MSIAC AUDIT PROCEDURE OF IM & IM/HC TESTING ORGANIZATIONS' CAPABILITIES & COMPETENCES

A Step towards Certifying Organizations Carrying Out Munitions Safety Tests

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1. INTRODUCTION

NATO is now an Alliance of 28 nations together with more than 30 Partners. Such an Alliance can only work effectively together, when there is a common set of standards to professionally execute joint and combined operations. In addition, The Alliance is involved more and more in out-of area expeditionary operations using forces from numerous member nations and Partners who all have different backgrounds. This common set of standards can be achieved by the development and use of one specific NATO Standardization Agency (NSA) product: the Standardization Agreement (STANAG). STANAGs and their associated documents are the main tool used to achieve interoperability and interchangeability because they provides uniform politics and procedures.

However, there is need to ensure that results requested in those standards can be trusted as the requirement for weapon manufacturers to meet government developed performance-based specifications has removed the military from direct control of their activities and placed reliance on the manufacturer's capability to produce the weapons and to demonstrate conformance. Accreditation of organization demonstrating conformance to standards is one way of ensuring that National and NATO and needs are met.

This issue was raised to the MSIAC Steering Committee (SC), which agreed to create a Work Element to address Certification for Munitions Safety Testing at Member Nation Test Ranges. It was also agreed that the initial phase will limited itself to IM testing. Accordingly, MSIAC has developed a procedure to audit capabilities and competences of organizations carrying IM tests. The SC also agrees to share this procedure with all Nations members of the Allied Committee 326 of the CNAD Ammunition Safety Group (CASG-AC/326).

2. TEST CENTER CERTIFICATION WITHIN NATO

Testing organization accreditation haves been around since a long time. As a result of the need for small arms ammunition interoperability/interchangeability recognized long time ago, NATO set up an accreditation process for small arms ammunition. As early as the late 1950's small arms ammunition interchangeability was an issue. Nowadays small arms interchangeability is still assessed through direct evidence testing although the amount of testing is much larger than in 1950's. Such interchangeability is verified by the NATO Regional Tests (RTC) or National Test Centers (NTC). These Regional Test Centers (North American Regional Test Center(NARTC) and European Regional Test Center(ERTC)) are accredited by Sub Group 1 of Land Capability Group 1 of the NATO Armaments Group (NAAG-LCG/1-SG/1)[1]. The NTCs are certified and inspected by either NARTC or the ERTC. The NTCs are then certified by the NAAG-LCG/1-SG/1. As one can see certification/accreditation of small arms test centers has been in place since about 50 years.

[1] Accreditation differs from certification by adding the concept of a third party (Accreditation Body) **attesting to technical competence within a laboratory** specific to a Scope of Accreditation.

Such certification has benefits not only for the users but also for the manufacturers. Many nations purchase only NATO qualified ammunition designs and NATO nominated national weapon systems[2]. The qualification tests of a new design, production lot acceptance tests and surveillance tests of stored ammunitions carried at certified RTCs/NTCs, prove that foreign ammunitions will work in foreign weapons and will work reliably from production to grave.

3. MSIAC AUDIT PROCEDURE

3.1 PURPOSE

The purpose of the MSIAC Audit Procedure of IM Testing Organization's Competences and Capabilities is to establish and promote mutually acceptable testing standards that will lead in internationally acceptable IM test results, reports and IM signatures as well as recognizing IM test organizations that meet the agreed standard. It is specializing in documenting technical competence and capabilities to carry IM testing and Hazard Classification (IM/HC) test harmonized to IM tests. It goes beyond traditional quality standards as it aiming at demonstrating that organizations have the competences to offer valuable insight in testing procedures and to develop sound test methods. Such competences are very important as IM and IM/HC tests are not defined very accurately in standards and can be carry out using alternative methods while still meeting standards. It was developed as support tool to the new AOP-39 Ed. 3 Annex H on "Conduct and Reporting of Full Scale Hazard Tests" developed by the Sub Group 3 (SG/3) of CASG-AC/326.

