“Relationships Between UN Transportation Tests and NATO SsD 1.2.3 and IM Tests”

Introduction

The United Nations (UN) has a well established and globally applied scheme for the classification of packaged explosives. These materials are assigned to UN Class 1, and there are 6 Divisions of Class 1 (i.e., Class Division (C/D) 1.1 through C/D 1.6). This scheme is based on the hazards the explosives substances and/or articles present if they were exposed to stimuli typically associated with transport accidents. The UN system, through a series of tests, identifies the expected risks and consequences associated with packaged explosives items in transport and then based on the results of those tests places them in the appropriate C/D (or Hazard Division (HD)) that reflects their predominant hazard (i.e., blast, fragments, fire, or minimal hazard).

NATO utilizes this same UN hazard classification system as the basis for its own safety rules for the transportation, as well as the storage of munitions. NATO further breaks down UN HD 1.2 and 1.3 into Storage sub-Divisions (SsD) to further define their expected risks and consequences associated with an inadvertent initiation involving munitions in those two HD.

Separately, NATO has approved a six-test protocol for determining whether or not a munition qualifies as an Insensitive Munition (IM)/Munition a Risques Attenues (MURAT). An IM is less susceptible to inadvertent initiation to unplanned stimuli and threats that the munition may experience over its lifetime and as determined through a Threat hazard Assessment (THA). In addition, if the IM were to inadvertently initiate, then the severity and hazard effects from that munition would be significantly minimized as compared to a similar non-IM.

In addition, NATO has established SsD 1.2.3 to denote an HD 1.2 munition that is less susceptible to inadvertent initiation, but if it does initiate, the severity of the event will be greatly reduced and limited to one munition. In order to qualify as a NATO SsD 1.2.3 munition, an HD 1.2 munition must successfully pass four of the six IM tests that were mentioned above.

In practice, there are a number of aspects of both the UN and NATO hazard classification systems that are common and inter-related. The Munitions Safety Information Analysis Center (MSIAC) located at NATO Headquarters in Brussels, Belgium, receives many questions regarding this area, and consistently finds that there is confusion among the various munitions-related communities about the inter-relationships between the UN and NATO hazard classification systems and the NATO IM/MURAT program. This paper, which provides supporting narrative for Annex A, the MSIAC poster titled “Relationships Between UN Transportation Tests and NATO SsD 1.2.3 and IM Tests,” attempts to piece the important parts of those 3 systems together, and in general terms, tries to explain how they are inter-related. Annex A does this in a flowchart manner that is easier to follow, as compared to having to review the numerous UN and NATO documents dealing with these topics to determine how it all fits together. In addition, this paper and Annex A identify where common testing opportunities exist within the UN and NATO, and where it is possible, given proper coordination and approval, for testing to meet similar requirements in multiple interest areas.

UN Transportation Regulations

The requirements for the UN hazard classification system are found in the UN Recommendations on the Transport of Dangerous Goods – Model Regulations [1]. The specific testing requirements (to include test methods and response analysis) associated with this system are found in UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria [2]. These documents are generally referred to as the “Orange Book”.

The United Nations (UN) has a well established and globally applied scheme for the classification of packaged explosives. These materials are assigned to UN Class 1, and there are 6 Divisions of Class 1 (i.e., Class Division (C/D) 1.1 through C/D 1.6). This scheme is based on the hazards the explosives substances and/or articles present if they were exposed to stimuli associated with a transport accident. The UN system, through a series of tests, identifies the expected risks and consequences associated with a packaged explosives item in transport and then based on the results of those tests places them in the appropriate C/D [1] (or Hazard Division (HD)) that reflects the predominant hazard (i.e., blast, fragments, fire, or minimal hazard).

The UN transportation regulations pertaining to Class 1 explosives apply to articles, packaged articles, or packaged substances that pass Test Series 3 (for new explosive substances) or Test Series 4 (for new explosive munitions or articles), as applicable. Passing those test series shows that the explosives item under consideration is stable enough to be safe to transport. If it were not safe for transport, then it would be banned from transport.

This paper and its accompanying poster (Annex 1) are written on the basis of those two assumptions: that munitions have been accepted as Class 1 and that they are deemed to be safe for transport. Figure 1 shows where those two assumptions fit into the overall UN protocol for explosives hazard classification.

