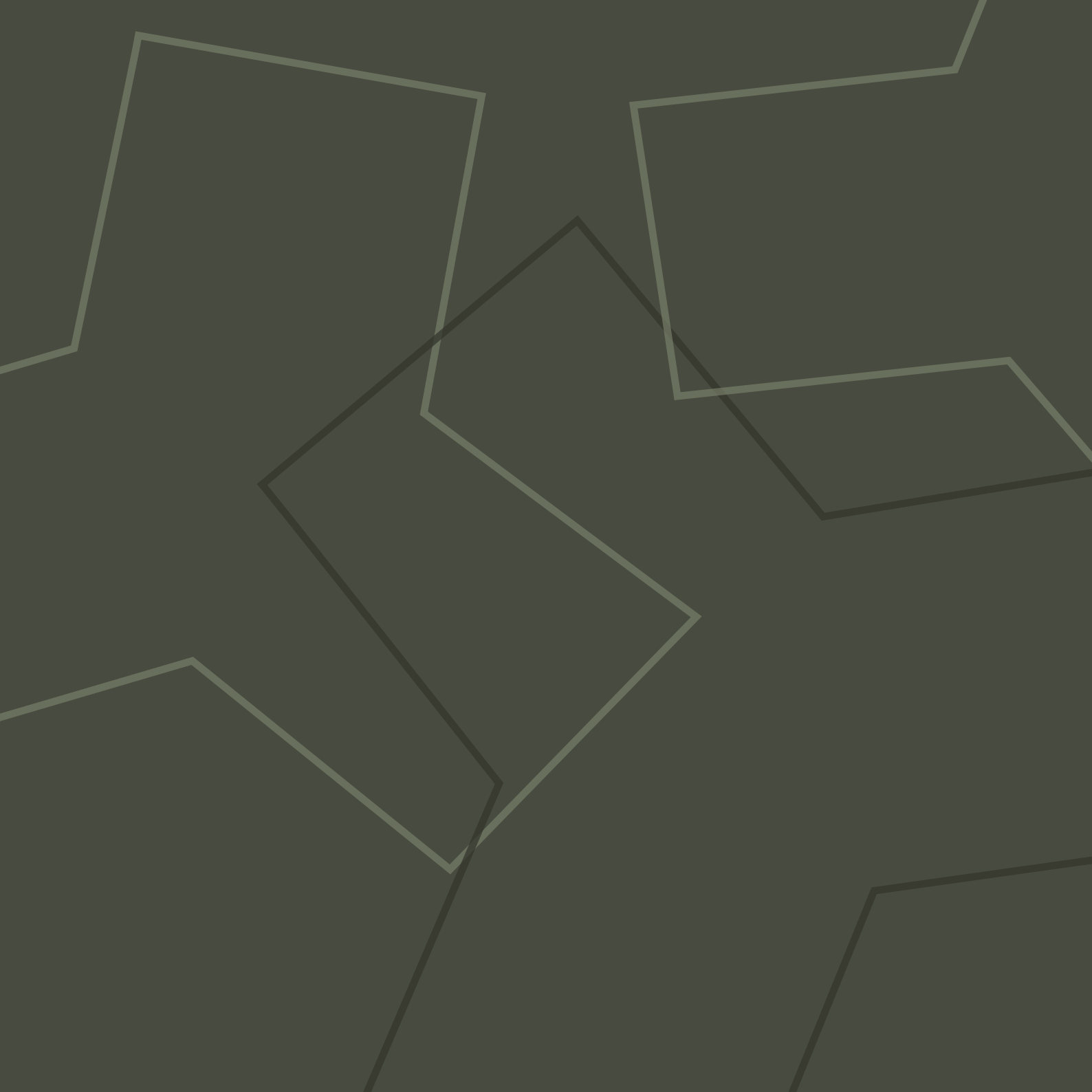
B.O.O.S.

Book of operational sculpture



Dear reader

Thank You, that You took our book.

We would like to introduce You our technique of sculpturing fashionable apparel, protection and field gear. Our techniques are based on the assessment of toughest world natural and man made environments and threats, special task operations and assigments of elite skilled operational units.

Following book we describe how toughest operational requirements, transformed into basic quality system requirements of apparel, protection and field gear through deep scientific proceedings. Thus guarantee creation of fashionable, health and life saving apparel, protection and field gear. We hope this is exactly You are looking for. We will be happy if You can share with us Your experience in the toughest environments of the world.

With the best regards
Dr. Igors Šitvjenkins

Introduction

1. Combat environment is the toughest. Knowing how to transform combat environment in fashionable apparel is what we are standing for to satisfy customer demanding needs, including civil customers, looking for high valuable apparel, protection and field gear (APFG), providing modern fashion and protection against tough environment our customers going to stay in.

2. Following more then 15 years of our experience we created model of operations, units and environment – "Book of operational sculpturing (BOOS)". Our customers can study book and learn how operational field is transforming into sculpturing of fashionable APFG. Customers will understand what the system, environment, unit, operation requirements are standing behind fashion and how we are creating our products are able to secure life and health, wherever our customers are going to stay in this Eternity.

3. Critical skills operational unit (CSOU) is our joint model of operators from elite special task units of military, law enforcement, special security services. Operations, skills, technics, combat and training of CSOU making the toughest influence on the APFG, what is main basis of the creation high valuable, fashionable products from the beginning of sculpturing, as a result of long term experience and field trials. Thus, guarantee customers long, succesfull and enjoyable using of products during all time staying under tough environment conditions.

4. Collateral task of the BOOS is to make platform of the CSOU APFG products for the further Sole Sourcing and Open Tendering of the allied brands, partners and representatives worldwide. More about Sole Source process please read on www.sole-source.eu.

1

Trinity of Operations

SO
Special Operations

ISTAR
Intelligence, Surveillance, Target acquisition, Reconnaissance

HUMINT
Human Intelligence

The most toughest operations of CSOU is based on trinity of following:

4.1 Special operations (SO);
4.2 Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR);
4.3 Human intelligence (HUMINT).

5. **Special operations (SO)** – Operations conducted by specially organized, trained, and equipped military and paramilitary forces (Special Forces – SF) to achieve military, political, economic, or informational objectives by unconventional military means in hostile, denied, or politically sensitive areas. These operations are conducted across the full range of military operations, independently or in coordination with operations of conventional, non special operations forces. Political-military considerations frequently shape special operations, requiring clandestine, covert, or low visibility techniques and oversight at the national level. Special operations differ from conventional operations in degree of physical and political risk, operational techniques, mode of employment, independence from friendly support, and dependence on detailed operational intelligence and indigenous assets[1].

6. SF trained and equiped to perform its principal missions of Unconventional Warfare (UW), Foreign Internal Defense (FID), Direct Action (DA), Special Reconnaissance (SR), Combatting Terrorism (CBT), Counterproliferation (CP), Information Operations (IO), Collateral Activities (CA), Psychological Operations (PSYOP), Multiple and follow-on missions (MFM), Support for National Army operations (NAO), Operations in rear areas (ORA), Force protection (FP), Support to Law Enforcement Agencies Forces (LEAF). SF missions are dynamic and constantly evolving in response to political-military considerations, technology, and other considerations. A change in national security policy, national military strategy, global or regional social structure, or technology may radically alter the manner in which SF conducts its principal missions and collateral activities[2].

5. Combatting terrorism (CBT) refers to the offensive and defensive measures taken by civilian and military agencies of a government to prevent, deter, and respond to terrorism. Couterterrorism (CT) measures are the offensive measures of CBT, whereas antiterrorism (AT) measures are the defensive measures. SF CBT operations encompass both CT and AT3. Nowdays, CBT becoming a significant part of the SF operations, making interferance with Law enforcement and Special Security services missions on providing inland security and combatting criminal elements.

[1] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. Special forces missions. Department of the Army. Washington, DC, 1st April 2004.
[2] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. Glossary-26. Department of the Army. Washington, DC, 1st April 2004.
[3] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. Combatting terrorism 2-17. Department of the Army. Washington, DC, 1st April 2004.
[4] AAP-15. NATO glossary of abbreviations used in NATO documents and publications. Research and Technology Organisation, North Atlantic Treaty Organisation. December 2004.
[5] http://www.parliament.uk/business/committees/committees-archive/defence-committee/def080313-no-28/

9. Intelligence is to provide information and assessments to facilitate mission accomplishment. This role is supported by a series of specific responsibilities to guide the intelligence directorate of a joint staff (J-2) and supporting organizations. These include: inform the commander, describe the operational environment; identify, define, and nominate objectives; support planning and execution of operations; counter adversary deception and surprise; support friendly deception efforts; and assess the effectiveness of operations[6]. Surveillance (combat) is a continuous, all-weather, day-and-night, systematic watch over the battle area in order to provide timely information for tactical combat operations[7]. Target acquisition is the detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons[8]. Reconnaissance is a mission to obtain information by visual observation or other detection methods, about the actvities and resources of an enemy or potential enemy, or about the meteorologic, hydrographic, or geographic characteristics of a particular area. It also produces tactical information, which is a by-product of all operations. Reconnaissance is performed before and during all combat operations. It focuses on obtaining information for the commander and his staff. This information is evaluated and used to confirm, modify, or formulate plans[9].

10. Human intelligence (HUMINT) is a category of intelligence derived from information collected and provided by human sources. It is collection by a trained HUMINT collector of foreign information from people and multimedia to identify elements, intentions, composition, strength, dispositions, tactics, equipment, personnel, and capabilities. It uses human sources and a variety of collection methods, both passively and actively, to gather information to satisfy the commander's intelligence requirements and cross-cue other intelligence disciplines[10].

11. HUMINT requires special designed for the purposes of HUMINT systems of APFG to keep low profile (non-combat visual appearance) of the SF or ISTAR warfigther, who is infolved in human intelligent operation. Risks are minimized through the situational awareness of HUMINT team members. They plan and rehearse to readily react to any situation and carry the necessary firepower to disengage from difficult situations. If it becomes necessary to call for assistance,adequate and redundant communications equipment is critical. HUMINT equipment, basic C2 (Command and Control), transportation, and weapons requirements do not differ significantly from most soldier requirements and are available as unit issue items. However, HUMINT teams have unique communications, collection, processing, and mission-specific requirements[11]. HUMINT playing significant role in the SF and ISTAR unit's oprations[12].

[6] Joint Publication 2-0. Department of Defense. Joint Intelligence. 22 October 2013. Page ix.

[7] Joint Publication 1-02. Department of Defense. Dictionary of Military and Associated Terms. 8 November 2010, (As Amended Through 15 February 2016). Page 39.

[8] Joint Publication 1-02. Department of Defense. Dictionary of Military and Associated Terms. 8 November 2010, (As Amended Through 15 February 2016). Page 235.

[9] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Chapter 4.1. Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001.

[10] FM 2-0. Field manual. Intelligence. Chapter 6.1. Headquarters. Department of the Army. Washington, DC, 17 May 2004. 11 FM 2-0. Field manual. Intelligence. Chapter 6.18 HUMINT team, 6-24 Operational risk mitigation. Chapter 6-27 HUMINT Equipment. Headquarters. Department of the Army. Washington, DC, 17 May 2004

[12] FM 3-55.93 (FM 7-93) Field manual. Long-Range Surveillance Unit Operations". Table 6-9. Department of the Army. Washington, DC, 23 June 2009.

2

Critical skills operational unit (CSOU)

CSOU-SF / TO&E / Asignments
Special Forces

CSOU-ISTAR / TO&E / Asignments
Intelligence, Surveillance, Target acquisition, Reconnaissance

CSOU-HUMINT / TO&E / Asignments
Human Intelligence

12. Establishing Table of Organization and Equipment (TO&E) of CSOU is important stage in the development APFG. TO&E identifying number of operators in CSOU, speciality and assigned armament to each operator. Knowing TO&E providing designiers with ability to calculate combat load of every operator, what is key factor in equation of metabolic heat rate – M (W/m2)[13] in the definition of the physiological quality of APFG.

13. The model of warfighting unit for the CSOU-SF is according to SF operational detachment A (SFODA)[14]. Unit consisting of 12 (twelve) operators. CSOU-SF TO&E according to BOOS established as following organizational structure – Table 1.

Table 1 – CSOU-SF TO&E

No	Title	Weapon No.1	Weapon No.2	Weapon No.3	Weapon No.4	Weapon No.5
1	Senior operator	P30 9x19 with suppresor	HK416 5.56 with suppresor/GLM 40mm	MP7A1 with silencer	HK417 7.62	-
2	Team leader	P30 9x19 with suppresor	HK416 5.56 with suppresor/GLM 40mm	MP7A1 with silencer	-	-
3	RTO/Comms expert	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	-	-
4	Demoliton expert/operator	P30 9x19 with suppresor	HK416 5.56 with suppresor/GLM stand alone 40mm	MP7A1 with silencer	HK417 7.62	FN minimi 5.56 (MK 46 MOD1)
5	Weapons expert/operator	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	HK417 7.62	FN minimi 7.62 (MK 48 MOD1)
6	Medic lifesaver	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	-	-
7	Sniper spoter	P30 9x19 with suppresor	HK 241/A DMR 7.62	MP7A2	-	-
8	Sniper shooter	P30 9x19 with suppresor	AXMC 338 Lap Mag/ 300 Win Mag	AX 50 Cal	MP7A1 with silencer	-
9	JTAC	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	HK417 7.62	-
10	Medic expert/operator	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	-	-
11	Demoliton expert/operator, enginier	P30 9x19 with suppresor	HK416 5.56 with suppresor/GLM stand alone 40mm	MP7A1 with silencer	HK417 7.62	FN minimi 5.56 (MK 46 MOD1)
12	Operator/language expert, HUMINT	P30S 9x19 with suppresor	HK416 5.56 with suppresor	MP7A2	-	-

[13] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing", Annex B, equation 8. June 1992. NATO International staff – Defence support division.
[14] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. Special forces operational detachment A. 3-28. Department of the Army. Washington, DC, 1st April 2004.Page 39.

14. Historically one of the main SF role was a reconnaissance force capable of providing otherwise unobtainable intelligence, known as special reconnaissance (SR). Another role was SF as a direct action (DA) force capable of unilaterally creating effects of operational and strategic significance[15].

15. DA operations are normally short-duration operations with a limited scope requiring an SFODA to infiltrate a denied area, attack a target, and conduct a preplanned exfiltration. They may include long-term, staybehind operations. DA operations achieve specific, well-defined, timesensitive results of strategic or operational significance. They normally occur beyond the range (or other operational capabilities) of tactical weapons systems and conventional maneuver forces. They may require the area specific knowledge of regionally oriented SF or other SF-unique skill sets developed in support of UW. DA operations may be unilateral or multinational, but they always occur under a U.S. chain of command. SF DA operations typically involve the: attack of critical target nodes; interdiction of critical LOCs or other target systems; capture, rescue, or recovery of designated personnel or materiel (to include support to CP). SF can conduct DA operations across the full spectrum of conflict at the operational or strategic level in support of the JFC and component commanders. In DA operations, SF can: employ sniper, direct assault, raid, or ambush tactics; emplace mines and other munitions; Conduct terminal guidance for precision-guided munitions or other standoff attacks by fire from air, ground, or maritime platforms; conduct sabotage; conduct PR operations.

16. The DA mission evolved from SF's capability to perform unilateral subversion and sabotage as part of the UW mission. Commanders at the operational and strategic levels may task SF to perform DA missions when engagement by conventional forces is not feasible. When a DA mission tasking is appropriate for SF, and SF forces conducting UW are unable to employ surrogate forces or to conduct unilateral sabotage or subversion against a target, an DA mission will be initiated. DA operations are shortduration strikes and other small-scale offensive actions conducted by SF to seize, destroy, or inflict damage on a specified target, or to destroy, capture, or recover designated personnel or materiel. DA missions are inherently risky, require time to adequately plan and prepare, and are resource intensive. The requirement to infiltrate into and exfiltrate from denied territory accounts for much of the risk and resource expenditure.

