INSENSITIVE MUNITIONS INDUSTRY CONTRIBUTION FOR NEW STANAG-AOP 4382 EDITION OF THE SLOW HEATING TEST

IMEMG's Expert Working Group on
Hazard Assessment & Classification

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INTRODUCTION

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- Various works are conducted by AC326 National Experts in the aim to define the new edition of STANAG-AOP 4382

- Technical arguments for changes can be extracted from the MSIAC Survey Questionnaire on the Slow Heating Test (December 2016) and the MSIAC Science of Cook-off workshop (March 2017)

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- The most important question is about the heating rate value : 3,3°C/h
  - *Reasons for a change ? If modification, which new value ? And why ?*
  - *Must heating rate represent the most severe accident scenario or the most severe munition response ?*
- STANAG-AOP are under responsibility of National Experts, nevertheless IM Manufacturer Designers can bring feed-back and improvement suggestions

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- IM Manufacturer Designers are concerned about objectives of the Slow Heating Test

  - *Must test represent the most severe accident scenario or most severe munition response ? It implies various test parameters …*
    - » *heating rate value : unique value or according to munitions size*
    - » *heating system : forced airflow or natural convection*
    - » *preconditioning temperature and duration : today unclear rules*

INTRODUCTION 4/4

- Major question is about the maximum response to slow heating : Type V

  - *It is pertinent if we consider that this threat can occur only in a closed space ?*
  - *projections and propulsion effects will be confined in this space without any external effect*

    ➔ ***Type IV*** *response requirement appears to be more appropriate*

THE HEATING RATE VALUE

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- Slow Heating Test is performed with 3,3°C/h rate for 3 decades and …
  - Is change really necessary ?
  - Why not, if the new heating rate is representative of the **most severe accident scenario**, it is the responsibility of AC326 National Experts
  - But, really there is a real concern if it must be representative of the **most severe munition response**, because :
    - » it depends on munition size and architecture
    - » it depends also on energetic material (cast-cured, melt-cast …)
    - » that it could introduce disconnectedness between nations and test centers

HEATING DEVICES

HEATING DEVICES

- STANAG 4382 ed2 “The test is **usually** performed by placing the test item in a disposable oven and heating the item with circulating heated air”
  - Is forced airflow the most representative of accidental scenario (circulating steam) ? Or is it the natural convection (battleship magazine) ?
  - It would be preferable to define more precisely the heating devices

PRECONDITIONING PHASE

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- STANAG 4382 ed2 "precondition the test item **at 50°C for 8 hours** or until the test item reaches thermal equilibrium at 50°C, whichever occurs first"

  - Why this preconditioning phase ? Maximum ambient temperature ?
  - This requirement is not pertinent for large munitions because 8 hours are insufficient to reach thermal equilibrium …
  - It would be more simple to start test at room temperature, global test duration would be more or less same

THE TYPE V RESPONSE TO SLOW HEATING

RESPONSE TO SLOW HEATING

- Slow Heating Threat corresponds to "Fire in an adjacent magazine, store or vehicle" with heating rate from 1°C to 30°C per hour"
- if an accidental scenario is able to heat munitions:

  some ten hours, higher than 150 to 300°C (300 to 500°F),
- this scenario requires a **closed space**: magazine battleship, armored vehicle, storehouse, bunker, igloo… **but not in open field conditions**

RESPONSE TO SLOW HEATING

- is it pertinent to require a Type V response ?
  - ➢ No-hazardous effects beyond 15 meters.
- i.e. it is reminded that the "20 Joules fragment" is not able to go <u>through only 2 mm thick aluminum sheet</u> *(test 6c UN Orange Book ST-SG-AC10-11 Rev6).*
- i.e. Typical walls of warships ammunition stores are some 8 mm thick steel sheets …

➔Type IV seems be a sufficient requirement for such a threat !!!

CONCLUSIONS AND PERSPECTIVES

CONCLUSIONS

- Concerns about objectives of heating rate modification
- Need for more precise STANAG-AOP 4382 requirements
- Change the maximum response from **Type V to Type IV**
  - because the **Type V effects are contained** inside the confined space (battleship magazine, underground store, armored vehicle …) where the slow heating threat can occur (some ten hours up to higher than 150 to 300°C)

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