

THE IMPORTANCE OF NATIONAL BALLISTIC RESISTANT EQUIPMENT STANDARDS AND NATIONAL BALLISTIC TEST CENTRE

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Abstract



This paper aims to present the the importance and effectiveness of ballistic protective material (BRM) standards in the new and changing conditions of armed conflict. The protection capabilities and levels of ballistic protective materials are determined in accordance with nationally or internationally proven BRM standards. However, due to the regional differences of the changes in the threat characteristics of regional armed conflicts, single international BRM standard is not sufficient for all regions and threats. Terrorist groups provide weapons and ammunition though different sources and countries. For instance, it is observed that NATO and former Warsaw Pact origin weapons and ammunition were also used by terrorist organizations. In addition to this, the exchange of arms and ammunition has become an ordinary trade activity among terrorist organizations such as PKK/YPG, ISIS and Taliban. That situaiton is another reason that increases the diversity of threats the security forces face. The assault, infantry and sniper rifles, light and heavy machine guns, and IEDs from the different origin in the neighbouring regions and inside of Turkey are intensively used by the terrorist organizations.

The BRM standard to be used in a geography with a wide spectrum of threats needs to be flexible for providing protection against current and emerging threats in real conflict conditions. Because of the diversity and wide range of threats, the national BRM standards became more critical than before. For the effectiveness and validity of national BRM standards, an independent and internationally accredited national ballistic test centre should be established. This centre is intended to be a national authority for the preparation, verification and implementation of test methods. Within this study, the framework of the threat/protection levels and the minimum requirements of the national ballistic test centre are mentioned within the scope of the national ballistic standard.

Keywords: Terminal Ballistics, Body Armour, Ballistic Resistant Equipment Standards, Ballistic Test Centre, Urban Warfare

ULUSAL BALİSTİK KORUYUCU MALZEME STANDARDI VE ULUSAL BALİSTİK TEST MERKEZİNİN ÖNEMİ

ÖZ

Bu çalışmada, silahlı çatışmaların yeni ve değişen koşullarında balistik koruyucu malzeme standartlarının önemine ve etkinliğine odaklanılmıştır. Balistik koruyucu

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malzemelerin koruma yetenekleri ve seviyeleri, geçerlilikleri kanıtlanmış ulusal veya uluslararası balistik koruyucu malzeme standartları doğrultusunda belirlenmektedir. Bununla birlikte, bölgesel silahlı çatışmaların tehdit özelliklerinde meydana gelen değişimin bölgesel farklılıkları nedeniyle, tek bir uluslararası balistik koruyucu malzeme standardı tüm bölgeler ve tehditler için yeterli olamamaktadır. Terörist gruplar, farklı kaynaklardan ve ülkelerden silah ve mühimmat temin etmektedirler. Örneğin, NATO ve eski Varşova Paktı kaynaklı silah ve mühimmatların aynı anda terör örgütleri tarafından kullanıldıkları görülebilmektedir, ayrıca silah ve mühimmat alışverişi PKK / YPG, DAESH ve Taliban gibi terör örgütleri arasında sıradan bir ticari faaliyet haline gelmiştir. Bu durum güvenlik güçlerinin karşılaştıkları tehdidin çeşitliliğini arttıran bir diğer sebeptir. Türkiye’de ve komşu bölgelerde farklı menşei saldırı, piyade ve keskin nişancı tüfekleri, hafif ve ağır makineli tüfekler ile EYB’lerin terör örgütleri tarafından yoğun şekilde kullanıldığı görülmektedir.

Bu kadar geniş bir tehdit yelpazesinin olduğu bir coğrafyada kullanılacak balistik koruyucu malzeme standardının gerçek çatışma koşullarındaki mevcut tehditlere ve yeni gelişecek tehditlere karşı koruma sağlaması için esnek bir yapıda olması gerekmektedir. Değişken ve geniş yelpazedeki tehditlere göre, ulusal balistik koruyucu malzeme standartlarının hazırlanması önceye nazaran daha kritik hale gelmiştir. Ulusal balistik koruyucu malzeme standartlarının etkinliği ve geçerliliği için bağımsız ve uluslararası akreditasyona sahip ulusal bir balistik test merkezi kurulması şarttır. Bu söz konusu merkezin test yöntemlerinin hazırlanması, doğrulanması ve uygulanması için ulusal otorite olması hedeflenmektedir. Çalışma kapsamında, ulusal balistik standardı kapsamında tehdit/koruma seviyelerinin çerçevesi ve ulusal balistik test merkezinin asgari şartları ifade edilmiştir.

Anahtar Kelimeler: Terminal Balistik, Vücut Zırhı, Balistik Koruyucu Ekipman Standartları, Balistik Test Merkezi, Meskun Mahal Çatışmaları.