17. DA operations are characterized by surgical precision. DA operations typically leave a smaller signature than conventional operations and can create effects disproportionate to the size of the committed force. A need for precision, combined with requirements for other SF-unique capabilities, may make SF the force of choice for a myriad of DA tasks, including support to IO and CP missions. Due to the small size and limited firepower of SFODs, DA mission success depends on the synergistic effect of speed, stealth, surprise, violence of action, and oftentimes the cover of darkness.

18. PR is an umbrella term that encompasses all activities to locate, identify, recover, restore to friendly control, and repatriate selected personnel isolated and threatened in sensitive, denied, or contested areas. SF performs specific functions as part of their principal missions of UW and DA that contribute to the overall theater PR effort.
SF conducts UAR under the UW mission area and recovery operations under DA. Recovery operations are operations to locate, recover, and return personnel or material held captive, isolated, or threatened in areas sensitive, denied, or contested to friendly control. SF recovery missions are often characterized by detailed planning rehearsal, and thorough intelligence analysis.

[15] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. The evalution of Special Force. 1-6. Department of the Army. Washington, DC, 1st April 2004.

SF can be tasked to plan and conduct the following DA missions in support of PR to: rescue allied prisoners of war (PWs) and U.S. or other selected personnel detained by a hostile power or terrorist group; conduct combat search and rescue (CSAR) to locate, identify, and recover downed aircrews; recover vital military, intelligence, scientific, or other equipment captured by a hostile power or terrorist group.

19. SF may be tasked to conduct CSAR missions. CSAR is a collateral activity for SF. SF has an inherent ability to conduct CSAR based on capabilities resident in its primary missions. SF may conduct CSAR missions unilaterally or as part of a joint force. This type of tasking often originates with the JFC and is routed through the joint search and rescue center (JSRC) to the SOC component commander.

20. Long-Range Surveillance Unit (LRSU)[16] is the basic organization structure for ISTAR. LRSU are not SF, although they share many of the same tactics, techniques, procedures, terms, equipment, and organizational structure. The clearest distinction between these units is who they work for and where they operate on the battlefield: Strategic Level – SF, including Army Special Forces, when assigned a special reconnaissance mission, generally operate at the strategic level. Operational Level – LRSU generally operate at the operational level. Unit consisting of 12 (twelve) operators. CSOU-SF TO&E according established as following organizational structure – Table 2.

Table 2 – CSOU-ISTAR TO&E

No	Title	Weapon No.1	Weapon No.2	Weapon No.3
1	Senior scout observer	P30 9x19 with suppresor	HK416 5.56 with suppresor /GLM 40mm	-
2	Team leader	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
3	RTO	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
4	Demolition	P30 9x19 with suppresor	HK417 7.62	GLM stand alone 40mm
5	Machine gunner	P30 9x19 with suppresor	FN minimi 5.56 (MK 46 MOD1)	FN minimi 7.62 (MK 48 MOD1)
6	2iC/JFO	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
7	Medic	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
8	Sharp shooter	P30 9x19 with suppresor	HK 241/A DMR 7.62	-
9	Scout diver team leader	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
10	Senior scout diver	P30 9x19 with suppresor	HK416 5.56 with suppresor /GLM 40mm	-
11	Scout diver	P30 9x19 with suppresor	HK416 5.56 with suppresor	-
12	Scout diver	P30 9x19 with suppresor	HK 241/A DMR 7.62	-

[16] FM 3-55.93 (FM 7-93) Field manual. Long-Range Surveillance Unit Operations". Organization. 1-4. Department of the Army. Washington, DC, 23 June 2009.

21. "FM 3-55.93 (FM 7-93) Field manual. Long-Range Surveillance Unit Operations" remains as a basic tactics of ISTAR units. For the LRSU, organizing, planning, and conducting tactical movement should be second nature. The LRSU conducts movement by foot, helicopter, boat, or vehicle. Regardless of the means of transportation into an area of operation, the unit eventually moves on foot to accomplish its mission. The ability to accomplish its mission is directly related to how it uses the terrain. The LRSU avoids enemy contact by using the most effective movement formation and technique and by maintaining security[17].

22. Soldiers within LRSU should also be the most tactically and technically proficient soldiers. LRSU soldiers are physically fit; they are expert in skills such as land navigation, communications, camouflage, individual movement, and survival. They know the enemy's order of battle and equipment. They understand the importance of their mission to the battalion and what is required to accomplish that mission. Like their leaders, soldiers use their initiative; they are intelligent, resourceful, dependable, and disciplined.

23. The main mission of LRSU is not to kill enemy18. In spite of this assumption, according to APFG CSOU concept, LRSU fire power, as well combat support assets remain high level and there is no diference comparing with fire power of the infantry unit, which main mission is to kill enemy. Warfighting against terrorism, made ISTAR units a valuable target to kill or capture by different types of the terroristics and separatistic forces, which become more trained and equiped, as well as implementing military types of the organization structure, command and control system. Therefore, mission of the reconnaissance can be transformed to the mission to kill enemy, if ISTAR unit can't break the contact with enemy.

24. ISTAR unit in the modern combat is equiped with wide range of the sensors, C4I devices, enhancing reconnaisance, surveillance, target acquisition, communication capabilities. Together with APFG and weaponry, this making high level of the equipment load and requires its ergonomic distribution on every soldier in ISTAR unit, what should be taken into consideration during development of the CSOU APFG system.

25. The success of the HUMINT collection effort depends on a complex interrelationship between command and control (C2) elements, requirements, technical control and support, and collection assets. Each echelon of command has its supporting HUMINT elements although no MI organization in the Army is robust enough to conduct sustained HUMINT operations under all operational environments using only its organic HUMINT assets. HUMINT units have specific support requirements to the commander. HUMINT units must be flexible, versatile, and prepared to conduct HUMINT collection and analysis operations in support of any echelon of command. A coherent C2 structure within these HUMINT organizations is necessary in order to ensure successful, disciplined, and legal HUMINT operations. This structure must include experienced commissioned officers, warrant officers, and senior NCOs conscientiously discharging their responsibilities and providing HUMINT collectors with guidance from higher headquarters19. Unit consisting of 12 (twelve) operators. CSOU-HUMINT TO&E according to FM-CSO established as following organizational structure – Table 3.

[18] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Chapter 1 – Introduction. Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001

Table 3 – CSOU-HUMINT TO&E

No	Title	Weapon No.1	Weapon No.2	Weapon No.3	Weapon No.4
1	FHT	P30S 9x19 with extra safety	MP7A1 ith silencer	-	-
2	FHT	P30S 9x19 with extra safety	MP7A1 with silencer	-	-
3	FHT operator/rto	P30S 9x19 with extra safety	MP7A1 with silencer	-	-
4	Analitic	P30S 9x19 with extra safety	MP7A1 with silence	-	-
5	FHT operator/medic	P30S 9x19 with extra safety	HK416 5.56 with suppresor	MP7A2	-
6	FHT operator	P30S 9x19 ith extra safety	HK416 5.56 with suppresor	MP7A2	-
7	CI team leader	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	CI - counterinteligence
8	CI operator	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	-
9	CI operator	P30 9x19 with suppresor	HK416 5.56 with suppresor	MP7A1 with silencer	-
10	CI analitic	P30S 9x19 with extra safety	MP7A1 with silencer	-	-
11	Interrogation team leader	P30S 9x19 with extra safety	MP7A1 with silencer	-	-
12	Interrogation operator	P30S 9x19 with extra safety	MP7A1 with silencer	-	-

26. HUMINT consists of three main groups of missions:

26.1 Intelligence Interrogation. Intelligence interrogation is a systematic process of using interrogation approaches to question a captured or detained person to obtain reliable information to satisfy intelligence collection requirements. Trained interrogators with current certification operating under DOD authority are permitted to conduct intelligence interrogations;

26.2 Source Operations. Designated and trained personnel in a unit with the "source operations" mission may devel op information through the direct and indirect questioning of overt or clandestine sources. These personnel operate under the authority and direction of a designated defense HUMINT executor;

26.3 Debriefing. Debriefing is the process of questioning cooperative human sources to satisfy intelligence require ments, consistent with applicable law. The source usually is not in custody and usually is willing to cooperate. Debriefing may be conducted at all echelons and in all OEs. Through debriefing, face-to-face meetings, conversations, and elicitation, information may be obtained from a variety of human sources.

27. The intelligence function adjusts to the degradation of its technical intelligence gathering systems by increasing emphasis on HUMINT in Urban operations (UO). HUMINT operations may be the primary and most productive intelligence source in UO. In urban offensive and defensive operations, HUMINT gathers information from refugees, immigrants and former citizens (especially previous civil administrators), civilian contractors, and military personnel who have operated in the area. Credible intelligence of this type can help meet requirements, provide more detail, and alleviate some of the need to physically penetrate the urban area with reconnaissance forces. In many urban operations where HUMINT is the primary source of intelligence, acting on single-source reporting is a constant pitfall. Yet, situations may arise where commanders must weigh the consequences of inaction against any potential negative consequences resulting from acting on uncorroborated, single-source information[20].

28. Human source contact operations (SCO) is classical way of conducting HUMINT. SCO are operations directed toward the establishment of human sources who have agreed to meet and cooperate with HUMINT collectors for the purpose of providing information. Within the Army, SCO are conducted by trained personnel under the direction of military commanders. The entire range of HUMINT collection operations can be employed. SCO sources include one-time contacts, continuous contacts, and formal contacts from debriefings, liaison, and contact operations. SCO consist of collection activities that utilize human sources to identify attitude, intentions, composition, strength, dispositions, tactics, equipment, target development, personnel, and capabilities of those elements that pose a potential or actual threat to US and coalition forces. SCO are also employed to develop local source or informant networks that provide early warning of imminent danger to US and coalition forces and contribute to the Military Decision-Making Process (MDMP)[21].

[20] FM 3-06. Field manual. Urban Operations. Increased Importance of Human Intelligence. 4-3. Department of the Army. Washington, DC, 26 October 2006.

[21] FM 2-22.3 (FM 34-52). Field Manual. Human intelligence collector operations. 1-9. Source contact operations 1-23. Department of the Army. Washington, DC, 6 September, 2006.

3

Operational terrain

URBAN
3D infrastructure, rugged

MOUNTAIN
3D movements, rocks, ice, sun, warm, cold, wind, rugged

TRANSITIONAL
Multi-terrain

DESERT
Excessive hot, cold, sand, sun, wind

JUNGLE
Excessive hot, humid, vegetated, rugged

ARCTIC
Excessive severe cold, wind

CBRN
Chemical, biological, radiological, nuclear contamination

29. Weather is part of the operational terrain, where CSOU is operating. Weather existing constantly, because Earth has atmosphere. Therefore, CSOU all the time is under certain weather conditions, differs according to climate. Climatic conditions are specified in the publication "NATO AECTP-230 (Edition 1) Climatic conditions" Allied environmental conditions and test publication. NATO International Staff – Defence investment division. May 2009". Climatic conditions are basis for the calculation of the required physiological quality of the CSOU APFG system. Basic world temperatures and humidity described in Table 4. The main influence of the temperature on the development of the apparel, protection and field gear will be discussed in the Chapter "Combat physiology".

Table 4 – Climatic conditions of NATO AECTP-230[22]

Climatic category	Temperature C°	Humidity %
A1	32 until 49	8 until 3
A2	30 until 44	44 until 14
A3	28 until 39	78 until 43
B1 (7 dienas)	24	100
B1 (358 dienas)	23 until 32	88 until 66
B2	26 until 35	100 until 74
B3	31 until 41	88 until 59
C0	–6 until – 19	Tending to saturation
C1	–21 until –32	Tending to saturation
C2	–37 until –46	Tending to saturation
C3	–51	Tending to saturation
C4	–57	Tending to saturation
M1	29 until 48	67 until 21
M2	25.5 – 35	100 until 53
M3	–23 until –34	Tending to saturation

[22] "NATO AECTP-230 (Edition 1) Climatic conditions" Allied environmental conditions and test publication. NATO International Staff – Defence investment division. May 2009"

30. The CSOU must be able to operate in enemy territory and remain undetected. Regardless of whether the CSOU is en route to an objective or operating near an objective, the CSOU takes all necessary actions to ensure it remains undetected. During movement, the CSOU uses stealth to exploit the natural cover and concealment of the terrain. When possible, the CSOU moves when visibility is reduced such as during darkness, fog, snow, or rain. It uses rough, swampy, or heavily vegetated terrain to avoid detection. All members of CSOU must be masters of stealth. The reconnaissance patrol must not let the enemy know it is in the objective area. The key is to see and not be seen. The patrol uses camouflage, discipline, and stealth to avoid detection. They plan routes to avoid the effectiveness of enemy radar and RSTA[23] devices. By reducing radio traffic, the CSOU limits the possibility of being detected by enemy RDF[24] devices[25].

31. CSOU unit uses rough, swampy, or heavily vegetated terrain to avoid detection. This making additional load on CSOU soldiers due to moving in the different landscapes (surfaces). Surface factor n should be taken into consideration when rectal temperature Tref and limited duration of exposure Dlim is calculated for APFG set accodring to "NATO ACCP-1 (Edition 2) Heat transfer and evaluation of clothing. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992".

32. The world is undergoing massive urbanization. Although exceptions exist, an overall trend of migration from rural to urban areas is occurring throughout the globe. (Australia, one of the world's most urbanized countries, is actually becoming less urbanized.) This trend is especially evident in developing nations. Combined with the exponential growth of the global population in the last quarter century, this migration has created massive urban areas that hold the centers of population, government, and economics in their respective regions. In many cases, rapid urbanization has overburdened already weak infrastructures, scarce resources, and a fragile economic base. As urbanization has changed the demographic landscape, potential enemies recognize the inherent danger and complexity of this environment to the attacker, and may view it as their best chance to negate the technological and firepower advantages of modernized opponents. Given the global population trends and the likely strategies and tactics of future threats, Army forces will likely conduct operations in, around, and over urban areas—not as a matter of fate, but as a deliberate choice linked to national security objectives and strategy, and at a time, place, and method of the commander's choosing[26].

33. Urban areas present an extraordinary blend of horizontal, vertical, interior, exterior, and subterranean forms superimposed on the natural relief, drainage, and vegetation. An urban area may appear dwarfed on a map by the surrounding countryside. In fact, the size and extent of the urban area of operations is many times that of a similarly sized portion of undeveloped natural terrain. A multi-storied building may take up the same surface area as a small field, but each story or floor contains approximately an equal area as the ground upon which it sits. In effect, a ten-story building can have eleven times more defensible area than "bare" ground - ten floors and the roof. It is the sheer volume and density created by this urban geometry that makes UO resource intensive in time, manpower, and materiel[27].

34. Special Forces advanced urban combat (SFAUC) refers to training encompassed by precision combative techniques used on urban or complex terrain. These techniques include CSOU unique explosive breaching, selective and discriminatory target engagement, and emergency assault methods utilizing special, nonstandard equipment and CSOU TTP. SFAUC is characterized

[23] RSTA – Reconnaissance, Surveillance and Target Acquisition

[24] RDF – Radio direction finder

[25] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Chapter 3-2, Chapter 4-1.b. Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001

[26] FM 3-06. Field manual. Urban Operations. The prospect of urban operations. 1-1. Department of the Army. Washington, DC, 26 October 2006

[27] FM 3-06. Field manual. Urban Operations. Multidimensional battlefield. 2-8. Department of the Army. Washington, DC, 26 October 2006.

by offensive operations where clearing built-up areas is necessary, but minimal collateral damage is a primary consideration and noncombatants are or may be present. Operations are characterized by CSOU special purpose weapons and equipment, a special personnel selection process, and advanced marksmanship on linear structures. These operations are conducted by ARSOF[28].

35. CSOU unit during conducting urban operation should increase the individual combat load and the types of ammunition they carry. Due to the increased likelihood of compromise and the chance of isolation, CSOU unit elements might need more firepower to break contact with a pursuing enemy element. Short ranges to and briefly exposed targets, limited visibility, constant engagements, and the requirement to suppress enemy fire, indicate the need for each squad to carry an AT4, extra rifle and machine gun ammunition, 40-mm grenades, hand grenades, and explosives. In urban operations, CSOU unit execute missions in changing conditions. For example, switching from stability and support operations to combat operations changes operational conditions from high-intensity to precision, or vice-versa. Political and threat situations determine when this change must occur[29].