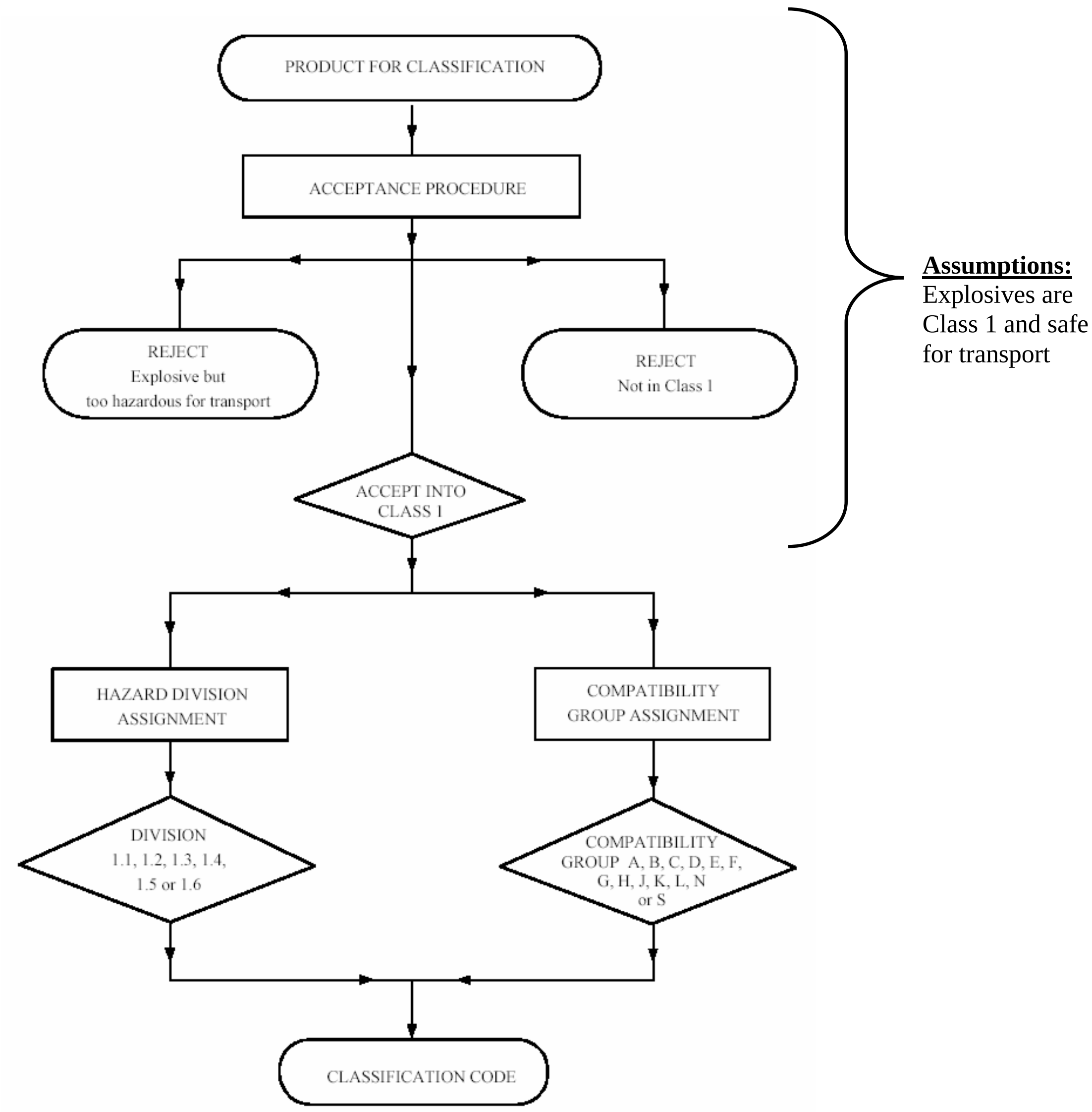

Figure 1 - Classification Procedure Schematic (Figure 2.1.1) from UN ST/SG/AC.10/1/Rev.14

[1] Class Division (CD) means the same as Hazard Division (HD). The UN uses both CD and HD, whereas NATO uses only HD in its regulations.

Munitions are generally transported in the public only after they have been fully characterized (hazard classified) in accordance with UN prescribed recommendations and testing. There are exceptions, but these exceptions will not be addressed by this paper. The hazard classification indicates the predominant type of hazard (e.g., blast, fragment, fire, or no-reaction) produced by the explosive item if it were initiated in a transport-related accident. The results of this testing determine its placement into the appropriate HD.

As shown in Figure 2, there are 3 UN test series (Test Series 5, 6, and 7) that are used to determine the appropriate HD of the substance or article/munition under consideration. The figure shows the key questions that must be answered in order to arrive at an eventual HD for the explosives of interest.

