UDK: 658:662.1/.4:355.5
COSATI: 19-01

Modifications of the UN Tests for the Determination of Explosive Ordnance Hazard Divisions

Radenko Dimitrijević[1)]
Radun Jeremić[1)]

The paper describes six UN test 6(a) modifications and one UN test 6(b) modification. Their applicability has been analyzed. The modified tests have been applied for the examination of chosen explosive ordnance articles. The procedure for the determination of hazard divisions based on the modified tests has been proposed. Based on the results of the examination through the modified tests, and according to the proposed procedure, the hazard divisions for the chosen explosive ordnance articles have been determined.

Key words: **pyrotechnic items, safety, explosive safety, explosive ordnance storage.**

Introduction

ALMOST all worldwide regulations that define explosive safety in the process of explosive ordnance (EO) storage are based on the UN Recommendations on the Transport of Dangerous Goods [1, 2, 3]. These recommendations are being regularly improved and supplemented with new documents [4]. The United States Department of Defense produced several documents that regulate explosive safety in the process of EO storing in a high quality manner, and on the basis of the UN Recommendations, as well as on the basis of their own research [5, 6, 7]. These regulations are also being regularly improved and supplemented [8].

On the basis of the UN Recommendations [1, 2, 3], all types of dangerous goods were divided into nine categories. According to this division, practically all types of conventional and unconventional EOs and explosives are identified within Class 1 of dangerous goods. Depending on their construction, explosive characteristics, packing, as well as on other important properties, the articles of this class were split into six hazard divisions.

Hazard division 1.1 includes EOs that have a tendency for mass detonation. It means that after the initiation of one article, a detonation of the complete EO amount in a specific stack occurs. Hazard division 1.2 includes EOs that have a tendency to detonate individually. Thus, if one article is activated, the detonation process will not be transferred to other articles within the EO stack.

The complete process of determination of EO article hazard divisions is elaborated in detail within developed national defense systems [5]. Also, the complete classifications of all EO articles are published [7].

The national instruction that regulates the EO storage [9] is based on the above-mentioned publications, and it envisages the storage of EO in respect to the hazard divisions. However, hazard divisions are not determined for none of the individual EO articles. Besides, there are no basic organizational, normative, and technological prerequisites for the determination of these groups. The aim of this paper is to seek the possibilities for the introduction of new modified tests that are going to be simpler for implementation, and that will also give more data about the behavior of EOs in accident situations.

In the defense system of the Republic of Serbia currently there are several hundreds EO articles that are not assigned with a specific hazard division. Regarding the technical condition of these EOs, and the condition of storage capacities [10], as well as the provisions of the instruction [9], the determination of hazard divisions and compatibility for all the EO articles is necessary and urgent.

UN Test Series 6(a) and 6(b)

The definite classification of the EO article within hazard division 1.1 and 1.2 is done through UN Test Series 6(a) and 6(b). The essence of these tests is based on the answer to the question: Is the induced detonation transferred from an article to another article within one package [Test 6(a)] or between two packages [Test 6(b)].

The specific application of Test 6(a) to the 100 mm ammunition for the T-55 tank gun, and to the 122 mm ammunition for the howitzer D-30, is shown in Figures 1 and 2.

The implementation of this test is linked with several issues:

- mutual position of active and passive articles (projectiles, rounds) in the horizontal plane is not reflecting real conditions within a stored EO stack; also, this kind of solution does not respect the basic principle that the test creates a situation that is harder than a real condition;
- if there is a package with a bigger number of individual articles (hand grenades, rifle grenades, grenade launcher ammunition, anti-aircraft ammunition, anti-personnel land mines, special fuze boxes, mortar bombs up to 82

[1)] Military Academy, Pavla Jurišića Šturma 33, 11000 Belgrade, SERBIA

mm, 57 mm and 64 mm unguided missiles, etc.), there is always large scattering of unexploded ordnance (UXO); the clearance of the experiment site additionally complicates these already sensitive and dangerous activities;
- also, if a package contains a bigger number of individual articles, the cost of EOs spent for testing, which is not small when used in this manner, should not be overlooked;
- at the end, and bearing in mind the above-mentioned, it is sure that the implementation of a test in this form would last too long, with bigger engagement of human and financial resources.

The specific application of Test 6(b) to the 100 mm ammunition for the T-55 tank gun is shown in Fig. 3 (vertical cross section) and in Fig. 4 (horizontal cross section).

This test should closely reflect a real situation within a stored EO stack. During the implementation of this test there are also certain difficulties:
- this test also foresees the position of active and passive macro packages of EOs in the horizontal plane, which, in essence, complicates the conditions for detonation transfer and does not suit a real situation;
- long-lasting preparation of the whole arrangement is needed for the test implementation, which includes using an original or similar container filled with sand or earth, or using bags instead of boxes;
- with this test, there is also a creation and large scattering of UXO, especially when there is more than one article in a particular packing;