36. The closeness of urban operations increases the likelihood that the enemy will detect the CSOU unit. Because some urban areas offer poor concealment and cover, the enemy is most likely to detect soldiers moving through urban areas. He is far less likely to detect soldiers operating from static positions inside buildings. If compromised in urban terrain, CSOU unit can become isolated or at least feel isolated. When this happens, a break-contact drill becomes a series of small-unit battles. Soldiers and squad or team leaders must have the initiative, skill, and courage to accomplish their missions while isolated from their parent units. Individual soldiers train physically and psychologically for this type of operation[30].

37. Casualties in urban operations are higher than in other types of terrain due to the following: Accidents. More casualties result from shattered glass, falling debris, rubble, ricochets, urban fires, and falls from heights than from actual combat engagements. (2) Situational Awareness. Difficulty in maintaining situational awareness also increases casualties, because leaders find preventing fratricide more difficult if they do not know the locations of other friendly personnel. (3) Psychological Illnesses. Stress naturally contributes to the number of accidents, fratricide incidents, and illnesses. Stress can also trigger other, latent psychological problems. (4) Physical Illnesses or Environmental Hazards. Nonbattle injuries result from illnesses, environmental hazards, unsanitary conditions, contaminated water, toxic industrial materials, and so forth. (5) Three-Dimensional Terrain. Friendly and threat forces operate in a three-dimensional battle space. Engagements can occur above, on, or below the surface, inside or outside buildings. Another complicating factor is that both friendly and enemy forces can control different floors or portions of multistory buildings.

38. Close quarter battle (CQB) is common warfighting type in the urban operations, required enhansed individual protection, especially from ballistics threats. From other perspective CSOU unit still required to be high mobile and able to break-contact with enemy or defeat if tasked. This makes crucial design of the CSOU individual armour system, where different types of design compromises should be implemented in order to develop ergonomic individual armour system, which will fit most of the CSOU unit warfaghting types and threat levels. Applying of the HUMINT APFG requires separately design individual armour system for low profile types of operations in human intelligence.

[28] FM 3-05.20 (FM 31-20) Field manual. Special Forces Operations. Special Forces advanced urban combat. Glossary-25. Department of the Army. Washington, DC, 1st April 2004.

[29] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Chapter 9-4.e. Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001

[30] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Chapter 9-4.i Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001.

39. Direct and indirect enemy fire, using of the different types of ammunition and exploisives during actual combat, generates flame from ignited materials of the man made and natural environment, as well as different objects locates inside this environment. In urban operations exploision of ammunition and different exploisive materials have enhansed flame and thermal flux effect due to thermal wave reflection from the different types of the contructions and infrastructure elements. CSOU unit using trucks, helicopters, boats to encrease their moving capabilities. All types of transportation could be possible source of the flame threats. Different levels of flame retardancy for the CSOU APFG systems should be applied in order to decrease degree of the burn injuries and its area on the soldier body.

40. Mountains exist in almost every country in the world and almost every war has included some type of mountain operations. This pattern will not change; therefore, soldiers will fight in mountainous terrain in future conflicts. Although mountain operations have not changed, several advancements in equipment and transportation have increased the soldiers' capabilities. The helicopter now allows access to terrain that was once unreachable or could be reached only by slow methodical climbing. Inclement weather, however, may place various restrictions on the capabilities of air assets available to a commander. The unit must then possess the necessary mountaineering skills to overcome adverse terrain to reach an objective[31].

41. Operations in the mountains require soldiers to be physically fit and leaders to be experienced in operations in this terrain. Problems arise in moving men and transporting loads up and down steep and varied terrain in order to accomplish the mission. Chances for success in this environment are greater when a leader has experience operating under the same conditions as his men. Acclimatization, conditioning, and training are important factors in successful military mountaineering[32].

42. When conducting mountain operations, commanders must clearly understand the effect the operational terrain level has on dismounted movement. Therefore, in addition to the general mobility classification contained in FM 2-01.3 (unrestricted, restricted, severely restricted), mountainous terrain may be categorized into five classes based on the type of individual movement skill required (see Figure 1-3). Operations conducted in class 1 and 2 terrain require little to no mountaineering skills. Operations in class 3, 4, and 5 terrain require a higher level of mountaineering skills for safe and efficient movement. Commanders should plan and prepare for mountain operations based, in large part, on this type of terrain analysis[33].

43. The mountain environment is complex and unforgiving errors. Soldiers conducting operations anywhere, even under the best conditions, become cold, thirsty, tired, and energy-depleted. In the mountains however, they may become paralyzed by cold and thirst and incapacitated due to utter exhaustion. Conditions such as high elevations, rough terrain, and extremely unpredictable weather require leaders and soldiers who have a keen understanding of environmental threats and what to do about them. A variety of individual soldier characteristics and environmental conditions influence the type, prevalence, and severity of mountain illnesses and injuries. Due to combinations of these characteristics and conditions, soldiers often succumb to more than one illness or injury at a time, increasing the danger to life and limb. Three of the most common, cumulative, and subtle factors affecting soldier ability under these variable conditions are nutrition (to include water intake), decreased oxygen due to high altitude, and cold. Preventive measures, early recognition, and rapid treatment help minimize nonbattle casualties due to these conditions[34].

[31] FM 3-97.61. Field manual. Military mountaineering. Preface. Headquarters. Department of the Army. Washington, DC, 20 February 2003.

[32] FM 3-97.61. Field manual. Military mountaineering. Mountain terrain. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 1-1.

[33] FM 3-97.6. Field manual. Mountain operations. Headquarters. Department of the Army. Washington, DC, 28 November 2000. Page 1-5.

[34] FM 3-97.6. Field manual. Mountain operations. Headquarters. Department of the Army. Washington, DC, 28 November 2000. Page 1-9.

44. The 60 mm mortar is an ideal supporting weapon for mountain combat because of its portability, ease of concealment, and lightweight ammunition. The 81mm mortar provides longer range and delivers more explosives than the 60 mm mortar. However, it is heavier and fewer rounds (usually no more than two per soldier) can be man-packed. The 120 mm mortar may be more desirable in some situations, since they can fire either white phosphorous (WP) or HE at greater ranges than lighter mortars and have a significantly better illumination capability. However, because of the weight of these mortars and their ammunition, it may be necessary to transport fewer of them into mountainous terrain and use the remaining gun crews as ammunition bearers, or position them close to a trail network in a valley or at lower elevations. The second technique may be satisfactory if the movement of the unit can be covered and sufficient firing positions exist[35].

45. An analysis of mountain weather and how it is affected by mountain terrain shows that such weather is prone to patterns and is usually severe, but patterns are less obvious in mountainous terrain than in other areas. Conditions greatly change with altitude, latitude, and exposure to atmospheric winds and air masses. Mountain weather can be extremely erratic. It varies from stormy winds to calm, and from extreme cold to warmth within a short time or with a minor shift in locality. The severity and variance of the weather causes it to have a major impact on military operations[36].

46. Commanders should take into account when considering the effect the mountainous environment may have on their weapons and equipment. Of these, the most important factor is the combined effects of the environment on the soldier and his subsequent ability to operate and maintain his weapons and equipment. Increasingly sophisticated equipment requires soldiers that are mentally alert and physically capable. Failure to consider this important factor often results in severe injury, lowered weapons and equipment performance, and mission failure[37].

47. High mountain air is dry and may be drier in the winter. Cold air has a reduced capacity to hold water vapor. Because of this increased dryness, equipment does not rust as quickly and organic material decomposes slowly. The dry air also requires soldiers to increase consumption of water. The reduced water vapor in the air causes an increase in evaporation of moisture from the skin and in loss of water through transpiration in the respiratory system. Due to the cold, most soldiers do not naturally consume the quantity of fluids they would at higher temperatures and must be encouraged to consciously increase their fluid intake[38].

48. Weather conditions in the mountains may vary from one location to another as little as 10 kilometers apart. Approaching storms may be hard to spot if masked by local peaks. A clear, sunny day in July could turn into a snowstorm in less than an hour. Always pack some sort of emergency gear. Dangers from impending high winds include frostbite (from increased wind-chill factor), windburn, being blown about (especially while rappelling), and debris being blown about. Wear protective clothing and plan the route to be finished before bad weather arrives. For each 100-meter rise in altitude, the temperature drops approximately one degree Fahrenheit. This can cause hypothermia and frostbite even in summer, especially when combined with wind, rain, and snow. Always wear or pack appropriate clothing. If it is snowing, gullies may contain avalanches or snow sloughs, which may bury the trail. Snowshoes or skis may be needed in autumn or even late spring. Unexpected snowstorms may occur in the summer with accumulations of 12 to 18 inches; however, the snow quickly melts. Higher altitudes provide less filtering effects, which leads to greater ultraviolet (UV) radiation intensity. Cool winds at higher altitudes may mislead one into underestimating the sun's intensity, which can lead to sunburns and other heat injuries. Use sunscreen and wear hat and sunglasses, even if overcast. Drink plenty of fluids[39].

[35] FM 3-97.6. Field manual. Mountain operations. Headquarters. Department of the Army. Washington, DC, 28 November 2000. Page 3-6.
[36] FM 3-97.61. Field manual. Military mountaineering. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 1-11.
[37] FM 3-97.6. Field manual. Mountain operations. Headquarters. Department of the Army. Washington, DC, 28 November 2000. Page 1-15.
[38] FM 3-97.61. Field manual. Military mountaineering. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 1-12.
[39] FM 3-97.61. Field manual. Military mountaineering. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 1-29.

49. Cold-weather injuries can occur during any season of the year. Death has resulted in temperatures as high as 10 degrees Celsius (50 degrees Fahrenheit). A loss of body heat combined with shock produces devastating results. Excess activity (overheating) results in loss of large amounts of body heat by perspiration. This loss of body heat combined with the loss of insulation value provided by the clothing (due to perspiration dampening the clothing) can subject a soldier to cold injuries. Weather conditions in mountainous terrain are known to change considerably throughout the day. Weather can quickly change to extremely cold and wet conditions, especially in higher elevations. Body heat may be lost through radiation, conduction, convection, or evaporation. (1) Radiation. The direct heat loss from the body to its surrounding atmosphere is called radiation heat loss. The head can radiate up to 80 percent of the total body heat output. On cold days, personnel must keep all extremities covered to retain heat. This accounts for the largest amount of heat lost from the body. (2) Conduction. Conduction is the direct transfer of heat from one object in contact with another (being rained on or sitting in snow). (3) Convection. Convection is the loss of heat due to moving air or water in contact with the skin. Wind chill is convection cooling. Clothing that ventilates, insulates, and protects must control the layer of warm air next to the skin. (4) Evaporation. The evaporation of perspiration causes heat loss. Wet clothing can cause heat loss by conduction and evaporation. Dressing in layers allows soldiers to remove or add clothing as needed[40].

50. In mountain operations cotton clothing, due to its poor insulating and moisture-wicking characteristics, is virtually useless in most mountain climates, the exception being hot, desert, or jungle mountain environments. Cotton clothing should be replaced with synthetic fabric clothing[41].

[40] FM 3-97.61. Field manual. Military mountaineering. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 2-11, 2-13, 2-14.
[41] FM 3-97.61. Field manual. Military mountaineering. Headquarters. Department of the Army. Washington, DC, 20 February 2003. Page 3-31.

51. Combat in the jungle is characterized by long periods of developing the situation and looking for the enemy; and short periods of violent, and sometimes unexpected, combat. The thick foliage and rugged terrain of most jungles limit fields of fire and speed of movement. These terrain characteristics make jungle fighting different from fighting on more open terrain. To be effective jungle fighters, soldiers must learn to use these characteristics to their advantage.

52. The aspects of terrain and enemy discussed above result in fewer set-piece battles. Rather than conventional attacks conducted against conventional defenses, jungle battles are more often ambushes, raids, and meeting engagements. Battles are not fought for high ground as frequently as conventional battles. Orientation is on the enemy rather than on the terrain. Hills in the jungle are often too thickly vegetated to permit observation and fire, and therefore do not always qualify as key terrain. In the jungle, roads, rivers and streams, fording sites, and landing zones are more likely to be key terrain features. The frequency of ambushes, raids, and meeting engagements makes it very important that units in the jungle practice immediate action drills. In the jungle firefight, the side which initiates contact and gains fire superiority in the first few seconds will normally have a decisive advantage[42].

53. In a tropical environment, rapid deterioration is a primary consideration in class II supply. Issue clothing, particularly combat boots and socks, lasts a very short time. Normal wear and tear on clothing may require a resupply every 5 to 6 days. Class II resupply can be a major morale builder. Class II requirements should be estimated well in advance and special provisions should be made for timely resupply. At battalion level, limited emergency supplies of assorted combat boots, socks, uniforms, and similar items of short wear periods should be stocked in the field trains. No one should move in the jungle without a compass. It should be tied to the clothing by a string or bootlace. Pieces of clothing caught on the walking on them. The same is true of dry sharp edges of bushes. In tropical environment clothing should be lighter and faster drying than standard fatigues. To provide the best ventilation, the uniform should fit loosely. It should never be starched. The insect (mosquito) bar or net should be used any time soldiers sleep in the jungle. Even if conditions do not allow a shelter, the bar can be hung inside the fighting position or from trees or brush. No part of the body should touch the insect net when it is hung, because mosquitoes can bite through the netting. The bar should be tucked or laid loosely, not staked down. Although this piece of equipment is very light, it can be bulky if not folded properly. It should be folded inside the poncho as tightly as possible. Straps wrapped around the lower part of the legs ("leech straps") will prevent leeches from crawling up the legs and into the crotch area. Trousers should be securely tucked into the boots[43].

54. The problem of excessive weight in eksistence loads needs to be closely monitored by commanders at all levels. Specific company and CSOUSOPs need to be reinforced with inspections prior to deployment, demanding strict adherence to packing lists. Unusable equipment should not be carried. Water will constitute the second greatest part of each soldier's load. Jungle fighters must be issued more canteens than normal, and they may have to carry 5 to 10 quarts of water attached to their rucksacks, especially in the dry season. Water purification tablets should be carried so that stream water may be used. Units should be told how long they can expect to operate without resupply. This figure becomes the basis for planning the equipment, supplies, and ammunition to be carried. Ammunition will normally make up the greatest part of each soldier's load, and ammunition supplies must be planned to last until troops can be resupplied. Rifle and machinegun ammunition and grenades should be loaded on pallets in a rear area so that units can easily be resupplied by helicopter, if required.

[42] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page 5-3.

[43] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page 7-5, B-2, B-7, 2-12, 2-3.

Every soldier should carry colored smoke grenades and flares for signaling, and tripflares and Claymore mines for security. Special ammunition may be carried, if required by the mission. The most common types of special ammunition and C4 explosives, concussion grenades, and CS munitions. Total fighting load of the soldier can be 29 kg[44].

55. Reconnaissance operations are always important in jungle warfare. Many offensive operations in the jungle take on the aspects of a reconnaissance operation during their early stages. This is because the success of offense in the jungle depends on ability to find the enemy. The excellent concealment found in the jungle enables the enemy to operate unobserved both by day and night. Extensive patrolling is necessary to obtain information on his locations, strength, and disposition[45].

56. In the jungle, there are many places where the vegetation or the ruggedness of the terrain will not permit a helicopter to land. Therefore, it maybe necessary to rappel from a helicopter to get on the ground. Special equipment is required to rappel from helicopters. There are no safe field expedients[46].

57. The fundamentals and tactics applicable in conventional ground operations apply in waterborne operations. However, special organization, equipment, and techniques are required when ground forces are supported by Navy ships and craft. The waterborne force should be employed with all available modes of transportation to seek out and destroy the enemy and his installations. One portion of the force may enter the area by watercraft; another may enter by helicopters; still another may enter the area by moving overland. All units then maneuver to attack the enemy. All available fire support should be used in the operation: close air support, attack helicopters, waterborne and landbased artillery, and naval gunfire[47].

