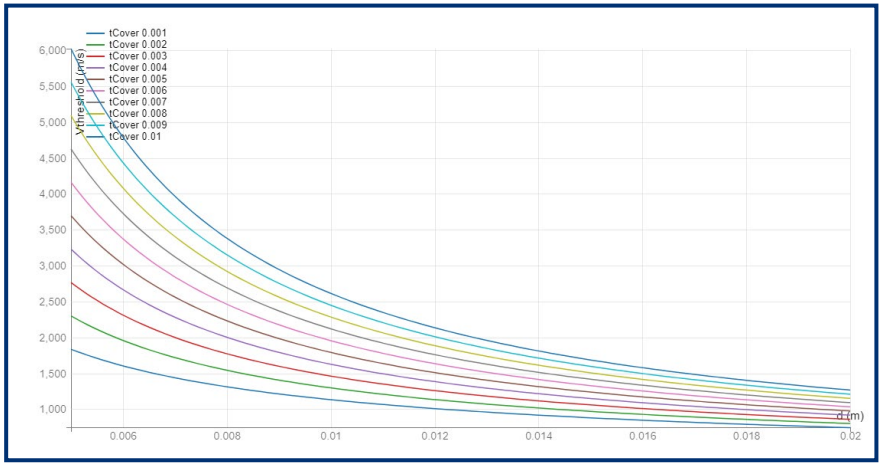
ARM is being incrementally developed as a browser-based replacement for the MSIAC TEMPER application.

The initial modeling capability provided in ARM is for the prediction of detonation by impact threats using the Jacobs-Roslund impact initiation model, supplemented by the MSIAC modified Jacobs-Roslund model; over time, additional functionality will be added including the THOR equations.

Responsible TSO:	Warhead Technology
Documents:	L-254 Analytical Response Models (ARM) Application Specification
Link:	https://arm.msiac.nato.int
Available to:	All approved users







EMC - Energetic Materials Compendium

Energetic Materials Compendium (EMC) is a fully searchable database of composition, performance and sensitivity data for energetic material formulations and their constituent substances. It is intended to support scientists and engineers during the design phase of new munition systems; equally, it may assist through life activities where knowledge of energetic material properties is required.

The data in EMC is sourced entirely from open source publications, and includes entries for high explosives, gun propellants, rocket propellants and pyrotechnic formulations.

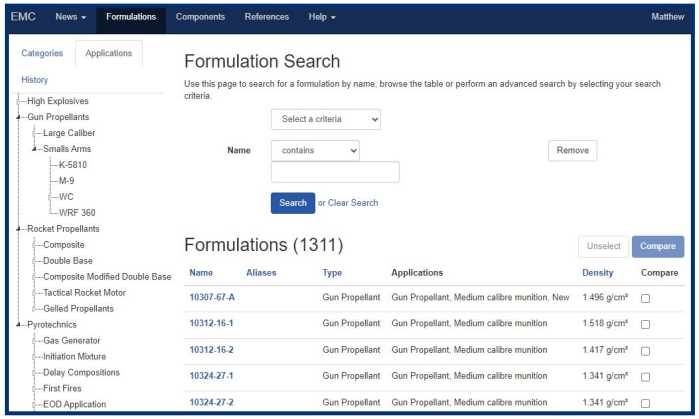
Formulation data can be searched across multiple fields such as performance (e.g. detonation velocity), sensitivity (e.g. impact), physical properties (e.g. thermal conductivity), composition details (e.g. component percentage), manufacturer and application.

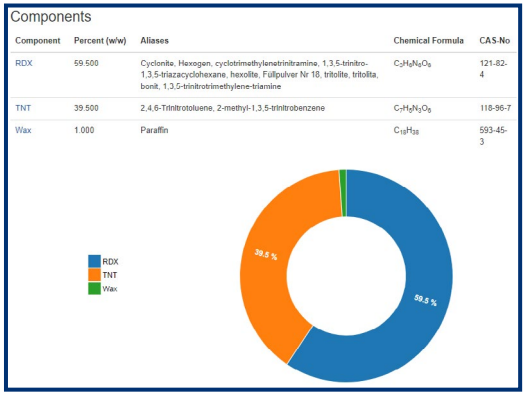
Energetic and non-energetic components can be searched by name, Chemical Abstract Service (CAS) number, and chemical formula, as well as chemical, physical, explosive, hazard and safety properties.

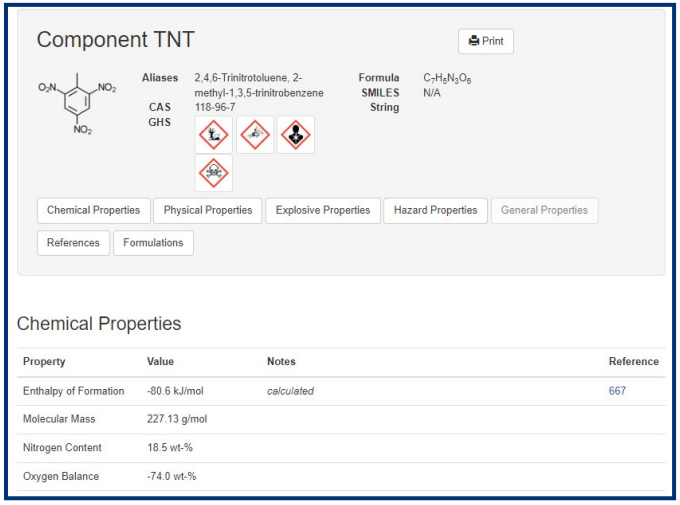
A side-by-side comparison tool for both the formulations and components databases allows users to compare properties for up to four materials.

All information in EMC is fully referenced, and in certain cases source material can be accessed directly via the MSIAC Laserfiche database.

