NATO STANDARD

AEP-2911

DESIGN CRITERIA FOR BODY ARMOUR CARRIAGE SYSTEMS

Edition A Version 1

DECEMBER 2018

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED ENGINEERING PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

13 December 2018

1. The enclosed Allied Engineering Publication AEP-2911, Edition A, Version 1, DESIGN CRITERIA FOR BODY ARMOUR CARRIAGE SYSTEMS, which has been approved by the nations in the NATO ARMY ARMAMENTS GROUP, is promulgated herewith. The recommendation of nations to use this publication is recorded in STANREC 2911.

2. AEP-2911, Edition A, Version 1, is effective upon receipt.

3.

4. This publication shall be handled in accordance with C-M(2002)60.

Zoltán Gulyás
Brigadier General, HUNAF
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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ABBREVIATION LIST

AEP	Allied Engineering Publication
BA	Body Armour
FR	Fire Resistant
IP	Interoperability Platform
IRR	Infra-Red Reflectance
MOLLE	Modular Lightweight Load-carrying Equipment
NA	National Authority
NATO	North Atlantic Treaty Organisation
NSO	NATO Standardization Office
PALS	Pouch Attachment Ladder System
STANAG	Standardisation Agreement
STANREC	Standardisation Recommendation

CHAPTER 1 INTRODUCTION

1.1 AIM

This STANREC serves to provide design criteria guidelines for nations planning a procurement of body armour carriers. Each section serves to outline what is considered to be the key design features of body armour carriers or to identify the interaction of the body armour carrier with other elements of the soldier system.

1.2 SCOPE

This STANREC does not cover the performance or design criteria of the ballistic panels or ballistic performance of the body armour.

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CHAPTER 2 DESIGN CRITERIA

2.1 BALLISTIC COVERAGE

The carrier design for body armour is critical not just for aesthetic value or material characteristics, but mostly is to ensure body armour is positioned correctly and consistently on the soldier to provide maximum protection and acceptable coverage of essential/desirable organs/structures. The following design criteria should be considered to ensure this property is met:

a. Promote by design, styling and comfort, the acceptance and confidence of the user in a combat environment;
b. Define desired coverage of torso area while permitting range of motion required to complete assigned tasks and use of assigned equipment;
c. Through sizing and design, ensure there is no gap between the front and rear soft armour panels along sides of vest;
d. Allow for removal and replacement of hard armour by user, so that proper positioning is maintained.

2.2 BALLISTIC UNDERGARMENTS

Ballistic undergarments can play a key role in providing protection from fine levels of blast ejecta fragmentation to critical regions of the body. The following carrier design criteria for undergarments are to be considered:

a. Be flame resistant and no melt/no drip;
b. Be of the lightest weight possible;
c. Be flexible and not cause binding or chafing;
d. Have a low profile to the extent it isn't easily discerned that it's being worn;
e. Be easy to clean;
f. Be air permeable and wicking.

2.3 CAMOUFLAGE

Camouflage and any associated infra-red reflectance protection shall be in accordance with the rest of the individual protection ensemble as defined by the National Authority. Refer to STANAG 2333 Performance and Protective Properties of Combat Clothing.

When multiple camouflage patterns for the body armour are used by a nation, carrier design should allow for easy transition of panels from one carrier pattern to another i.e. arctic to desert.

2.4 CARE/CLEANING/REPAIR

As an outer layer garment, body armour carriers are subject to high exposure to dirt, sweat and fluids. Carrier designs should incorporate materials that are easy for the user to care for while maintaining protective properties i.e. IRR or flame resistance. NA's are to determine what level, if any, a BA carrier is to be subject to repair based on inherent capabilities and cost analysis.

2.5 CLOSURE SYSTEM

2.5.1 The closure system of body armour carrier provides two functions. First is to allow the armour to be worn securely and well fitting, regardless of activity and associated clothing worn under or over the armour. Second is to ensure that the vest and its contents i.e. plates, remains on the wearer during a blast event.

2.5.2 Closure methods can feature a number of elements and styles. Most common methods include:

a. Hook and loop fastener sewn onto straps of elastic or webbing;
b. Quick release buckle style attachments (refer to 2.14.3);
c. Sewn-in straps with adjustment sliders.

2.5.3 The following design criteria for closure systems are to be considered regardless of style:

a. Ease of use, with minimal effort, using either hand, with or without a gloved hand;
b. Robust materials;
c. Materials such as hook and loop or buckles, must meet the IRR levels of the rest of the protective ensemble;
d. Generate minimal noise during operation of closure system;
e. Must not be located on a position where weapon sighting ability is hindered;
f. Must minimize interference with or generate pressure points when load carriage is worn;

g. Must have low profile and minimize snag hazards. It shall be possible to tie down loose ends of straps.