58. Helocasting is an excellent method for deploying troops and equipment in any terrain in which water courses exist[48]. This technique involves a helicopter, rubber boat and a squad. The boat is loaded with the squad's rucksacks, crew-served weapons, radios, and other heavy mission-essential items. All this equipment is kept in the boat by a lashing system. At the desired time, the boat is pushed off the ramp and into the water. The squad follows it, exiting the helicopter in two columns off the tailgate.

59. Successful desert operations require adaptation to the environment and to the limitations its terrain and climate impose. Equipment and tactics must be modified and adapted to a dusty and rugged landscape where temperatures vary from extreme highs down to freezing and where visibility may change from 30 miles to 30 feet in a matter of minutes. Deserts are arid, barren regions of the earth incapable of supporting normal life due to lack of water. The highest known ambient temperature recorded in a desert was 136 degrees Fahrenheit (58 degrees Celsius). This produced internal tank temperatures approaching 160 degrees Fahrenheit (71 degrees Celsius) in the Sahara Desert during the Second World War. Winter temperatures in Siberian deserts and in the Gobi reach minus 50 degrees Fahrenheit (minus 45 degrees Celsius). Low temperatures are aggravated by very strong winds producing high windchill factors. Desert winds can achieve velocities of near hurricane force; dust and sand suspended within them make life intolerable, maintenance very difficult, and restrict visibility to a few meters[49].

[44] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page H1-H2.
[45] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page 5-8.
[46] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page C-6.
[47] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page D-2.
[48] FM 90-5. Field manual. Jungle operations. Headquarters. Department of the Army. Washington, DC, 16 August 1982. Page D-9.
[49] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page 1-1, 1-8, 1-9.

60. The extreme heat of the desert can cause heat exhaustion and heatstroke and puts troops at risk of degraded performance. For optimum mental and physical performance, body temperatures must be maintained within narrow limits. Thus, it is important that the body lose the heat it gains during work. The amount of heat accumulation in the human body depends upon the amount of physical activity, level of hydration, and the state of personal heat acclimatization. Unit leaders must monitor their troops carefully for signs of heat distress and atjust schedules, work rates, rest, and water consumption according to conditions. Normally, several physical and physiological mechanisms (e.g., convection and evaporation) assure transfer of excess body heat to the air. But when air temperature is above skin temperature (around 92 degrees Fahrenheit) the evaporation of sweat is the only operative mechanism. Following the loss of sweat, water must be consumed to replace the body's lost fluids. If the body fluid lost through sweating is not replaced, dehydration will follow. This will hamper heat dissipation and can lead to heat illness. When humidity is high, evaporation of sweat is inhibited and there is a greater risk of dehydration or heat stress[50].

61. Radiant light comes from all directions. The sun's rays, either direct or reflected off the ground, affect the skin and can also produce eyestrain and temporarily impaired vision. Not only does glare damage the eyes but it is very tiring; therefore, dark glasses or goggles should be worn. Overexposure to the sun can cause sunburn. Persons with fair skin, freckled skin, ruddy complexions, or red hair are more susceptible to sunburn than others, but all personnel are susceptible to some degree. Personnel with darker complexions can also sunburn. This is difficult to monitor due to skin pigmentation, so leaders must be ever vigilant to watch for possible sunburn victims. Sunburn is characterized by painful reddened skin, and can result in blistering and lead to other forms of heat illness[51].

62. The wind can be as physically demanding as the heat, burning the face, arms, and any exposed skin with blown sand. Sand gets into eyes, nose, mouth, throat, lungs, ears, and hair, and reaches every part of the body. Even speaking and listening can be difficult. Continual exposure to blown sand is exhausting and demoralizing. Technical work spaces that are protected from dust and sand are likely to be very hot. Work/rest cycles and enforced water consumption will be required. The combination of wind and dust or sand can cause extreme irritation to mucous membranes, chap the lips and other exposed skin surfaces, and can cause nosebleed. Cracked, chapped lips make eating difficult and cause communication problems. Irritative conjunctivitis, caused when fine particles enter the eyes, is a frequent complaint of vehicle crews, even those wearing goggles. Lip balm and skin and eye ointments must be used by all personnel. Constant wind noise is tiresome and increases soldier/marine fatigue, thus affecting alertness[52].

63. Uniforms should be worn to protect against sunlight and wind. Wear the uniform loosely. Use hats, goggles, and sunscreen. Standard lightweight clothing is suitable for desert operations but should be camouflaged in desert colors, not green. Wear nonstarched long-sleeved shirts, and full-length trousers tucked into combat boots. Wear a scarf or triangular bandanna loosely around the neck (as a sweat rag) to protect the face and neck during sandstorms against the sand and the sun. In extremely hot and dry conditions a wet sweat rag worn loosely around the neck will assist in body cooling. Combat boots wear out quickly in desert terrain, especially if the terrain is rocky. The leather drys out and cracks unless a nongreasy mixture such as saddle soap is applied. Covering the ventilation holes on jungle boots with glue or epoxies prevents excessive sand from entering the boots. Although difficult to do, keep clothing relatively clean by washing in any surplus water that is available.

[50] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page 1-18.
[51] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page 1-20.
[52] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page 1-20.

When water is not available, air and sun clothing to help kill bacteria. Change socks when they become wet. Prolonged wear of wet socks can lead to foot injury. Although dry desert air promotes evaporation of water from exposed clothing and may actually promote cooling, sweat tends to accumulate in boots. Soldier/marines may tend to stay in thin clothing until too late in the desert day and become susceptible to chills – so respiratory infections may be common. Personnel should gradually add layers of clothing at night (such as sweaters), and gradually remove them in the morning. Where the danger of cold weather injury exists in the desert, commanders must guard against attempts by inexperienced troops to discard cold weather clothing during the heat of the day[53].

64. A decision on the level of protection is made according to the circumstances. If partial protection is ordered, the pace of physical work will be slower and proficiency reduced. The bulk of strenuous physical activity must be done at night or during the coolest part of the desert day. In the desert, heat casualties (5 percent minimal) can be expected to occur in 30 minutes while performing heavy work in 90 degree Fahrenheit (32 degree Celsius) temperatures when dressed in MOPP 4[54]. Work/rest periods must be utilized to reduce the chances of heat fatigue. When protective clothing is worn, at least 10 degrees should be added to the WBGT index. Because of higher body temperatures, soldiers/marines in MOPP equipment perspire more than usual. Water must be consumed (2 quarts per hour) during continuous moderate work periods (and in MOPP equipment) when temperatures reach 80 degrees Fahrenheit (27 degree Celsius) and above to replace lost fluids or dehydration will follow[55].

65. The risk of sunburn, particularly to the uncovered face, is greater in mountains than on the desert floor due to thinner atmosphere. Use antisunburn ointment and keep the face in shade around midday, using face nets or sweat rags. An individual camouflage net or scarf is particularly useful for this purpose. Recognition of heat illnesses in higher altitudes may not be as apparent as at lower altitudes because sweat evaporates very quickly. Measures to avoid dehydration and salt loss are extremely important. Daily temperature variations may be considerable making it necessary to ensure troops do not become chilled at night. Layering of clothing is essential. Troops who have been sweating heavily before the temperature starts to drop should take their wet shirts off and place them over relatively dry shirts and sweaters. Soldiers/marines should add layers of clothing as it gets colder and remove them as needed. This may have to be leader supervised and disciplined in the same manner as water consumption[56].

66. The Arctic environment is a dynamic force. He who recognizes and understands this force can use it; he who disregards or underestimates this force is threatened with failure or destruction. Because of the demanding requirements on the individual solider, leadership must be of the highest caliber. Leaders at all levels down to the squad, must make decisions far surpassing the scope of their usual responsibilities. In the north the human element is all-important. The effectiveness of equipment is greatly reduced. Specialized training and experience are essential. The climate does not allow a margin of error for the individual or the organization[57]. Special clothing is required due to two types of cold encountered: Wet-cold and drycold during Arctic warfare[58].

[53] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page 1-26.

[54] MOPP - A soldier's mission-oriented protection posture (MOPP) gear protects against NBC contamination. MOPP4 – mask, overgarment, overboot, gloves, helmet, helmet cover, undergarnment. FM 3-4. NBC protection. Headquarters Department of the Army US Marine Corps Washington, DC, 29 May 1992.

[55] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page D-9.

[56] FM 90-3. Field manual. Desert operations. Headquarters. Department of the Army. Washington, DC, 24 August 1993. Page F-2.

[57] FM 31-71. Field manual. Northern operations. Department of the Army. Washington, DC, 21 June 1971. Part 1-3.

[58] FM 31-71. Field manual. Northern operations. Department of the Army. Washington, DC, 21 June 1971. Part 3-26.

67. The effects of extreme cold must be considered in planning operations. The propser use and care of clothing and equipment will largely overcome most difficulties; however, extremely low temperatures combined with wind can be very hazardous to personnel operating outside. The effect of these two elements occurring together is called windchill, which greatly increases the speed at which exposed flesh will freeze and the length of time personnel can operate in the open. The human body is continually producing or losing heat. Wind increases the loss of heat by reducing the thin layer of warm air next to the skin. This loss increases as the speed of wind increases Any movement of air past the body has the same cooling effect as wind. This may be produced by walking, running, skiing, or riding in an open vehicle[59].

68. During the beach assault, waterproof suits must be provided troops and crews of landing craft to protect them from sea spray and, if a dry ramp landing cannot be made, from freezing sea water. Operation of all mechanized equipment, boats, amphibian tractors, and aircraft in subfreezing temperature is difficult. Provisions must also be made for freeing the landing craft ramps should they freeze during the movement ashore. Amphibian wheeled vehicles of the LARC type are unsuitable for landing operations either afloat or ashore due to the fragile hull and the difficult trafficability ashore. Therefore, the use of amphibian tracked vehicles is emphasized for the movement of both troops and supplies from ship to shore[60].

[50] F59 FM 31-71. Field manual. Northern operations. Department of the Army. Washington, DC, 21 June 1971. Chapter 2. Operations.
[60] FM 31-71. Field manual. Northern operations. Department of the Army. Washington, DC, 21 June 1971. Chapter 6. Effect of Northern Conditions on Personnel and Equipment.

69. Layer Principle-Attaining additional insulation by trapping dead air in the space(s) between successive layers of clothing. Two or more thicknesses of clothing, with intervening air space, provide greater insulation than the same thickness of clothing of the same material in a single layer[61].

70. Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives (CBRNE) Hazards. Those chemical, biological, radiological, nuclear, and high-yield explosive elements that pose or could pose a hazard to individuals. Chemical, biological, radiological, nuclear, and high-yield explosive hazards include those created from accidental releases, toxic industrial materials (TIM) (especially air and water poisons), biological pathogens, radioactive matter, and high-yield explosives. Also included are any hazards resulting from the deliberate employment of weapons of mass destruction (WMD) during military operations[62].

71. Chemical, biological, radiological, nuclear (CBRN) weapons can cause casualties, destroy or disable equipment, restrict the use of terrain, and disrupt operations. They can be used separately or in combination to supplement conventional weapons. The reconnaissance CSOU must be prepared to operate in an NBC-contaminated battlefield Operating in an NBC environment degrades the overall effectiveness of the CSOU unit[63].

72. The effects of CBRNE are as follows: complete or partial destruction of the infrastructure over a short period of time; disposal of material and technical means; large casualties and civilian casualties over a short period of time; massive radiation sickness; massive, uncontrolled, infectious lethal diseases; water and food poisoning; fires in large areas; large area, infrastructure, material and technical means of radiation with radiation; personnel (who survived) has critical psychic and psychic physical condition.

73. Warfare after the use of WMD has a different character, which is mainly related to the management and liquidation of the consequences of the use of WMD, as well as the preservation of the health and life of the personnel, the civilian population, while continuing the combat task. Soldiers must be capable of: maintain a satisfactory psychological state of mind when performing the task; to withstand the high physical load from the portable battle equipment and AMII equipment; stay on long-term AMI equipment while performing battle tasks; being able to fight airspace for limited air access due to AMII equipment; maintain the optimum heat exchange between the bodies and the environment due to AMII equipment; take degassing and deactivation measures; complete the task and return to the place of dislocation.

61 FM 31-71. Field manual. Northern operations. Department of the Army. Washington, DC, 21 June 1971. Glossary. Layer principle.
62 Multiservice tactics, techniques, and procedures for chemical, biological, radiological, and nuclear consequence management operations. 2.Terms of Reference. b – clause. FM 3-11.21 / MCRP 3-37.2C / NTTP 3-11.24 / AFTTP(I) 3-2.37. April 2008.
[63] FM 7-92. Field manual. The Infantry Reconnaissance Platoon and Squad (Airborne, Air Assault, Light Infantry). Page B-1. Headquarters. Change 1. Department of the Army. Washington, DC, 13 December 2001.

4

Combat Physiology

Area temperature
+ 58°C / – 68°C ever recorded
+ 49°C / – 57°C summarized

Loading
45kg to 51kg – assault load / speciality, no restrictions

Metabolic heat rate
40 W/m^2 – sleeping; 650 W/m^2 – combat, no restriction

Rectal temperature
T_{ref} = 40°C – 100% probability of overheating casualties

Limited duration of exposure
D_{lim} = 1 hour, survival

Sleeping
$I_{tot, serial}$ = 1.819 m^2K/W – survival 4 hours, C0-C1

Swimming and diving
Water 14°C (+/- 1.5°C), 180 min, Tref drop by 2^0C

74. Combat physiology is the quality of the CSOU APFG, identifying reaction of the operator's organism on the high and low air and low water temperature, associated air humidity, while being under certain load of the apparel and carried equipment, while performing required combat or training activities, moving in the specified landscape. Reaction of the operator's organism identifying by calculation two parameters of the physiological quality. Those parameters are:

- rectal temperature Tref – reaction on hot environment;
- limited duration of exposure Dlim – reaction on cold environment;
- rectal temperature Tref – reaction on cold water.

75. T_{ref} predicts level of overheating during hot / extremely hot, humid weather conditions, by calculating time frame, when rectal temperature (core temperature) of the body T_{ref} achieving not safe limit and overheating of the body is probable. The calculation should be done according to equation of T_{ref}[64] and PHS2 model of Lund Univercity. The main parameters of the equation and PHS2 model are: metabolic heat rate – M (W/m2), showing actual level of performing work; area temperature Ta (0C), humidity %, thermal insulation of APFG system I (clo) and water vapour permeable index (im), weight and height of operator. NATO identifying following levels of probalities to be overheated[65]:

- rectal temperature Tref ≤ 38.2°C – safe limit;
- rectal temperature Tref = 39.2°C – 25% probability of overheating;
- rectal temperature Tref = 39.5°C – 50% probability of overheating;
- rectal temperature Tref = 40°C – 100% probability of overheating.

76. D_{lim} predicts time (hours) operator is capable to withstand influence of cold environment, without undercooling, being equipped with specified set of the APFG and performing work activity. Determination and interpretation of Dlim should performed according to IREQ – required clothing insulation of ISO 11079 "Ergonomics of the thermal environment. Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects", as well according to ISO 15831, ASTM F 2370 and NATO ACCP-1. The main parameters of the equation and IREQ model are: metabolic heat rate – M (W/m2) showing actual level of performing work activity; area temperature – Ta(0C); humidity – %; thermal insulation of APFG system – I(clo).

77. Area temperature Ta (0C) is one of the obligatory parameter to identify level of rectal temperature – Tref and limited duration of exposure – D_{lim}. Modern textile technologies are not allowing yet to make unified APFG through all climatic categories. Therefore, following ranking of the climatic categories and associated area temperatures should be established for specified APFG systems:

77.1 temperate climate

C1 (–210C till –330C) / A3 (+ 280C till + 390C);

77.2 arctic climate

C2, C3, C4, M3 up to minus – 570C; severe cold

[64] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Equation 9. B-5. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

[65] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Annex B, clause 9. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

77.3 torrid climate

A1, A2 up to plus + 490C; hot, extreme hot, dry

77.4 tropic climate

B1, B2, B3 up to plus + 410C; hot, extreme hot, wet

78. In case of CSOU unit operating in the Arctic climatic categories C2, C3, C4 and M3, with possible air temperature droping until – 57°C, CSOU unit should be equipped with additional layers of APFG developed especially for Arctic climatic categories. NATO STANAG 4573 „Design criteria for arctic clothing" can be possible guidelines of the Arctic APFG development; however, development and calculation of limited duration of exposure Dlim should comply according to IREQ – required clothing insulation of ISO 11079 "Ergonomics of the thermal environment. Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects", as well according to ISO 15831, ASTM F 2370 and NATO ACCP-1.