This procedure also provides the technical information needed to document testing according to ISO/EIC 17025 General Requirements for the Competence of Testing and Calibration Laboratories Clause 5 (Technical requirements). This is a testing laboratories quality management system that applies to all organizations performing tests and/or calibrations regardless of the number of personnel or the extent of the scope of testing and/or calibration activities. Unlike certification to ISO9001, ISO 17025 laboratory accreditation uses criteria and procedures specifically developed to determine technical competence, thus assuring customers that the test, calibration or measurement data supplied by the laboratory or inspection service are accurate and reliable. Most National accreditation bodies have adopted ISO/IEC 17025 as the basis for accrediting their country's testing and calibration laboratories. As such, the US National Institute of Standards and Technology uses ISO 17025 to accredit organizations testing Personnal Body Armor. Therefore organizations carrying IM & IM/HC testing could potentially be accredited to ISO17025 for this type of testing.

3.2 DESCRIPTION

The MSIAC Audit Procedure is a living document that will be updated to reflect the evolution IM & IM/HC test procedures. This third edition that reflects changes from by the previous version of AOP-39(Ed.2) and other relevant standards comes as four Excel questionnaires and user' manual:

- Guidance on General Standards (Part A).
- Guidance on IM Testing Competences (Part B)
- IM Test Procedures Mandatory Requirements (Part C)
- Guidance on Reporting Additional IM Testing Capabilities (Part D)

It is designed in such a way that the self audit (internal audit) can also be used to carry out formal audits. Initially, it is expected that it will be used in the self audit mode by test organizations to

[2] NATO Small Arms Ammunition Interchangeability via Direct Evidence Testing, L. Geddes, Joint Services Small Arms Systems Annual Symposium, Exhibition and Firing Demonstration, Virginia Beach, 2000.

promote their competences and capabilities. It is also useful to identify weakness, limits and potential for nonconformity in a formal audit.

3.2.1 Guidance on General Standards (Part A)

This part inquires about the existence of an environmental management system, an occupational health and safety system and a quality management system. Although the former systems are not expecting to have a direct impact on the test results, having an occupational health and safety system and an environmental management system specifically addressing IM & IM/HC testing is important as IM & IM/HC tests often result in violent reaction of large amount energetic materials in the open. IM testing differs from all other ordnance/munitions safety and all other testing in that the pass criterion for each test involves a violent response. In addition, to mechanically projected debris, potentially hazardous chemical compounds that are not commonly released in testing range can result from such test as the munitions most of the time do not function as designed. These chemical compounds may affect the health of the workers as well as heavily polluting test sites with toxic products. The questionnaire can be found in Table I and as well all the other questionnaires on the MSIAC secure website (https://sw.msiac.nato.int/secureweb).

An environmental management system will help to keep the IM testing organization in line with their national Environmental Legislation, to aid range management, and to help with post operation clean-up. It ensures that organizations exercise duty of care towards the protection of the environment and therefore showing to your business partners, regulatory agencies, and community that you are environmentally responsible. An occupational health and safety system will help to ensure that workers are not exposed to, in addition to the usual risks associated ordnance/munitions handling and testing, to toxic compounds rarely found in testing range. Nowadays a quality management system is required everywhere and there is no need to justify such a need for organizations carrying out IM & IM/HC testing. However ISO17025 a standard dedicated to testing laboratories is not as common and it certainly worth implementation in a test organization.

Table I: General Standards

General Standards	
Criteria	**Comments**
Do you have implemented a quality management system that specifies the general requirements for the competence and capabilities to carry out tests and/or calibrations such as ISO/IEC 17025:2005 (General Requirements for the Competence of Testing and Calibration Laboratories) or ISO 9001? Identify this system, the certification/accreditation agency, the certification past history and validity period of the certificate. Do you have procedures specifically dedicated to assess the quality of IM tests?	
Do you have implemented an Occupational Health & Safety system based on a standard such as ILO-OSH 2001? Identify this system and its past history. Do you have procedures specifically dedicated to assess the safety of IM tests? Provide a list of these procedures.	
Do you have implemented an environmental management system based on a standard of the ISO14000 type? Identify this system and its past history. Describe the relevant parts of this plan. Do you have procedures dedicated to assess the environmental impact of IM tests? Provide a list of these procedures. (In some countries, government agencies must meet their national regulations even when operating aboard.)	
Do you have implemented other relevant general standards? Identify this system, the certification agency (if relevant), certification past history and validity period of the certificate. Do these systems have procedures specifically dedicated to assess the IM tests? Provide a list of these procedures.	