Responsible TSO:	Energetic Materials
Documents:	O-157 The Development and Future of EMC
Link:	https://emc.msiac.nato.int
Available to:	All approved users







MADx - MSIAC Accident Database Exchange

The MSIAC Accident Database Exchange (MADx) contains details of over 16,000 accidents and incidents involving munitions. Information is provided by Australia, Canada, France, Germany, the Netherlands, Switzerland, the United Kingdom and the United States. MADx is intended to provide information in support of munition safety assessment activities during introduction into service for the purpose of hazard identification; it may also be used to support in-service activities such as incident investigations.

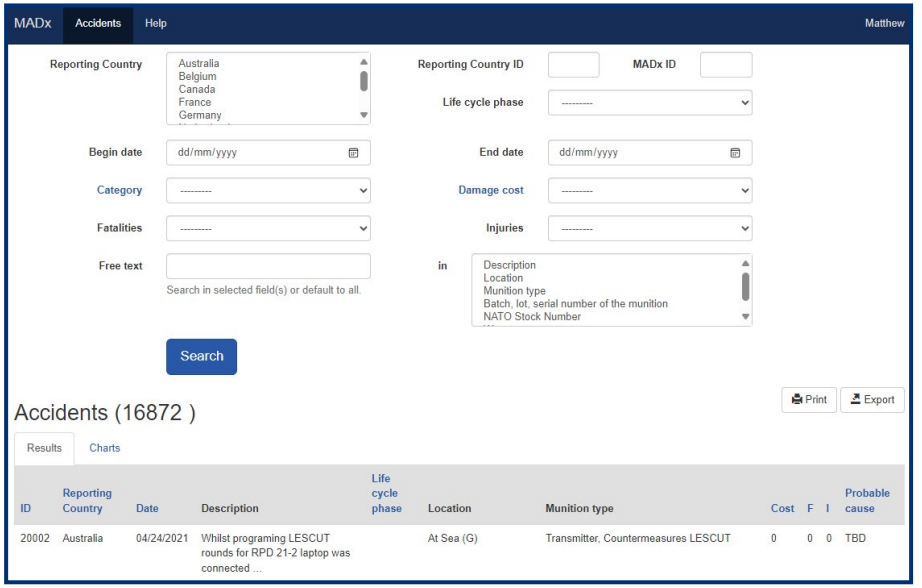
The database contains information about the accident date, location, weapon and munition type, cause, life cycle phase, damage category, and both the number of fatalities and injuries.

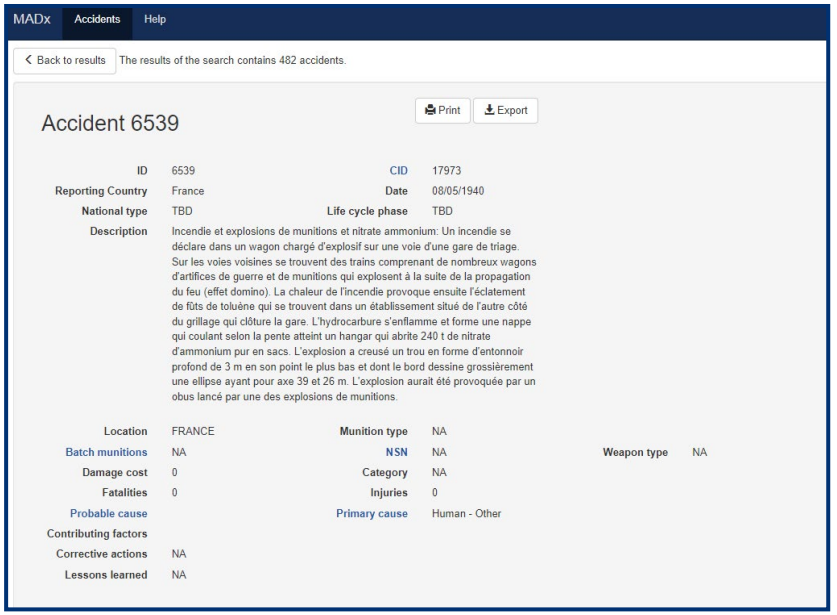
All national contributions are presented in a common format, allowing the whole database to be searched on the aforementioned criteria. Search results are displayed in a summary table including a brief description of the accident, date and location. Results are also displayed as histograms that show the number of accidents per year, probable cause, category and country. The application also offers the possibility to select a list of accidents and then print or export as a spreadsheet for further analysis.

Note:

Access to MADx is restricted to government employees of contributing nations; however, all MSIAC nations are invited to contribute, and will in turn gain access to the database.

Responsible TSO:	Munitions Transport and Storage Safety
Documents:	None
Link:	https://madx.msiac.nato.int
Available to:	Approved government users from contributing nations