79. In case of CSOU unit operating in the categories B1, B2, B3 (wet warm / wet hot / humid hot climates) or A1, A2 (hot dry / extreme hot dry climates) CSOU unit should be equipped with additional layers of APFG developed especially for such climatic categories. The calculation should be done according to equation of T_{ref}[66] and PHS2 model of Lund Univercity, as well should comply with the ISO 15831, ASTM F 2370 and NATO ACCP-1.

80. Swimming and diving are both CSOU unit technique. Hypothermia in the water is the basic physiological threat to the CSOU soldier during water reconnaissance. Typical methodology of the evaluation APFG physiological quality in the water is EN ISO 15027-3: Immersion suits – Part 3: Test methods. The main criterion of the physiological quality of the protection systems of supercooling in water is the rectal temperature – Tref of body (core), providing survival time until core temperature droping by 20C. As an example, test of system of long underwear and dry wet suit, can be considered. CSOU APFG when tests were performed in a test pool where the water temperature was kept at 14 °C (+/- 1.5°C), as a model of Baltic sea in the summer time, throughout the test period, and with the water being circulated, providing 180 min survival time until core temperature Tref droping by 20C, which is criteria for the finishing of the test[67].

81. Metabolic heat rate M (W/m2) showing actual level of performing work (work activity). Metabolic heat rate M is significant parameters when calculating level of physiological quality of the CSOU APFG rectal temperature Tref and limited duration of exposure Dlim. Therefore, should describe the methods of determination M:

- Following norm for the identification of M should be applied ISO 11079 "Ergonomics of the thermal environment. Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects", ISO 8996 "Ergonomics of the thermal environment. Determination of metabolic rate";
- The calculation method[68] described in NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". The method includes calculating the metabolic heat rate, which based on mass factors of load bearing; speed of movement; the angle of ascent; type of relief and weight of operator.

[66] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Equation 9. B-5. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

[67] Evaluation of the thermal protection properties for Polartec underwear in combination with Ursuit dry suits. 08.10.2016. Nr. 02.2016. Ursuk Oy. ErgoPro. 2015.gada 15.oktobra Līgums p-213/NP/2015/NP2015/031 „KSP fizioloģiskie testi ūdenī".

[68] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Annex B, clause 8. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

82. When performing operational activities Metabolic heat rate M of the CSOU unit operators could reach following levels according to ISO 11079 and ISO 8996:

- Up to 40 W/m2 (sleeping position)
- Up to 60 W/m2 (stationary position, seating);
- Up to 70 W/m² (stationary position, standing);
- Up to 200 W/m2 (foot patrolling 5 km/h, without load);
- Up to 340 W/m2 (foot fast patrolling 8 km/h, without load);
- Up to 100 W/m2 (driving light car);
- Up to 150 W/m2 (driving cargo car);
- Up to 100 W/m2 (work in HQ);
- Up to 290 W/m2 (digging work);
- Up to 390 W/m2 (foot patrolling 3.2 km/h, 250 inclinations, hard surface);
- Up to 650 W/m2 (riots, hand-to-hand combat);
- Up to 400 W/m2 (average warfighting in urban terrain);
- Up to 130 W/m2 (maintenance works in depot);
- Up to 120 W/m2 (investigation work on scene).

83. The calculation M (W/m2) should be done according to NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Of particular interest from all the above mass of the load is crucial parameter.

84. CSOU operators are always loaded with different king of weapons, ammunitions, special devices, C4I assets, protection systems, water, dry rations, additional clothing, field equipment, personal hygiene products to carry on and load of APFG. The mass of the load to be carried is determined depending on the task and CSOU operator role in the unit, which was considered in a paragraph " Critical skills operations unit".

85. The problem of overloading the infantry man with equipment can been seen throughout history of military combat. The armies of antiquity traveled with loads equivalent to modern day armies; however, they offset their loads utilizing auxiliary transport (carts, animals, porters) in order to maximize combat effectiveness. Despite modern technologies (aircraft, wheeled vehicles), the infantryman continues to carry ever-increasing loads. Identifying the correct load for the infantryman to carry, is essential for optimum performance effectiveness and mission success[69].15831, ASTM F 2370 and NATO ACCP-1. The main parameters of the equation and IREQ model are: metabolic heat rate – M (W/m2) showing actual level of performing work activity; area temperature – Ta(0C); humidity – %; thermal insulation of APFG system – I(clo).

86. Current doctrinal US Army publications FM 21-18 (Foot Marches) and FM 7-10 (Infantry Rifle Company) prescribe weights of 48 pounds (22 kg) and 72 pounds (33 kg) for the fighting and approach march loads, respectively. In a scenario defined as

[69] Combat Load Report. LCDR Demetri Economos USN. Marine Corps Combat Development Command. Material requirement devision. Quantico, Virginia. December 31, 2003

Emergency Approach March Load, higher loads of up to 120 pounds (54 kg) are allowed in conditions where approach marches are through terrain impassable to vehicles, or ground/air transport are not available, or when the mission demands that soldiers be employed as porters. Enemy contact should be avoided at the higher than 54 kg load[70]. The USMC made actual calculation of assault load of 23 kg. The USMC made actual calculation of marches load of 34 kg. The USMC made actual calculation of long marches load of 46 kg. The USMC made actual calculation of deployment load of 58 kg[71].

87. The following definition of the above-mentioned loading should be given:

- **Assault load** – minimum required load for a given assault. The maximum weight of the combat loading will be such a weight at which the average soldier can conduct combat operations indefinitely with a minimum reduction in combat capability from human factor point of view.
- **Marches load** – the required load to perform operations on a long-time interval with access to daily supply. The maximum weight of the combat loading on march will be such a weight at which the average sildier was able to spend 32 km march within eight hours with a 90% retention of combat capability
- **Long marches load** – necessary load may be required to perform operations within 72 hours, when the supply is unavailable. Well-trained soldier can carry this kind of load from the human factor point of view.
- **Deployment load** – load taken from a point of permanent dislocation and moved to the collection point. The maximum weight of the combat loading will be such a weight at which the average soldier can conduct limited movement within the limits of transportation and make a march from the delivery area to the protected area from human factor point of view.

88. This conditional classification describes the standard loading of light infantry units with a high level of combat training. The load of operator in special operations forces is significantly different. The standard minimum assault load of CSOU unit soldier by system elements in warm weather conditions presented in Table 5.

Table 5 – Fighting load of the CSOU operator (hot weather conditions)

Items	Item weight, kg
T-shirt and boxers	0,21
pant	0,616
belt	0,15
socks	0,048
ear plugs	0,013
goggles tactical	0,125
gloves	0,061

[70] USMC Combat Load report. LCDR Demetri Economos USN Marine Corps Combat Development Command Materiel Requirements Division, Quantico, Virginia, 31 Dec 2003, page 9 – Assault load.

[71] Combat Load Report. LCDR Demetri Economos USN. Marine Corps Combat Development Command. Material requirement devision. Quantico, Virginia. December 31, 2003, page 13, chapter 6.d.

Table 5 – Fighting load of the CSOU operator (hot weather conditions)

Items	Item weight, kg
elbow pads	0,34
knee pads	0,39
boots	1,29
combat shirt	0,352
tagelmust	0,06
ID-patch-"FLAG"	0,004
ID-patch-"NAME"	0,004
ID-patch-"RANK"	0,003
ID-patch-"UNIT"	0,007
ID-tag	0,014
ID-patch-"FLAG"-NIR	0,004
ID-patch-"1x1-inch-sqr"-NIR	0,003
tactical vest	1,525
grenade pouch	0,17
5.56 mm ammo magazines double pouch (x4)	0,56
radio pouch	0,111
IFAK pouch	0,82
helmet	1,29
armour vest (NIJ IIIA)	2,355
armour plates (NIJ IV+) front and back	5,34
5.56 mm assault rifle	3,835
5.56 mm muffler	0,58
assault rifle cleaning kit	0,282
5.56 mm ammo magazines (×8)	1,12
9 mm pistole	0,625
9 mm muffler	0,2
9 mm pistole mag (×2)	0,154

Table 5 – Fighting load of the CSOU operator (hot weather conditions)

Items	Item weight, kg
9 mm pistol mag double pouch	0,094
9 mm pistol holster	0,35
9 mm pistol safety lanyard	0,02
fragmentation grenade (×2)	1,16
5.56×45 mm NATO ball cartridges (30×8)	2,844
9×19 mm NATO ball cartridges (2×17)	0,43
DBAL-I laser	0,205
radio station individual	0,952
battery for radio station individual	0,342
ear phones active	0,58
night vision device (set)	1,158
3L water back pack	0,53
3L water	3
tactical light	0,1
rescue NIR light	0,11
individual GPS	0,094
notebook and pen	0,093
Total assault load, warm time, kg:	**35**

89. Standard assault load for soldier of CSOU unit is 35 kg. And this is 34% more than the standard loading of light infantry units soldier according to the norms of the publications reffered above. 40% of the individual load consists of armament, its accessories, ammunitions and night vision device.

90. Assault load can be significantly increased in case if CSOU operator is carrying additionally another type of weapons and associated ammunition and accessory load. CSOU-SF TO&E representing different loading of the armament: including 5.56 mm assault rifle with 40 mm underbarrel grenade launcher, 5.56 mm, 7.62 mm machine guns, sniper rifles, designated marksman rifles, as well as C4I equipment common for all unit. Sniper in addition carrying 4.6 mm sub-machine gun. In case of different

operational scenarios, together with individual load, operators might be equipped with additional load of ammunition for all unit as was mentioned in the Chapter 35 for urban operations, where increased likelihood of compromise and the chance of isolation, CSOU might need more firepower to break contact with a pursuing enemy element – Table 6.

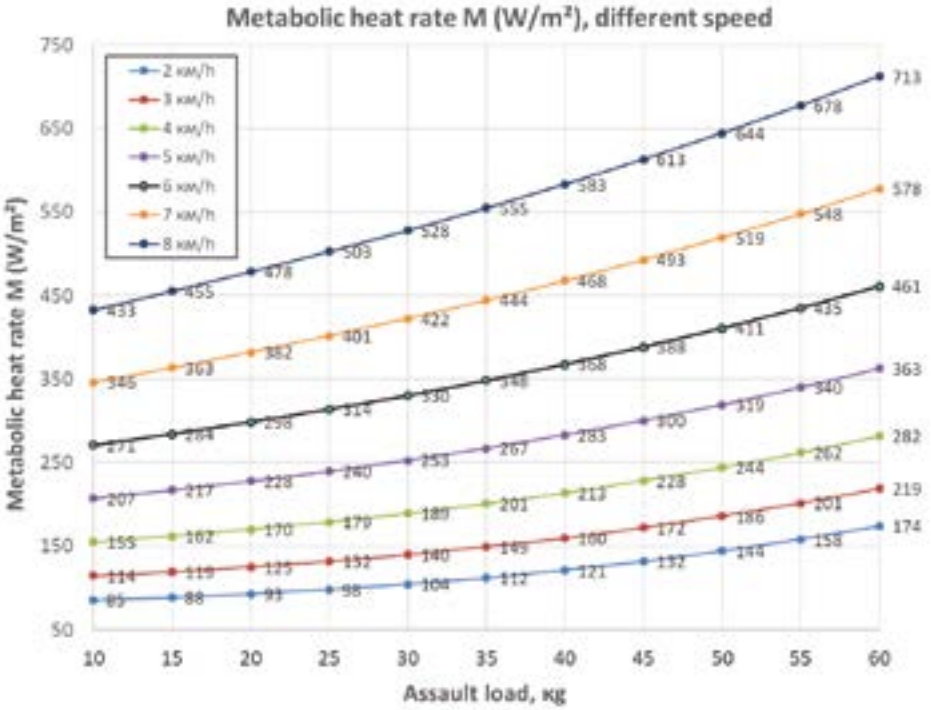
Table 6 – Fighting load of the CSOU operator, increased weaponry load (hot weather conditions)

Items	Item weight, kg
Senior operator (HK 416 / 40 mm GLM)	39
Team leader (HK 416 / 40 mm GLM)	39
RTO/Comms expert (HK 416)	40
Demoliton expert/operator (5.56 mm Minimi)	44
Weapons expert/operator (7.62 mm Minimi)	51
Medic lifesaver (HK 416)	37
Sniper spoter (HK 241)	37
Sniper shooter (AXMC 338)	44
JTAC (HK 416)	35
Medic expert/operator (HK 416)	35
Demoliton expert/operator, enginier (5.56 mm Minimi)	44
Operator/language expert, HUMINT (HK 416)	35
Individual load, kg:	479
Individual average load, kg:	40
additional 5.56 mm ammo belts load × 1	11,1
additional 7.62 mm ammo belts load × 1	16,8
AT4 × 2	16
additional 5.56 mm ammo load (4 clips × 12)	17
additional 40 mm ammo load (1 × 10)	2,7
additional unit load, kg:	**64**
total average individual load, kg:	**45**

91. In case of operations with increased fire power CSOU-SF will be equipped with three MG – one 7.62 mm and two 5.56 mm. Significant part of the gunner 7.62 mm load is armament its accessories and night vision device – 57%. Machine guns, making significant increasing of the loading, because of MG ammunition heavy load, 600 cartridges belted (7.62 mm) and 800 cartridges belted (5.56 mm). Equalised average individual load is 40 kg, together with unit additional load spreaded per operators, average

load increses until 45 kg. In order to determine the metabolic heat rate during assault load, the calculation M (W/m2) should be done according to formula[72] from NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". The level of M parameter while patrolling under different weights of loading and speed of the patrol showing Diagram 1[73].

Diagram 1 – Metabolic heat rate – M (W/m2), assault loading



92. The calculation of Diagram 1 has been done according to the main parameters of metabolic heat rate equation: coefficient of surface η = 1.1 (gravel road), human body mass W = 81 kg, height 181 cm, body surface 2.0 m^2, surface slope G = 0%.

93. Taking into consideration that basic required physiological quality should be identified for the conditions of NATO AECTP-230 „Climatic conditions" climatic category C1 (–21^{0}C till –33^{0}C) and climatic category A3 (+ 28^{0}C till + 39^{0}C) CSOU APFG should comply with the following minimum levels of the physiological requirements according to ISO 15831, ASTM F 2370 and NATO ACCP-1:

- thermal insulation no less than Icl = 4.23 clo (0.606 m^2W/K);
- water vapor resistance not more than Ret = 86.7 m^2Pa/W;
- water vapor permeability index no less than im = 0.76.
- rectal temperature Tref ≤ 38.2°C – no risk of thermal overheating;

[73] Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Summary of Doctoral thesis.-R.:RTU, 2014, page 15. ISBN 978-9934-507-77-9.

- rectal temperature Tref = 39.2°C – 25% probability of overheating;
- rectal temperature Tref = 39.5°C – 50% probability of overheating;
- rectal temperature Tref = 40°C – 100% probability of overheating.