3.2.1 Guidance on IM Testing Competences (Part B)

This part requests detailed information on the quality assurance system and references on relevant documentation describing these procedures. It also request information on qualification, training, expertise and experience of personnel in carrying out IM & IM/HC testing More specifically it request what is the experience and expertise of personnel in developing IM tests, writing tests plans, carrying out IM tests, carrying out IM test results assessment and reporting IM tests results according to STANAG 4439/AOP-39 Ed.3 requirements. In addition, to enquiring about personnel competencies, it is also requesting about organizations past and current history in carrying out IM and IM/HC tests as well as participating the trial planning group. These group typically include representation of the project team, the relevant safety authority and, where appropriate, relevant specialists from research establishments as well as from the testing organization itself.

This part address in details the technical information needed to document compliance with sections 5.2 (Personnel), 5.4 (Test and Calibration Methods and Method Validation), 5.6 (Measurement Traceability), 5.7 (Sampling) and 5.10 (Reporting of Results) of ISO/EIC 17025 Clause 5. In the MSIAC procedure, the information requested in the various sections has been merged into two parts (IM Testing Competences and Capabilities) in order to cope with the specific of the IM and IM/HC testing procedures. The questionnaire providing guidance on IM Testing Competences can be seen in Table II.

Table II: IM Testing Competences

IM Testing Competences	
Criteria	**Comments**
It is assume that each test is carried out on an entirely different test site. Therefore this guidance document contains a section for each IM test.	
Do you have quality management and quality assurance documents specific to IM testing and Hazard Classification tests* associated with IM testing? Provide a list of these procedures. Would you provide them? (*Relevant IM/HC tests are UN tests 6b, 6c, 7g, 7h, 7i, 7k.)	
Is all the instrumentation calibrated on regular basis? Are these calibrations traceable to national or international standards? What is the organization responsible for the maintenance of these standards?	
What are the staff qualification related specifically to IM tests especially the key staff?	
What training and competency evaluation related specifically to IM tests does the test directors responsible for carrying IM test have followed?	
What training and competency evaluation does the staff involved in IM tests has followed to report optimally IM test results?	
What knowledge and experience does the staff has in collecting IM test data such as air blast pressure, etc?	
What knowledge and experience does the staff has in developing and carrying out IM tests?	
How frequently are you carrying out training update course?	
Provide a list of the relevant technical positions that require personnal certification, of the certifying organization, of the frequency of certification and a brief description of the certification process if applicable	
What is your organization capability and past history in developing IM test plans, carrying IM tests, assessing IM test results and producing required IM test conditions repeatedly? What is your organization capability and past history in participating group equivalent to trial planning group as described AOP-39 Ed. 3 Requirements on Reporting Trial and Test Report Template (Annex H, Appendix 4 and 5)?	
Do the local conditions impose any restriction on carrying IM tests?	
Could your test center provide reports according to AOP-39 Ed. 3 Requirements on Reporting Trial and Test Report Template (Annex H, Appendix 4 and 5)?	

3.2.2 IM Test Procedures Mandatory Requirements (Part C)

This part is an exhaustive and detailed questionnaire compiling of the IM and IM/HC mandatory instrumentation equipment and site requirements as described in NATO and UN relevant testing procedures, i.e., STANAG 4240 Ed.2 (15 April 2003), STANAG 4241 Ed.2 (15 April 2003), STANAG 4382 Ed.2 (15 April 2003), STANAG 4396 Ed.2 (15 April 2003), STANAG 4496 Ed.1 (13 Dec. 2006), STANAG 4526 Ed.2 (15 July 2004), AOP-39 Ed. 3 (March 2010), STANAG 4589 Ed.1 (20 October 2000), TOP 4-2-822, (25 September 2000) and UN Transport of Dangerous Goods Manual of Test and Criteria, Ed. 4, 2003. It also contains minimum requirements (Sentencing) established on the basis of various tests requirements, rationale for each minimum requirements, detailed references used in establishing these minimum requirements and a comment field to report compliance.

This part contains seven spreadsheets. One spreadsheet (Response Assessment Instrumentation) specifically addresses instrumentation needed to assess the item response in each of the six IM and IM/HC tests. The other six spreadsheets address individually, for the Fast Cook Off, the Slow Cook Off, the Bullet Impact, the Fragment Impact, the Shaped Charge Jet Impact and the Sympathetic Reaction test, dedicated instrumentation equipment, test site layout and the testing parameters assessment instrumentation. Part of the Response Assessment Instrumentation questionnaire can be found in Table III while part of the Shaped Charge Jet questionnaire can be found in Table V. Complete questionnaire could not be shown here because of lack of space.