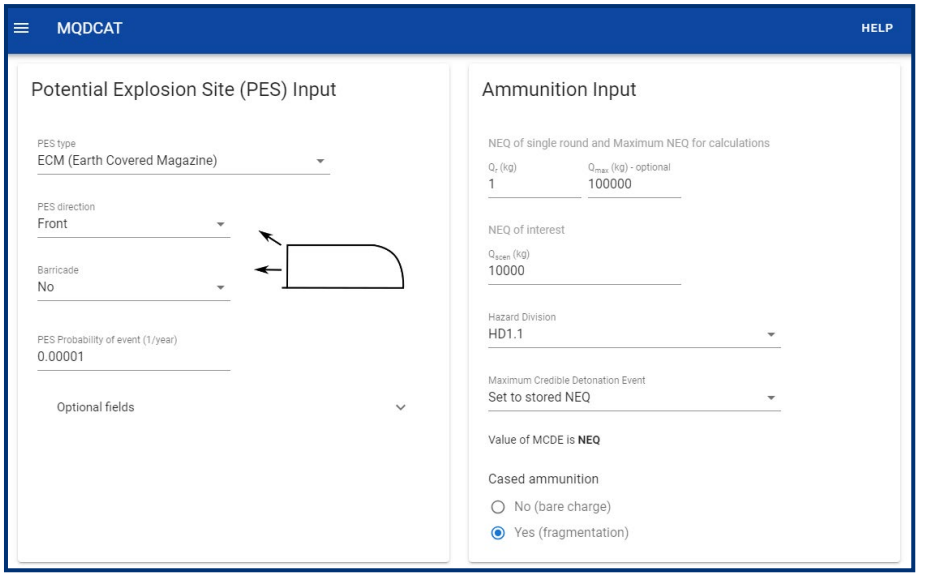


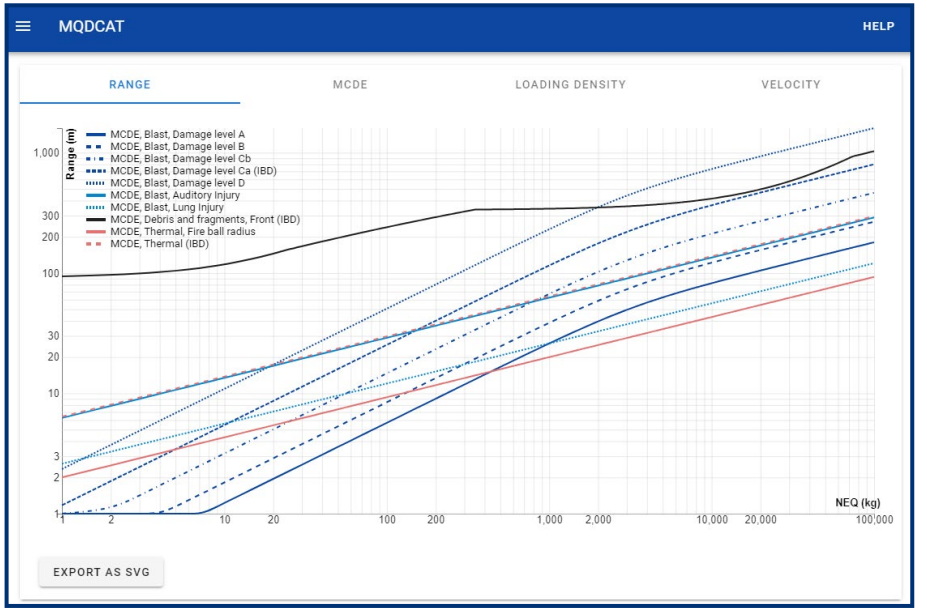


MQDCAT - MSIAC Quantity Distance Consequence Analysis Tool

The MSIAC Quantity Distance Consequence Analysis Tool (MQDCAT) performs an experimentally validated consequence analysis of the accidental initiation of various types and quantities of munitions in various types of magazines, and with possible mitigation measures in place. This includes blast damage to buildings, direct blast injury, thermal effects, as well as hazards from debris and fragments. The results can be compared with current QD standards for all Hazard Divisions (HD) over the full range of NEQ. This provides insight into which consequences are to be expected at the QDs and informs risk analysis. MQDCAT also supports further development of QDs, making use of up to date experimental results.

Responsible TSO:	Munitions Transport and Storage Safety
Documents:	L-229 Experimental and Theoretical Basis of NATO standards for safe Storage of Ammunition and Explosives – Final Report L-252 Specification of the MSIAC Quantity Distance Consequence Analysis Tool (MQDCAT) v2.4 L-289 Release Notes for MQDCAT v2.6
Link:	https://mqdcat.msiac.nato.int/
Available to:	All approved users





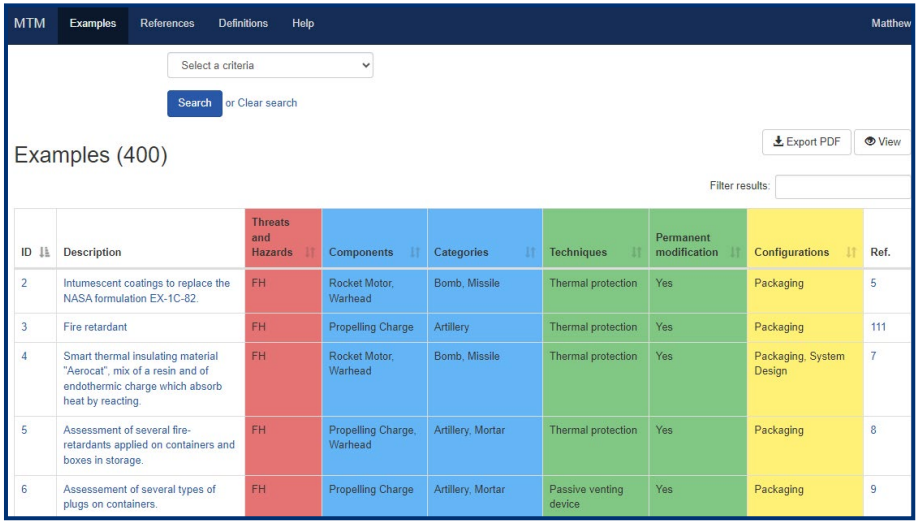
MTM - Mitigation Techniques For Munitions

Mitigation Techniques for Munitions (MTM) is a database of technologies and techniques that may be used to improve the response of munitions when exposed to threat environments defined by NATO Insensitive Munitions (IM) policy. It is intended to support munitions designers, IM boards, program managers and the military by describing potential solutions to satisfy the requirements of national IM policy.

