

**2000 INSENSITIVE MUNITIONS AND ENERGETIC MATERIALS TECHNOLOGY SYMPOSIUM**

**NOVEMBER 2000**

**SAN ANTONIO TEXAS - USA**

**TITLE : MIXING UNIT RISK 1.2 ITEMS**

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**SUMMARY**

French DOD recognized the unit risk 1.2 property of insensitive munitions in 1997.

French DOD awarded the MURAT label to three munitions in 1999, and thus u. r H D 1. 2 items are already present in French Forces.

They are planning to incorporate unit risk 1.2 concept in their military handbook (some equivalent of US 6055. 9 - STD).

Mixing rules come under scrutiny by French DOD.

Mixing of two different types of u.r 1.2 items should lead to an overall u.r 1.2 classification.

It is the case in the last amendment of 6055. 9 - STD.

Unlike the US, French DOD plans to put each mix of different u.r 1.2 items under technical scrutiny before any common storage: in fact, the French DOD considers the guarantee of non-sympathetic detonation might weaken, in certain circumstances.

Standard and Label Committee (SLC) of Club MURAT analyses the problem, and makes proposals to avoid a case - per - case examination.

## **INTRODUCTION**

French DOD recognized the unit risk property of MURATs in 1997.

US DOD recognizes unit risk property of some Insensitive Munitions in 6055. 9 - STD.

Club MURAT has compared the access to u.r HD 1. 2 and the logistic benefits in both countries. A paper has been presented on this comparison, by Club MURAT at the last 1998 DDESB seminar (Ref 1).

Since 1998, situation evolved in each country.

In France, French DOD has awarded the MURAT label to three munitions:

- a 125 Kg bomb (CBEMS) = two-star MURAT label
- a 155 mmHE shell (LU 211) = one-star MURAT label
- an additional protection module (Brenus reactive brick) = one-star MURAT label.

(cf Club MURAT Newsletters 3 and 4)

With these labels, these three munitions are automatically attributed the u.r 1.2 property. So, u.r HD 1.2 items are already present in French forces and corresponding QD could be used.

However, the French equivalent of 6055. 9 - STD, the " 1007" instruction, has not yet formally incorporated the concept. A text is in preparation and mixing rules come under scrutiny.

In the USA, the definition of u.r HD 1.2 has been modified and the new one is incorporated in the last revision of the 1.2 HD chapter of 6055. 9 - STD.

As the approach of mixing rules seems different in each country, SLC has analysed the situation and worded proposals to avoid a case – per – case examination of 1.2.3 storages.

Nota : unit risk HD 1.2 is designated as HD 1.2.3 in 6055. 9 - STD.

## **1. MIXING RULES IN FRANCE AND IN THE USA**

### **1.1 US MIXING RULES**

New amendment of 6055. 9 - STD for chapter on 1.2 ammunition, presents explicitly the mixing rules (§2. m).

"m. For storage of mixed Unit Risk HD 1.2 (HD 1.2.3) ammunition, multiply the NEWQD for the HD 1.2.3 items by the corresponding number of HD 1.2.3 rounds and use Table 9 – 10 with a minimum fragment distance based on the largest minimum fragment distance for the HD 1.2.3 ammunition in storage. When HD 1.2.3 ammunition is located with any other HD ammunition, the HD 1.2.3 ammunition is considered HD 1.2 (HD 1.2.1 or HD 1.2.2, according to NEWQD) for quantity – distance purposes. The mixing rules provided in subsection B.1 above then apply to the combination of the hazard divisions."

As far as we can understand :

- different types of unit risk 1.2 items, stored together, remain 1.2.3
- minimal fragment distance is based on the largest one in the storage
- when 1.2.3 items are stored with other not 1.2.3 (however 1.2) items, Q D of 1.2.1 or 1.2.2 are used.

## **1.2. PLANNED FRENCH MIXING RULES**

They are as follows:

- when different types of unit risk HD 1.2 items are stored together, unit risk property of the overall storage is never automatically accepted; a technical analysis must be realized on a case – per – case basis.
- unit risk 1.2 stored with ordinary 1.2 are considered 1.2.

