

## French MURAT Assessment Panel: from expert analysis to IM/MURAT signature score.

F. Chassagne<sup>1</sup>, C. Jacq<sup>1</sup>, Q. Weisse<sup>1</sup>, V. Vincent<sup>2</sup>, B. Julien<sup>2</sup> and P. Lamy<sup>2</sup>

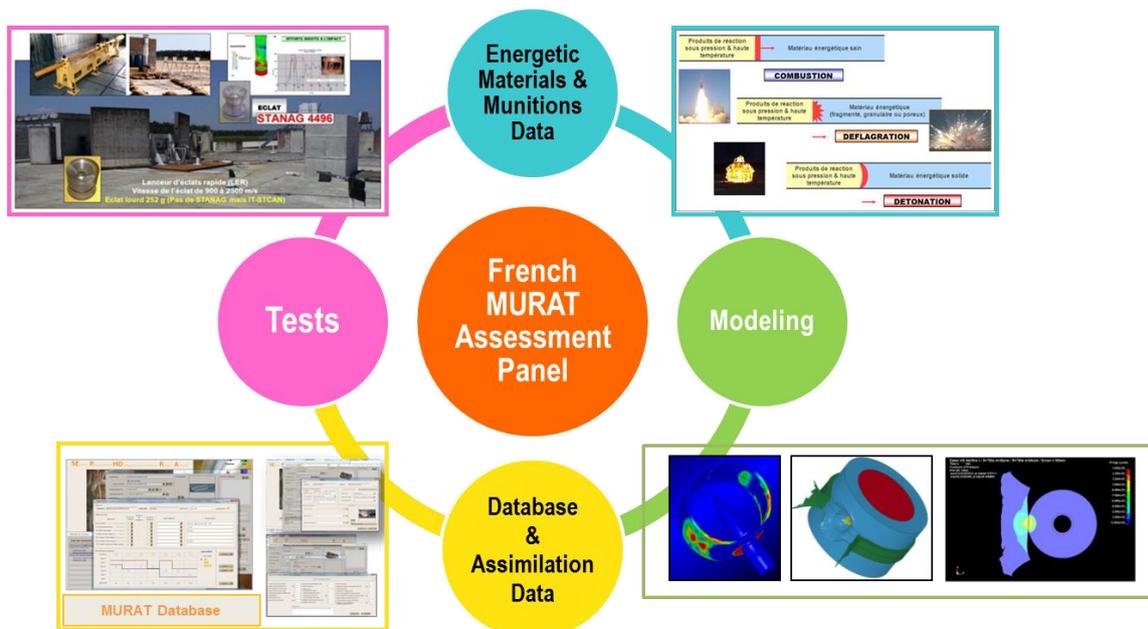
[fabien.chassagne@intradef.gouv.fr](mailto:fabien.chassagne@intradef.gouv.fr)

<sup>1</sup> DGA Missile Testing - BP 80070 - 33166 St Médard-en-Jalles cedex

<sup>2</sup> DGA/INSP/IPE, 5 bis avenue de la Porte de Sèvres - 75509 Paris cedex 15

In 2011 the French MURAT Policy has been updated by the French MoD DEF n°211893 document. As a result, IM/MURAT signature assessment has been generalized to in service munitions to give Forces better knowledge on explosive hazards in operations. The French MURAT panel composed by IPE/Munitions Safety Office and DGA MURAT experts makes the assessment as required by the **IPE instruction n°1187**. It reviews and validates the relevance of the evaluation by analyzing the full-scale test results and all the other pieces of evidence such as modeling results or lab-scale test results on energetic materials.

The aim of the present paper is to point out how the French MURAT assessment panel gathers the whole body of evidence in order to score the IM signature for the domain of analysis with a good confidence level as defined in the IPE instruction n°1187 (p.2 to p.20). The full-scale and/or mock-up test results are analyzed by following the AOP 39 guidelines. Results on similar munitions may also be reviewed by using MSIAC or French IM databases. Data on energetic materials (shock sensitivity, friability, ignition temperature,...) are also very useful to increase the confidence level on the reaction type of the all-up round munitions when faced to mechanical or thermal threats. On the other hand, modeling results from analytical tools to more sophisticated hydrodynamic codes are collected to assess reaction level for the analysis domain or when no experimental test results are available.