94. Calculation of Dlim (Table 7)[74] has been made in accordance with the standard ISO 1107:2008 "Ergonomics of the thermal environment–Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects", modelling different environment conditions and soldier metabolic rates. Limited duration of exposure Dlim identifying actual time (hours) CSOU soldier is capable to withstand influence of cold environment, being equipped with basic set of CSOU APFG. The parameters of the maximum thermal insulation Icl system (which fixed for a specific set) and metabolic heat rate M give initial parameters for calculating Dlim. Maximum thermal insulation of the system is determined by thermal manikin in the climatic chambers according to ISO 15831 "Clothing. Physiological effects. Measurement of thermal insulation by means of a thermal manikin". In the calculations for various clothing sets the metabolic heat rate M, environmental temperature Ta, thermal insulation clo were varied. Unvariable parameters are air humidity RH%=85, human body mass 81 kg, height 181 cm, body surface 2.0 $m^{2.}$

Table 7 – Limited duration of exposure D_{lim}

Icl = 4.23 clo, RH%=85, human body mass 81 kg, height 181 cm, body surface 2.0 m2.								
M (W/m^2)	70	80	80	100	110	120	110	150
Ta (°C)	-25	-25	-30	-30	-30	-30	-40	-50
Dlim, h.	1.3 - 1.1	2.0 - 1.5	1.4 - 1.1	4.0 - 2.3	4.8 - 8.0	over 8	2.3 - 1.6	over 8

T-shirt, boxers, under shirt, leggings, Grid shirt, Grid leggings, Liner jacket, Liner pants, Severe jacket, Severe overpants, Beanie hat, Severe boots, Severe gloves

95. CSOU unit normally is able to operate in very hot environment, under heavy load of the carrying equipment, patrolling over different landscapes with different speed of movement. Prediction of the thermal overheating in such hot environment become crucial for the maintaining of the soldiers combat effectiveness. Prediction of thermal overheating is done, by calculating parameters of rectal temperature Tref (Table 8) in time, (min) according to the equation of Tref model and Lund University calculation model PHS2 as well according to ISO 15831, ASTM F 2370 and NATO ACCP-1 standards. The main parameters of the equation and IREQ model are: metabolic heat rate – M (W/m2) showing actual level of performing work activity; area temperature – Ta(°C); humidity – %; thermal insulation of APFG system (Table 5) – I (clo), vapor permeability index – i_m, weight and height of operator.

Table 8 – Prediction of thermal overheating, assault loading

T_{ref}, I = 0,94 clo (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 5 km/h, 40 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,3	37,7	37,9	38	38,1	38,1	38,1
T_{sk} (°C)	34,5	35,1	35,3	35,5	35,6	35,6	35,6	35,6
Water loss (g)	3	36	116	226	352	486	623	1460
T_{ref}, I = 0,94 clo (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 5 km/h, 50 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,3	37,8	38,1	38,2	38,3	38,3	38,3
T_{sk} (°C)	34,6	35,3	35,6	35,7	35,8	35,9	35,9	35,9
Water loss (g)	3	41	135	265	414	574	737	1737
T_{ref}, I = 0,94 clo (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 6 km/h, 50 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,5	38,1	38,5	38,7	38,8	38,9	39,4
T_{sk} (°C)	34,8	35,8	36,2	36,4	36,5	36,6	36,7	36,9
Water loss (g)	4	54	180	356	553	758	965	2221
T_{ref}, I = 0,94 clo (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 7 km/h, 50 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,7	38,5	39,1	39,7	40,1	40,6	42,7
T_{sk} (°C)	35,1	36,4	36,9	37,3	37,6	37,8	38	39,2
Water loss (g)	6	70	225	417	621	830	1041	2314

96. Table 8 showing prediction of overheating 25% for CSOU operators loaded with 50 kg fighting load, in 120 minutes at speed of movement 6 km/h, on the gravel surface, reach the critical level of Tref = 39.4°C. At speed of movement 7 km/h on the gravel surface, in 30 min, reach the critical level of Tref = 39.1°C, prediction of overheating 25%. But when CSOU operator loaded with 50 kg, in 40 min, reach the critical level of Tref=39.70C, and probability of overheating 50%. It should be considered that in modern CSOU operations, fighting loading is dramatically increased comparing with specified in manuals.

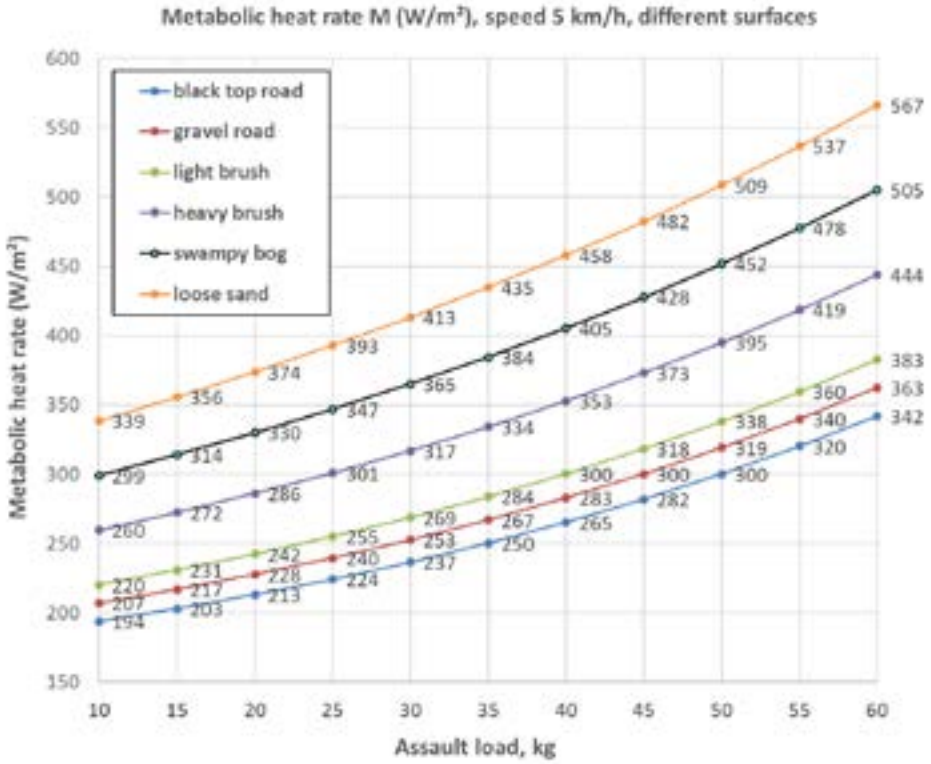
97. Often CSOU unit eventually moves on foot to accomplish its mission, which occurs in landscapes with different factors of surface coefficient η[75] , which is taken into account in the formula of metabolic heat rate – *M* (W/m2). As example the impact of changes in metabolic heat rate – *M* for 6 different surfaces and their coefficients were evaluated. Coefficients of different surfaces: black top road (1.0), gravel road (1.1), light brush (1.2), heavy brush (1.5), swampy bog (1.8) and loose sand (2.1).

[75] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Annex B, Table B-III Terrain Factors Marching metabolic heat rate. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

[76] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Annex B, clause 8. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

Selected speed of movement is 5 km/h. The calculation *M* (W/m²) should be done according to formula[76] from NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". The level of *M* parameter while patrolling on the different surfaces showing Diagram 2.

Diagram 1 – Metabolic heat rate – M (W/m²), assault loading



98. The calculation of Diagram 2 has been done according to the main parameters of metabolic heat rate equation: human body mass W = 81 kg, height 181 cm, body surface 2.0 m², surface slope G = 0%. The calculation show that metabolic heat rate increased from 300 W/m² to 482 W/m² while patrolling over different landscapes with 45 kg load and with surface changing from gravel surface to sandy surface.

99. Prediction of thermal overheating is done, by calculating parameters of rectal temperature Tref (Table 9) according to the equation of T_{ref} model and Lund University calculation model PHS2 as well according to ISO 15831, ASTM F 2370 and NATO ACCP-1 standards. The main parameters of the equation and IREQ model are: metabolic heat rate – *M* (W/m²) showing actual level of performing work activity; area temperature – Ta (0C); humidity – %; thermal insulation of APFG system – I(*clo*), vapor permeability index – im, weight and height of operator.

[76] NATO ACCP-1 "Heat transfer and physiological evaluation of clothing". Annex B, clause 8. Allied Combat Clothing publication. NATO International Staff – Defence Support Division. Military agency for standardization. 1992.

Table 9 – Prediction of thermal overheating, assault loading (variation of surface coefficients)

T_{ref}, I = 0,94 clo, n=1.1 (Gravel), 81 kg, 181 cm, 2,0 m², Ta=30°C, RH%=70, 5 km/h, 45 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,3	37,8	38	38,1	38,2	38,2	38,2
T_{sk} (°C)	34,6	35,2	35,4	35,6	35,7	35,7	35,7	35,7
Water loss (g)	3	38	125	244	381	527	676	1587
T_{ref}, I = 0,94 clo, n=2.1 (Sandy surface), 81 kg, 181 cm, 2,0 m², Ta=30°C, RH%=70, 5 km/h, 45 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,6	38,4	38,9	39,4	39,8	40,2	42,1
T_{sk} (°C)	35	36,2	36,7	37	37,2	37,5	37,7	38,7
Water loss (g)	5	68	221	411	614	822	1032	2299

100. Table 9 showing prediction of overheating 25% for CSOU operators loaded with 45 kg fighting load, in 40 minutes at speed of movement 5 km/h, on the sandy surface, reach the critical level of Tref = 39,4°C. But when CSOU operator loaded with 45 kg, in 50 min, reach the critical level of Tref=39.80C, and probability of overheating 50%. Based on the analysis, the physical load of special units soldier is always more. The route of nomination is always chosen the most difficult, in order to reduce the likelihood of seeing the enemy. Unit always choose the most difficult route of advancement in order to reduce and minimize the likelihood of seeing the enemy.

101. In case of survival, CSOU operator eventually drop or possibly could lost significant part of the fighting load, staying only with essential APFG, C4I and weaponry for personal protection, until CSAR will not provide recovery. The situation can be complicated due to soldier location on the enemy territory, and soldier will have to break away from the pursuit. CSOU operator Survival load representing following items – Table 10.

Table 10 – Survival load of CSOU operator(hot weather conditions)

Items	Item weight, kg
T-shirt and boxers	0,21
pant	0,616
belt	0,15
socks	0,048
ear plugs	0,013
tagelmust	0,06
gloves	0,061
boots	1,29
rapid assault shirt	0,352

ID-patch-"FLAG"	0,004
ID-patch-"NAME"	0,004
ID-patch-"RANK"	0,003
ID-patch-"UNIT"	0,007
ID-tag	0,014
ID-patch-"FLAG"-NIR	0,004
ID-patch-"1x1-inch-sqr"-NIR	0,003
IFAK pouch	0,82
armour vest (NIJ IIIA)	2,355
9 mm pistol	0,625
9 mm pistol mag (×2)	0,154
9 mm pistol mag double pouch	0,094
9 mm pistol holster	0,35
9 mm pistol safety lanyard	0,02
9×19 mm NATO ball cartridges (2×17)	0,43
radio station individual	0,952
battery for radio station individual	0,342
ear phones active	0,58
night vision device (set)	1,158
3L water back pack	0,53
3L water	3
tactical light	0,1
rescue NIR light	0,11
individual GPS	0,094
notebook and pen	0,093
total assault load, warm time, kg:	**15**

102. Prediction of thermal overheating is done, by calculating parameters of rectal temperature T_{ref} (Table 11) in time, (min) according to the equation of Tref model and Lund University calculation model PHS2 as well according to ISO 15831, ASTM F 2370 and NATO ACCP-1 standards. The main parameters of the equation and IREQ model are: metabolic heat rate – *M* (W/m^2) showing actual level of performing work activity; area temperature – Ta (0C); humidity – %; thermal insulation of APFG system (Table 5) – I(clo), vapor permeability index – im, weight and height of operator.

Table 11 – Prediction of thermal overheating, Survival loading

T_{ref}, (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 5 km/h, 15 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,8	37,2	37,5	37,7	37,7	37,8	37,8	37,8
T_{sk} (°C)	34,3	34,7	34,9	35	35,1	35,1	35,1	35,1
Water loss (g)	2	27	84	162	250	342	437	1013
T_{ref}, (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 6 km/h, 15 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,3	37,7	37,9	38	38,1	38,1	38,1
T_{sk} (°C)	34,5	35,1	35,3	35,5	35,6	35,6	35,6	35,6
Water loss (g)	3	35	113	220	341	470	603	1409
T_{ref}, (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 7 km/h, 15 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,4	38	38,3	38,4	38,5	38,5	38,5
T_{sk} (°C)	34,7	35,5	35,9	36,1	36,2	36,2	36,2	36,2
Water loss (g)	4	46	151	297	465	644	828	1953
T_{ref}, (n=1.1, 81 kg, 181 cm, 2,0 m²) Ta=30°C, RH%=70, 8 km/h, 15 kg								
$T_{id,}$ min	2	10	20	30	40	50	60	120
T_{ref} (°C)	36,9	37,5	38,3	38,7	39	39,2	39,4	40,4
T_{sk} (°C)	35	36	36,5	36,8	36,9	37	37,1	37,7
Water loss (g)	5	59	196	380	580	787	996	2258

103. Table 11 showing prediction of overheating 25 % for CSOU operators loaded with 15 kg survival load, in 50 minutes at speed of movement 8 km/h, on the gravel surface, reach the critical level of Tref = 39,2^{0}C. But when CSOU operator loaded with 15 kg, in 60 min, reach the critical level of Tref=39.4^{0}C, and probability of overheating 50%. It should be considered that in modern CSOU operations, 15 kg survival loading can cause overheating.

104. For the purposes of the CSOU soldier's protection against hypothermia during period of resting and sleeping in training and combat operations on the field, CSOU soldiers applying sleeping bag system. Additionally, sleeping bag system providing protection against enemy surveillance within electromagnetic range of visual camouflage, night vision devises range of 450 nm up to 1100 nm (NIR) as well as thermal spectral surveillance 3 μm up to 12 μm (TIR).

105. Protection against hypothermia, provided by sleeping bag system differs depending on the set of APFG CSOU soldier applying during actual sleeping or resting. Typical levels of the protection against hypothermia, when using sleeping bag system are presented in Table 12. Certain set of sleeping beg system are presented in Table 13.

Table 12 – Typical levels of the protection against hypothermia of sleeping bag system[77]

Set	Itot, parallel	Itot, serial	Itot, standard	It,r, local (5) clo	It,r, local (1) clo	I cl,r local (5) m^2K/W	I cl,r total (1) m^2K/W	Extreme temperature, C^0
1	1.159	1.296	1.034	8.36	7.48	1.189	1.060	**-23**
2	1.294	1.434	1.126	9.25	8.35	1.327	1.195	**-27.3**
3	1.171	1.329	1.056	8.58	7.56	1.222	1.072	**-24.3**
4	1.139	1.273	1.019	8.21	7.35	1.166	1.040	**-22.5**
4A	1.304	1.425	1.121	9.20	8.41	1.319	1.205	**-27.5**
5	0.824	0.881	0.758	5.69	5.32	0.775	0.725	**-9**
6	1.247	1.356	1.074	8.75	8.04	1.249	1.148	**-25.0**
7	1.399	1.516	1.181	9.78	9.03	1.410	1.300	**-30.5**
8	1.409	1.547	1.202	9.98	9.09	1.440	1.310	**-31.1**
9	1.169	1.352	1.072	8.73	7.54	1.246	1.070	**-25.0**
10	1.220	1.321	1.051	8.52	7.87	1.214	1.121	**-24.0**
11	1.612	1.819	1.383	11.74	10.40	1.713	1.514	**-40.2**
12	1.062	1.120	0.917	7.22	6.85	1.013	0.963	**-17.3**
13	1.265	1.347	1.068	8.69	8.16	1.240	1.167	**-25.0**

106. Protection against hypothermia, provided by sleeping bag system differs depending on the set of APFG CSOU soldier applying during actual sleeping or resting. Typical levels of the protection against hypothermia, when using sleeping bag system are presented in Table 12. Certain set of sleeping beg system are presented in Table 13.

107. Main evaluation parameter is extreme temperature of sleeping beg system and certain set of the APFG that can provide protection from cold. All measurements are done according to ISO 15381 "Clothing. Physiological effects. Measurement of thermal insulation by means of a thermal manikin", ASTM F2370-05 "Standard Test Method for Measuring the Evaporative Resistance of Clothing Using a Sweating Manikin" and EN 13537 "Requirements for sleeping bags".