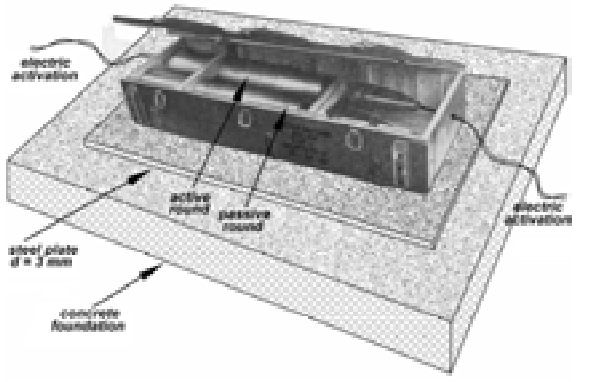


Figure 1. Test 6(a) applied to the 100 mm T-55 tank gun ammunition with HE projectiles

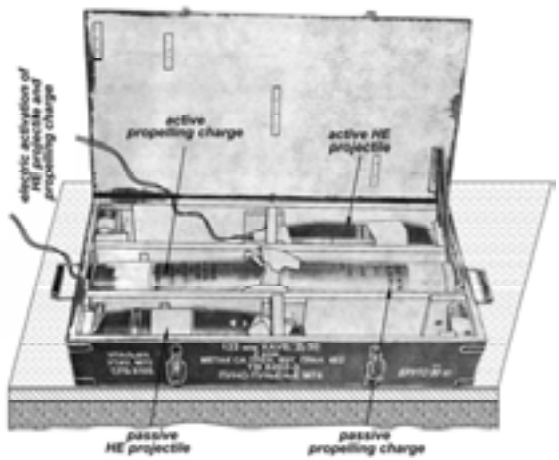


Figure 2. Test 6(a) applied to the 122 mm howitzer D-30 ammunition with HE projectiles

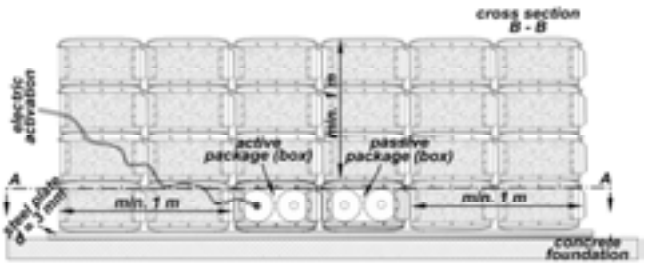


Figure 3. Test 6(b) applied to the 100 mm T-55 tank gun ammunition with HE projectiles (vertical intersection)

- further, similar with the Test 6(a), the implementation of this test would last too long with significant spending of EOs and financial assets and engagement of human resources.

In the end, both tests do not give us answers to the behavior of the EO articles in other areas of the EO disposal system. It is primarily connected with the production and maintenance of EO, its placement in combat vehicles and aircraft, on battle positions, etc.

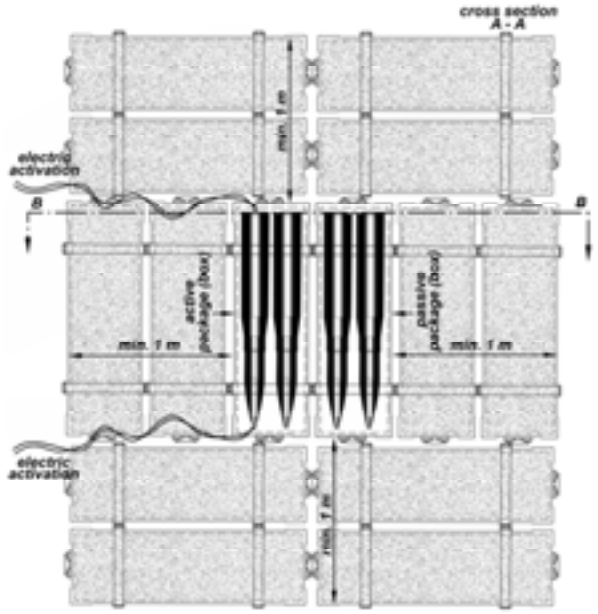


Figure 4. Test 6(b) applied to the 100 mm T-55 tank gun ammunition with HE projectiles (horizontal intersection)

On the other side of the whole issue, in the Republic of Serbia there is no experience in the implementation of these tests. Also, there is no documentation that would regulate closely testing techniques and methodology. Still, the defense system of the Republic of Serbia has professionals, organizational and technical capabilities that were dealing with EO testing during the development and production. It can be said that the necessary conditions for relatively quick determination of hazard divisions exist for all the EO articles in the defense system of the Republic of Serbia.

Test 6(a) and 6(b) Modifications

Regarding the above-mentioned deficiencies of the original tests 6(a) and 6(b), and the situation of our EO disposal system, the need rises for the determination of hazard divisions through the application of modified tests that would:
- enable faster testing preparation and performance with smaller EO consumption and the consumption of other resources,

- create a smaller number of UXO and reduce their scattering from the explosion centre,
- give answers to the behavior of EO articles in other areas of the EO disposal, like: production and repair, maintenance, placement on combat platforms, placement on battle positions, placement in artillery rocket systems, etc.,
- be flexible, and enable the choice of a test regarding the specific EO article.

Original tests 6(a) and 6(b) would be kept as the last solution. The aim is, when possible, to avoid testing in a macro-package.

As both UN tests are assigned for testing the detonation transfer, and regarding that the conditions and detonation process of smokeless powders and rocket fuels were examined in detail [11], it is logical that both propellant EO parts (propelling charges and rocket fuels) and projectiles (warheads) are activated with a detonation booster. For that purpose, the boosters of the mass similar to the mass of the detonators in fuzes as well as to the mass of the igniter charge were used. It is possible that the activation is done with the defined fuzes for static testing within the construction documentation for every EO article.