Note: If a quick release system is used, it should have minimal parts and must be easily re-assembled if deployed accidently.

2.6 CONSTRUCTION

2.6.1 All stitches shall be firm and carefully and strongly tightened. The type and size of the stitches shall be adapted to the component and the confectioning area. In areas of high stress and key points, the stitches shall be reinforced [back tacks, Z tacks (a double back tack) or bar tacks where appropriate]. Double stitching shall be applied to heavily strained parts.

2.6.2 Materials used shall be known to resist the mechanical wear and tear (abrasion, tear strength, strain) and environmental conditions (sand and dust, sun, humidity, extreme cold) during the requested in service life. Textile materials shall be durable water repellent or waterproof.

2.6.3 Ingress of sand and dust into the interior of the carrier should be prevented.

2.6.4 Textile materials shall be colour fast when subjected to light, sweat, industrial washing, rubbing and sea water.

2.7. DESIGN TRADE-OFFS

2.7.1 Body armour faces a perennial debate on armour weight versus armour protection coverage. Nations procuring BA will consider armour that maximizes threat protection at the lowest possible weight. In addition, from a burden perspective, increased mobility and endurance provided from lighter, better fitting BA can be a trade-off against protection. Nations must risk assess survivability across all aspects and weigh the associated trade-offs to achieve optimal performance of both the body armour and the soldier.

2.7.2 Carrier designers must be cognizant of generating weight gain opportunities in the design. A minimalistic design could take the form of base material weight, performance coatings on the carrier material or by providing the soldier opportunities to add weight through pockets or straps.

2.8 FLAMMABILITY

When identified as a requirement by the NA, body armour carrier materials are to be made from materials that provide flame protection or flash protection in accordance with STANAG 2333. The level of FR should be compatible with the level assigned to the combat clothing.

2.9 FLOATATION

Nations may require body armour to have a floatation capability. Whether working with carriers with built-in floatation or an external floatation device is to be worn, carrier design must take the placement of floatation device into consideration relative to the armour closure system and functionality. In addition floatation actuators (CO_2 or hand pull) need to have ballistic protection to limit potential damage from a ballistic threat.

2.10 HIP BELTS

If used, body armour carriers shall be designed such that no interference occurs between the hip belt and the body armour carrier and shall minimize pinch points.

a. Should be designed so it transfers the weight evenly to the hips;
b. Should be designed so it fit both male and female hips;
c. Should be designed so it does not impede the soldier's movements unnecessarily;
d. Should be designed so it does not interfere with the rest of the body armour;
e. Should be designed to carry various items in both MOLLE, normal belt carrying devices or national systems;
f. Should be designed so it can be connected with the body armour to help dissipate the weight from the rest of the system;
g. Should be designed so it can accommodate integration with a backpack to avoid "belt on belt" solutions;
h. Should be designed to allow insert of soft ballistic panels;
i. Should be strong enough to carry the full weight of the combat soldier when he/she is lifted in it.

2.11 HUMAN FACTORS

The use of body armour by military personnel is best accepted when it is shown to be designed for use in combat while keeping user protection, mobility and comfort at the forefront. Human factors elements of body armour carriers can be evaluated through user trials, reference STANAG 2138 Troop Trials Principles and Procedures - Combat Clothing and Personal Equipment. The following human factors design criteria are to be considered:

a. Promote by design, the distribution of weight over the largest possible area of the torso;
b. Be provided in sufficient sizes to properly fit a nation's military population;
c. Be able to be put on and taken off, with minimal effort, using either hand, with or without a gloved hand;
d. Have sufficient adjustability in size to allow for use under and over various clothing layers;
e. Compatibility with rucksacks and other pack systems generating minimal to no pressure points or interference points. Reference STANAG 2311 Principles Governing the Design of the Individual Load Carrying Equipment of the Combat Soldier;
f. Compatibility with the combat helmet (prone position);
g. Carrier design features should not degrade the ability to sight and utilize standard personal weapons;
h. Ability of carrier to maintain its protective coverage when user is in various positions (prone, sitting, kneeling);
i. Range of motion should be considered and evaluated;
j. Promote by design and material use the dissipation of heat and sweat to the environment.