From 2011, the French MURAT panel has scored more than 60 MURAT signatures on different types of munitions from Army cartridge to Air Force bombs and missiles. At the end, the French Inspector for Propellants and Explosives (IPE) has officially scored 64 MURAT signatures and 26 MURAT labels.

# **IPE Instruction n° 1187 concerning the assessment and the validation of the IM signature for any new munition procurement**

*Dated 06 December 2013*

*(Non official translation)*

## *References:*

[a] Ministerial Instruction n°211893 dated 21 July 2011 establishing the policy on MURAT munitions (Munitions à Risques Atténués) and its implementation

[b] STANAG 4439 and AOP-39 on the policy for introduction and assessment of insensitive munitions (IM)

[c] IPE Instruction n°1184 concerning the specification of the MURAT requirements for any new munitions procurement

[d] Decree dated 16 May 2008 establishing the specific missions of the Armament Inspector for Propellants and Explosives (IPE)

[e] Instruction n°125 DEF/EMA/PLANS/COCA - 1516 DEF/DGA/DP/SDM dated 26 March 2010 on the course and conduct of armament programs

[f] IPE MO-2 guideline for munitions classification following NATO and AASTP-3 storage criteria

*Attachments: 7 Annexes*

*This Instruction supersedes:*

INSP N° 21 S-CAT guideline on the elaboration of the dossier justifying the MURAT label assignment

---

## **1. Aim**

The aim of the instruction is to establish, for munition procurement contracts, the implementation procedure of the Ministerial Instruction n°211893 dated 21 July 2011 establishing the French policy on MURAT munitions [a].

## **2. Scope**

This instruction concerns all services of the Ministry of Defense involved in the capability definition, the development and the procurement of munitions for the French armed forces.

It is effective upon publication. If the strict implementation of the instruction is not compliant with the progress of the contractual procedures, it is recommended to apply the general principles.

## **3. Introduction**

Ministerial Instruction n°211893 dated 21 July 2011 establishes the French policy on MURAT munitions (MUnitions à Risques ATténués) and its implementation. In conformity with the Defense Code, which requires to implement the best system safety management practices,

instruction n°211893 is the document that implements STANAG 4439 [b], and specifies the roles and responsibilities of the involved parties in the armed forces and the DGA (Direction Générale de l'Armement - French armament directorate).

Its implementation to any munition procurements is covered by two distinct instructions published by the armament Inspector for Propellants and Explosives (IPE). The first one, referred as the instruction IPE n°1184 [c], defines the process for the MURAT signature specification for any new munitions procurement and relates to armament program phases before supplier consultation up to contract notification. It details the methodologies to be followed both to define the military requirements in collaboration with the French armed forces and to reach a safety level as high as possible in compliance with STANAG 4439. It also outlines the process of gaps' treatment from the MURAT/IM requirements and criteria laid down in STANAG 4439.

The present instruction is the second implementation document of Ministerial Instruction n°211893. It aims at defining the methodologies and the process of evaluation and validation of the munition MURAT signature. This process leads to the assignment of the MURAT signature called « realized » which is the signature of the munition currently in service.

#### 4. Definitions

**MURAT munition (MUnitions à Risques ATtenués) / IM (Insensitive Munitions):** Munitions which reliably fulfil their performance, readiness and operational requirements on demand and which minimize the probability of inadvertent initiation and severity of subsequent collateral damages to weapon platforms, logistic systems and personnel when subjected to selected accidental and combat threats.

**MURAT signature:** Representation of the overall safety level of the munition in a given configuration with regard to the reference threat stimuli of Ministerial Instruction n°211893 (Annex 1) as assessed through the NATO response descriptors, from detonation (type I) to simple combustion (type V) or no reaction (type VI) as defined in AOP-39 and recalled below in Annex 2. MURAT signature is directly linked to the munition configuration (e.g. in logistical, unpackaged or tactical configuration). One munition can therefore get several MURAT signatures depending on the phases of its lifecycle.

« **Reference** » **MURAT signature:** MURAT signature resulting from the bidding process and written in the contractual clauses [c]. One « Reference » MURAT signature is determined for each munition configuration.