In respect to the principle that the testing conditions for detonation transfer should be more rigorous than the conditions in specific EO stacks, the vertical mutual position of active and passive EO articles (micro - and macro-package) was preferred.

Due to economic reasons, the foreseen metal base of the arrangement (3 mm thick) is replaced with a wooden base 15 mm thick and a steel plate 0.5 mm thick, on compressed earth. A metal plate still enables the rough reading of fragmentation effects.

Essentially, the proposed modified tests create more rigorous conditions for the classification, because they give better conditions for detonation transfer. Also, these tests are far more precise, because they give answers to larger number of situations within other areas of the EO disposal system, and especially in the EO maintenance system.

As well as the original tests, the modified tests are also the elimination type of tests. It means that, in the case of detonation non-transferring, the examined article is immediately classified within hazard division 1.2. In further lines the modified tests with appropriate specific examples are given. The original test names are kept, and the modifications were marked with numbers. The decision-making process (classification of individual EO articles into hazard divisions) is showed through the appropriate block-diagram in Fig.17.

Test 6(a1)

In this test, the examined articles are mutually positioned in the vertical plane as showed in Figures 5 and 6. This test is a starting one as well as an eliminatory one for all the testing.

Figure 5. Modified Test 6(a1) applied to the 100 mm T-55 tank gun ammunition with HE projectile

For the determination of the mutual position between active and passive articles, it is intended that they represent positions that are expected in real situations. If the detonation transfer does not occur (negative result), the article is definitely classified within hazard division 1.2. In case of a positive result it is moved to Test 6(a2) whether or not the articles are packed in the micro-package, or to Test 6(a4) if they are packed in the oposite order.

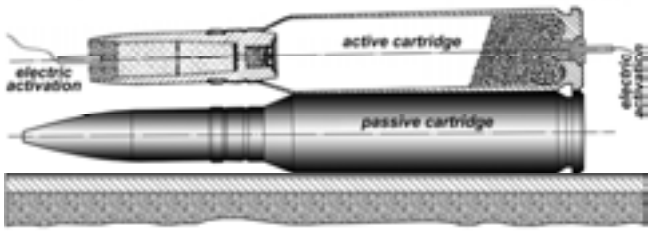


Figure 6. Modified Test 6(a1) applied to the 30 mm M53/59 AA gun ammunition with HE-T projectile

Test 6(a2)

In this test, the examined articles are also positioned in the vertical plane, parallel to each other, as shown by the example in Figures 7 and 8. It serves for testing articles without micro-packages. The distancers separate active from passive articles to the distance that is represented in a real macro-package.

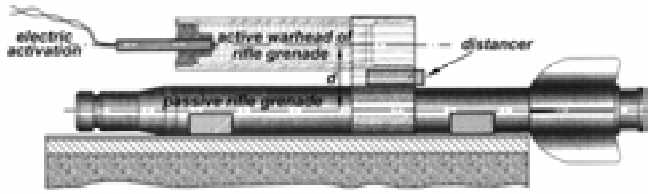


Figure 7. Modified Test 6(a2) applied to an HE rifle grenade

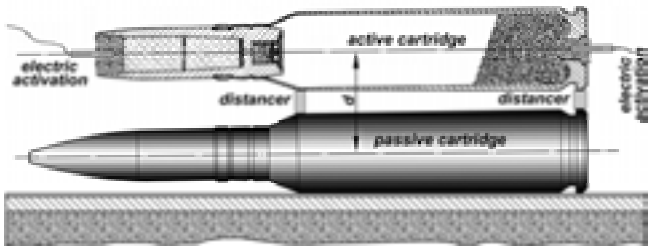


Figure 8. Modified Test 6(a2) applied to the 30 mm M53/59 AA gun ammunition with HE-T projectile

If the detonation transfer does not occur at longer distances than the real distance in the macro-package, the article is definitely classified within hazard division 1.2. If the detonation transfer does occur at distances equal to or smaller than the real distance between the articles in the macro-package, and the articles are in the micro-package, then Test 6(a3) is applied. In case that the articles are without the micro-package, tests 6(b1), 6(a), and 6(b) are applied, depending on the estimation of further testing results.

Test 6(a3)

In this test (Figures 9 and 10), the EO articles are tested in a micro-package (cases, containers, boxes, etc.). Similarly to tests 6(a1) and 6(a2), they are positioned in the vertical plane, but without any distance.

If during this testing the detonation transfer does not occur, the article is definitely classified within hazard division 1.2. In case of detonation acceptance, it is moved to Test 6(b1), or to tests 6(a) and 6(b), depending on the estimation of further testing results.

The introduction of the variation of this test with distancers, and similarly to Test 6(a2), is not justified because all the articles in a micro-package are directly positioned one with another in a macro-package, without any distance.

