

CAPABILITIES OF NON-LETHAL HAND GRENADES DEVELOPED AT IMSETHAC-BAS

ПОТЕНЦИАЛНИ ВЪЗМОЖНОСТИ НА НЕЛЕТАЛНИ РЪЧНИ ГРАНАТИ, РАЗРАБОТЕНИ В ИМСТЦХА-БАН

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Abstract: The capabilities of a non-lethal weapon (NLW) are its potential to successfully execute certain operational task. Non-lethal hand grenades are amongst the most used means for influence on people in any kind of missions and various operational contexts. This paper presents results of studies on the capabilities of seven types of hand grenades with different effects or combinations of effects developed and produced at the Institute of Metal Science, Equipment and Technologies (IMSETHAC-BAS). The capabilities assessment covers 14 operational tasks in which non-lethal grenades could be applied. Obtained results are compared to capabilities of highest evaluated current/programmed NLWs of leading NATO countries producers.

Keywords: NON-LETHAL WEAPON (NLW), NON-LETHAL HAND GRENADE, CAPABILITIES ASSESSMENT

Introduction

The non-lethal hand grenades are amongst the most used means in the operational tasks executed by anti-terrorist units, law and order protection forces. They are also applied by military forces during various kinds of peace-supporting missions, assuring critical infrastructure security, protection of ships against pirate and sea terrorist actions and other operations where the aim is neutralization of threat with minimum damages on people, material objects and environment.

The aim of present paper is evaluating the capabilities of 7 types of non-lethal hand grenades developed at the IMSETHAC-BAS and comparison to capabilities of highest evaluated non-lethal weapons used in NATO countries.

Evaluated Non-Lethal Weapons, Operational Tasks and Applied Methods

The following seven types of non-lethal hand grenades are evaluated:

- teargas (CS) grenade designated as (TGG);
- "sting-ball" grenade (SBG);
- "flash-bang" grenade (FBG);
- smoke grenade (SG);
- flash-bang teargas grenade (FBTGG);
- flash-bang sting-ball grenade (FBSBG);
- flash-bang smoke grenade (FBSG).

The grenades are designed, tested and produced at the IMSETHAC-BAS – Sofia, Bulgaria, under the leadership of S. Kalpakchiev and used by special units in Bulgaria and several other countries.

Data from NATO RTO Working group on NLWs capabilities assessment report [1] are used for comparing the capabilities, namely: operational scenarios, operational requirements and evaluations of highest scored current/programmed NLWs (*HS NLW*) for the correspondent operational scenario/task (such as munitions containing rubber balls, PVC elements or teargas shot by various devices, acoustic systems, electro-shock devices, etc.).

According to the aim of operation and the level of desired influence on the target, the operational scenarios/tasks described in [1] and studied here can be grouped as follows:

- 1) Move individuals (moving individuals/groups out or to certain area);
- 2) Stop individuals (prevent or impede access to certain area, stopping or changing the movement direction);
- 3) Degrade individuals (selective reducing of one or some functions/responses of the object);
- 4) Disable individuals (general reducing the most or all functions/responses of the object);
- 5) Deny access (denying the use of access/entry points).

The studied non-lethal grenades can be applied in 3 kinds of spaces – building, open area and "confined space" ("an area of varying dimensions and size that has limited or restricted avenues to enter, egress or evade engagement" [1]).

The 14 studied operational task are selected among the scenarios used in [1] with the view to cover all tasks which can be executed by non-lethal hand grenades – 5 tasks in open areas, 5 in confined areas and 4 in buildings (operational requirements for "Deny access" to buildings are not formulated in [1] due to the great variability of possible situations in this kind of space).

The capabilities assessment is made by applying the Improved methodology of assessing the NLWs capabilities [2, 3], based on general approach, scenarios, criteria and operational requirements of [1]. Data from [4-9, etc.] are used for specifying requirements for some criteria and the results analysis. The evaluation is made on 10 criteria (territory, space, targets number, targeting, mobility, physical characteristics, range, covering, onset and duration of the effect) with fixed importance according to [1]. The evaluation for a criterion represents the degree to which the NLW meets the requirement, calculated using the criterion relative weight. The overall rating for the task is the sum of rates for all the ten criteria.

Evaluation Results and Discussion

The studied NLWs evaluations are given in Table 1. The column *HS NLW(2)* presents evaluations of the highest scored NLW for each operational task published in [1] and the *HS NLW(1)* - evaluations of the same products recalculated by the Improved methodology. It can be seen that most of results for the best evaluated NLWs used or in process of development in NATO countries calculated using the Improved methodology are higher than those published in [1].