*Note: If « Reference » MURAT signature has not been determined because the munition procurement procedure has progressed too far when the IPE instruction n°1184 was published [c], the MURAT signature written in the contract could be used instead.*

« **Realized** » **MURAT signature:** MURAT signature scored for munition associated with a standard design that represents the manufactured munition. It corresponds to the MURAT signature of the in-service munition. One « Realized » MURAT signature is assigned by the IPE for each munition configuration from the dossier compiled by the person designated by the the procurement manager.

**MURAT label:** Standardized MURAT signature symbolized by one, two or three stars (Annex 1). MURAT label is assigned by the IPE for one given configuration [d] according to the « realized » MURAT signature obtained in the configuration and following the criteria defined in paragraph § 5.4.5.

## **5. Assessment and validation of the « realized » MURAT signature**

### **5.1. Summary of the Principles of Ministerial Instruction n°211893**

The Ministerial Instruction n°211893 outlines in its paragraph §4.2 that:

- 1. For any new munition procurements, demonstration program and assessment results of MURAT signature for one given configuration must be presented and validated by the Armament Inspector for Propellants and Explosives.*

Note 1: If many munition configurations are met throughout the lifecycle, (e.g. logistical, tactical) one signature is scored for each of them. One munition can get several MURAT signatures scored for any particular configuration.

Note 2: If it is not possible to specify in detail all the phases of the lifecycle, the most relevant ones should be identified from criteria such as percentage of lifetime in these configurations or the munition reaction consequences on human and material surroundings in these configurations (cf. §4.1 of the instruction n°211893 [a]). This analysis is carried out by the group of experts formed when the MURAT requirement is specified [c].

- 2. The MURAT assessment must allow the quality of the demonstration to be evaluated. The level of confidence ascribed to the MURAT signature must be assessed.*

### **5.2. Definition of the « realized » MURAT signature**

The « realized » MURAT signature corresponds to the MURAT signature of the in-service munition. It is scored for munition associated with a standard design that represents the manufactured munition. In the case of a modular munition, it is determined for each component or subcomponent having its own logistical phase and for the All-Up-Round munition in the life phases as far as it is concerned.

The threats taken into account for the assessment of this signature are indicated in Table 1. One standard threat (e.g. 12.7 mm AP bullet at 850 m/s) and one analysis range (e.g. 12.7 mm AP bullet in the velocity range of 400 m/s to 850 m/s) are defined for each MURAT threat (e.g. bullet impact).

The standard aggressions correspond to the stimuli defined in the MURAT/IM test standards. The analysis ranges increase the spectrum of the stimuli to be regarded. Their objective is to ensure that the munition insensitivity is not only limited to the standard threats and that munition vulnerability is decreased in a larger range which covers specific configurations wherein other reaction mechanisms can occur (e.g. case of a bullet stopped into the main loading of a warhead because the impact velocity is less than 850 m/s).

The « realized » MURAT signature takes into account both the munition response to the standard aggression and to the threat range. It is defined for each standard threat by the reaction level demonstrated for the standard aggression. The reaction level is assigned with caution if reaction is showed to be less violent than type III or equivalent to (i.e. no detonation) in the threat range. However a reaction level of type I is scored for the « realized » MURAT signature if a risk of detonation is really identified in the threat range whatever the score obtained at the standard aggression.