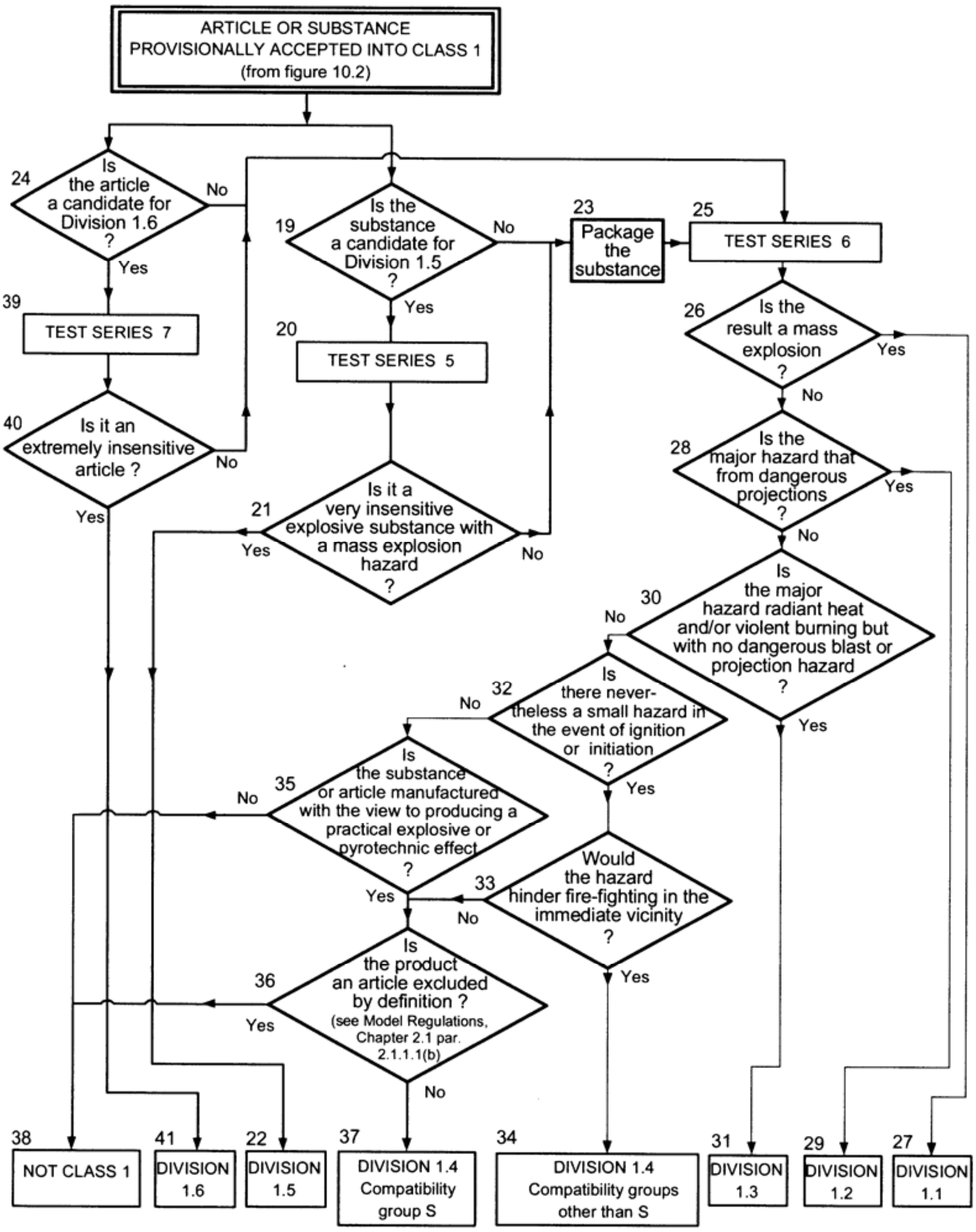

Figure 2 - Class 1 Division Assignment Schematic (Figure 10.3) from UN ST/SG/AC.10/1/Rev.14

1. Test Series 5 is used to test explosive substances that are expected to have a mass explosion hazard, but which are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport. If testing is successfully passed, then the explosive substance would be assigned to UN HD of 1.5. (Note: The "reduced vulnerability" explosives of the types developed for "IM" application may potentially fall into this Division.)

2. Test Series 7 is used to test extremely insensitive detonating substances (EIDS) or articles that contain only EIDS. These items are expected to demonstrate a negligible probability of accidental initiation or propagation. Test Series 7 consists of 2 sets of tests (substances and articles), both of which must be successfully passed in order to be considered as UN HD 1.6:

a. The first set of tests is conducted on the explosive substances themselves to insure that each meets the requirements for being considered as EIDS. Explosives substances must pass Tests 7a through 7f.

b. The second set of tests is conducted on the packaged articles to insure that the EIDS properties of the explosives substances contained within them have not changes as a result of packaging into a munition. Articles must pass Tests 7g through 7k.

3. Test Series 6 is reserved for testing of all other explosives substances or articles where it is known that they will not qualify as HD 1.5 or HD 1.6. The types of responses achieved in the required tests making up Test Series 6 determines if the substance or article (in its shipping configuration) will be assigned to HD 1.1 (mass explosion hazard, or otherwise known as mass detonating, where blast and projections present predominant hazards), to HD 1.2 (projection hazard but not a mass explosion hazard), to HD 1.3 (fire hazard with minor blast or projection hazard, but not mass explosion hazard), or to HD 1.4 (no significant hazard). HD 1.1 represents the greatest risk and threat to its surroundings; whereas, HD 1.4 represents minimal risk.

As mentioned previously, the UN HD assigned to a munition applies to transportation only. The UN system only recognizes HD 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6. This is a point that needs to be remembered for the discussion later in this paper on the NATO hazard classification system. (Note: Though it will not be addressed further in this paper, readers need to be aware that the UN hazard classification system does also require that each Class 1 item be assigned to one of the 13 possible Storage Compatibility Groups (SCC), based on their potential for increasing either the probability or magnitude of an accident or event [1].) Figures 3a through 3c show munitions in their transportation configurations where UN transportation rules would apply

Figure 3a - 155mm Pallet Prepared for Shipment

Figure 3b - Truck loaded with Ammunition Containers

Figure 3c - WDU-42/B Warheads in Transit

NATO Hazard Classification

NATO uses the UN hazard classification system as the basis for its own safety rules for the storage and transportation of munitions. NATO further breaks down UN HD 1.2 and 1.3 into Storage sub-Divisions (SsD) to better define the expected risks and consequences associated with an inadvertent initiation involving munitions in those two HD.