This part provides detailed the technical information needed to document compliance with sections 5.3 (Accommodation and Environmental Conditions), 5.5 (Equipment) and 5.9 (Assuring the Quality of Test and Calibration) of ISO/EIC 17025 Clause 5.

3.2.3 Guidance on Reporting Additional IM Testing Capabilities (Part D)

Compliance with General Standards, IM Testing Competences and IM Test Procedures Mandatory Requirements is relatively straightforward to demonstrate. However, successfully demonstrating compliance to these requirements and standards does not tell you a lot about a test organization other than it have the correct instrumentation, test equipment, physical test site layout, training and quality management system to enable IM and IM/HC testing to be completed as per NATO and UN standards requirements. The capabilities of test organizations to perform tests effectively with a high degree of result reproducibility, their strengths and their limitations are not assessed. The variability of the results is magnified by the fact that IM and IM/HC tests procedures are not defined very accurately and can be carry out using alternative methods permitted that are not may entirely equivalent. The discussion about fuel acceptable for Fast Cook Off illustrated this.

This part attempts to address this by providing a range of questions that are intended to help organization in “drawing a picture” of their capability and competences and to acknowledge their strengths and limitations. A test organization could demonstrate advantageously their capabilities to carry out complete, accurate and reproducible IM and IM/HC testing. The content of this questionnaire is not directly attributed to requirements within an IM and/or IM/HC test procedures but rather to the capacity to go beyond mandatory requirements.

Table III: IM Test Procedures Mandatory Requirements, Part of the Response Assessment Instrumentation Sheet

Response Assessment Instrumentation					
Type of Criteria	Criteria	Rationale	References	Sentencing	Comments
References: STANAG 4240 Ed.2 (15 April 2003), STANAG 4241 Ed.2 (15 April 2003), STANAG 4382 Ed.2 (15 April 2003), STANAG 4396 Ed.2 (15 April 2003), STANAG 4496 Ed.1 (13 Dec. 2006), STANAG 4526 Ed.2 (15 July 2004), AOP-39 Ed. 3 (March 2010) UN Transport of Dangerous Goods Manual of Test and Criteria, Ed. 4, 2003, Test 6c, 7g, 7h,7i, 7k, Related documents: STANAG 4589 Ed.1 (20 October 2000), TOP 4-2-822, (25 September 2000)					
It is assumed that each test is carried out on an entirely different test site. Therefore this document contains a section for each IM test.					
Air blast pressure		According to STANAG 4382, 4496, 4241, 4526, 4396, 4240 and AOP-39, air blast pressures must be measured. According to AOP-39, At least two rows of blast over pressure gauges sited orthogonally should be used in every IM test.	AOP-39 Ed.3 Annex H, Para. 22.1 & 22.4, p. H2-6 STANAG 4382 Ed.2, Para. 16i, p. 3 STANAG 4496 Ed.1, Para. 17a, p. 4 STANAG 4241 Ed.2, Para. 12a, p. 3 STANAG 4526 Ed.2, Para. 17a, p. 4 STANAG 4396 Ed.2, Para. 12g, p. 5 STANAG 4240 Ed.2, Para. 17, p. A-3 AOP-39 Ed.3 ,Annex H, Appendix 7,8,9,10, 11 and 12, Para. 4, p. H7-2, H8-2, H9-2, H10-2 and H11-2 and Para. 5, p. H12-2	A capability to use air blast gauge is required with two rows of blast over pressure gauges sited orthogonally.	
Air blast pressure measurement with mechanical gauges	Minimum number of gauge in a single test	According to AOP-39 Ed. 3 and STANAG 4142, 2 rows of blast over pressure gauges should be used. Each row should have 3 gauges.	AOP-39 Ed.3, Annex H, Para. 22.3 & 22.4 3, p. H- 2-6 STANAG 4241 Ed.2, Para. 12a, p. 3	A capability to measure air blast pressure with minimum of 6 gauges is required.	
Air blast pressure measurement with electronic gauges		According to AOP-39, pressure time history is a minimum observation during all IM tests. Electronic air blast pressure must be used to record such a history. According to STANAG 4382, 4496 and 4526, electronic air blast gauges should be used.	STANAG 4382 Ed.2, Para. 14a, p. 4 STANAG 4526 Ed.2, Para. 17a, p. 4 AOP-39 Ed.3 , Annex H, Appendix 7,8,9,10, 11 and 12, Para. 5.1, p. H7-3, H8-3, H9-3, H10-2, H11-2 and Para. 6.1, p. H12-3	A capability to use off ground electronic air blast gauges is required.	
	Gauge range	According to STANAG 4382 and STANAG 4526, the best air blast pressure measurements are obtained between 35 and 700mbar and 70 to 700 mbar respectively.	STANAG 4382 Ed.2, Para. 14a, p. 3 STANAG 4526 Ed.2, Para. 17a, p. 4	Capacity to measure an air blast pressure of 50 mbar is required in order to sentence between type III & IV.	Capacity to measure air blast pressure between 35 and 700 mbar is suitable.
	Gauge accuracy	It is required in TOP 4-2-822 that the non linearity of the pressure gauges shall be a maximum of 3 % of the pressure range used.	TOP 4-2-822, Para 4.3.1.2, p. 14	The linearity of the gauges output must be better than 3% full scale output.	