## **1.3. TECHNICAL BACKGROUND OF THE FRENCH DOD POSITION**

Background of this position is based on the fact that classification is built on testing and evaluation of identical munitions.

On this basis, one cannot totally exclude, that, for example, a fragmenting bomb, induces a detonation of an adjacent heavy torpedo warhead with a thin casing, even if separately, each munition is u.r 1.2.

## **1.4. PROBLEM BREAKDOWN**

This position was analysed by SLC and estimated severe.

Industrials and procurement agencies have generally storages with a limited number of different 1.2 munitions : they will be able to use the u.r 1.2 concept.

Unlike those entities, Forces have simultaneously different types of munitions in the same magazine : a case – per – case examination is complex and time consuming, and will preclude the use of the concept in Forces.

Also SLC established a problem breakdown, which resulted in three questions :

1 / What are exactly the litigious cases ? What types ? What frequency ? .

2 / Is this situation a new one ?  
What about 1.2 mixes and 1.3 mixes?

3 / Is it possible to have general rules which would avoid a case – per – case analysis?

## 2. WHAT ARE THE LITIGIOUS CASES ?

### 2.1. NON – ROBUST MUNITION CONCEPT USE

Major difficulty seems to come from fragments ; for a thorough analysis, we will use the "robust / non – robust munition" concept as it is defined in the glossary of 6055. 9 – STD.

**"Non – Robust Munitions.** Those items that do not meet the definition of Robust or Fragmenting munitions. Examples include torpedo warheads, underwater mines, most CBU's, and TOW and Hellfire missiles.

**Robust Munitions.** These are munitions that meet two of the following three criteria : (1) have a ratio of the explosive weight less than 1.00, (2) have a nominal wall thickness of a least 0.4 inches, and (3) have a case thickness / NEW  $^{1/3} > 0.05$  in / lb  $^{1/3}$ . The following cartridges are, by definition, robust : 20 mm, and 30 mm. Other examples of robust ammunition include MK 80 series bombs, M 107 projectiles, Tomahawk and Harpoon penetration warheads.

**Fragmenting Munitions.** Items that have cases that are designed to fragment in a specified manner. Examples include continuous rod warheads, items with scored cases and items that contain pre – formed fragments. Items that fit this definition are usually air – to – air missile warheads such as Sparrow and Sidewinder."

We will divide the munitions items in two parts :

- Non – robust ones (NRM)
- Robust or Fragmenting ones (RFM).

### 2.2. FIRST ANALYSIS

According this divide line, we have four cases which are presented in the table 1 below.

Cases 1 and 4 seem marginally delicate.

As the contrary, the case 2, Robust or Fragmenting munition against a non – robust munition needs further evaluation hereafter.

The case 3, non – robust against robust or fragmenting or non – robust ones, presents no difficulty.

Case	Donor	Receiver	First analysis
1	Robust or fragmenting munition	Robust or fragmenting munition	No secondary detonation (marginal risk)
2	Robust or fragmenting munition	Non - robust munition	Secondary detonation possibility, to evaluate
3	Non - robust munition	Robust or fragmenting munition	No secondary detonation to fear
4	Non - robust munition	Non - robust munition	No secondary detonation (marginal risk)

Table 1 : u. r 1.2 mixes cases

### 2.3. NON - ROBUST MUNITION AS A RECEIVER, ROBUST OR FRAGMENTING MUNITION AS A DONOR

In this paragraph, we examine the most litigious case, a RFM as donor against a NRM as acceptor.

We have built three samples and analysed the possible results as shown in the table 2 hereafter; Q D calculations are based on French Q D regulations.