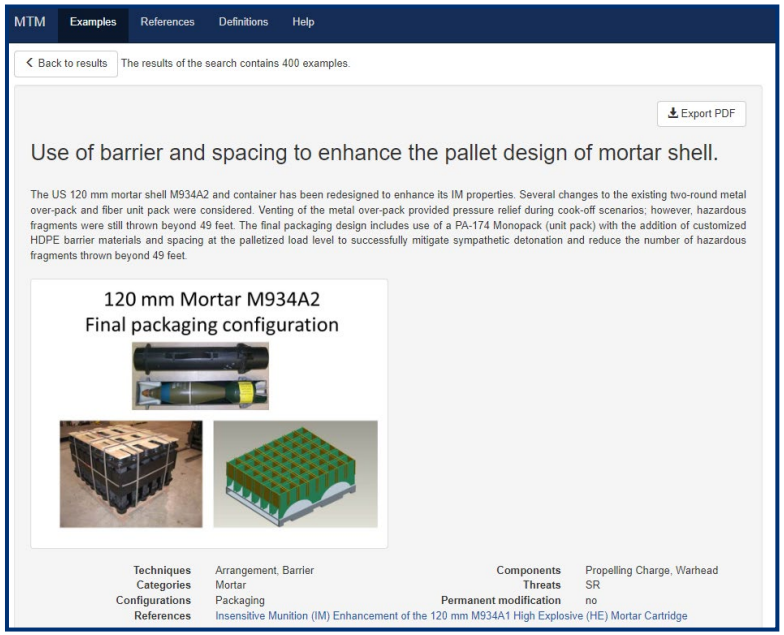
Over 400 examples of mitigation technologies and techniques are included, all of which can be filtered and searched on criteria including threat type, munition category, and the system level at which the mitigation is applied. Each entry in the database provides a detailed description of the particular mitigation technology or technique, including images (where available).

Each technology is fully referenced, and in certain cases source material can be accessed directly via the MSIAC Laserfiche database.

Responsible TSO:	Propulsion Technology
Documents:	O-165 MTM – Technical Specifications O-173 MTM – Easy Access Online
Link:	https://mtm.msiac.nato.int
Available to:	All approved users



ID	Description	Threats and Hazards	Components	Categories	Techniques	Permanent modification	Configurations	Ref.
2	Intumescent coatings to replace the NASA formulation EX-1C-82.	FH	Rocket Motor, Warhead	Bomb, Missile	Thermal protection	Yes	Packaging	5
3	Fire retardant	FH	Propelling Charge	Artillery	Thermal protection	Yes	Packaging	111
4	Smart thermal insulating material "Aerocat", mix of a resin and of endothermic charge which absorb heat by reacting.	FH	Rocket Motor, Warhead	Bomb, Missile	Thermal protection	Yes	Packaging, System Design	7
5	Assessment of several fire-retardants applied on containers and boxes in storage.	FH	Propelling Charge, Warhead	Artillery, Mortar	Thermal protection	Yes	Packaging	8
6	Assessement of several types of plugs on containers.	FH	Propelling Charge	Artillery, Mortar	Passive venting device	Yes	Packaging	9



SASo - Safety Assessment Software

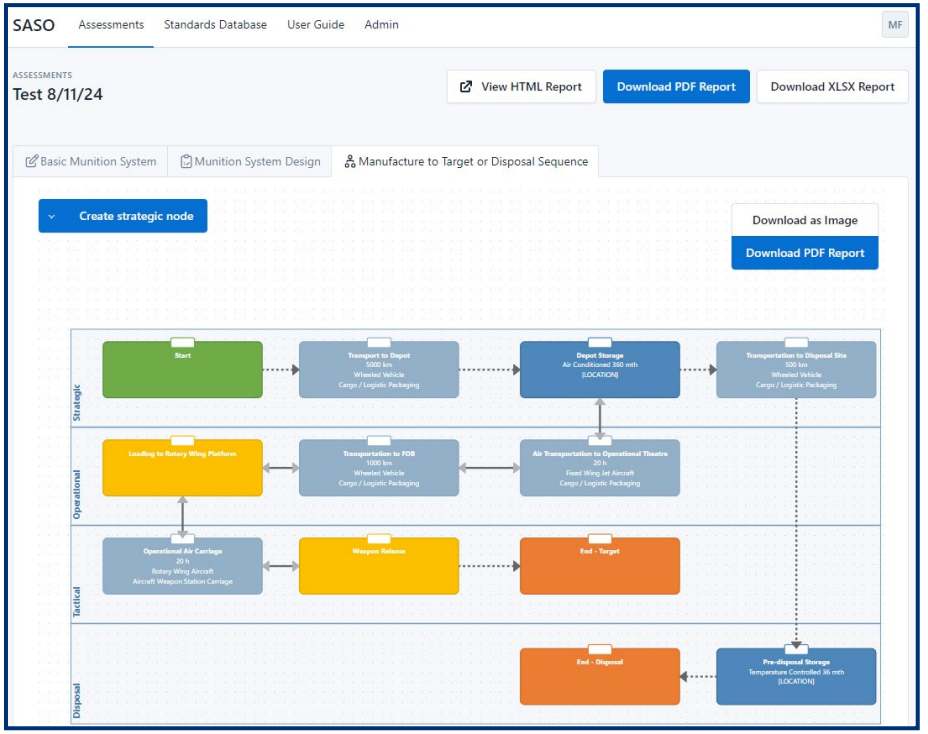
Safety Assessment Software (SASo) is a browser-based tool designed to assist munition designers, procurers and any personnel supporting these activities in the identification of appropriate safety-related requirements and associated standards. It consists of:

- A drag-and-drop graphical user interface (similar to MS Visio) that allows users to rapidly construct a Manufacture to Target/Disposal Sequence (MTDS) for a munition system. The resulting flowchart can be exported as a high quality image file and used in associated munition reports. Each "node" in the flowchart represents a specific lifecycle activity, for which the user defines parameters such as location, duration, configuration, etc.
- Once the MTDS has been constructed, SASo will generate a list of "design safety requirements" and "assessment requirements". The "design safety requirements" are based on basic information provided by the user on the munition design. The "assessment requirements" are based on the activity types defined in the MTDS, and also draw out all associated parameter information from each MTDS node
- Each requirement has an associated standard or standards (default NATO, but also US and UK if desired)

The output of SASO consists of:

- An assessment report which details the MTDS (including image), and a list of design and assessment requirements, plus all associated standards. Each of the standards is hyperlinked and accessible on the MSIAC secure website for convenience
- A V&V matrix (.xlsx format) containing the same information as the assessment report, with space for compliance assessment

Responsible TSO:	Munition Systems
Documents:	None
Link:	https://saso.msiac.nato.int
Available to:	All approved users



MSIAC Tools

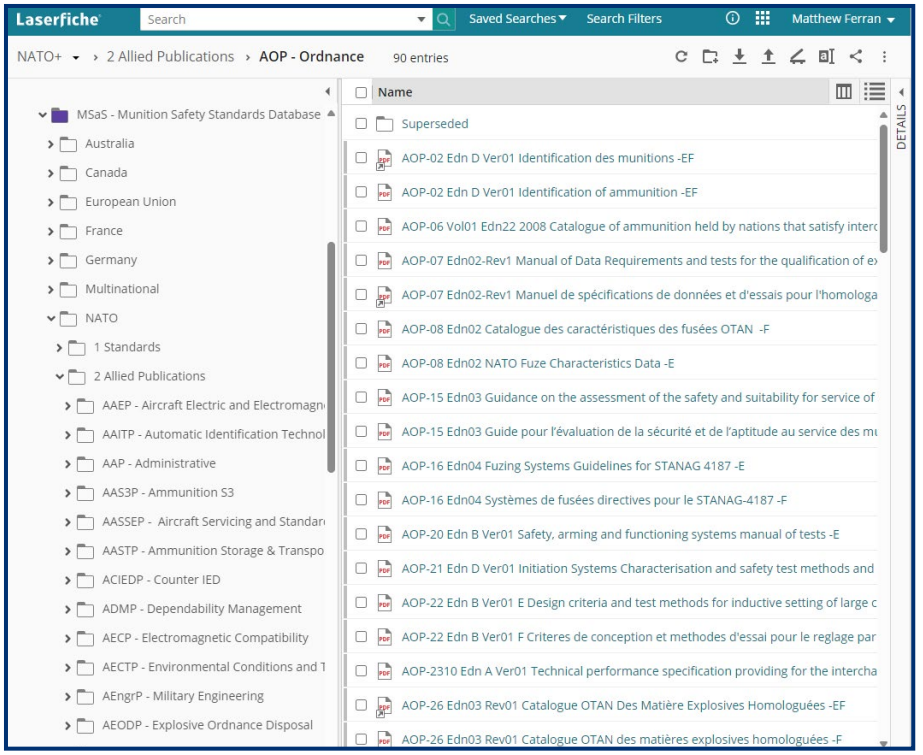
MSIAC Tools

MSaS - Munition Safety Standards Database

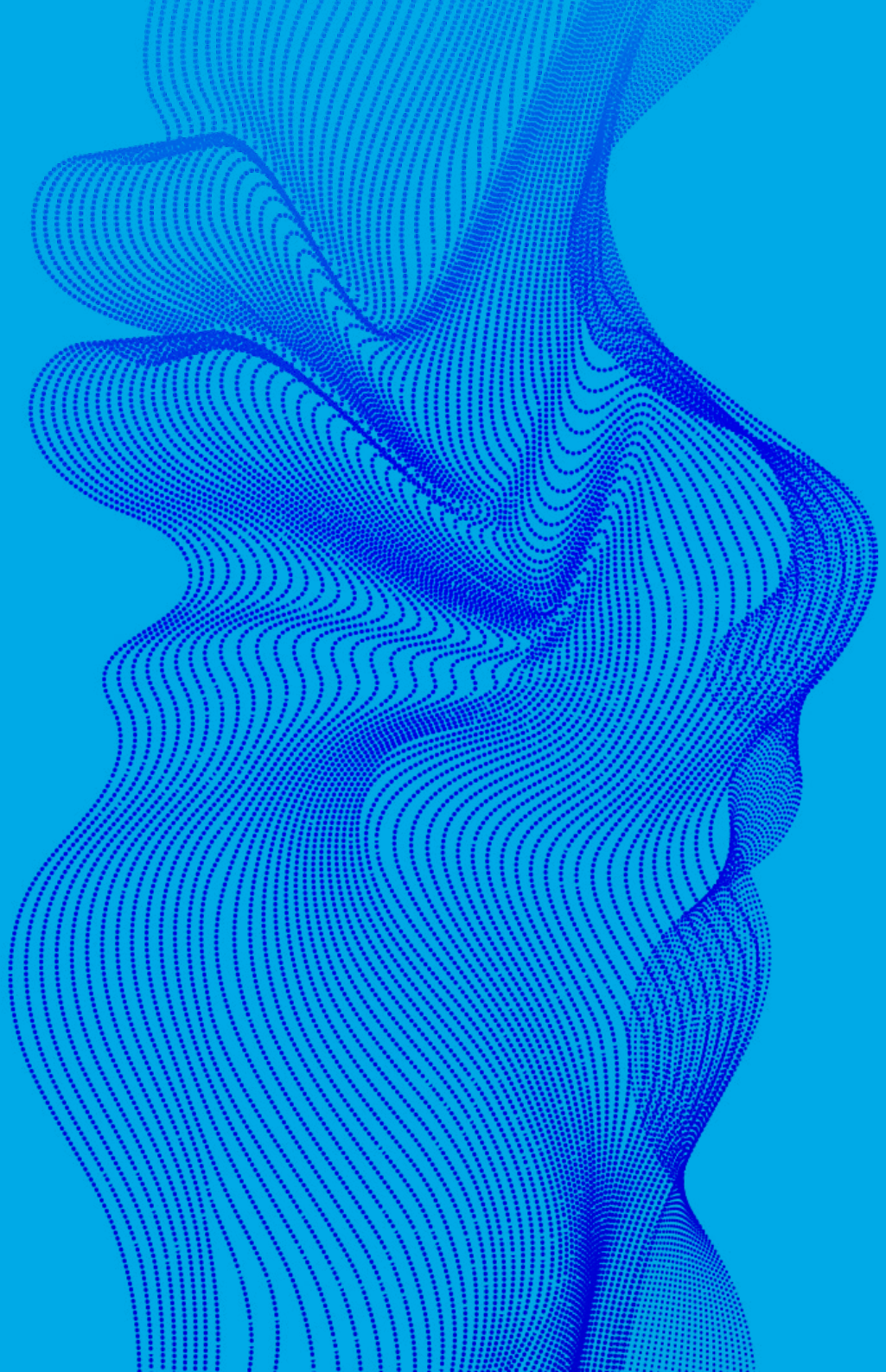
The Munition Safety Standards database (MSaS) is a repository of some of the most important NATO, national and international standards related to munition safety. MSaS is regularly updated with the most recent versions of relevant standards; it also includes a history of previous versions of standards that have been superseded or cancelled.