[77] *Igors Sitvjenkins, Iveta Abele, Kalev Kuklane, Ausma Vilumsone. Estimation of combat sleeping bag system of Latvian National Armed Forces. In: Conference abstract, 13th International Conference on Global Research and Education, Latvia, Riga, 10,-12 September, 2014.*

Table 13 – Combat equipment, uniform systems and sleeping systems sets

Set	Items in the sets
1	Boxers, T-shirt, under shirt, leggings, Grid jacket, Grid leggings, Liner jacket, Liner pants, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Element sleeping bag, matt-carpet
2	Boxers, T-shirt, under shirt, leggings, Grid jacket, Grid leggings, Liner jacket, Liner pants, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Element sleeping bag, Amid sleeping bag, matt-carpet
3	Boxers, T-shirt, under shirt, leggings, Grid jacket, Grid leggings, Liner jacket, Liner pants, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag, matt-carpet
4	Boxers, T-shirt, under shirt, leggings, Grid jacket, Grid leggings, Liner jacket, Liner pants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag, matt-carpet
4A	Boxers, T-shirt, under shirt, leggings, Grid jacket, Grid leggings, Liner jacket, Liner pants, Beanie hat, boots Severe, socks Severe, gloves Severe, Severe sleeping bag, matt-carpet
5	Boxers, Hybrid Torrid Combat Shirt, Combat pants, boots Torrid, socks Torrid, gloves Torrid, Amid sleeping bag, matt-carpet
6	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag, matt-carpet
7	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Severe sleeping bag, matt-carpet
8	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag (like a blanket), matt-carpet
9	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag (sitting position), matt-carpet
10	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag (opened zipper closure), matt-carpet
11	Under shirt, leggings, Severe Jacket, Severe overpants, Beanie hat, boots Severe, socks Severe, gloves Severe, Amid sleeping bag (closed with zipper closure), Amid sleeping bag (like a bedcover) matt-carpet
12	Under shirt, leggings, Grid jacket, Grid leggings, liner jacket, liner pants, Beanie hat, boots Severe, socks Severe, gloves Severe, Element sleeping bag, Amid sleeping bag, matt-carpet
13	Under shirt, leggings, Grid jacket, Grid leggings, liner jacket, liner pants, Beanie hat, boots Severe, socks Severe, gloves Severe, Element sleeping bag, Severe sleeping bag, matt-carpet

108. It should be noted that sleeping and rest time in combat conditions or in combat training conditions occurs with full combat equipment and personal weapons in sleeping bag. Therefore, physiological experiments of sleep systems quality should show (Table 13) different versions of combat equipment sets, uniform systems with different combinations.

109. The qualitative physiology of combat sleep depends not only on correct using of sleeping bag, but also of combat uniform system. Necessary to choose right layers of uniform, as well as their quantity under sleeping bag, in order to avoid unnecessary compression of layers with closed air in yarn and to avoid overheating and excessive sweating. As is known, that confined air in yarn provides thermal insulation.

110. Because of the air layers of both bags get compressed in synthetic yarns of the fillers, it is not needed to use as "2-in-1" sleeping bag system. No expected effect from the double sleeping bag, therefore no need to carry an additional sleeping bag. Instead of this necessary to correctly plan required material and technical means, which at all times during operation will provide protection against cold. As well necessary to know weather conditions in all the prospective unit locations.

111. Should also take into account the operational situation in which unit is located, therefore, as a rule, all soldiers do not sleep all, at the same time, even during combat training. If allow the operative situation, then soldier sleeping duration not more than 4 hours[78]. In fact sleeping bags use together with clothes systems. The design of combat sleeping systems necessary to consider in accordance with EN 13537 "Requirements for sleeping bags". If necessary, unused sleeping bags can be used as blankets for warming, as modeled in combination 6 and 11 (Table 12 and 13). As a result, the protection of sleeping bag system from – 25°C increased to – 40°C.

[78] FM 3-55.93 (FM 7-93) Field manual. Long-Range Surveillance Unit Operations". Fatigue J-12. Department of the Army. Washington, DC, 23 June 2009.

5

Design

Pedestal of shapes
Intelectual combat design

Bio-mechanics
Dynamic, high amplitude movements

Neurodynamics
Design influence on common condition

3D warfare
Operations in three-dimensional space

Concealament
Professional and attractive

Fashion
Elegance for daily use

112. We are designing our apparel, protection and field gear, based on two main assumptions: 1 – design in fashionable appereance and 2 – design in influent on human body. 1st is crucial important in designing of HUMINT apparel, because of civilized look for dedicated covered military missions, law enforcement and special security operations. 2nd is crucial important for designing of combat apparel due to influence on operator's body bio-mechanics (mechanical influent on body) and body neurodynamics (total influence on organism, including brain) during actual combat. Therefore, there is always training and trial of any king of apparel, protection and field gear to make body adaptation, approved or reject certain design.

113. Never the less HUMINT is CSOU type of operations. APFG for HUMINT still required 2nd design assumption together with fashionable appereance. Both assumptions making HUMINT apparel extremely fashionable, durable and attractive for civil casual wearing in both scenarious of duty tasks under cover, uncovered operations and supplying civil market. Beside necessary features of combat apparel, protection and field gear, it should be fashionable too. There is wrong opinion, that combat operators don't need fashionable apparel. Therefore, this giving added value to developed products and making attractive combat products for civil wearing.

114. CSOU APFG system is particularly different to the design quality, then regulary combat uniform. Soldiers carrying out CSOU special tasks is to be determined the special requirements related to the APFG design quality, size scales systems depending on body statics and dynamics, design elements placement and cut, as well as requirements for bio-mechanicas and neurodynamics. CSOU APFG design should guarantee no negative effects on the soldiers who carries out special CSOU tasks, creating no burden to movement, inability to quickly react, using the weapons and open fire, using special CSOU surveillance equipment. Inability quickly get to necessary equipment, which are located on the APFG can create unsafe situation for CSOU soldier.

115. Design of CSOU APFG should guarantee subconscious reflexes developing to the soldiers, which will ensure their ability to quick reaction on APFG in the combat situation. Particularly important design compatibility of CSOU APFG and CSOU soldier when going combat in restricted visibility, dark, enclosed space, tunnels and cellars, close quarters combat (CQB) conditions, as well as water and underwater operations, using of diving and swimming equipment, where the crucial importance of the soldier bio-mechanical and neirodinamical compatibility with CSOU APFG design. Additionally, significant importance of the CSOU APFG design quality is for CSOU special task soldiers during airborn operations, deploy from helicopters, boats and trucks. Therefore, it is crucial compatibility between CSOU APFG and parachuting, climbing and other descent systems. CSOU design quality is crucial and must be provided by developing whole justified system.

116. STANAG 2138 "Troop trial principles and procedures – combat clothing and personal equipment" is the basic guidlines covering developing of the CSOU APFG design. Significant role in the design development process takes bio-mechanical and neurodynamical evaluation techniques[79] [80] [81] [82].

[79] Development of the bio-mechanical model for the personnel of the army, police, emergency and rescue units. Mechanical impact testing, oxygen consumption, three-dimensional gait analysis. Testing Report June 2nd – June 10th, 2014. Logistics Command. National Armed Forces Republic of Latvia. Bio-mechanical laboratory testing order October 14th, 2013 – 07/1480.

[80] Development of the neurodynamical model for the personnel of the army, police, emergency and rescue units. Igors Šitvjenkins, Viesturs Lāriņš, Ausma Viļumsone, Hanna Torbicka, Iveta bele, Zane Pavāre. Latvian Academy of Sport Education. Testing July 28th – July 29th, 2014.

[81] Development of the neurodynamical and bio-mechanical model for the personnel of the Special Force units. Igors Šitvjenkins, Viesturs Lāriņš. Latvian Academy of Sport Education. P-174/NP/2015/NP2015/024.

[82] Igors Šitvjenkins, Ausma Viļumsone, Viesturs Lāriņš, Hanna Torbicka, Iveta bele, Zane Pavāre. Quality evaluation of the combat individual protection system by EUROFIT physical fitness testing Latvian Academy of Sport Education. LASE Journal of Sport Science. ISSN: 1691-7669, Vol.3 (2012) Nr.1, pages 31 – 46

6

Camouflage

TripleX
Harmony of landscapes

TripleX in Urban
Conceal in urban terrain

TripleX in Mountain
38% Earth is covered by mountains

TripleX in Transitional
Landscapes are not homogeneous

TripleX in Forest
Optimal annualy

TripleX in NIR
Near infrared protection

117. Development of the multi-terrain pattern is always compromise of finding appropriate solution of the camouflage provide adequate concealment of the operators on the background of the certain terrain. Even more complex task, is to develop pattern which will provide sustainable concealment on the different distances within certain type of the terrain and will not become one-color spot, which is easy to target. In most cases natural terrain is not one-color spot perfectly comparable with pattern. Terrain is seasonally and daily changeable, which making development of the pattern even more complex. TRIPLEX multi-terrain camouflage pattern is developed based on our 7 years research, taking into consideration above mentioned basics. Our goal was to make unique pattern, providing three operational terrains – forest, urban, mountain, as well as covering transitional terrain in between. Main effort was camouflage colour and contrast that helps our camouflage blend in forest areas and mountainous terrain. Pattern element as we call it TIPLEX is based on Euclid geometrical element that allows shape it in different irregular forms and build a pattern that has horizontal and vertical lines as much as in nature or urban environment at the same time keeps it DIGITAL and has ability to converge with surrounding elements and light. Since the effect of pattern of camouflage is gained at distances 50 m and above, main focus is on right colours of pattern element. Not only has each colour dictated camouflage, but also what colour they make when mixed in pattern. TRIPLEX camouflage tone gives ability to call it multi-terran. Next factor is pattern element shape, size and ratio.

118. TripleX in FOREST terrain, the main element is the camouflage greenish background that has greyish colouring and gives most effective bland in effect in wooden areas as in leaf tree areas and in conifer tree areas. Dense forests or sparse forests. One of the basis of camouflage is the tone from wild animal fur that comes out at autumn season and with greyish colour is most optimal spectrum for concealment. To get most effect in different forest areas the TRIPLEX element is added and the focus is on element size ratio. Grey and brown elements provide camouflage with grate blending at autumn summer and spring seasons. TRIPLEX elements are placed as so to give camouflage pattern a "digital" blur at the same time, in close distance make horizontal and vertical lines that are distinctive in nature. We reduced possibility that elements together make spots or standing shadow effect that are not distinctive for environment.

119. Tactical doctrine stresses that urban combat operations are conducted only when required and that built-up areas are isolated and bypassed rather than risking a costly, time-consuming operation in this difficult environment. Adherence to these precepts, though valid, is becoming increasingly difficult as urban sprawl changes the face of the battlefield. Major urban areas represent the power and wealth of a particular country in the form of industrial bases, transportation complexes, economic institutions, and political and cultural centers. The denial or capture of these centers may yield decisive psychological advantages that frequently determine the success or failure of the larger conflict. Villages and small towns will often be caught up in the battle because of their proximity to major avenues of approach or because they are astride lines of communications that are vital to sustaining ground combat operations. Urbanization is a complex, multifaceted process influenced by many factors including a nation's cultural development, its economic resources, and its industrial capacity. Although its form varies from region to region, urbanization is characterized by a general pattern of changes in land usage and the spread of manmade features across natural terrain. Tactical terrain analysis has traditionally considered some elements of the urban environment such as the allocation of land to agriculture or forestry and the distribution of railway or road networks. However, the focus has been on natural terrain elements. In Europe and other urbanized areas of the world, increased awareness of the effects of manmade features on the overall tactical scheme is necessary. How urban terrain elements impact on operations is an important consideration in determining our tactical options. Expanding urban development affects military operations as the terrain is altered. The increased population and accelerated growth of cities have made the problems of combat in built-up areas an urgent requirement for the military, law enforcement, special security forces. This type of combat cannot be avoided. The makeup and distribution of smaller built-up areas as part of an urban complex make the isolation of enemy fires occupying one or more of these smaller enclaves increasingly

difficult. Urban terrain is expected to be the future battlefield in Europe and Asia with brigade- and higher-level commanders focusing on these operations. The closeness of urban operations increases the likelihood that the enemy will detect operators of the unit. Because some urban areas offer poor concealment and cover, the enemy is most likely to detect soldiers moving through urban areas. Camouflages effectiveness in urban terrain is dictated by colour of elements, and size ratio that allows to blur and not stand out on built up area background. Either it is in urban built up areas or in debris of built up areas. As one of the methods for concealment with triplex, when lighter pattern is mandatory, is wearing any clothing with triplex camouflage inside out.

120. With approximately 38% of the world's landmass classified as mountains, the Army must be prepared to deter conflict, resist coercion, and defeat aggression in mountains as in other areas. Mountains exist in almost every country in the world and almost every war has included some type of mountain operations. This pattern will not change; therefore, soldiers will fight in mountainous terrain in future conflicts. Although mountain operations have not changed, several advancements in equipment and transportation have increased the soldiers' capabilities. The identification and proper use of the cover and concealment provided by mountainous terrain are fundamental to all aspects of mountain operations. Mountainous terrain is where urban spectrum mixes with forest spectrum depending on types of rock and forests. That is why TRIPLEX can provide concealment and blurring with surrounding in Dolomites Mountains, high altitude mountain terrain or at the bases of mountains with vegetation or at the highlands.

121. Very offen terrain is transitional and doesn't fit any specific operational terrain. As main factor for camouflage TRIPLEX is light effect on pattern. In any terrain and environment blending in is dictated by first and last light and shadow effects. Intensity of light, artificial or natural. TRIPLEX provides camouflage with chameleon effect, when camouflage contrast changes depending on light intensity. When surrounding background changes contrast, the TRIPLEX does the same and does not stand out. As a benefit TRIPLEX changes contrast together with surroundings during first and last light and does not stand out as light or dark spot.

122. Camouflage in wide spectrum electromagnetic wave lenght – visual (VIS), near infrared (NIR), far infrared (termal infrared – TIR) as well as ground surveillance radar (RADAR) taking a vital role in providing protection of the CSOU unit from being detected. Every soldier from CSOU should be equiped with neccessary amount of APFG providing required level of the wide spectrum camouflage. During actual reconnaissance patrolling, CSOU soldier using different operational techniques in order not beeing detected. During patrol terrain is changing, therefore the basic VIS camouflage of APFG should be multiterrain (universal). In conjunction with operation technique multiterrain camouflage pattern provides high level of the visual deception. When taking static positions (observation posts, ext.) CSOU unit should be capable to adjust camouflage, by using additional items from camouflage set of APFG in order to fit actual terrain of the static position, such as woodland, desert or transitional[83].

123. It should be taken into consideration role of layering and different special items of APFG, as well as natural vegetation in the providing thermal infrared – TIR protection[84]. The basic Field Manual of the providing TIR protection is APFG ability to redirect or absorb termal waves from the line of sight of the thermal sensor. Therefore, using of additional APFG design to provide redirection and absorbtion of the thermal waves should be used during actual patrolling. Basic patrolling tactics should remain high priority, because APFG is just additional items to enhansed unit protection during patrolling from being detected.

[83] Often refer to FIBUA (fighting in buil-up areas) environment.

[84] Sitvjenkins, I., Abele, I., Vilumsone, A., Torbicka, H. Camouflage Quality Evaluation of the Combat Individual Protection System in the Thermal Infrared Spectrum. Material Science. Textile and Clothing Technology. Vol.7, 2012, pp. 97-106. ISSN 1691-3132. e-ISSN 2255-8888.

124. Camouflage pattern is main element providing visual – VIS and near infrared – NIR. Degradation of the camouflage pattern, while being used, should be considered, during the development of the camouflage system[85]. The life time of the camouflage pattern should comply with life time of the textile system itself, otherwise textile product with remain acceptable quality will be remove from using, due to degradation of camoufage pattern. Applied camouflage pattern should remain its quality as long as possible in order to keep all APFG combat and cost effective.

125. Development of the universal camouflage pattern required specified evaluation technique in different environment. Universal pattern should be trade-off between main environment types: woodland, desert, urban and transitional. Evaluation technique could be based on two stage process: 1 – passive experiment with electronic pattern ranking evaluation by expert group[86]; 2 – active experiment, evaluation in the field, correction and photosimulation[87].