2.12 LOAD CARRIAGE INTEGRATION

2.12.1 Soldiers wear a variety of load carriage systems based on mission type and duration. For some nations, the plate carrier or soft body armour carrier provides the ability for load carriage via webbing. In these cases the following design criteria are to be considered:

a. Ensure load does not disrupt proper positioning of plate for protection of vital organs;
b. Ability to access load regardless of tactical position;
c. Ability to access load regardless of clothing posture;

d. Ability to access load with right or left hand;
e. Ability to distribute load on smaller framed members;
f. Awareness of potential fragmentation threat created from rounds hitting load i.e. radio, magazines, batteries;
g. Reduction of pressure points through armour;
h. Interference with straps from secondary load carriage systems such as a rucksack or day bag.

2.12.2 MOLLE/PALS (webbing and laser cut) – what are design implications?

a. Additional weight increase to garment;
b. Snag hazards;
c. Acknowledgement of increased load and burden opportunity provided to user by provision of MOLLE;
d. Potential fragmentation hazards associated with various items hung on straps.

Note: pockets must have ability to self-drain and be rated/constructed for intended load weight.

Refer to STANAG 2311 Principles Governing the Design of the Individual Load Carrying Equipment of the Combat Soldier.

2.13 POWER AND DATA INTEGRATION

Many nations are incorporating power generating systems and data devices into the soldier systems, which may include attachment to or integration into body armour. The following design criteria are to be considered:

a. Awareness of potential secondary fragmentation and fire threat created from rounds hitting any hard cased power systems;
b. Reduction of pressure points through armour;
c. Interference with any installed quick release systems or standard closure systems;
d. If mounted to a standalone plate carrier, capability to mount to soft armour system, when plate carrier removed;
e. Routing of cables through the carrier.

2.14 SAFETY FEATURES

2.14.1 Body armour carriers may incorporate features that allow for the evacuation or care of an injured soldier. These may include casualty drag strap or quick release systems. The following design criteria are to be considered:

2.14.2 Casualty drag (man down) strap features:

a. Be made of nylon webbing;
b. Use sewing techniques (i.e. bartacks) sufficient to hold strap to carrier under suspended weight of soldier and his equipment (up to 150kg);
c. Be positioned so that strap can be accessed if soldier is prone;
d. Be positioned so that when lifting, the armour remains in position on the wearer's body with minimal upwards movement.

2.14.3 Quick release features:

a. Be easily identifiable in an emergency i.e. different colour;
b. Allow for release of armour in one motion;
c. Be made of corrosion resistant material;
d. Be located on carrier in a way to avoid accidental activation from snag or entanglement;
e. Be easily re-assembled if deployed accidently.

2.15 SCALABILITY/MODULARITY

Body armour carriers should provide the ability to upgrade from a base soft armour system to allow for higher protection against specific threats or potential increased threat environments. This upgrade can take the form of adding extremity protection i.e. brassards, adding hard armour plates or adding additional soft armour panels or panel configurations into or on the carrier. Additional armour should be able to be added by the user, without removing base layer of soft armour.

2.16 SIZING GUIDELINES

2.16.1 Standard measurements include:

a. Height;
b. Weight;
c. Standing torso length;
d. Sitting torso length;

e. Chest breadth;
f. Waist circumference;
g. Suprasternal notch to lower 10th rib;
h. Suprasternal notch to iliac crest;
i. Chest circumference;
j. Waist circumference.

2.16.2 Use of known physical landmarks to measure from:

a. Sternal notch;
b. C7 vertebrae;
c. Iliac crest;
d. Bottom of 10th rib;
e. Omphalion height.

2.17 USE IN PARACHUTE OPERATIONS

Body armour worn in conjunction with parachute operations should take the following design considerations:

a. Reduce/remove snag hazards;
b. Maintain a low profile over shoulders to ease pressure points from parachute harness.

2.18 WEAPON INTEGRATION

Body armour carriers shall be designed in a manner that does not introduce weapon integration issues that degrade sighting capability or ability to operate due to restricted range of motion. User trials should be conducted with all of a nation's weapon systems before procuring a body armour system.

**ANNEX A TO
AEP-2911**

ANNEX REFERENCE STANDARDS

A.1 REFERENCES

Related standards:

STANAG 2138 Troop Trials Principles and Procedures - Combat Clothing and Personal Equipment
STANAG 2311 Principles Governing the Design of the Individual Load Carrying Equipment of the Combat Soldier
STANAG 2333 Performance and Protective Properties of Combat Clothing

The following is a list of material standards that can be used as reference to obtain some of the design criteria provided in this document:

Reference #	Title
MIL-DTL-32439	DETAIL SPECIFICATION CLOTH, DUCK, TEXTURED NYLON
A-A-55126B	COMMERCIAL ITEM DESCRIPTION FASTENER TAPES, HOOK AND LOOP, SYNTHETIC
MIL-W-17337F	MILITARY SPECIFICATION WEBING, TEXTILE, WOVEN NYLON

AEP-2911(A)(1)