Standard threat	Standard aggression	Full-scale tests	Threat range	Comments
Fast heating	800°C Fuel fire Temperature of 550°C reached in no more than 30 sec after ignition of the fire.	Carried out in accordance with STANAG 4240.	Temperature range: average temperature of the fire between 550°C and 850°C	Temperature maintained until all the munition reactions are completed
Slow heating	3.3°C/h heating rate	Carried out in accordance with STANAG 4382.	Heating rate of 3.3°C to 30°C per hour starting from ambient temperature	Regular increase in temperature starting from ambient temperature, until all the munition reactions are completed*.
Bullet impact	12.7 mm AP bullet impact at 850 m/s	Carried out in accordance with STANAG 4241.	12.7 mm AP bullet Velocity range : 400 m/s to 850 m/s	No firing of bursts.
Sympathetic reaction	Donor detonation in an appropriate configuration	Carried out in accordance with STANAG 4396.	Donor detonation in an appropriate configuration.	For solid-fuel motors or artillery propellant charges, the donor shall be initiated by an external stimulus represented by a shaped charge jet aggression approved by the IPE.
Light fragment impact	NATO 18.6 g fragment impact at 1830 m/s	Carried out in accordance with STANAG 4496.	NATO 18.6 g steel fragment Velocity range : from 0 m/s to 1830 m/s	Fragment defined by STANAG 4496
Heavy fragment impact	1 parallelepiped-shaped steel 250 g fragment at 1650 m/s	Carried out in accordance with STANAG 4496 **.	1 parallelepiped-shaped steel fragment of 250 g Impact velocity from 0 m/s to 1650 m/s	French requirement Parallelepiped-shaped steel fragment with 31.7 mm side
Shaped charge jet	CCEB 62 shaped charge	Carried out in accordance with STANAG 4526.	CCEB 62 shaped charge	

\* If this condition is not completed for all-up-round munition, assessment to be done for each sub-component (e.g. rocket motor, propelling charge, warhead)

\*\* Tests carried out in accordance with STANAG 4496 but with the 250 g parallelepiped-shaped steel fragment

Table 1: MURAT/IM threats

### **5.3. Generalities on the evaluation of the « realized » MURAT signature**

The process of « realized » MURAT signature evaluation describes the steps to be followed to collect the body of evidence that justifies the MURAT level and which is necessary for validation by the IPE.

If the « realized » MURAT signature does not fulfil the MURAT requirements specified by the « reference » MURAT signature, a treatment of gaps from the MURAT/IM policy must be done in order to analyze their influence on the risk along the munition lifecycle.

The added logistical constraints and the capabilities of compensatory measures must also be studied. Note that this process is dissociated from the contractual aspects linked to the unfulfilled MURAT requirements and that are not dealt with in the present instruction.

### **5.4. Assessment and validation procedure of the « realized » MURAT signature**

The procedure is divided in five sequential phases that can be adapted depending on the type of munition procurement:

- Program of MURAT assessment;
- Detailed tests program;
- Proposal dossier of the « realized » MURAT signature;
- Assignment of the « realized » MURAT signature and a MURAT label if obtained;
- Treatment of gaps from MURAT/IM policy.

A flow chart of the process is depicted Figure 1.

The analysis of the documents required in those different phases is made by the experts designated by the procurement manager.

Note that munitions containing a small amount of energetic material and inducing no severe hazards in logistical phase, as showed by an eventual hazard classification in HD 1.4, are not concerned by the process described hereafter.

#### **5.4.1. MURAT assessment program**

The MURAT assessment program describes the methodology to be followed during the procurement in order to establish the « realized » MURAT signature. It can include full-scale tests and other evidence such as test results on similar munitions, mock-up tests, numerical simulation, and properties of energetic materials. The program must show how proposed work and available data generate the body of evidence needed to make the proposal dossier of the « realized » MURAT signature in the different munition configuration (logistical, tactical, etc).

The assessment program also takes into account the possibility to couple some IM tests with trials used for transport and storage classification. A template of the document is proposed in Annex 3.

Note that full-scale tests, because of their limited number, give limited confidence in obtained results. So it is required to systematically combine several complementary data to increase the level of confidence in the munition response.

The assessment program within designated expert's advice is forwarded by the procurement manager to the IPE. The IPE forwards his advice to the procurement manager in four weeks delay. Recommendations can be added if the proposed program does not allow to establish the munition MURAT signature in the different configurations.