[86] Sitvjenkins, I., Vilumsone, A., Kreslins, K. KIAS-Mod1-LATPAT maskēšanas apdrukas transformācija KIAS-Mod11-LATPAT (EUROPE) maskēšanas apdrukā. 1. posms - izslēgšanas eksperiments. Militārā zinātne, vol.2(6), 2012, pp. 80-89. ISSN 1691-9300.

[87] Igors Sitvjenkins, Inese Ziemle, Iveta Abele, Inese Pazane, Ausma Vilumsone. Evaluation of camouflage. IN: Conference abstract, 13th International Conference on Global Research and Education, Latvia, Riga, 10,-12 September, 2014.

7

Protection against flame threats

Flame wounds
Combat burn injuries,
reasons, classification

Interpretation
Survival forecast
“Rule 100”, “Frank index”

Architecture
Protection by layers,
wearing SOPs, trade-off

Textiles
Basic standards, protection
against flame threats

Physiology
Physiological quality of the systems
with protection against flame threats

126. Protection against flame threats have lately become increasingly in demand in clothes design. Especially for combat operations in urban terrain infrastructure, during riots, special anti-terrorist operations, as well in performance of duties in conditions when unit move by different types of transportation.

127. Varying degrees of burns characterized by long-term consequences. Burns can lead to death, long loss of combat capability, mutilation, disability, long recovery with little chance of returning to combat work.

128. In combat operations threat may be basically of three types[88]: 1 – thermal threat of open flame, 2 – secondary threat and 3 – threat from hot surfaces.

128.1 Thermal threat of open flame is generated by intentional action of relevant type weapons – flamethrowers, napalm, incendiary liquids during riots and other.

128.2 Secondary threat is generated after the action of ammunitions, for example, ammunition explosions when burns are inflicted by incendiary substances and infrastructure, which are set on fire as well as by burning materials and equipment.

128.3 Threat from hot surfaces is posed by contact with hot surfaces, for example weapon parts, machine parts etc., and causing burns.

129. Burns are usually subdivided into three levels. First-degree burns are characterised by redness and slight swelling, in case of second-degree burns affect also the underlying levels of skin and cause blistering and third-degree burns affect deeper skin layers and body tissues[89].

130. The main role in determining the level of protection from burn injuries are right principles of architecture building of uniforms system, protection and equipment and choosing the correct methodology for testing and interpreting the results in order to obtain the most accurate prediction about loss of combat capability or death.

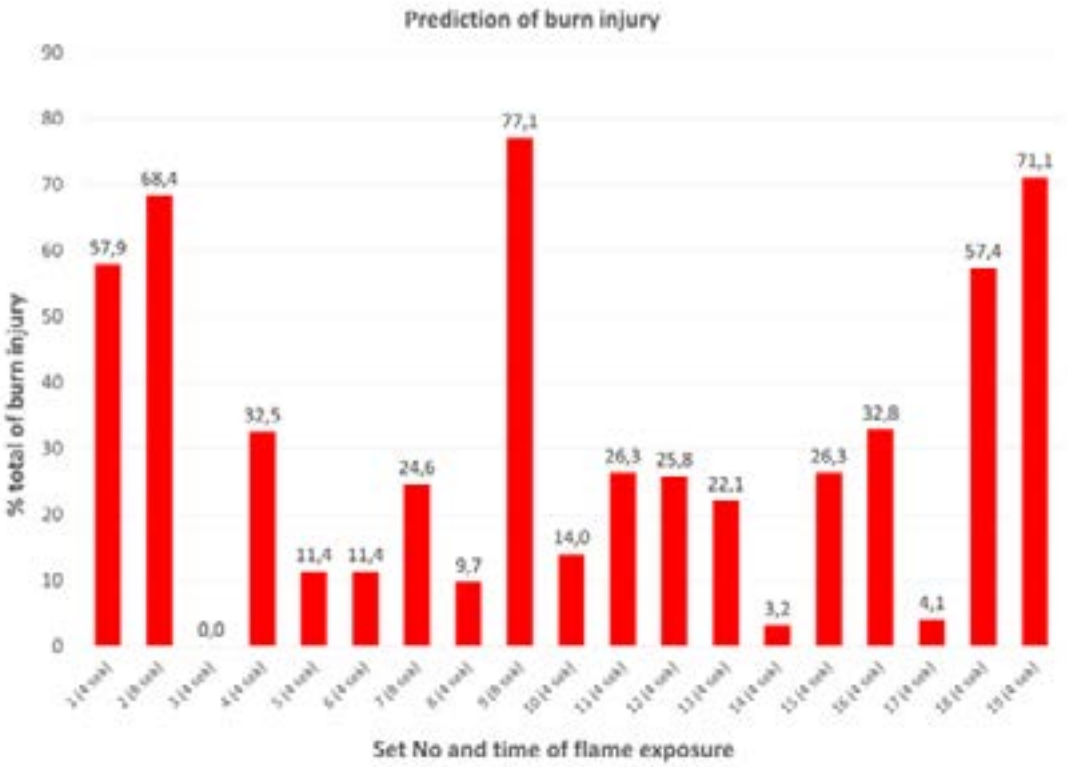
131. Applying flame retardancy (FR) to the CSOU APFG significantly reduce probability of burn injuries during actual combat. However, protection against burns varies depending on many factors. In Diagram 3 presented test results of the 19 (nineteen) different APFG sets90 of combat uniform, protection equipment, and including without protection against burn. In Diagram 3 presented total percentage of burn injuries in all three degrees. Tests were carry out according to ISO 13506:2008 "Protective clothing against heat and flame – Test method for complete garments – Prediction of burn injury using an instrumented manikin". Instrumented mannequin test provides the possibility to evaluate the predicted degree of a skin burn injury in all areas of the body excluding feet, palms and the upper part of the head, because of the location of sensors. The degrees of skin burn injuries in the areas of the body were evaluated according to the following scale: no burns, pain, first-degree burn, second-degree burn, third-degree burn. Depending on the operational task an open flame with a power of 82 kW/m2, affects on each set 4 or 8 seconds.

[88] Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Doctoral thesis.- R.: RTU, 2014, page 35. ISBN 978-9934-507-77-9.

[89] Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Doctoral thesis.- R.: RTU, 2014, page 35. ISBN 978-9934-507-77-9.

[90] Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Summary of Doctoral thesis.- R.: RTU, 2014, table 3.25, page 146. ISBN 978-9934-507-77-9.

Diagram 3 – Burn injury prediction



132.Based on the results of the research, we can draw the following conclusionsabout architecture of systems with protection against flame threats:

132.1. Multilayer systems have a large capability of protection against flame threats, which is physically explainable by time that a flame needs to overcome the protective layers and air layers.

132.2. Typically, it is crucial to apply FR capabilities on all outer layers, which are in use during high intense combat, such as combat jackets, pants, combat shirts, including gloves for warm / hot season, hats, different types of face covers, neck gaiters, boonie hats, boots for warm / hot season.

132.3. Recommended to apply FR capabilities also on underwear, because personnel often use underwear as outer layer in high intense operations and riots. However, it should be remembered that textiles for underwear have low parameters for heat transfer under the influence of flame, so it is absolutely necessary to put outer layers on top of the undergarment. In case of not applying FR capabilities on underwear, requirements should be developed with restriction of using not-FR underwear as outer layer in high intense combat operations.

Applying FR capabilities on underwears increses whole protection of the layering system.

132.4. It is forbidden to wear outer combat layers without protection against flame threats on flame resistant underwear. In this sequence, outer layers will be on fire, also will ignite underwear, despite protection against flame threats.

132.5. The outer layers, which are worn over the underwear, should be obligatory protected against flame threats, to prevent flame penetration on underwear layers. Not-FR underwear should be always covered with FR outer layers.

132.6. Load bearing armor vest, pouches, holsters, helmets, individual armor panels, tactical goggles are increasing total protection against flame injury. Following above mentioned requirements with these items will decrease level of predicted burn injury.

132.7. Fleece systems with protection against flame threats are dense, with optimal thickness, and have a significant degree of protection from burn damage. Fleece systems always wear over underwear layers, which further reduce burn damage.

132.8. When using systems with weather protection (rain or extreme cold weather) there is small probability of falling under burn injury, because such systems rarely are in used during high intense combat, except specific weather conditions only. However, this assumption extends mainly to land operations. But in cases with crews of combat vehicles, aircraft, ships and boats, mechanized units, one must consider about protection against flame threats.

132.9. Extreme cold weather garments, which is not in common use during actual combat of high intense, when metabolic heat rate of soldier is increasing significantly and soldiers removing such a thick clothing providing increased warm to the body. However, this assumption extends mainly to land operations. But in cases with crews of combat vehicles, aircraft, ships and boats, mechanized divisions, one must consider about protection against flame threats.

133. Testing according to ISO 13506:2008 give an estimate of the predicted burn injury in all three threat degrees in percentage, but this estimate does not give a correct interpretation of soldier survival. In practice, there are two used methods how to assess soldier survival: "rule of 100%" and "Frank index".

134. Prognostic index "rule of 100%" is obtained by summing age of injured and scorching forecast percentage of burn surface area (in % to the total body surface). Forecasts are made by based on the obtained value: less than 60 (favorable); 61-80 (relatively favorable); 81-100 (doubtful); more than 100 (unfavourable)[91].

135. H. Frank proposed a prognostic index, which based on an assessment of the depth and extent of the threats, expressed in conventional units. Frank index is obtained by summing area of the injury (each % is taken as 1) with tripled depth of the injury. Forecasts are made by based on the obtained value: less than 30 (favorable); 31-60 (relatively favorable); 61-90 (doubtful); more than 91 (unfavourable)[92].

[91] Burns, burn disease. bases of reconstructive plastic. (For students of the medical faculty of the English-speaking department). Stavropol State Medical Academy. Stavropol: Publishing house of StSMU. - 2009. UDC616-001.17: 616-089.844 (07.07), page 6.

[92] Burns, burn disease. bases of reconstructive plastic. (For students of the medical faculty of the English-speaking department). Stavropol State Medical Academy. Stavropol: Publishing house of StSMU. - 2009. UDC616-001.17: 616-089.844 (07.07), page 6.

136. Testing according to ISO 13506:2008 show the most important criterion for assessing the overall protection against flame threats, percentage of severity level of possible burns, which soldier can receive as a result of the general action from open flame on a specified set of uniforms system, protection and equipment.

137. "ISO 14116. Protective clothing -- Protection against heat and flame -- Limited flame spread materials, material assemblies and clothing", "ISO 15025. Protective clothing -- Protection against flame -- Method of test for limited flame spread". According to ISO 15025 specimen measuring 160×200 mm was attached to a metal frame. A burner flame was brought into contact with specimen surface and edge for 10 seconds. Both standards are related, so ISO 14116 classifies the ISO 15025 methodology into three fire resistance levels (indices).

138. The highest index 3 according to ISO 14116 corresponds to the following parameters:

- Flame spread – No specimen shall permit any part of lowest boundary of any flame to reach the upper or either vertical edge.
- Flaming debris – No specimen shall give flaming or molten debris.
- Hole formation – No specimen shall give hole formation of 5 mm or greather in any direction, except for an interlining that is used for specific protection other than flame protection.
- Afterglow – A glowing inside the charred area is defined in ISO 15025 asafterglow without combustion and, for the purpose of this clause, shall not be regarded as afterglow. Afterglow time shall be ≤ 2 s.
- Afterflame – Afterflame time shall be ≤ 2 s.

139. The level of fire resistance, which according to index 3 from ISO 14116 can be considered as minimum required level of fire resistance for combat uniform systems development. Accordance this index of fire resistance does not yet guarantee protection against flame threats.

140. In addition to woven outer layers, fleece layers, as well Grid fabrics according to index 3 minimal requirements from ISO 14116 should also apply standard "ISO 6940 Textile fabrics. Burning behaviour. Determination of ease of ignition of vertically oriented specimens". According to ISO 6940 specimen measuring 200×80 mm should be attached to a metal frame. Specimen surface and edge ignite with a 20 s flame application.

141. An important standard of combat clothing and textiles quality is "ISO 9151. Protective clothing against heat and flame. Determination of heat transmission on exposure to flame" (HTI). The method is determined by heat transfer index– HTI (flame). In evaluation of the protective properties of textiles HTI is a criterion for rate of flame heat transfer on skin surface through levels of textiles.

142. Heat transfer index (HTI) is an integer, is calculated as the arithmetic mean. Flame mean time in whole seconds to achieve a temperature rise of (24,0±0,2)°C when tested by using a copper disc of mass (18,00±0,05) and incident heat flux of (80±2) kW/m2. Also is possible in seconds to measure temperature rise of (12,0±0,1)°C. A horizontally oriented specimen is restrained from moving and subjected to an incident heat flux of (80±2) kW/m2 from the flame of a gas burner placed benath it. The heat passing through the specimen is measured by means of small copper calorimeter on top of and in contact with the specimen. The time, in seconds, for the temperature in the calorimeter to rise (24,0±0,2)°C is recorded. The mean result for three test specimens is calculated as the "heat transfer index (flame)".

144. As result of the above analysis, necessary to put forward the following basic requirements for fire resistant textiles, to ensure protection against flame threats in APFG sets systems from Diagram 3 model:

144.1 For underwear:

- 3 index according to ISO 14116;
- HTI (12) not less than 4.6 / HTI (24) not less than 6.4 according to ISO 9151;

144.2 For woven outer layers:

- 3 index according to ISO 14116;
- HTI (12) not less than 4.8 / HTI (24) not less than 6.5 according to ISO 9151;
- 20 s on specimen surface / 20 s on specimen edge according to ISO 6940

144.3 For fleece layers and Grid fabrics:

- 3 index according to ISO 14116;
- HTI (12) not less than 6.3 / HTI (24) not less than 8.7 no ISO 9151;
- 20 s on specimen surface / 20 s on specimen edge according to ISO 6940

145. Necessary to know that the textiles themselves do not guarantee protection against flame threats. Only in system of common layers with uniforms system, protection and equipment is possible to achieve a reduction in the degree of burn injury. As example will consider No.12 set from Diagrams 3. The set shows "Assault load" in warm weather, which presented in Table 5 in part of uniforms system, protection and equipment.

146. In result of manikin tests according to ISO 13506:2008 the following results were obtained[93]: pain sensation – 20.8%; 1st degree burns – 0.8%; 2nd degree burns – 15%; 3rd degree burns – 10%. Total against flame threats 25.8%. Based on survival forecast from "Rule 100", favorable and relatively favorable forecast soldier age is 54 years, which virtually guarantees survival for any soldier from the unit. Based on "Frank index", the total index is 45.8, which allows predicting a relatively favorable outcome and recovery after a burn injury. The following items from uniforms system, protection and equipment were producing with protection against flame threats: combar pants, combat shirt; body armor, body armor plates, helmet, protective glasses, tagelmust, and gloves.

147. When creating systems with protection against flame threats, the main thing is to evaluate the changing physiological quality of textiles. According to our research about physiological quality of modern textiles with protection against flame threats practically does not differ from equivalent textiles without protection. Therefore, the system indexes also remain equal, and soldiers will not feel any discomfort, as heat stroke or absence of thermal insulation. Textiles are made from yarns with protection against flame threats and are harmless to the health of system wearer[94 95].

[93] *Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Doctoral thesis.- R.: RTU, 2014, table 3.25, page 146. ISBN 978-9934-507-77-9.*

[94] *Šitvjenkins Igors. Enhancement of Combat Individual Protection System. Doctoral thesis.- R.: RTU, 2014, paragraph 3.10.1, page 146, 3.10.2, page 148. ISBN 978-9934-507-77-9.*

[95] *Sitvjenkins, I., Vilumsone, A., Baltina, I., Torbicka, H., Zarina, U., Abele, I. Heat Transfer and Physiological Evaluation of the Flame Retard Combat Individual Protection System. In: Innovative Textile for High Future Demands: 12th World Textile Conference AUTEX, Croatia, Zadar, June 13-15, 2012, pp. 1073-1078. ISBN 9789537105440.*

148. Despite the similarity of physiological quality, textile technologies systems development with protection against flame threats usually is significantly more expensive. Therefore, always necessary to assess the operational need in purchase of systems with protection against flame threats.

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