Figure 9. Modified Test 6(a3) applied to the 40 mm L/70 "Bofors" AA gun ammunition with HE-PF projectile

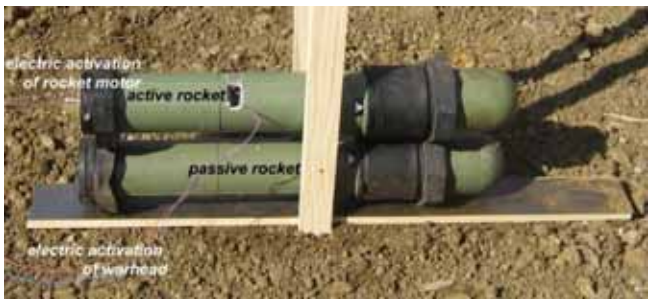


Figure 10. Modified Test 6(a3) applied to the 90 mm M79 "Osa" unguided HEAT rocket

Test 6(a4)

This test (Figures 11 and 12) is applied to the EO articles positioned in a macro-package in the oposite order. Similarly to other tests, they take mutual position in the vertical plane. When arranged, the articles should be positioned as close as possible, in the position that can be expected in real situations.

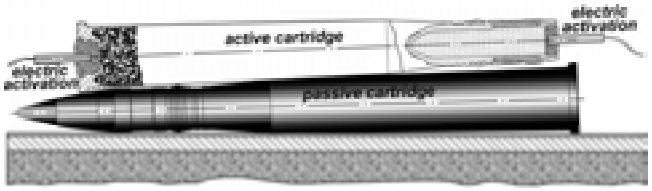


Figure 11. Modified Test 6(a4) applied to the 40 mm L/70 "Bofors" AA gun ammunition with HE-PF projectile

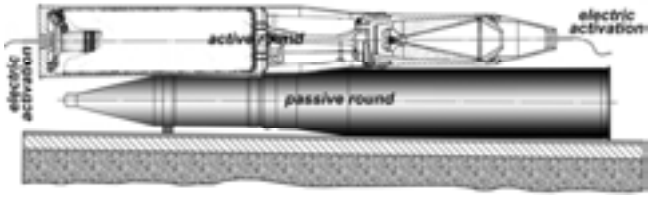


Figure 12. Modified Test 6(a4) applied to the 100 mm T-55 tank gun ammunition with HEAT-T projectile

If with this testing the detonation transfer does not occur, the article is definitely classified within hazard division 1.2. In case of detonation acceptance, it is moved to Test 6(a5) whether the articles are packed in a macro-packiage or not.

Test 6(a5)

This test is similar to Test 6(a2). Thus, the articles are positioned in the vertical plane in the oposite order. They are also parallel, as in Test 6(a4). Regarding the assortment (collection) of the tested EOs (Table 1), the test was not implemented, the 30 mm ammunition for AA M53/59 gun showed negative results to tests 6(a1) and 6(a4). The examples of the arrangement are presented in Figures 13 and 14.

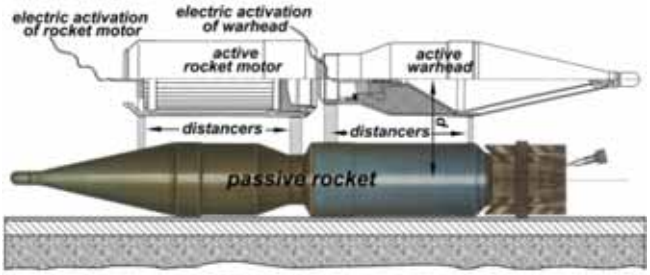


Figure 13. Modified Test 6(a5) applied to the 90 mm M79 "Osa" unguided HEAT rocket

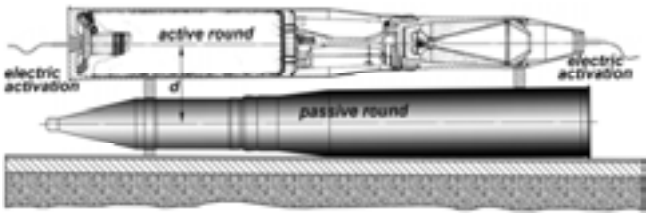


Figure 14. Modified Test 6(a5) applied to the 100 mm T-55 tank gun ammunition with HEAT-T projectile

If there is no detonation transfer at distances bigger than the real distance within the macro-package, the article is definitely classified within hazard division 1.2. If the detonation transfer occurs at distances equal to or smaller than the real distance between the articles in the macro-package, then Test 6(a6) is applied. In case that the articles are without a micro-package, tests 6(b1), 6(a), and 6(b) are applied, depending on the estimation of further testing results.

Test 6(a6)

This test is very similar to Test 6(a3). The EO articles are tested in a micro-package (cases, containers, boxes, etc.). Similarly to Test 6(a5), they are positioned vertically and in the oposite order, but without any distance.

If during this testing the detonation transfer does not occur, the article is definitely classified within hazard division 1.2. In case of detonation acceptance, it is moved to Test 6(b1), or to tests 6(a) and 6(b), depending on the estimation of further testing results.

The introduction of the variation of this test with the distancers, similarly to Test 6(a5), is not justified because all the articles in a micro-package are directly positioned one with another in a macro-package, without any distance.

Test 6(b1)

This test (Figures 15 an 16) represents the modification of Test 6(b). Similarly to the original test, the EO articles are tested in their own macro-packages. However, instead of horizontal and parallel mutual position of active and

passive macro-packages, their vertical position is introduced as a position that makes the detonation transfer easier. Also, differently from the original test, in the active package all the articles are activated, as well as projectile warheads and propelling elements. On the other hand, there is no inert covering like in the original test (Figures 3 and 4).