The NATO requirements for classification of ammunition are addressed in NATO Standardization Agreement (Stanag) 4123, "Determination of the Classification of Military Ammunition and Explosives" [3]. Specific hazard classification requirements are delineated in NATO AASTP-3, "Manual of NATO Principles for the Hazard Classification of Military Ammunition and Explosives" [4]. This manual describes the considerations and criteria used to assess the correct HD and compatibility group (CG) for a given substance or article, to calculate the net explosive quantity (NEQ) for storage purposes, and to show which explosives may be stored or transported together. NATO AASTP-1, "Manual of NATO Safety Principles for the Storage of Military Ammunition and explosives" [5] provides safety distances for the munitions, based on the HD or SsD assigned to them.

NATO's uses UN HD 1.1, 1.4, and 1.6 as is without further breaking them down. UN HD 1.5 is treated as HD 1.1. However, as mentioned above, UN HD 1.2 and HD 1.3 are broken down into Storage sub-Divisions (SsD). The applicable SsD designation is assigned by National Competent Authorities by applying specific rules and after reviewing the results of UN Test Series 6. All HD 1.2 items (except as noted below for munitions that qualify for SsD 1.2.3) are placed in either SsD 1.2.1 or SsD 1.2.2, while HD 1.3 items are placed in either SsD 1.3.1 or 1.3.2.

AASTP-1 [5] provides QD tables that show required safety distance for each HD or SsD. For the purposes of determining quantity-distances (QD), AASTP-1 [5] for SsD 1.2.1 and 1.2.2, NATO makes a distinction, depending on the size and range of fragments, between those items that produce fragments of moderate range (hazard classified as SsD 1.2.2) and those that produce fragments with considerable range (hazard classified as SsD 1.2.1). The significance of having an SsD 1.2.3 designation is that its corresponding safety distances or QD are based on only one munition reacting. This is because testing that must be passed in order to obtain the SsD 1.2.3 designation demonstrates that there is very little likelihood of detonation propagation occurring if transported or stored with similar SsD 1.2.3 munitions in the event one of them does detonate/react, as discussed below.

NATO SsD 1.2.3

NATO uses the SsD 1.2.3 designation to identify an HD 1.2 munition that is less susceptible to inadvertent initiation, but if it does initiate, the severity of the event will be greatly reduced and limited to one munition. In order to qualify as a NATO SsD 1.2.3 munition, an HD 1.2 munition must pass the following four IM tests:

a. Slow Heating (also known as Slow Cook-Off (SCO)), which is addressed by NATO Stanag 4382 [6]. The worst reaction permitted in a test item is a Type V reaction, as described later. (Note: If properly configured and agreed to by both the HC and IM authorities, conduct of this test could also be used to meet the UN Test Series 7 (test 7h) SCO article test; thereby possibly eliminating one test). Figure 4 shows examples of SCO test configurations.

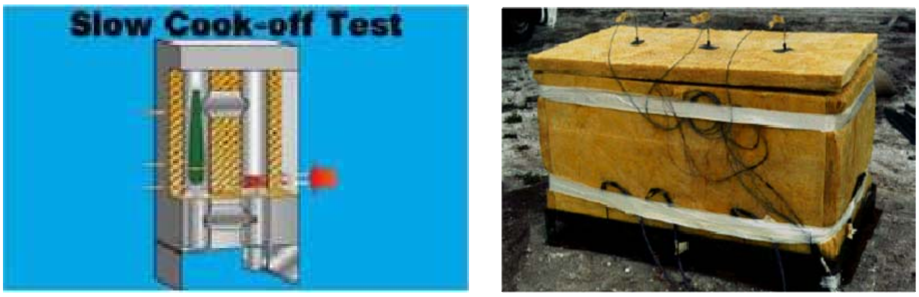

Figure 4 – Examples of SCO Test Configurations

b. Liquid Fuel/External Fire (also known as Fast Cook-Off (FCO)), which is addressed by NATO Stanag 4240 [7]. The worst reaction permitted in a test item is a Type V reaction, as described later. (Note: If properly configured and agreed to by both the HC and IM authorities, conduct of this test could also be used to meet both the UN Test Series 6 Liquid Fuel/External Fire test and the UN Test Series 7 (test 7g) HD 1.6 article External Fire test; thereby possibly eliminating two tests). Figure 5 shows examples of FCO test configurations.