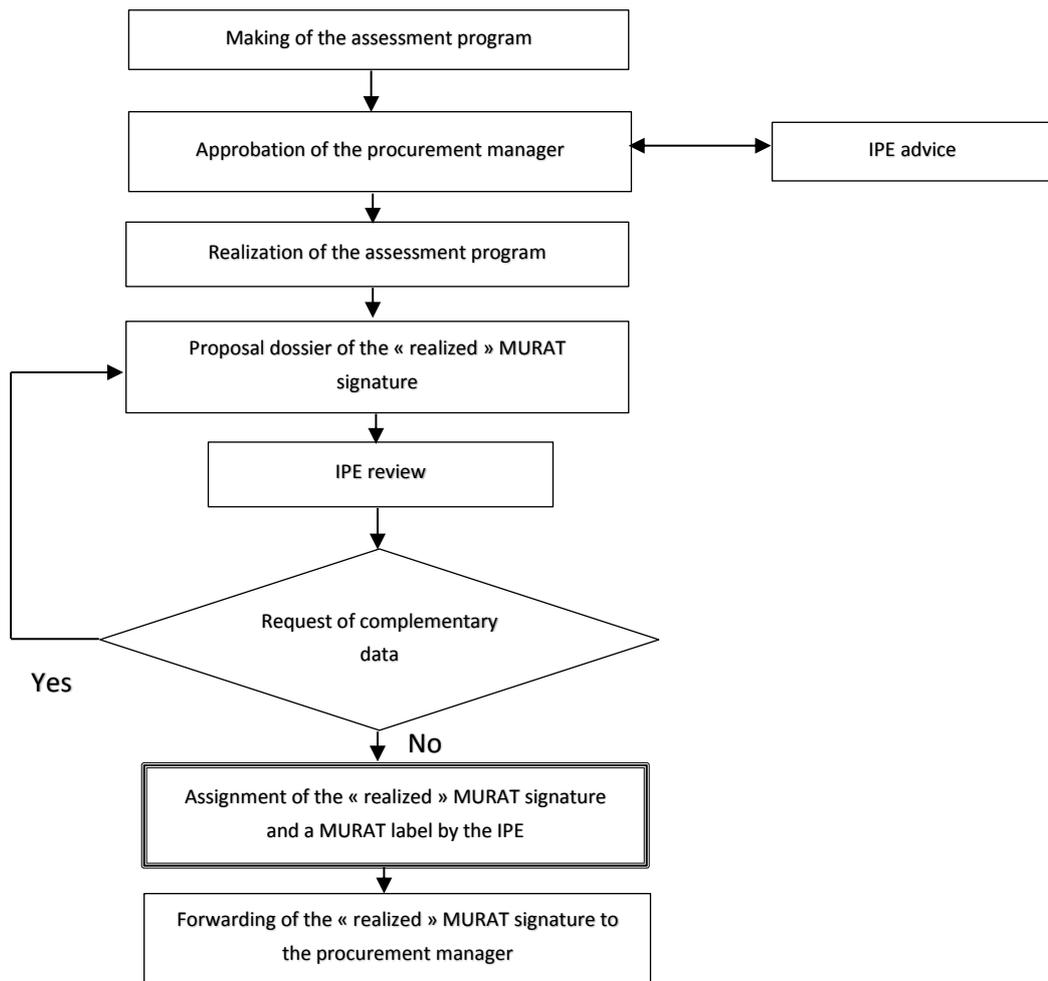


Figure 1: Flowchart of the assessment and validation of the “realized” MURAT signature

#### 5.4.2. Detailed test program

If IM tests are planned, a detailed test program is given to the procurement manager before assessment. This document describes for each trial the test configuration, measurement, standard aggression and the evidence allowing to control compliance with the IM standards and is written in French or English.

The procurement manager sends the document to designated experts for validation and to the IPE for information. The document shall be forwarded sufficiently early before tests in order to take into account potential modifications consequently to the designated expert analysis.

#### 5.4.3. Proposal dossier of « realized » MURAT signature

This dossier proposes and justifies « realized » MURAT signature of the munition in every configuration. It is based on the standard design that represents the manufactured munition. During the munition development, the writing happens after the realization of the assessment program. A template of this document is proposed in Annex 4.

The justifications provided for the munition response to standard aggression are based on full-scale tests, similar tests, mock-up tests, numerical simulation, and properties of energetic materials. The coupling of many evidence is highly required in order to consolidate the analysis and increase the level of confidence in the proposed reaction types.

The munition response in the threat range is studied following a similar process but is mainly based on existing data. The back-up full-scale tests are principally used to exclude the risk of detonation identified in the ranges.