Testing of separated artillery ammunition (122 mm, 125 mm, 130 mm, 152 mm, 155 mm, etc.) can be started directly with this test. Also, for a more precise determination of the characteristics of this ammunition, some elements (propelling charges, projectiles) can be tested with a series of modified tests 6(a).

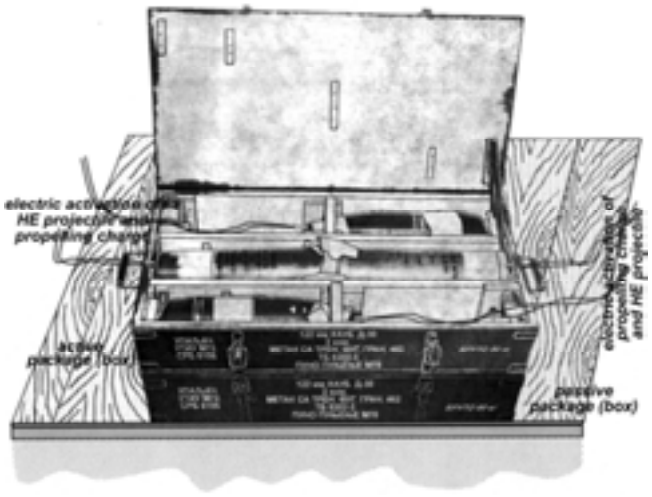


Figure 15. Modified Test 6(b1) applied to the 122 mm howitzer D-30 ammunition with HE projectile

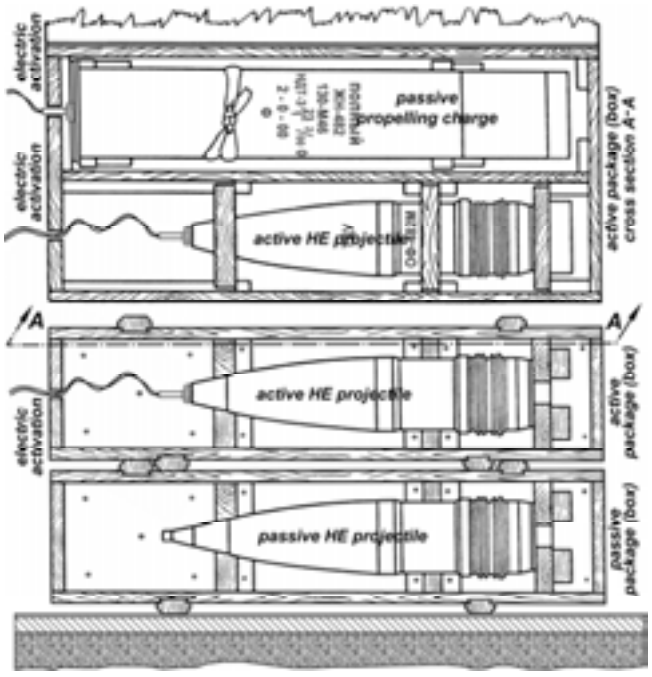


Figure 16. Modified Test 6(b1) applied to the 130 mm

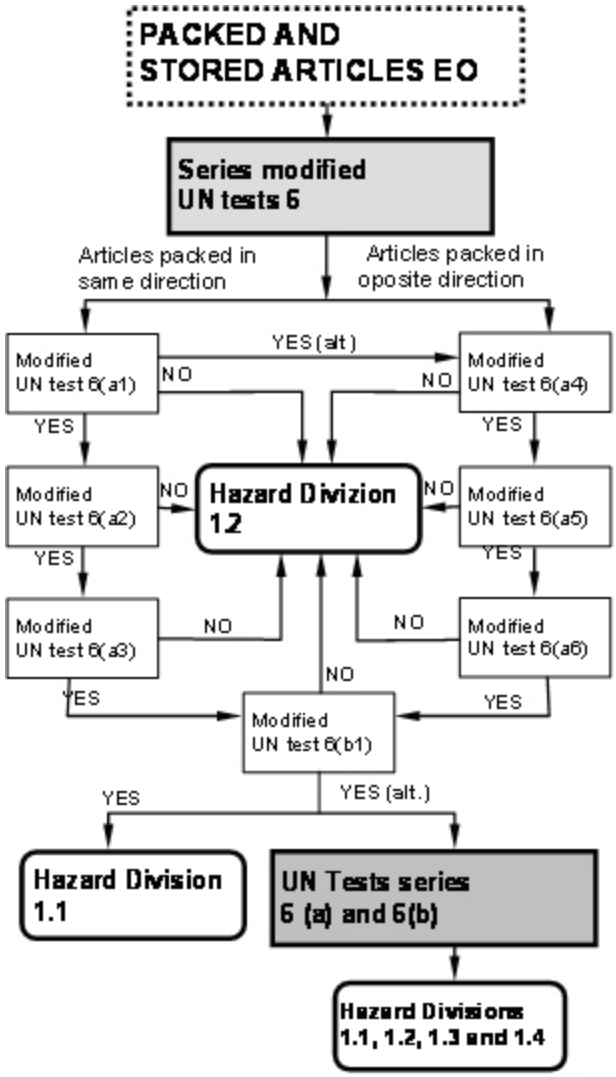
M-46 gun ammunition

The improvement of the test is possible to be realized through loading the arrangements from Figures 15 and 16 with 1-2 macro-packages (case, box) filled with earth or sand. For the case of unpacked EO articles, the modification of Test 6(b) was not considered.