Note:

- It is not the intention of MSaS to provide access to all NATO standards, only a curated selection of those deemed most relevant to munition safety. For a comprehensive listing of all NATO standards please refer to the NATO Standardization Office (NSO) website: https://nso.nato.int/
- Individual access to standards within MSaS is restricted based on user nationality, in accordance with all applicable document release statements.



Responsible TSO:	Munition Systems
Documents:	None
Link:	https://www.msiac.nato.int/tools/msas/
Available to:	All approved users



Downloadable Tools

The following tools must be downloaded to your computer before use

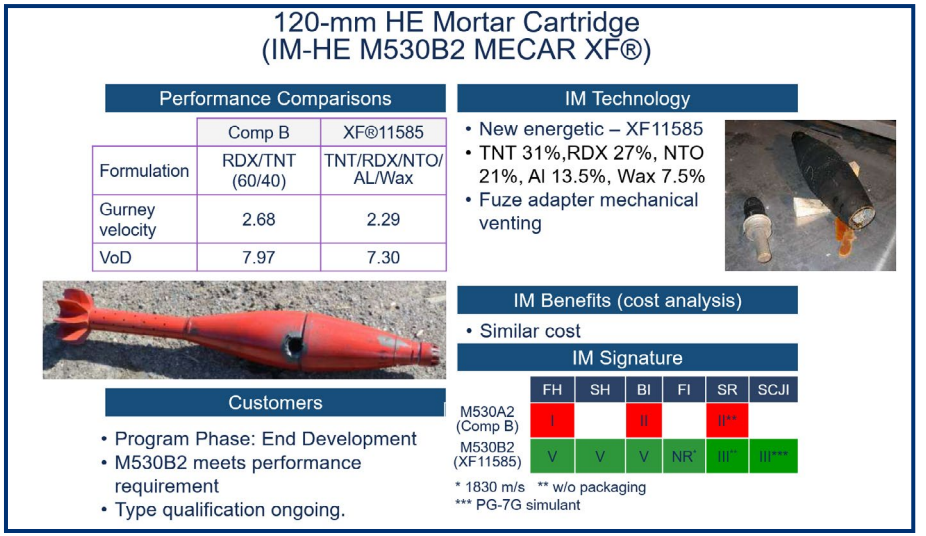
Insensitive Munitions Benchmarks

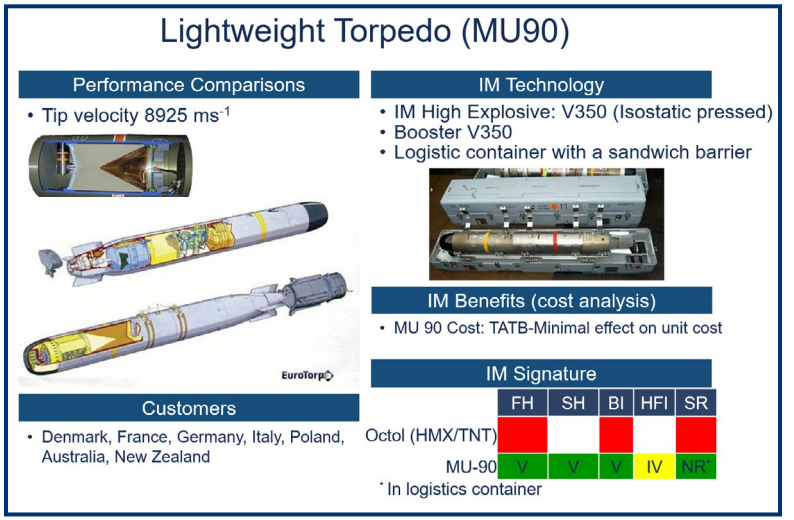
It is a common misconception that reduced munition vulnerability is either not achievable, or must come at the expense of reduced performance. Insensitive Munitions (IM) Benchmarks is a resource intended to demonstrate that, with careful system design, it is entirely possible to deliver munitions which meet NATO and national vulnerability requirements without compromising on performance.

For each of the three operational environments (i.e. land, sea and air), IM Benchmarks provides select examples of high-performing munitions which have improved vulnerability over comparable predecessors, and which in some cases meet or exceed NATO IM requirements.

IM Benchmarks is formatted as a brochure that can be easily shared with stakeholders such as user representatives, requirements setters, and procurement staff, in order to help them be properly informed in their decision making processes.