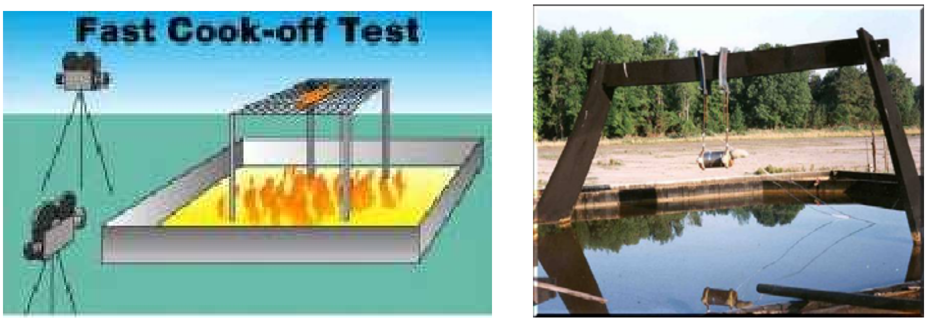

Figure 5 – Examples of FCO Test Configurations

c. Bullet Impact (BI), which is addressed by NATO Stanag 4241 [8]. The worst reaction permitted in a test item is a Type V reaction, as described later. (Note: If properly configured and agreed to by both the HC and IM authorities, conduct of this test could also be used to meet the Test Series 7 (test 7j) HD 1.6 article BI test; thereby possibly eliminating one test). Figure 6 shows examples of BI test configurations.

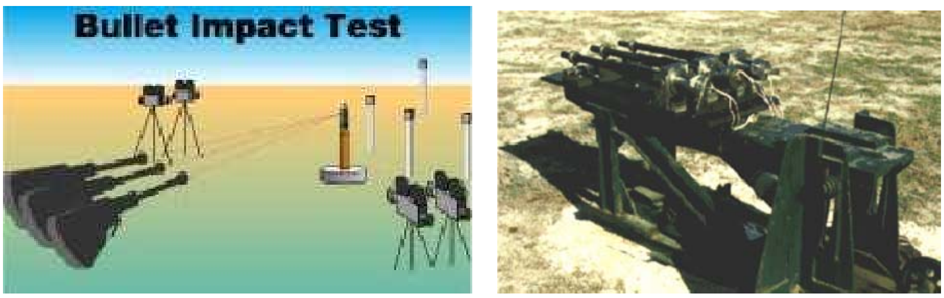

Figure 6 - Examples of BI Test Configurations

d. Sympathetic Reaction (SR) (also known as sympathetic detonation (SD)), which is addressed by NATO Stanag 4396 [9]. The worst reaction permitted in a test item is a Type III reaction, as described later. (Note: If properly configured and agreed to by both the HC and IM authorities, conduct of this test could also be used to meet both the UN Test Series 6 SR test and the UN Test Series 7 (test 7k) HD 1.6 article Stack test; thereby possibly eliminating two tests). Figure 7 shows examples of SR test configurations.

Figure 7 - Examples of SR Test Configurations

The four (4) above tests, their procedures, and their passing criteria are outlined in each of their respective NATO Stanags listed above, as well as in the over-arching NATO IM policy contained in Stanag 4439 [10] and as implemented by NATO Allied Ordnance Publication (AOP)-39 [11]. The 2 latter documents pertain to NATO's IM program, which is discussed in much greater detail in the next section.

NATO criteria in Stanag 4439 [10] specify that the worst reaction permitted in a test item during FCO, SCO, and BI testing is a Type V reaction and a Type III reaction during SR testing, in any adjacent (acceptor) munition. Reference [11] describes the following characteristics for Type III and Type V reactions (<u>Note</u>: a Type III reaction is more violent than a Type V reaction):

<u>Type III Reaction Characteristics</u> (Figure 8 shows results examples of a Type III reaction)

- ✓ Ignition and rapid burning of EM
- ✓ High local pressure yields violent pressure rupture.
- ✓ Large case fragments, energetic material scattered.
- ✓ Minor craters and witness plate damage

Figure 8 – Results Examples of a Type III Reaction

<u>Type V Reaction Characteristics</u> (Figure 9 shows results examples of a Type V reaction)

- ✓ Ignition and burning of energetic material (EM)
- ✓ Nonviolent pressure release
- ✓ Case may rupture (not fragment), scattering EM
- ✓ Item may go propulsive (moves reaction to Type IV)
- ✓ No blast effect or significant damage

Figure 9 – Results Examples of a Type V Reaction

Because a fragment distance (e.g., (07)1.2.3 - 700 feet in this example) is always assigned to an SsD 1.2.3 item, QD criteria and distances are governed by whether the SsD 1.2.3 munitions are located in the open or in a lightweight structure that cannot stop primary fragments or in a hardened structure which can stop primary fragments, but which will generate structural debris in the event of an internal detonation involving a single SsD 1.2.3 munition.

It needs to be mentioned that the HD designations of SsD 1.2.3, SsD 1.3.1, and SsD 1.3.2 will not be found in the current Change 2 version of AASTP-1 [5], but will be in Change 3 of that manual, which is expected to be issued before the end of 2006. However, use of these designations has been approved by AC/326 Subgroup (SG) 5, the owner of [5].

NATO IM

NATO Nations have established a policy that they will develop and procure munitions that are less vulnerable to accidental and combat stimuli than legacy munitions, but that retain their operational capabilities in their intended applications. Better known as insensitive munition (IM)/Munitions a Risques Attenuees (MURAT), such munitions are less susceptible to inadvertent initiation to unplanned stimuli, thereby presenting less risk and consequences to their surroundings in the event they did inadvertently initiate. As IM, the severity and hazard effects produced by the initiating munition would be significantly reduced as compared to a similar non-IM.