If during this testing the detonation transfer does not occur, the article is classified within hazard division 1.2. In case of detonation acceptance, it is moved to original tests 6(a) and 6(b). The results obtained in these tests are then final. Depending on the specific article, and after the positive results in Test 6(b1), the hazard division 1.1. can be assigned.

General Organization and Evaluation of Testing Results

The block-diagram of determination of hazard divisions through the series of modified tests 6(a) and 6(b) is shown in Fig.17.



NO – the complete detonation of all examined articles in the arrangement did not occur, the distance between the examined articles is equal or smaller thandistances between articles within macro package
YES – the complete detonation of all examined articles in the arrangement occurred, the distance between the examined articles is bigger than distances between articles within macro package

Figure 17. Block-diagram of determination of hazard divisions for chosen EO articles through the series of modified tests

As seen in the block-diagram, the whole modified tests system, together with the original tests 6(a) and 6(b), is very flexible. Regarding the fact that all the tests are for elimination purposes, the arrangement of the test application is not necessary, but any can be used, depending on the characteristics of the tested article. In the final case, modified tests can completely be left out, and then the original tests 6(a) and 6(b) could be directly implemented.

Testing of the chosen EO articles are conducted based on the appropriate testing program. This program must anticipate and solve several groups of problems.

Within the testing program the arrangement shape is precisely defined – exact mutual position of tested articles with their mutual distances and displacements, foundation, etc.

Further, all needed activities in the preparation of articles for testing have been precisely determined – unscrewing of fuzes, rocket motors, fin assemblies, gun primers, drilling elements for installation of electric conductors, exact spot of activation and mass, position of detonation boosters, etc. Preparation activities differ significantly by their complexity. For example, preparations for the implementation of the tests of the 105 mm howitzer ammunition are minimal, while on the other hand, preparations for the implementation of the tests of the 90 mm "Osa" rockets demand much more complex actions.

Also, the complete activation procedure is defined, as well as basic explosive safety measures and the UXO procedure.

The program also defined the criteria for the evaluation of detonation acceptance/non-acceptance like: the condition of elements or complete EOs (condition of package, body parts or propelling assemblies, explosive rests), the condition of the metal plate on the foundation, the size of the crater after explosion, the detonation transfer distance with tests 6(a2) and 6(a5), etc. Likewise, in cases of detonation acceptance, there is a regulation to move to other modified tests.

The basic elements for making a decision on the classification of EO articles into an appropriate hazard division are foreseen. *This decision is based on given data from testing, but also from bibliographical data* [7], *as well as from experience with behavior of tested article in the EO accidents* [10]. These elements differ significantly from one EO article to another. For example, the size of ammunition body parts, considered during evaluation, is not the same for rifle grenades and 122 mm HE projectiles. Sizes and shapes of craters are not the same for hand grenades and 128 mm unguided rockets, and the condition of the steel plate on the foundation is not the same for hand grenades with prefragmented bodies and mortar shells, etc.

Everything above-mentioned confirms the need for tests to be as flexible as possible, which means applicable to as different EO groups as possible.

Testing Results and Discussion

For the verification of the applicability of the suggested modified tests, the testing of the chosen EO articles was realized [10, 12].

The articles were chosen mainly on the basis of their availability in the depots of the Serbian Armed Forces. Also, it was important that the chosen articles are representative, which means that they represent as many types of EO as possible. Regarding the fact that in the Republic of Serbia defense system there is a need for urgent determination of the EO hazard divisions, the goal was for tested articles to be perspective, which means that are planned to be used for at least ten years. Likewise, the choice of samples determined the scope and the possibilities of the preparation of the samples for examination.

The complete results of testing through modified tests, and through Test 6(a), are shown in Table 1.

Overall, 22 complete articles were tested, and five assemblies (individual projectiles and propelling charges). For all the examined articles, hazard divisions were determined.

As it can be seen from Table 1, the majority of the examined articles was classified into hazard division 1.2 (15 out of 22 articles). Regarding the bibliographical data [7], as well as some of our experiences [10], this kind of results could have been expected.

The results from Test 6(a1) correspond to the final result (final classification of an article within a hazard division) in 15 cases out of 22 examined articles. Bearing in mind the need for further application of other modified tests, their cost, as well as the cost of the original tests, it is obvious that the application of the vertical mutual position of the examined articles is very useful.

Test 6(b1) was used in six cases. In all of them the results correspond to the final result.

Test 6(a2) was used in six cases, and in four of them it confirmed the results of Test 6(a1), while in two of them it gave the opposite responses. In all the six cases it gave the final results.

Test 6(a3) was used in ten cases. In eight cases it confirmed the results of tests 6(a1) and 6(a2), while in two cases it gave the opposite responses. In all ten cases the results of this test were also the final decision. It has to be pointed out that the final decision was made both on the basis of the testing results and on basis of the bibliographical data [7], and on the behavior of articles in accident situations [10].

Test 6(a4) was used in one case, while tests 6(a5) and 6(a6) were not used at all, primarily because of the nature of chosen articles.