#### **5.4.4. Assignment of the « realized » MURAT signature**

The procurement manager sends the proposal dossier of the «realized » MURAT signature to the IPE within designated experts' advice. The advice may include complementary data (such as tests, simulations and properties of energetic materials) from other programs, upstream studies, etc.

The dossier is analyzed by IPE who requests an oral presentation if needed. Following the analysis the IPE may request complementary data and justifications to establish « realized » MURAT signature. This request is forwarded to the person responsible for procurement in six weeks delay from dossier reception.

When the dossier is completed without any other remarks, the IPE assigns « realized » MURAT signature of the munition in the different configurations in four weeks delay from the date of the completed dossier reception. The template of decision of « realized » MURAT munition assignment is presented in Annex 5.

The « realized » MURAT signature is forwarded to the person responsible for procurement. It will be used for treatment of gaps between realized and reference MURAT signatures (§ 5.4.6). It will also be included in the munition safety report and used to establish the classification for transport and storage [f].

#### **5.4.5. Assignment of a MURAT label**

A MURAT label for some or all the munition configurations may be assigned if :

- The « realized » MURAT signature passes or overpasses one of the required MURAT levels (Annex 1);
- The body of evidence of the MURAT signature gives a good level of confidence in the proposed reaction levels;
- A particular attention has been paid to the compliance with the munitions design standards;
- MURAT threats may not induce a nominal firing of the munition main charge;
- The mitigation devices to achieve one of the MURAT label levels are included into the munition or in the container during the life phases concerned by the label (e.g. barrier inserted in a container to prevent munition from sympathetic detonation).

The label assignment does not concern potentially low dangerous munitions as pointed out by a hazard classification in HD 1.3G or HD 1.4.

MURAT label is assigned at the same time that as “realized” MURAT signature. A template of the assignment decision is presented in Annex 6. The template also details the item on which MURAT label can be marked (unpackaged munition, container, etc.). It is forwarded to the procurement manager and the industrial contractor.

#### **5.4.6. Treatment of gaps from IM/MURAT policy**

The treatment of gaps from MURAT/IM policy aims at analyzing the impact of gaps between « realized » and « reference » MURAT signatures in term of risks during munition lifecycle.

The IPE shall then request the group of experts constituted for the specification of MURAT requirements [c]. The group carries out a risk analysis as described in Annex 5 of the instruction n°1184 [c] and proposes some possibilities of compensatory measures. This analysis takes as reference the most violent but still accepted reaction level. The evidence of analysis and the justifications are included in the dossier of MURAT gaps' treatment (Annex 7). The dossier is forwarded by the president of experts' group to the procurement manager. After validation of the analysis by the IPE, the concerned staff decides to accept or not the gaps and the proposed treatment.

**5.5. Examples of Application to Different Types of Procurement**

**5.5.1. Armament program**

An armament program follows the procedure described in the paragraph §5.4 to establish the “realized” MURAT signature. In the case of armament program following the instruction [e], this procedure is applied at the realization stage (Figure 2).

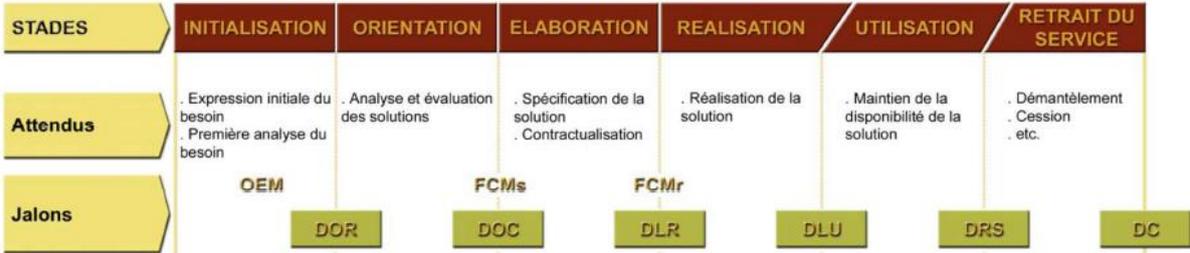


Figure 2 : MURAT Milestones and Sequence of an Armaments Program in Accordance with Instruction n°125 DEF/EMA - 1516 DEF/DGA

**5.5.2. Cooperation program**

For cooperation program, « realized » MURAT signature is established following the procedure described in §5.4. The hereafter particularities linked to the type of procurement must also be taken into account.