Table 1. Evaluations of NLWs capabilities

Space	Task №	TGG	SBG	FBG	SG	FBTGG	FBSBG	FBSG	HS NLW (1)	HS NLW (2)
Building	1	0.92	0.72	0.78	0.77	0.87	0.80	0.77	0.84	0.65
	2	0.86	0.67	0.75	0.70	0.81	0.76	0.71	0.65	0.59
	3	0.86	0.67	0.75	0.70	0.81	0.76	0.71	0.64	0.60
	4	0.86	0.67	0.75	0.70	0.81	0.80	0.71	0.50	0.46
Open area	1	0.68	0.62	0.62	0.57	0.68	0.63	0.64	0.86	0.79
	2	0.86	0.68	0.73	0.73	0.83	0.73	0.76	0.73	0.76
	3	0.82	0.68	0.73	0.68	0.79	0.74	0.71	0.79	0.75
	4	0.82	0.68	0.73	0.68	0.79	0.78	0.71	0.54	0.54
	5	0.65	0.62	0.61	0.56	0.65	0.67	0.63	0.73	0.68
Confined space	1	0.63	0.58	0.57	0.52	0.63	0.58	0.59	0.64	0.63
	2	0.81	0.63	0.68	0.68	0.78	0.68	0.70	0.72	0.66
	3	0.76	0.62	0.68	0.62	0.73	0.68	0.65	0.83	0.72
	4	0.80	0.62	0.67	0.67	0.77	0.72	0.69	0.50	0.46
	5	0.65	0.58	0.60	0.55	0.64	0.65	0.60	0.71	0.63
Average values		0.78	0.65	0.69	0.65	0.76	0.71	0.68	0.69	0.64

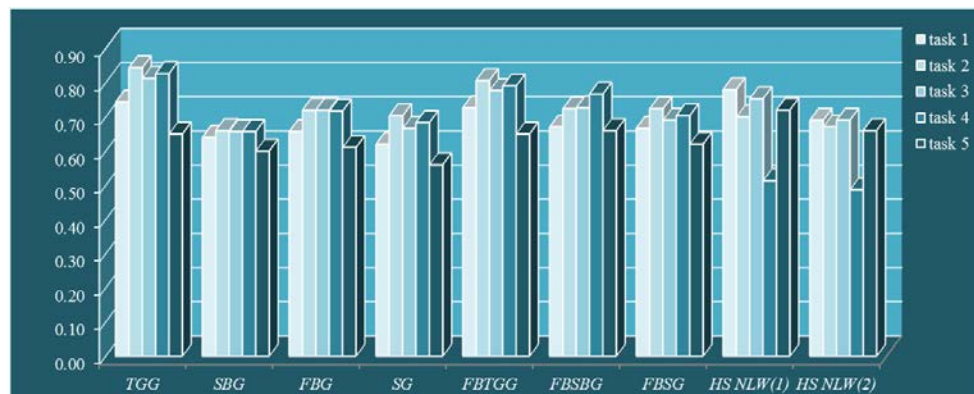
As a whole, best results demonstrates the hand grenade with chemical effect (*TGG*) followed by the grenade with combined chemical and flash-bang effect (*FBTGG*) which have the biggest coverage (radius of the effect) and duration of the effect. Lowest results show the grenades with kinetic effect (*SBG*) and smoke effect (*SG*) which have comparatively small coverage and short-time influence. Although the grenades with flash-bang (*FBG*) and flash-bang combined with kinetic (*FBSBG*) and smoke (*FBSG*)

effects are very appropriate for application in many operational tasks, as a whole their evaluations are lower due to the very short effect duration. Most of evaluated *HS NLW*s are delivered by various devices therefore they have ranges significantly higher than all hand thrown grenades - this criteria is of very high importance in the *NLW*s capabilities assessment.

The average values for the operational tasks are presented in Table 2 and Figure 1.

Table 2. Evaluations of capabilities by operational tasks – average values

Task №	TGG	SBG	FBG	SG	FBTGG	FBSBG	FBSG	HS NLW (1)	HS NLW (2)
1	0.74	0.64	0.66	0.62	0.73	0.67	0.67	0.78	0.69
2	0.84	0.66	0.72	0.70	0.81	0.72	0.72	0.70	0.67
3	0.81	0.66	0.72	0.67	0.78	0.73	0.69	0.75	0.69
4	0.83	0.66	0.72	0.68	0.79	0.77	0.70	0.51	0.49
5	0.65	0.60	0.61	0.56	0.65	0.66	0.62	0.72	0.66

**Fig. 1.** Evaluations of NLWs capabilities by operational tasks – average values.

Best average results for task 1 „Move individuals“ has *HS NLW (1)* followed by *TGG* and *FBTGG*. For tasks 2 „Stop individuals“ and 3 „Degrade individuals“ *TGG* and *FBTGG* have highest ratings, and *SBG* – lowest. For task № 4 „Disable individuals“ the hand grenades have evaluations similar to tasks 2 and 3, the *HS NLW* (electro-shock device) has lowest result due to its small range, short effect and applicability to one person. In spite of such rating this

device is the most suitable mean for immediate and full disabling in some situations. For task 5 „Deny access“ (where the requirements are high) all hand grenades have lower evaluations compared to the other tasks, and the *HS NLW*, which range is several times bigger, has best rating.