Response Assessment Instrumentation					
Type of Criteria	Criteria	Rationale	References	Sentencing	Comments
	Gauge resonance Frequency	According to TOP 4-2-822, the resonance frequency of the pressure gauges shall be at least 100 kHz.	TOP 4-2-822, Para. 4.3.1.2, p. 14	It is required in TOP 4-2-822 that the resonance frequency of the pressure gauges shall be at least 100 kHz.	
	Gauge acceleration sensitivity	According to TOP 4-2-822 the sensitivity to acceleration of the pressure gauges shall be less than 1.5 Pa/(m/s^2) in any axial direction and 7 Pa/(m/s2) in any transverse direction.	TOP 4-2-822, Para. 4.3.1.2, p. 14	It is required that the sensitivity to acceleration of the pressure gauges shall be less than 1.5 Pa/(m/s^2) in any axial direction and 7 Pa/(m/s2) in any transverse direction.	
	Gauge thermal sensitivity	Pressure gauges must have minimal thermal effects. Temperature compensated gauges shall be used.	TOP 4-2-822, Para. 4.3.1.2, p. 14	It is required that the pressure gauges with minimal thermal effects be used.	
	Gauge vibration sensitivity	It is required in TOP 4-2-822 that pressure gauges with minimal or no sensitivity to vibration be selected.	TOP 4-2-822, Para. 4.3.1.2, p. 14	It is required in TOP 4-2-822 that the pressure gauges with minimal or no sensitivity to vibration be used.	
	Maximum number of gauges	According to AOP-39 Ed. 2 and STANAG 4241, 2 rows of blast over pressure gauges should be used. Each row should have 3 gauges.	AOP-39 Ed.3, Annex H, Para. 22.3 & 22.4, p. H-2-6 STANAG 4241 Ed.2, Para. 12a, p. 3	A capability to measure air blast pressure with minimum of 6 gauges is required	
	Data acquisition system resolution and rate	The digitizing recorder must have a resolution of at least 12 bit and a sampling frequency of at least 160 kHz).	TOP 4-2-822, Para. 4.3.6.2, p. 15	A capability of digitizing air blast gauges output at rate of at least 160 kHz and a resolution of at least 12 bit is required for each gauge.	
	Data acquisition system filtering	According to TOP 4-2-822, the high cut off frequency (-3 dB) should be limited by means of Bessel type filter. Traditionally 2 different bandwidths and slopes have been used by nations The entire measurement system (transducers cable, signal conditioning and recorder) must have a frequency response flat to twice the Bessel filter cut off frequency (i.e. 40 or 80 kHz).	TOP 4-2-822, Para. 4.3.3.3, p. 14	A capability of filtering signal with a high cut off frequency 40 kHz Bessel type filter with a36 dB/octave roll off is required.	
	Data acquisition system accuracy	The electronic recording system accuracy must be 1%.	TOP 4-2-822, Para. 2.2, p. 2	It is required that the electronic system accuracy been 1% or better.	
	Data acquisition system sensitivity	The overall system (data acquisition, cabling, conditioning unit and gauges) must have linearity better than or equal to 3%.	TOP 4-2-822, Para. 2.2, p. 3	It is required that the overall system linearity must be better than or equal to 3%.	
	Installation and operation	Install and operate air blast gauges using experienced personnel	STANAG 4526 Ed.2, Para. 17a, p. 4	It is required that installation and operation of air blast gauges must be done by experienced personnel.	
	Holding fixtures	Holding fixtures must not interfere with the air flow	STANAG 4396 Ed.2, Para. 11e, p. 5	Holding fixtures that do not interfere with air flow measurements are required	