The person in charge of MURAT assessment program and proposal dossier of “realized” MURAT signature is designated by the procurement manager. She/he can be the munition industrial contractor or a person from the MoD. In both cases the procurement contract must anticipate the provision of data needed for their writing, as it is detailed in §5.4.1 and 5.4.3 and in the Annexes 3 and 4.

Besides it is recommended to establish jointly French official documents with the concerned national authorities. The different documents shall be provided both in French and English versions.

**5.5.3. Off-the-shelf procurement**

For off-the-shelf procurement, the “realized” MURAT signature is established following the procedure described in §5.4. The hereafter particularities linked to the type of procurement shall also be taken into account.

If bought munition has already been developed, the score of the « realized » MURAT signature can be only based on tests and existing data. If the evidence are sufficient to propose a signature, the assessment program is not needed.

The person in charge of proposal dossier of “realized” MURAT signature and potentially of the MURAT assessment program is designated by the procurement manager. She/He can be the munition industrial contractor or a person from the MoD.

In both cases the procurement contract must anticipate the provision of data needed for the writing of the proposal dossier of “realized” MURAT signature (§5.4.3) and potentially of the assessment program (§5.4.1).

The different documents must be provided both in French and English versions.

#### **5.5.4. Modernization**

The procedure to apply depends on the nature of munition parts that are modernized. If pyrotechnic parts (warhead, gun propellant, etc.) influencing MURAT behavior of munition are modified, then the procedure described in §5.4 applies.

In the other cases the objective is to ensure that the treatment of obsolescence and/or potential modifications of munition design do not induce the decrease of MURAT level. The procedure for assessment and assignment of “realized” MURAT signature is similar to that one described in § 5.5.5.

#### **5.5.5. Replenishment of Munitions**

In case of replenishment, the objective is to ensure that the treatment of potential obsolescence does not induce the decrease of MURAT level.

The justifications must be based on the describing of the new version of munition and indicates the modifications added to the existing munition and likely to affect the MURAT characteristics. The influence of these modifications must be analyzed and must show that the MURAT level has not been decreased for each reference threat (Table 1).

The evidence must be included in a supporting dossier the person responsible for procurement forwards to the IPE within an advice of the designated experts (cf. § 5.4). The assignment of the “realized” MURAT signature occurs following the procedure defined in § 5.4.4 on the basis on the dossier and the MURAT signature of the existing munition (cf. § 5.4.5 and 5.4.6 of the IPE instruction n°1184).

Note that if the replenishment does not need treatment of obsolescence, the “realized” MURAT signature is the MURAT signature of the existing munition (cf. § 5.4.5 and 5.4.6 from IPE Instruction n°1184).

### **6. Configuration management**

Design updating are likely to occur during munition lifecycle after its qualification without any modernization (cf. § 5.5.4) or replenishment (cf. § 5.5.5).

If the proposed changes can influence the MURAT characteristics of munition (e.g. material modification of the event, geometry modification of one piece interfering with deconfinement pathway), the person in charge of configuration management conducts a similar procedure to the one described in §5.5.5.

## ANNEX N°1

### MURAT REQUIREMENTS AND LABELS

Analysis by NATO confirms the pertinence of the reference threats defined at the origin of the IM concept, in particular heating, sympathetic reaction and impact of light fragments at high speed.

Bullet impact type threats have evolved, with additional incendiary and explosive effects, but the feedback is not sufficient to justify a review of the reaction mechanisms already established for munitions submitted to bullet impact.

The current operational context justifies systematic assessment of the munition behavior to shaped charge aggression. In addition, France has chosen to retain the high-speed heavy fragment threat that is not part of the NATO set of reference threats, but that can in some ways and with the customary precautions represent a certain class of improvised explosive devices (IED).