As previously mentioned, the NATO policy for the introduction, assessment, and testing of IM/MURAT is addressed in Stanag 4439 [10] and AOP-39 [11], which provides the guidance and direction for the implementation of [10]. Many NATO Nations have developed national polices and implementation plans to insure “IM” are procured and used [12].

Stanag 4439 [10] identifies the 6 potential threats to be addressed by IM and the required IM response goal for each of those threats (see Figure 10 below). As previously mentioned, 4 of those threats are the same as those required to be met by an HD 1.2 munition in order to qualify as SsD 1.2.3. The remaining two threats are Fragment Impact (FI), addressed by Stanag 4496 [13], and Shaped Charge Jet (SCJ), addressed by Stanag 4526 [14]. The worst allowable response (discussed in an earlier section) is a Type V reaction in the FCO, SCO, BI, and FI tests and a Type III reaction in the SR and SCJ tests. (Note: Though not specified in NATO criteria, the 4 NATO IM tests (i.e., SCO, FCO, SR, and BI) are considered by many to be the core IM tests. If possible, these 4 tests should be conducted as part of any IM test program in order to take advantage of logistical and storage benefits associated with HD 1.2 and SsD 1.2.3).)

However; it must be pointed out that all IM may not be tested to the same level and to the same tests. As outlined in [10] and [11], the determination of which of the 6 IM tests are conducted for a particular munition is dependent on the policies of the Nation involved. The IM program is flexible enough to permit Nations to configure a test (e.g., 7.62 mm bullet versus 12.7 mm bullet) as necessary based on the results of a Threat Hazard Assessment (THA) that evaluated the threats an IM was likely to experience during its lifetime. An IM test can be removed from consideration from a test program if its THA determined the munition would never experience the threat the test was meant to address. (Note: Eliminating any test has the potential for creating problems later if the planned use for the munition changes (e.g., new platform, new transport method, use by a different Service or Nation).

It is the opinion of this writer that the four core IM tests (SCO, FCO, SD, and BI) should never be eliminated by a THA as these tests are required, at a minimum, in order to hazard classify a UN HD 1.2 to a NATO SsD 1.2.3. Also, these four tests could be used to meet UN HD 1.6 article (7g through 7k) tests if the IM contained EIDS. In addition, it is possible that Nation's efforts towards trying to change UN criteria to establish an HD 1.6-equivalent designation for IM without EIDS may be successful at some point. For those munitions where the IM rating does not include all of the four core tests, such a change in UN criteria would likely result in the need to conduct additional, expensive testing after the development project is completed. Combining test requirements (IM and hazard classification) to the extent possible, in order to eliminate duplicative testing, will have a positive impact on reducing time and money and the number of assets specified in the Test and Evaluation Master Plan (TEMP) for a particular IM program.

The conduct of the remaining two IM tests (FI and SCJ) that are unique to the IM community should be based on the reality of that IM facing those threats in an operational environment, as determined by the THA.