Table IV: IM Test Procedures Mandatory Requirements; Part of the Shaped Charge Jet Sheet

Shaped Charge Jet					
Type of Criteria	Criteria	Rationale	References	Sentencing	Comments
References STANAG 4526 Ed.2 (10 December 2004), AOP-39 Ed. 3 (March 2010) Related documents TOP 4-2-822, (25 September 2000)					
It is assumed that each test is carried out on an entirely different test site. Therefore this document contains a section for each IM test.					
Testing Parameters Instrumentation					
Met. conditions	Ambient temp., wind speed and direction	According to AOP-39, meteorological conditions should be recorded throughout the test.	AOP-39 Ed. 3, Annex H, Appendix 12, Para. 6.1, p. H-12-3	A capability to record met. conditions(ambient temperature, wind direction and velocities, etc.,) during the entire test is required.	
Test Equipment					
Shaped Charge Jet Charac.	Type	According to STANAG 44526, the standard shaped charge is the 50 mm Rockeye. According D. Houchins NSWC DD, the US is requesting an 81 mm shaped charge with conditioning plate as a minimum	STANAG 4526 Ed.2, Para 12, p. 3	A capability to fire 50mm Rockeye shaped charge or an equivalent charge is required. In the US, an 81mm charge with conditioning plates is required.	A capability to fire an 81 mm shaped charge is suitable.
	Charac.	According to AOP-39, characterized shaped charge must be available. According to STANAG 4241, suitable copper shaped charge other than 50 mm Rockeye might be used as long as the characteristics mentioned are made available with the test data. These characteristics are: • Charge stand-off used to establish characterization data • Velocity of the jet leading particles • Diameter of the jet leading particles • Average diameter of the jet particles after particulation • Break up time (time from detonation to jet particulation) • Position of the virtual origin of the jet within the cone • Charge penetration capability • thickness/properties of the conditioning armour block if any is used for test to calibrate the jet velocity or diameter by eroding the first jet element • Charge standoff used to characterize the charge.	AOP-39Ed. 3, Annex H, Appendix 12, para 6.1 p. H-12-3 STANAG 4526 Ed.2, Para 11b, 13 and 16, p. 3 and 4	A capability to fire other characterized shaped charge is required. A capability to provide the characteristics of test center issued shaped charges used during test results is required.	
	Stand off	According to STANAG 4526, it is best to choose a standoff so that the jet does not particulate before reaching the energetic material.	STANAG 4526 Ed.2, Para. 16, p. 4	A capability to provide stand that will position the SC at the proper standoff distance	
Witness plate		According to AOP-39, 25 mm thick steel witness plates should be used while testing heavy munitions with steel walls.	AOP-39 Ed 3, Annex H, Para 24.3, p. H-2-7	Availability of 25 mm thick steel witness plates is required	
Test Site					
Test site charac.	Item temp. before testing	According to AOP-39, the test items should be at ambient temperature (i.e. 21°C)	AOP-39 Ed. 3, Annex H, Appendix 12, Para 3.4, p. H-12-2	A capability to provide a test item conditioned at ambient temperature is required.	It is suitable to be capable to condition the test item at various temperatures as it might be required in the THA.

Part D contains seven spreadsheets. A spreadsheet designated 'Common Instrumentation' contains criteria for general instrumentation such as calibration traceability and maintenance and criteria requesting information on response assessment instrumentation available (Table V). The remaining six spreadsheets address individually, for each IM test, equipment, test site layout and the testing parameters assessment instrumentation. A typical test spreadsheet (Sympathetic Reaction) can be found in Table VI .

Table V: Guidance on Reporting Additional IM Testing Capabilities; Common Instrumentation Sheet