Standard threat	Threat range	Comments	Reaction level required <sup>(1)</sup>
Fast heating	Temperature range: average temperature of the fire between 550°C and 850°C until all the munition reactions are completed. Temperature of 550°C reached in no more than 30 sec after ignition of the fire. Full-scale tests shall be carried out in accordance with STANAG 4240.		V
Slow heating	Regular increase in temperature of 1°C to 30°C per hour starting from ambient temperature, until all the munition reactions are completed. Full-scale tests shall be carried out in accordance with STANAG 4382.	Temperature increase rate is limited, which improves the representativeness of the threat over the whole range.	V
Bullet impact	Velocity range: 400 m/s to 850 m/s. Full-scale tests shall be carried out in accordance with STANAG 4241.	Range of velocities is limited. No firing of bursts.	V
Sympathetic reaction	Donor detonation in an appropriate configuration. Full-scale tests shall be carried out in accordance with STANAG 4396.	For solid-fuel motors or artillery propellant charges, the donor shall be initiated by an external stimulus represented by a shaped charge jet aggression approved by the IPE.	III
Light fragment impact	- 15 g steel fragment at velocity 2600 m/s - 65 g steel fragment at velocity 2200 m/s Full-scale tests shall be carried out in accordance with STANAG 4496.	NB: According to STANAG 4496, standard procedure uses 18.6 g fragment at velocity 2530 m/s, alternative procedure uses same fragment at velocity 1830 m/s.	V
Heavy fragment impact	1 parallelepiped-shaped steel fragment of 250 g Impact velocity from 0 m/s to 1650 m/s	French requirement	III
Shaped charge jet impact	Shaped charges with calibres up to 85 mm. Full-scale tests shall be carried out in accordance with STANAG 4526.	The reference shaped charge is the CCEB 62 (φ 62 mm) or equivalent.	III

(1) The munition reaction is characterized by standard levels designated response types, numbered from I to VI in decreasing violence of the reaction. These response descriptors are detailed in AOP-39.

**Table 1: French MURAT Requirements**

## MURAT LABELS

MURAT labels enable to:

- establish a direct link with the hazard divisions and provide a logistic benefit;
- rapidly identify, by simple marking of the munition, the suitable methods for its handling and neutralization;
- promote the concept for export.

There are three labels, symbolized by one, two or three stars that correspond to the particular signature requirements defined in the table below.

Label	MURAT ☆	MURAT ☆☆	MURAT ☆☆☆
<b>Standard threats</b>			
Fast heating	IV <sup>(1)</sup>	V <sup>(2)</sup>	V <sup>(2)(3)</sup>
Slow heating	III	V	V <sup>(3)</sup>
Bullet impact	III	V	V <sup>(3)</sup>
Sympathetic reaction	III	III	III <sup>(3)</sup>
Light fragment impact	I	V	V <sup>(3)</sup>
Heavy fragment impact	I	III	III <sup>(3)</sup>
Shaped charge jet impact	I	III	III <sup>(3)</sup>

<sup>(1)</sup> Type IV without propulsive effect.

<sup>(2)</sup> At the earliest 5 minutes after the start of the fire.

<sup>(3)</sup> Energetic materials that comply with the criteria of test series 7 (UN Manual of Tests and Criteria - Orange Book).

**Table 2: MURAT Labels**

It should be noted that the definitions of labels MURAT \*\* and MURAT \*\*\* have been modified to align them respectively with the criteria for inclusion in NATO sub-storage division SsD 1.2.3 and hazard division HD 1.6 for UN transport and NATO storage.

## **ANNEX N°2**

### **DEFINITIONS OF REACTION LEVELS AND RESPONSE DESCRIPTORS**

*(Not included in the present document)*

**ANNEX N°3**

**MURAT ASSESSMENT PROGRAM**

*(Not included in the present document)*

**ANNEX N°4**

**PROPOSAL DOSSIER OF “REALIZED” MURAT SIGNATURE**

*(Not included in the present document)*

**ANNEX N°5**

**ASSIGNMENT TEMPLATE OF “REALIZED” MURAT SIGNATURE FOR A GIVEN CONFIGURATION**

*(Not included in the present document)*

## **ANNEX N°6**

### **ASSIGNMENT TEMPLATE OF A MURAT LABEL**

*(Not included in the present document)*

**ANNEX N°7**

**DOSSIER JUSTIFYING THE GAPS BETWEEN “REALIZED” AND “REFERENCE”  
MURAT SIGNATURES**

*(Not included in the present document)*