The average values for each kind of space are presented in Table 3 and Figure 2.

Table 3. Evaluations of NLWs capabilities by operational spaces - average values

Space	TGG	SBG	FBG	SG	FBTGG	FBSBG	FBSG	HS NLW (1)	HS NLW (2)
Building	0.88	0.68	0.76	0.72	0.83	0.78	0.73	0.66	0.58
Open area	0.77	0.66	0.68	0.64	0.75	0.71	0.69	0.73	0.70
Conf. space	0.73	0.61	0.64	0.61	0.71	0.66	0.65	0.68	0.62

All hand grenades (markedly these which contain teargas) demonstrate best capabilities for all operational tasks in buildings - they meet the requirements for covering and range to bigger degree than the requirements for open and confined areas.

The evaluated *HS NLWs* have good performance in open and confined areas due to their extended ranges, smaller average values are calculated because of the low evaluation of the *HS NLW* for some criteria in task 4.

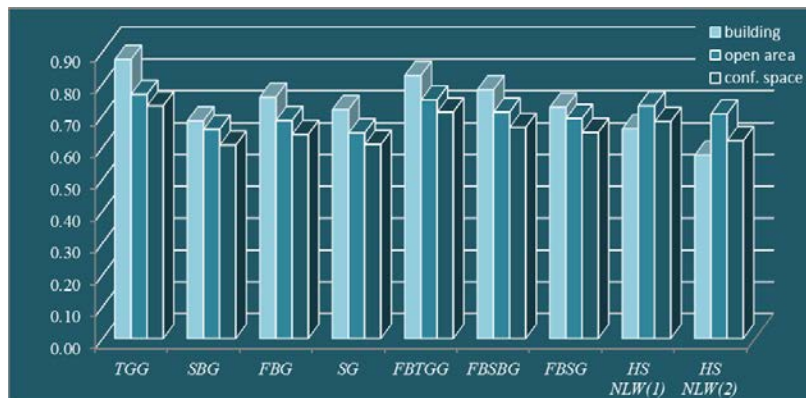


Fig. 2. Evaluations of NLWs capabilities by operational spaces – average values.

The following conclusions concerning the studied types of non-lethal hand grenades can be drawn on the base of their capabilities comparative analysis:

- The Teargas grenade (*TGG*) has highest capabilities compared to the rest grenades for the studied operational tasks and spaces. It is very appropriate for individual application in buildings as well as in most of tasks in open and some tasks in confined spaces.

- The Sting-ball grenade (*SBG*) has lowest average evaluation. It shows sufficient capabilities in buildings and some tasks in open areas. The grenade can be successfully used in situation where application of other grenades is connected with high level of risk.

- The Flash-bang grenade (*FBG*) has good evaluations for the operational tasks in buildings and some tasks in open areas, and lower for tasks with high requirements for coverage and/or effect duration. Regardless of its short-time effect this grenade is very suitable for situations where powerful disorientating effect is necessary.

- The Smoke grenade (*SG*) has lowest average evaluation due to delayed onset of the effect (3-4 s) especially in situations demanding immediate influence. The capabilities of this grenade in buildings are higher than these in open and confined areas.

- The Flash-bang teargas grenade (*FBTGG*) has the second highest capabilities. Combining the advantages and eliminating some shortcomings of chemical and flash-bang grenades, it is appropriate for application in all spaces and tasks except for some situations in open which require large range.

- The Flash-bang sting-ball grenade (*FBSBG*) has evaluations higher than these of the flash-bang and the sting-ball grenades for all operational tasks. Obviously a good balance between the components is achieved which leads to increased capabilities of this grenade with combination of light, sound and kinetic effects.

- The Flash-bang smoke grenade (*FBSG*) has capabilities slightly higher or between these of the grenades with flash-bang and smoke effects. These evaluations are result of lower coverage (area of effect) owing to decreased quantities of the active components compared to flash-bang and smoke grenades separately.

Conclusions

1. The evaluated hand grenades developed at the IMSETHAC-BAS have good capabilities for a big part of the operational tasks and spaces. They demonstrate best performance in buildings and lower in open and confined areas.

2. The non-lethal hand grenades developed at the IMSETHAC-BAS have capabilities comparable to these of best evaluated NLWs used or in process of development in NATO countries.

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