Common Instrumentation	
Criteria	**Comments**
It is assume that each test is carried out on an entirely different test site. Therefore this guidance document contains a section for each IM test.	
General	
Is all the instrumentation calibrated on regular basis? Are these calibrations traceable to national or international standards? What is the organization responsible for the maintenance of these national or international standards?	
Response Assessment Instrumentation	
What are the characteristic of the air blast pressure measurement instrumentation available? (maximum number and type of gauges during a test , range, accuracy of the measuring chain rate of data acquisition at the fastest rate, duration of data acquisition period at the fastest rate, etc) More specifically provide evidences that: the fixtures holding air blast gauges do not interfere with air flow.	
What are the characteristic of the video and audio equipment? (maximum number and type of units available to record visual and audio observation during a test, speed, spectral response, resolution, recording duration at the fastest speed, external trigger, adjustable pretrigger, external synchronisation etc) . More specifically: Does your video and sound equipment have an external synchronization capability? Do you infrared video capability?	
What are the characteristic of the test item generated fragment velocity measurement instrumentation available? (maximum number and type of gauges available to carry measurements during a test, range, accuracy of the measuring chain rate of data acquisition at the fastest rate and slowest rate, duration of data acquisition period at the fastest rate, external synchronization, etc)	
What type of material is available for witness plates and in what sizes?	
What are the characteristics of the thrust measurement instrumentation available? (maximum number and type of gauges available to carry measurements during a test, range, accuracy of cell, accuracy of the measuring chain, fastest rate of data acquisition , duration of data acquisition period at the fastest rate and the slowest rate, external synchronization, etc)	
What are the characteristic of the thermal flux measurement instrumentation available? (maximum number and type of gauges available to carry measurements during a test , range, accuracy of the measuring chain, fastest rate of data acquisition, duration of data acquisition period at the fastest rate, external synchronisation etc)	
What are the characteristic of velocity of detonation measurement equipment available? Ionisation probes and piezoelectric pins have been reported as potential sensor to measure velocity of detonation	

3.3 AVAILABILITY

MSIAC Audit Procedure Ed. 3 instruction manual and questionnaires will be available for download in November 2010 from MSIAC secure website (https://sw.msiac.nato.int/secureweb*).* Your feedback would be mostly appreciated. They can be addressed to: MSIAC, NATO HQ, B-1110 Brussels ,Belgium, msiac@msiac.nato.int or p.archambault@msiac.nato.int, Tel: (32-2).707.5416 or (32-2).707.5447

3.4 BENEFITS OF SELF AUDIT

There are clear benefits in carrying out self audit procedure. These are:

- A compendium of equipment, capabilities, and competences dedicated to IM IM/HC testing. It will help to:
  - Train staff new in the field of IM testing.
  - Establish quickly organization competences and capabilities to carry a specific test for a specific munitions.

- Plan future IM testing development requirements
- Identify potential non-compliance prior to a formal ISO/IEC 17025 certification audit

- Assurance that you have identified your health and safety, environmental, and quality management system commitments as far as IM & IM/HC testing is concern.
- Assurance that information is properly reviewed, documented, communicated and retained.
- Documentation that can be attach to proposals to demonstrate your organization competencies, capabilities and performance in carrying IM & IM/HC tests.
- Greater international recognition/confidence of your test organization which will aid working on joint international programmes since amongst other things:
  - Self audited test centers will be listed in the new section of the MSIAC Directory of Insensitive Munitions Testing Facilities (L-106). If agree, your self-audit report could be publish in this document.
  - Self audited organizations will be reported into the MSIAC newsletter as well the availability of the self audit data.

Table VI: Guidance on Reporting Additional IM Testing Capabilities; Sympathetic Reaction Sheet

Sympathetic Reaction	
Criteria	**Comments**
UN Transport of Dangerous Goods Manual of Test and Criteria, Ed. 4, 2003, test 6b, 7k, STANAG 4396 Ed.1 (15 April 2004), AOP-39 Ed. 3 (March 2010)	
It is assume that each test is carried out on an entirely different test site. Therefore this guidance document contains a section for each IM test.	
Testing Parameters Instrumentation	
What are the characteristic of the meteorological measurement instrumentation available? Can you measure meteorological data including wind velocity and direction and ambient temperature during the entire duration of the test?	
Test Equipment	
What are the type, caliber and designation of shaped charge available to be used as an initiator when rocket motors or gun propellants are as used as donors	
What are the type, caliber and designation of other high explosive initiation devices charge available to be used as an initiator for explosives?	
Provide sketch or drawing picture with distance of any part of the test fixture that could had any confinement or/and restriction to the distance that fragments could travel.	
Test Site	
What is the largest volume of munitions/NEQ that can be tested at once? Please remember that UN request that articles confinement must be at least 1 m thick in all directions in confined test.	
What is the largest test item that can be tested in terms of NEQ?	
What is the size of this site safety template?	
Provide sketch or drawing or picture with distance of any equipment/staff protective gear or landscape that could had any confinement or/and restriction to the distance that fragments could travel.	
What is the largest amount of explosive that can be detonated on the site? (It might be necessary to detonate entire item on the test site to calibrate air blast pressure (AOP-39 Ed.3, Annex I, p. I-5 and Annex H, Para 22.2, p. H-2-6))	
What is the maximum NEQ that can be store on this site?	
What is the largest item (size and NEQ) that can be conditioned on this site	
What are the dimensions of the largest flat leveled and unobstructed area available around the test fixture? Provide pictures?	
What is the largest surface suitable to measure air blast pressure of 50 mbar available around the test fixture?	
What is the largest surface suitable to measure the test item generated fragment velocity?	
What is the largest surface suitable available around the test fixture to measure a thermal flux of 4 kW/m^2?	
Do air space limitations result in the need to use overhead shielding?	
What are the largest witness plates that can be used on this site (dimensions and weight)?	