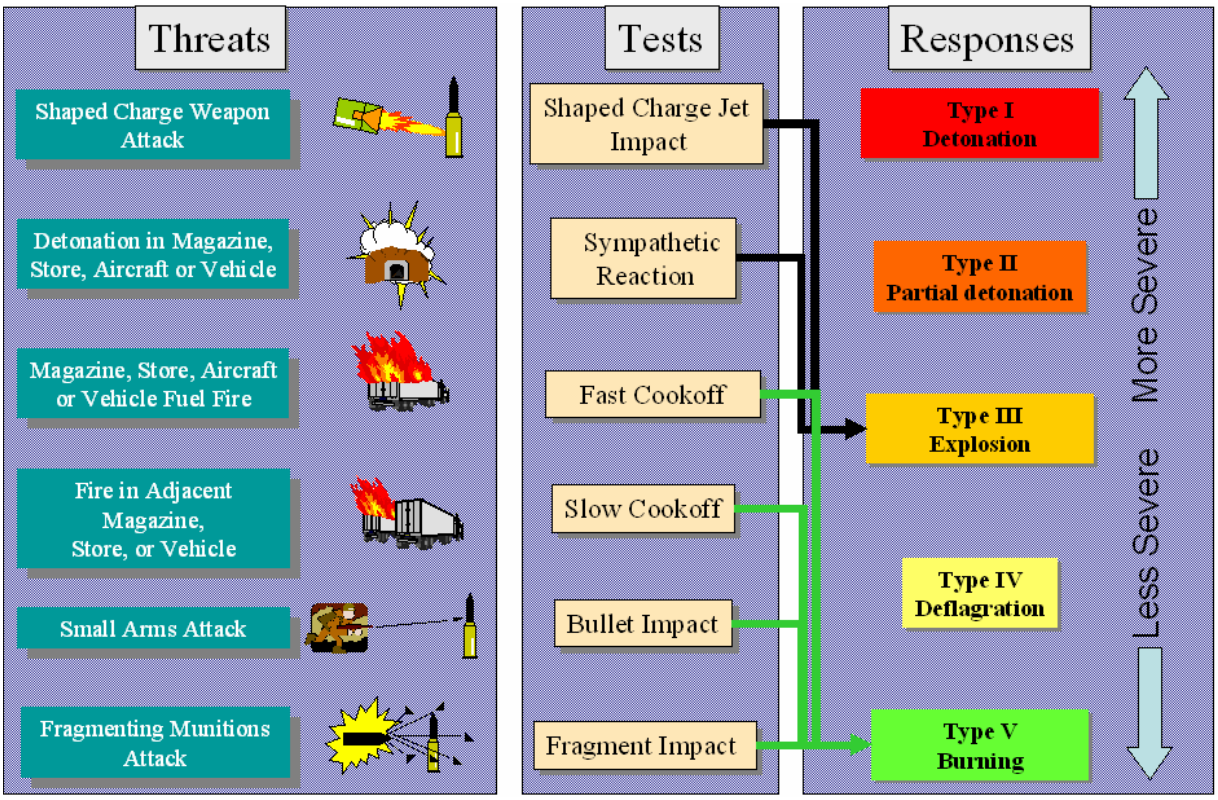

Figure 10 – Tests and reaction Levels [10]

Currently, there is some confusion and some misunderstanding between the IM and the hazard classification communities regarding the inter-relationships between the UN and NATO hazard classification and IM programs. For this reason, MSIAC developed the Annex A poster, which show the many elements associated with UN and NATO hazard classification, the NATO SsD hazard classifications for 1.2, and the NATO IM program. Annex A tries, in a flowchart format, to show how these all fit together. In general, the IM community has its sights set on a completely IM product (the Holy Grail) and has lesser interest in incremental improvements in the HD of munitions (i.e., from 1.1 to 1.2 to 1.2.3 to 1.6). However, from the perspective of the hazard classification community and the user in the field, there are significant storage and transportation benefits to be gained from incremental munitions HD improvement, because of the reduced risk, consequences, and required safety distances associated with a munition that is classified as SsD 1.2.1, 1.2.2, or 1.2.3 as compared to HD 1.1. Incremental gains in reduced vulnerability, risk, and consequences can also be used to advantage in many other areas where the munitions will be processed, handled, stored, and used.

In addition, though munitions technology is bringing us closer to the ultimate IM goal, there still remains an issue with IM and how it is perceived from a UN hazard classification criteria viewpoint. If an IM does not contain EIDS, but passes all NATO IM tests and all UN Test Series 7 HD 1.6 article (7g through 7k) tests, it still cannot be classified as an HD 1.6. The best the IM can hope for is an HD 1.2 for transportation and an SsD 1.2.3 for storage. Consequently, IM cannot benefit from the large logistical benefit associated with an HD 1.6, though it will react in a manner similar to HD 1.6. A number of Nations are pursuing efforts to change UN criteria to establish an HD 1.6-equivalent HD for IM without EIDS.

If all energetic materials in the IM are EIDS and all UN Series 7 substance and article tests (7a through 7k) have been passed, then the IM could be hazard classified as UN HD 1.6.

<u>Commonality and Harmonization</u>

Assignment of an HD or an SsD within the UN and NATO hazard classification systems and NATO's determination of a munitions' IM characteristics are all based on testing, much of which are very similar. The annex A poster tries to identify where commonality exists and where properly configured testing, contingent on approval by both IM and hazard classification authorities, could possibly be conducted to meet testing requirements for multiple areas.

IM Test references for SCO [6], FCO [7], BI [8], SR [9], and SCJ [14] currently reference commonality with the UN hazard classification tests of the same type. As indicated in those Stanags, where those tests are to be used to meet requirements in both areas, then coordination with the appropriate hazard classification and IM authorities should be conducted.

As an example of commonality: Two tests (SR and Liquid Fuel/External Fire) are part of the 3 required tests that must be conducted as part of UN Test Series 6 to determine the HD of a munition (i.e., 1.1, 1.2, 1.3, or 1.4). The UN test and response criteria for those two tests are very similar to those found in NATO Stanags 4396 and 4240, which are, respectively, the IM test documents for SR and FCO. Those tests are also specified as two of the four tests required to be conducted in order to obtain SsD 1.2.3 (for items that meet HD 1.2 UN test criteria). In addition, those tests could be used for conducting two of the four article (7g and 7k) tests specified by the UN for an HD 1.6 item.

Another example of commonality: four (SCO, FCO, BI, and SR) of the six (SCO, FCO, BI, SR, FI, and SCJ) IM tests are specified by NATO criteria in order to show that a munition item meets SsD 1.2.3 requirements. These same four tests could be used for conducting the 4 article tests specified by the UN for an HD 1.6 item. The responses may be slightly different but the test set-up protocol, if set up properly and agreed to by National Competent Authorities, could be used to meet requirements for both areas.