Through the analysis of the final testing results, the tendency of shaped-charge projectiles to mass detonation is noted (HEAT hand grenades, HEAT rifle grenades, 90 mm "Osa" HEAT rockets, 100 mm T-12 gun rounds with HEAT-T projectiles, 125 mm HEAT-T projectiles, etc.). It can be said that it is in accordance with their explosive characteristics – thin bodies, charges from more power and more sensitive high explosives, etc.

It can be also noticed that M-57 hand defensive grenades are classified within hazard division 1.1. Regardless the illusory unexpected result, it is also in accordance with the bibliographical sources [7], as well as with their explosive characteristics – more power and more sensitive high explosive charges, weak plastic and prefragmented bodies, as well as fuzes without the interrupted explosive train.

A fuze without the interrupted explosive train, and the presence of the detonation cap in the base of shaped charge is the cause (among other causes) of the high sensitivity of the 100 mm T-12 gun ammunition with HEAT-T projectiles and HEAT rifle grenades.

Table 1. Results of testing of chosen EO articles through the application of modified UN tests 6(a) and 6(b)

No.	EO ARTICLE	Test 6(a1)	Test 6(a2)	Test 6(a3)	Test 6(a4)	Test 6(a5)	Test 6(a6)	Test 6(a)	Test 6(b1)	HAZARD GROUP	PACKAGE
1.	Grenade, hand, defensive, M50P3 and M52P3	yes		no						1.2	In wooden case with 30 or 35 pieces in plastic boxes.
2.	Grenade, hand, defensive, M75	yes		yes						1.1	In wooden case with 30 or 60 pieces in plastic boxes.
3.	Grenade, hand, HEAT, M79	yes	yes 30							1.1	With 12 pieces in wooden case with separated initial parts.
4.	Grenade, rifle, HE, M60, with fuze UT M70P1	yes	yes 20							1.1	With 40 pieces in zinc-metal case and in wooden case.
5.	Grenade, rifle, HEAT, M60P1, with fuze UTI M84	yes	yes 30							1.1	With 20 pieces in zinc-metal case and in wooden case.
6.	Mortar bomb 60 mm, M73, with fuze UT M68P1	no		no						1.2	In wooden case with 12 pieces in cardboard cases.
7.	Mortar bomb 82 mm, M74, with fuze UT M68P1	no		no						1.2	In wooden case with 5 pieces in cardboard cases.
8.	Mortar shell 120 bomb, M62P1, with fuze UTU M78	yes		yes						1.1	In wooden case with two pieces in cardboard cases.
9.	Cartridge, 30 mm, for AA gun M53/59 with HE-T shell JFSv	no			no					1.2	With 40 pieces in zinc-metal case and in wooden case in oposite order.
10.	Cartridge, 40 mm, for AA gun "Bofors L/70", with HE-T shell M75, fuze UT M75SP	no		no						1.2	In wooden case with 20 pieces in cardboard cases in oposite order.
11.	Cartridge, 40 mm, for AA gun "Bofors L/70", with HEPF shell M75, fuze BR M75SE	no		no						1.2	In wooden case with 20 pieces in cardboard cases in oposite order.
12.	Round, 100 mm, for gun on tank T55, with HE shell M63P1 and fuze UTIU M63	no								1.2	With two rounds in wooden case.
13.	Round, 100 mm, for gun on tank T55, with HEAT-T shell M69 and fuze UT PE M69	no								1.2	With two rounds in wooden case.
14.	Round, 100 mm, for anti-tank gun MT12, with HEAT shell BK3 and fuze GPV-2	yes	yes 25							1.1	With two rounds in wooden case.
15.	Round, 100 mm, for anti-tank gun MT12, with HE shell and fuze UTIU M72	yes	no 25							1.2	With two rounds in wooden case.
16.	Round, 105 mm, semifixed, for howitzer M56, with HE shell M1, fuze UTU M51A5	yes	no 25	no					no	1.2	With two rounds in cases in oposite order in wooden case.
17.	Projectile, 122 mm, HE M462, fuze UTIU M72	yes									–
18.	Round, 122 mm, with projectile HE M462, full charge, fuze UTIU M72							no		1.2	With two rounds in case in oposite order.
19.	Propelling charge, 125 mm, base M88	no									–
20.	Projectile, 125 mm, HEAT-T, M88, fuze UT PE M87	yes									–
21.	Projectile, 125 mm, HE-T, M86, fuze UTIU M85	no									–
22.	Round, 125 mm, with HEAT-T projectile M88								no	1.2	With one round in wooden case.
23.	Round,125 mm, with HE-T projectile M86								no	1.2	With one round in wooden case.
24.	Projectile, 130 mm, HE M79	no									–
25.	Round, 130 mm, with HE projectile M79, reduced charge								no	1.2	With one round in wooden case.
26.	Rocket, 128 mm, M63, with HE warhead, fuze UTI M63	yes		yes					no	1.2	Package of two rockets in cardboard cases in wooden case.
27.	Rocket, 90 mm, HEAT-T M79	yes		yes				yes	yes	1.1	With three rockets in containers in wooden case.

YES – passive article (package, assembly) received a detonation of an active article (package, assembly), number shows the detonation transfer distance.

NO – passive article (package, assembly) did not receive a detonation of an active article (package, assembly).

Conclusions

On the basis of everything exposed, it can be claimed that the proposed set of modified tests enables determination of hazard divisions for tested EOs with significantly less engagement of material as well as human and financial resources.