The benefits of self auditing have already been recognized by few organizations. Rheinmetall (DEU) and NAMMO(NOR) are currently in the process of carrying out self audit. FOI(SWE),

Bofors Test Center (SWE) are planning to do it during the fall 2010. In late 2010 or early 2011, CAEPE will intend to do it in presence international observers to add credulity to the process.
In addition, the MSIAC audit procedure is provides building blocks necessary to write the document requested in clause 5 of the ISO/IEC 17025 quality manual.

4. BENEFITS OF CERTIFICATION

Such a system, like NATO certification for small arms ammunition, offers to the user the advantage of internationally acceptable safety certificates with corresponding compliance to National duty of care requirements and provides money savings. It assists in assessing munitions manufacturers' claims of complying with NATO's Munitions Safety requirements. In addition it provides trusted data needed to assess munitions interoperability and interchangeability that are a must nowadays.

It is especially of interest to small nations where competences to review new munitions projects, correct project requirements, and supervise contractors carrying out these projects are rapidly eroding. Therefore these countries must rely more and more on consultants or industry to carry out or exercise their duty of due diligence in assessing munitions safety. Countries are unwilling to do so as they lack of knowledgeable resources needed to assess the independence, the competences and the quality of the work carried out by consultants in ammunition safety. Accordingly there is a trend towards introducing in contracts clauses holding ammunition contractors accountable for their products. Nevertheless, Ministry of Defense and government will always be somewhat responsible for their munitions.

As more and more munitions are developed and/or manufactured by groups of nations or by international consortiums, participants in these ventures will need assurance that their partners carried out tests adequately. This will lead of some sort of multilateral certification process between partners within a program if not for any other reasons than to make sure that their duty of care obligations are meet and they will not be responsible for their partners behaviour. A recent example of such a situation is: BP that is considered to be responsible, rightly or wrongly by the news media, for the oil spill in the Gulf of Mexico while the oil rig was run by a contractor. In regards of this event and others, industrials will become increasingly prudent and more stringent with their partners especially if their liability might at risk.

Such a certification will offers a number of benefits, including acting as a sign that your company is well established and has the necessary structure and process in place to carry out high quality IM and IM/HC tests. Even small business can benefit from certification as it standardizes the way the businesses are run and reduce the risk of test being invalidated because of non-compliance with testing requirements.

5. CONCLUSIONS/RECOMMENDATIONS

The need for interoperability/interchageability is not limited to small arms, it will apply to every munitions that can be used in weapons from more than one nation. As the need to certify munitions interoperability/interchageability will become larger; the need to certify IM IM/HC tests will grow and therefore the need for accredited IM and IM/HC testing organizations.

MSIAC audit procedure is a tool helping test organizations to document capabilities and competences, to develop consistency in carrying out IM tests, in reporting IM test results, in assessing these results, and to demonstrate competencies and capabilities. This procedure is available for all Nations members of the AC/326. In addition, the MSIAC audit procedure provides some technical nature building blocks necessary to obtain an ISO/IEC 17025 certification. It is believe that there are a number of short and long term benefits that could be realized if this tool is adopted widely by NATO Nations. With this in mind, MSIAC would be very grateful if you would help to improve this procedure by providing feedback on your intentions/actions regarding self audit including any outputs should you wish to share them with MSIAC or would like to be included in the MSIAC limited publication L-106.

As the procedure matures and progress are made, it is hope that this procedure will be the first step leading towards an accreditation procedure documenting internationally acceptable IM test results, IM test reports and IM signatures as well as internationally certified IM test organizations. CASG-AC/326-SG/3 could be the organization granting such an accreditation much in the same way as Sub Group 1 of the Land Capability Group 1 of the NATO Armaments Group (NAAG-LCG/1-SG/1) is accreditating NATO Regional Tests that certified small arms ammunition.