Case									Results / Analysis		
Donor = RFM					Receiver = NRM						
Type	High explosive weight	ur fragment distance	ur blast distance	No simultaneous detonation distance ①	Type	High explosive weight	ur fragment distance	ur blast distance	Fragment distance ②	Equivalent blast weight ③	Secondary detonations admitted ④
MK 82 Bomb	99 kg	90 m	37 m	11 m	antitank weapon	4 kg	90 m	13 m	90 m	1420 kg	330
HE Shell	15 kg	90 m	20 m	6 m	Heavy torpedo	500 kg	135 m	63 m	135 m	4800 kg	9
MK 82 Bomb	99 kg	90 m	37 m	11 m	Heavy torpedo	500 kg	135 m	63 m	135 m	4800 kg	8

**Table 2 : Robust or fragmenting munition (RFM) against a non robust one (NRM)**

- ① : Distance at which there is no simultaneous propagation of detonation between donor and receivers
- ② : The largest one between the donor and the receiver
- ③ : Equivalent TNT weight, having the same blast isolation distance as fragment one
- ④ : Maximal number of receiver items, the detonation of which would not induce a blast zone larger that the fragment one (donor and receivers are supposed to detonate simultaneously, this is the worst case)

Distances are towards PTR (Public Traffic Routes) (under 200 vehicles per day).

We observe that several secondary detonations, can be accepted, in open air, without exceeding fragment distances (last column number).

### 3. IS THE U.R MIXING PROBLEM A NEW ONE ?

All classification procedures are based on tests with identical munitions.

Collective tests, such as fire test or stacks tests are always realized with identical munitions.

By this way, 1.2 and 1.3 munitions mixes can be in the same situation as u. r mixes.

Suppose 105 mm artillery rounds and shaped charge missiles, both in 1.2 and in the same storage, engulfed in a fire.

It is possible that the 105 shells, detonating one after the other, send fragments which induce detonation of multiple non – robust shaped charges; and multiple might become massive.

In the same way, 1.3 mixes, may present hazards beyond 1.3 usual ones.

However these cases seem to have been judged sufficiently remote and not significant: NATO and UN committees accept than 1.2 and 1.3 mixes remain respectively in 1.2 and 1.3.

Probably, these experts consider the benefits with less hazardous items exceed largely some marginal situation consequences.

#### **4. PROPOSALS OF GENERAL RULES TO AVOID A CASE – PER – CASE ANALYSIS**

From our analysis we retain:

- a) u. r 1. 2 mixes and 1. 2 mixes or 1. 3 mixes present similar difficulties :  
guarantee linked with classification may weaken in certain circumstances.
- b) the significant delicate situation for u. r 1. 2 mixes is the situation where robust or fragmenting munitions are stored nearby non – robust ones. Guarantee of unit – risk detonation is weakened in this situation.
- c) in the open air, fragment distances exceed largely unit – risk blast distances. And several secondary detonations of non – robust munitions could be admitted without exceeding fragment distances.

So when this situation is encountered, general precaution rules must be applied:

- RFM and NRM must be stored as far as possible from each other in the same magazine
- NRM must be stored in order to present the minimum surface towards potential donor fragments: the number of receivers potentially submitted to fragments from a donor must be reduced to a minimum.

Thanks to these additive rules, it seems sensible to maintain u. r 1. 2 mixes in u. r 1. 2.

These proposals are not definitive, and should be debated by experts, but they can constitute a basis.

#### **CONCLUSIONS**

IMs or MURATs are already stored in Forces. They present less hazards than ordinary munitions.

Tactical and operational benefits will be significant with these munitions. It seems sensible that MURATs benefit also reduced Q D through u. r concept.

Thanks to additional general precautions such as these indicated here above, it appears sensible that u. r 1.2 items mixes should benefit of an overall u. r 1.2 classification.

NATO experts of AC258 group ( group of experts on the safety aspects of transportation and storage of military ammunition and explosives) should analyse the u. r concept topic and introduce it in their recommendations.

This would reduce national discrepancies between NATO nations, and promote less – sensitive munitions.

Ref 1 – "Comparison of French and US unit risk 1. 2 " – by Veronique KAYSER et al-  
Twenty Eighth DDESB seminar – Orlando – Florida – August 1998.