The set of the proposed modified tests includes more rigorous testing conditions, first of all because of the mutual position of the tested articles in the vertical plane. Also, thanks to that position, the set of tests gives an answer to EO articles behavior in other situations that could occur in the EO disposal system.

The existing UN tests 6(a) and 6(b) have to be kept as the final way of testing, while modified tests serve as far more simple and faster replacement.

The whole proposed system of modified tests is more flexible because it enables the choice of tests appropriate for tested articles. Still, before making a decision about the way of testing, it is necessary to conduct a detailed analysis that would result in a decision on the applied test sets. The implementation of the tests is conducted through detailed technological documents that include all phases of testing, starting with the preparation of articles, arrangement, safety measures, to the evaluation of the results.

The given results can be served as temporary data in the process of EO storage. Also, the given data, as well as the gained experience, are sufficient for the development of appropriate sublegal (standards, instructions, etc.) and other (technical and technological documentation) documents that would be a normative basis for the determination of hazard divisions for all EO articles.

References

[1] Transport on Dangerous Goods, *Recommendations of the Committee of Experts on the Transport of Dangerous Goods*, Third Revised Edition, United Nations, New York, 1984.

[2] Recommendations on the Transport of Dangerous Goods, *Test and Criteria*, First Edition, United Nations, New York, 1986.

[3] Recommendations on the Transport of Dangerous Goods, *Model regulations*, United Nations, New York, 1997.

[4] UN Internet sites.

[5] Ammunition and Explosives Hazard Classification Procedures, TB 700-2, NAVSEAINST 8020.8B, TO 11A-1-47, DLAR 8220.1, Department of Defense, Washington, 1998.

[6] DOD Ammunition and Explosives Safety Standards, DOD 6055.9-STD, Department of Defense, USA, 1999. DOD Ammunition and Explosives Safety Standards, DOD 6055.9-STD, Department of Defense, USA, 2008.

[7] Hazard Classification of United States Military Explosives and Munitions, U.S. Army Defense Ammunition Center, McAlester, 2007.

[8] Organizations that are mostly dealing with these issues and publishing in this area, are: U. S. Army Defense Ammunition Center (DAC), www.dac.army.mil and DoD Explosives Safety Board (DDESB).

[9] Instruction for the Work of Ammunition Depots (in Serbian), General Staff of the Yugoslav Armed Forces, Logistics Division, Technical Department, TU-V, 5105, Belgrade, Serbia, 2002.

[10] JEREMIĆ,R., DIMITRIJEVIĆ,R., MILOSAVLJEVIĆ,D., BAJIĆ,Z.: Solving the Problem of Explosive Safety in Ammunition Depots (in Serbian), Science and Research Project, Ministry of Defense, Military Academy, Belgrade, Serbia, 2008.

[11] DIMITRIJEVIĆ,R. JEREMIĆ,R.: Dependence of the Detonation Velocity upon Diameter and Bulk Density for Smokeless Powders (in Serbian), Scientific-Technical Review, Belgrade, Serbia, 2001, Vol.LI, No.6.

[12] RADOSAVLJEVIĆ,A.: Technology and Organization of Hazard Divisions Determination for Chosen Explosive Ordnance Articles (in Serbian), Final exam paper, Ministry of Defense, Military Academy, Belgrade, Serbia, 2009.

Received: 11.12.2009.

Modifikacija UN testova za odredjivanje grupa opasnosti ubojnih sredstava

U radu je opisano šest modifikacija UN testa 6(a) i jedna modifikacija testa 6(b ubojna sredstva). Analizirana je njihova primenljivost. Modifikovani testovi su primenjeni za ispitivanje odabranih artikala UbS. Predložena je procedura određivanja grupa opasnosti po modifikovanim testovima. Na osnovu rezultata ispitivanja po modifikovanim testovima, a po predloženoj proceduri određene su grupe opasnosti za odabrane artikle UbS.

Ključne reči: **pirotehnička sredstva, bezbednost, pirotehnička bezbednost, skladištenje NVO (naoružanje i vojna oprema).**

Видоизменение УН проверок для определения групп опасности средств поражения

В настоящей работе описано шесть модификаций УН проверки 6(а) и одна модификация УН проверки 6(б) и анализирована их применимость. Видоизмененые проверки использованы для исследования отобранных сортов средств поражения. Тоже предложена и процедура определения групп опасности по видоизмененым проверкам. На основании полученых результатов исследований по видоизмененым проверкам, а по предложеной процедуре определены группы опасности для отобранных сортов средств поражения.

Ključevne reči: **пиротехнические средства, безопасность, пиротехнические безопасность, склад средств наоруженя.**

Modification des tests pour la détermination des groupes du risque chez les moyens de combat

Dans ce papier on a décrit six modifications du test UN 6(a) et une modification mayens de combat du test 6(b). On a analysé leur applicabilité . Les tests modifiés ont été employés pour les essais des articles UbS (moyens de combat) choisis. On a proposé le procédé pour la détermination des groupes de risques à partir des tests modifiés. Selon les résultats des tests modifiés et d'après le procédé proposé on a déterminé les groupes du risque pour les articles UbS choisis.

Mots clés: **moyens pyrotechniques, sécurité, dépôt des moyens de combat.**