Format:	.pdf
Responsible TSO:	Warhead Technology
Documents:	None
Link:	https://www.msiac.nato.int/tools/imbenchmark/
Available to:	All approved users





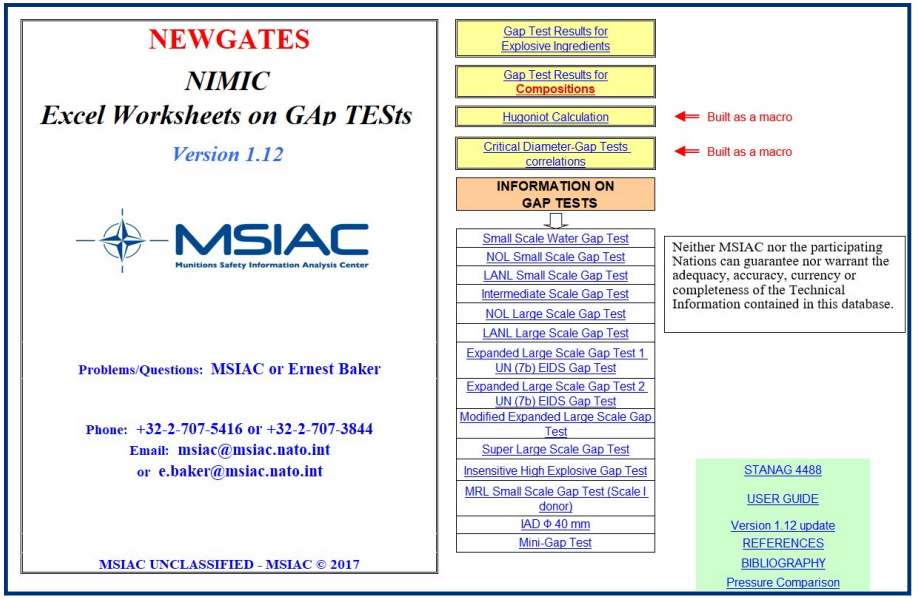
NEWGATES - NIMIC Excel Worksheets on Gap Tests

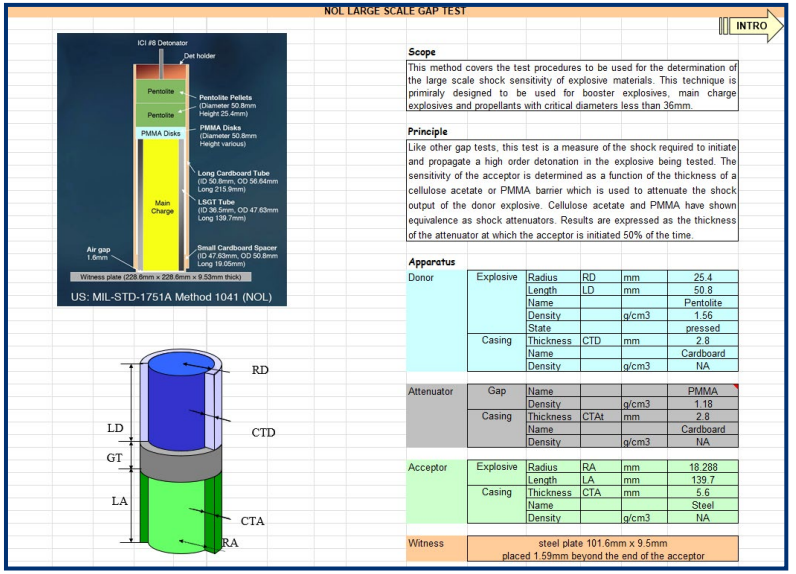
NEWGATES is a database of common gap test set ups and test results. It has been designed to provide scientists and engineers with a tool to compare gap test results and/or calculate critical initiation pressure and time.

NEWGATES comprises:

- Information about 10 gap test configurations (description and diagrams, complete with dimensions, scope, principles and principles of operation)
- Pressure calibration curves
- Time calibration curves
- Shock curvature calibration curves
- Several thousand fully referenced gap test results
- Over 250 Hugoniots, as well as a module to analytically determine Hugoniot parameters for an energetic material from its ingredients

Format:	Spreadsheet (.xlsx)
Responsible TSO:	Warhead Technology
Documents:	O-89 The NIMIC Excel Worksheets on Gap Tests (NEWGATES O-219 Improving the MSIAC Gap Test Computational Tool and Database) L-148 Ed3 NEWGATES Version 1.10 User Guide
Link:	https://www.msiac.nato.int/tools/newgates/
Available to:	All approved users





TEMPER - Toolbox of Engineering Models for the Prediction of Explosive Reactions

TEMPER is a tool that uses empirical and semi-empirical models to predict munition response to insensitive munitions (IM) threats.

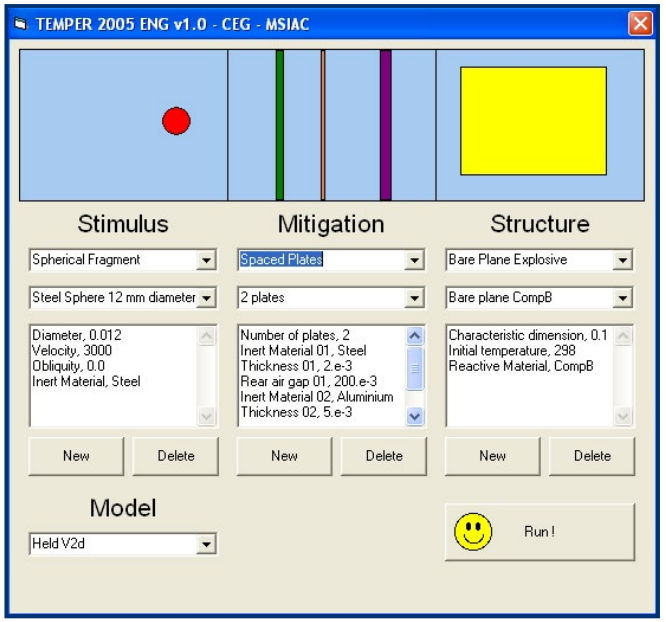
It includes models for fragment impact, shaped charge, sympathetic reaction and thermal threats such as:

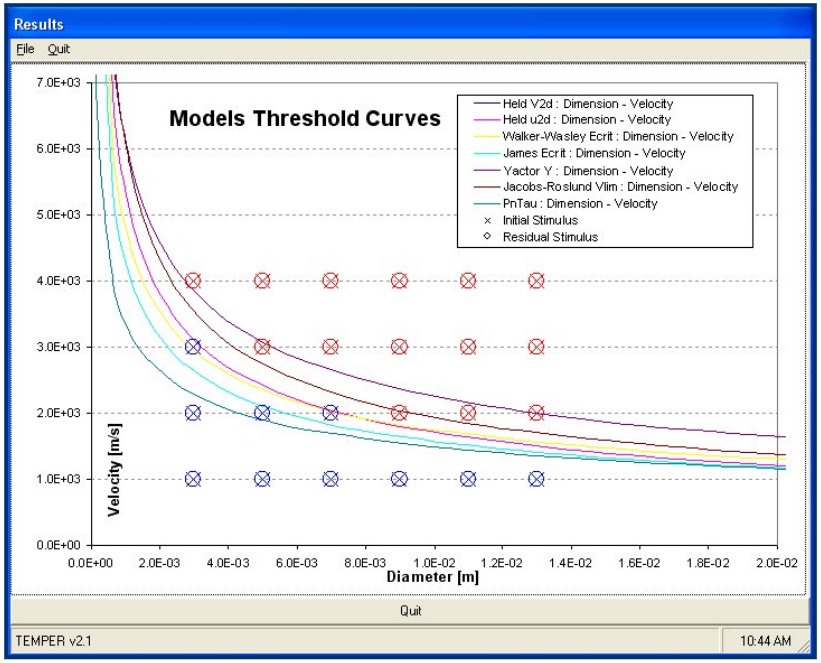
- An MSIAC modified Jacobs-Roslund model that is based on an analysis of many experimental test results and that requires only one parameter.
- The implementation of conical fragment that enables simulation of the NATO fragment defined in STANAG 4496.
- The modelling of a residual fragment after perforation of a mitigation for conical-ended and parallelepiped fragment. This model may be used to simulate the impact of a NATO fragment on bare or packed munitions.
- A sympathetic reaction model, SANDI, that is based on a different approach than that of the One on One Warhead model.

Note:

The functionality of TEMPER is being incrementally included in the browser-based application ARM.

Format:	Executable (.exe)
Responsible TSO:	Warhead Technology
Documents:	O-176 Temper status and recommendations L-139 TEMPER v2.0 – User's Manual
Link:	https://www.msiac.nato.int/tools/temper/
Available to:	All approved users





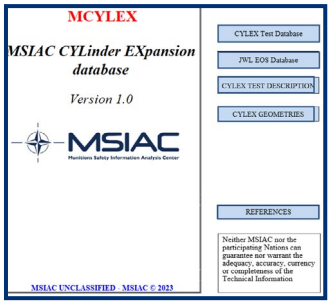
MCYLEX - MSIAC Cylinder Expansion Database

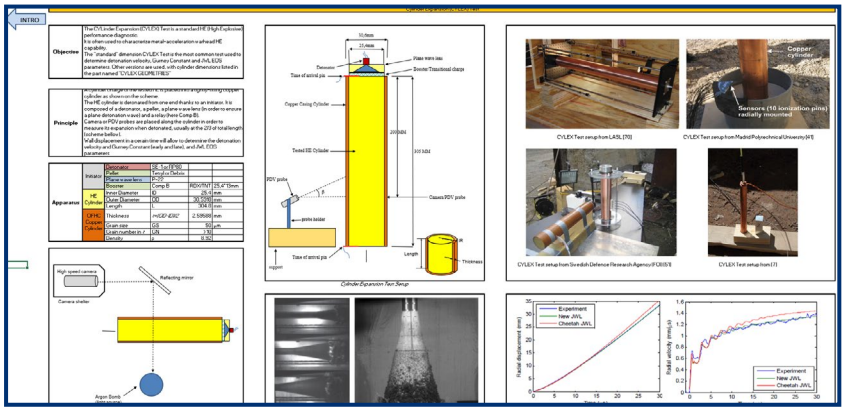
MCYLEX is a database of high explosive cylinder expansion test setups and test results, as well as a collection of Jones-Wilkins-Lee (JWL) equation of states. It has been designed to provide scientists and engineers with a comparison and analysis tool.

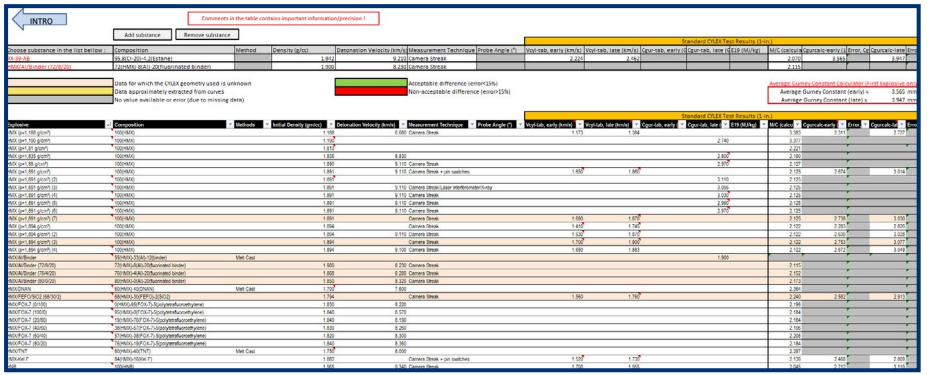
MCYLEX provides:

- A listing and descriptions of cylinder expansion test geometries and setups.
- A database of high explosive cylinder expansion experimental test results with source references that includes comparisons and analysis.
- A database of JWL equation of state parameters along with references that can be used for modelling of high explosives.

Format:	Spreadsheet (.xlsx)
Responsible TSO:	Warhead Technology
Documents:	O-222 MCYLEX Introduction (MSIAC CYLinder EXpansion Database)
Link:	https://www.msiac.nato.int/tools/mcylex/
Available to:	All approved users







NOTES

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0014-25 NATO Graphics & Printing (EM(ICTM)AIM)