Harmonization of IM and hazard classification test criteria does present some challenges that change the way hazard classifiers have traditionally evaluated certain munitions and these situations need to addressed/considered as part of consolidating tests. An example of this occurs with the use of Stanag 4396 [9] for SR testing to also meet the UN SR requirement for hazard classification under Test Series 6. The method of initiation of the donor is significantly different between Stanag 4396 [9] and the UN Test Series 6 protocol [2] for rocket motors and gun propellants. The Stanag requires that for those munitions the donor be initiated "with a credible threat (for example, Shaped Charge Jet)(SCJ) that produces the worst donor reaction." Conversely, the UN specifies that one packaged item (in this case a rocket motor or gun propellant) be initiated with its own means of initiation or if without one, then caused to initiate in the designed mode. The UN test requirements for SR are decidedly not as stringent as the Stanag SR test requirements (which through a THA evaluates threats over a munitions lifecycle), with the result being that an item that might react in the UN test as a HD 1.3 will likely in the NATO SR test [9], with a SCJ impact, react as a HD 1.1 or 1.2. From a threat standpoint, the SCJ does represent the worst credible threat to that munition item over its lifetime. Faced with this information, the hazard classification authorities cannot ignore the THA determination that a SCJ threat exists or the test data that demonstrates a more violent reaction than would have been obtained with the UN test protocol, and as a result should hazard classify the munition based on the results of the NATO test.

Optimizing testing through harmonization of UN and NATO IM test requirements, to address operational as well as transportation (the focus of UN hazard classification) and storage threats, will provide a munition hazard classification based on the worst credible threat during its lifetime. This provides the best protection of assets and personnel because the safety distances associated with the hazard classification would reflect the worst effects produced by the worst threat. This may be, however, a very conservative approach, especially if a munition is exposed to the worst threat only a small percentage of its lifetime.

Conclusions

Eventually, all munition items will be shipped on public roads, waterways, railroads, or other system. To do so requires that the munitions be hazard classified and tested in accordance with UN transportation regulations. The UN system only recognizes HDs 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6 for transportation purposes.

NATO has developed SsD 1.2.1, 1.2.2, 1.2.3, 1.3.1, and 1.3.2 for storage purposes and the assignment of QD, to better describe the effects and consequences associated with inadvertent initiation of munitions in HD 1.2 and 1.3. Additionally, NATO Nations have testing requirements associated with their IM program and for the assignment of SsD 1.2.3 and these are found in NATO Stanags and AASTPs.

Testing associated with UN hazard classification (transportation threats), NATO's assignment of SsD 1.2.3 (storage threats), and NATO IM (potential threats over a munitions life cycle) are extremely expensive and in a number of areas overlapping each other. Consequently, the consolidation of testing requirements in those 3 areas, in order to reduce the number of test assets needed or tests conducted, is in everyone's best interests. This paper attempts to explain in general terms each program's requirements, where common testing elements exist, and where testing harmonization already exists or is possible. Annex A illustrates in a flowchart program how these elements fit together in the big picture. It does this by identifying test types (e.g., SCO, FCO, SR) and Stanags associated with those tests.

As illustrated by the rocket motors and gun propellants example in the previous section, assignment of a hazard classification to an IM item needs to consider the conceivable operational threats identified by the THA (beyond those faced in transportation and therefore addressed by UN testing protocols) and the IM test results. Testing results associated with a Stanag test may influence the final UN hazard classification.

The development of IM cannot be conducted in isolation to the hazard classification process. If the IM testing has not been fully coordinated with the hazard classification community, prior to getting to the UN hazard classification level, then there may be an increased risk that required information may not be available, and additional tests may be necessary in order to satisfy UN hazard classification test requirements. Regardless, coordination of testing to satisfy multiple areas should be closely coordinated with both IM and HC authorities prior to beginning any testing.

The four tests (FCO, SCO, BI, and SR) are considered by the author to be core IM tests and should always be conducted with IM because the results, if properly configured and coordinated, could be used to satisfy three areas (UN Series 7 article tests, NATO SsD 1.2.3 tests, and NATO IM tests), as outlined in this paper.

References

[1] UN Recommendations on the Transport of Dangerous Goods – Model Regulations, Fourteenth revised edition
[2] UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, Fourth revised edition
[3] Stanag 4123, Edition 3, Determination of the Classification of Military Ammunition and Explosives
[4] NATO AASTP-3, Edition 1, Change 1, Manual of NATO Principles for the Hazard Classification of Military Ammunition and Explosives
[5] NATO AASTP-1, Edition 1, Change 2, Manual of NATO Safety Principles for the Storage of Military Ammunition and explosives
[6] Stanag 4382, Edition 2, Slow Heating, Munitions Test Procedure
[7] Stanag 4240, Edition 2, Liquid Fuel/External Fire, Munition Test Procedures

[8] Stanag 4241, Edition 2, Bullet Impact, Munition Test Procedures
[9] Stanag 4396, Edition 2, Sympathetic Reaction, Munition Test Procedures
[10] Stanag 4439, Edition 1, Policy for Introduction, Assessment, and Testing for Insensitive Munitions (MURAT)
[11] AOP-39, Edition 1, Guidance on the Development, Assessment, and testing of Insensitive Munitions (MURAT)
[12] MSIAC Secure Website www.nato.int/related/msiac, Insensitive Munitions Policies Section (MSIAC assigned User name and Password required)
[13] Stanag 4496, Edition 1 (Ratification Draft 1), Fragment Impact, Munitions Test Procedure
[14] Stanag 4526, Edition 2, Shaped Charge Jet, Munitions Test Procedure