INTRODUCTION

Since the Second World War, it has been seen that the armed conflict has shifted from the trench or the rural wars to the urban war, and this situation has dramatically increased the severity and diversity of the threat. Today, the armies and law enforcement agencies face with the new warfare type; an asymmetric and hybrid wars in the urban area (Johnson and Marke et al, 2013:17). These changes on warfare location and environment has caused changes in the characteristics of weapons, ammunition and ballistic resistant equipment used by the armed forces and law enforcement agencies. As a nature of the urban warfare, the range of armed conflict is closer than other conflict zones (Vautravers, 2010:437). This close range has caused

some problems; first of all the counter attack reaction time of soldiers or law enforcement agents get short. Secondly, the needs of firearms and ammunition with less recoil has emerged. The urban warfare environment increases the risk of high kinetic energy projectile, shrapnel and blast injuries. This situation increases the importance of ballistic resistant equipment, such as body armour, combat helmet, ballistic shield, and armoured tactical vehicle, and also force their ballistic protection limits (Villner, 2017:7)

This paper highlights the importance of ballistic resistant equipment standards in the new warfare location and the urban warfare circumstances. Today, the protection capabilities and levels of ballistic resistant materials are determined within the framework of proven national or international standards. Within the most common international ballistic resistant materials or equipment standards; the threats and the protection levels are optimized. In this way; in theory, it may be accepted that the ballistic resistant material can be used against the various threats levels in different conflict zones. However, because of the change in the regional threat characteristics of armed conflicts, the specific international ballistic resistant equipment standard is not sufficient for all regions. Additionally the regional threats are so dynamic; especially in the Middle East region, the terrorist groups obtain weapons and ammunition from different sources and countries (Cragin and Chalk et al, 2007:11). For example, in a conflict area, terrorist groups use NATO-originated weapons and ammunition, therewithal the same terrorist group use weapons and ammunition originating from the former Warsaw Pact in the other conflict fields. Moreover, in some regions, weapons and ammunition from both sources can be used together (Conflict Armament Research, 2017:31). This is a natural result of asymmetric and hybrid war. And the exchange of the weapons and ammunition among terrorist groups such as PKK/YPG, ISIS, and Taliban is an ordinary trade in Syria, Iraq and Afghanistan. These terrorist groups also produce weapons and/or ammunition (McColum, 2017) (Milliyet, 13.02.2019). The illegal production and mobility of weapons and ammunition are another reasons of threat diversity (Burke, 2018).

Due to these national and regional threats, the preparing of the national ballistic resistant material standards has become more critical especially for Turkey and other the Middle East countries than ever. Because of both Turkey's experience on the armed conflicts and the diversity of the threats that she has faced in the last three decades, the national ballistic resistant material standards will be developed by the Turkish agencies can be applied to common ballistic threats in the different regions of the world.

In the preparation stage of national ballistic resistant material standards, current threats should be analysed and the threats and test procedures defined in the current standards should be examined. The harmonization of the new standard with existing national and international standards will assist the exchange of ballistic resistant materials between armies in international joint operations (Bolduc and Jager, 2016:25). For the effectiveness of the national ballistic resistant material standards, an independent and internationally accredited national ballistic test centre should be established before the beginning of preparation studies which will be conducted on standard sample. In the ballistic test centre, the threat levels accepted as standard will be tested and validation studies of the test methods will be performed. An internationally recognized test certificate will be provided through testing the protection capabilities of ballistic resistant materials produced by the domestic and foreign manufacturers by the accredited and independent national ballistic test centre.

In this study, the efficiency of the national and international ballistic resistant material standards is examined by analysing ballistic threats around Turkey and its regions. In this context an outline of the national ballistic resistant standard of Turkey and the role and importance of the National Ballistic Test Centre on standards studies are determined.

1. THE MOST WIDELY USED INTERNATIONAL AND NATIONAL BALLISTIC RESISTANT MATERIAL STANDARDS

Four international and seven national ballistic resistant body armour standards and seven international and one national ballistic resistant material standards are widely used around the world (Table-1).

Table-1. Widely Used National and International Ballistic Resistant Material Standards

National Ballistic Standards
Personal Body Armour and Helmet Standards
<ol style="list-style-type: none"> 1. NIJ 0101.04 Ballistic Resistance of Personal Body Armor Standard (2001) 2. NIJ 0101.06 Ballistic Resistance of Body Armor Standard (2008) 3. NIJ 0101.07 Ballistic Resistance of Body Armor Standard (Draft version) 4. NIJ 0115.00 Stab Resistance of Personal Body Armor (2000) 5. NIJ 0106.01 Ballistic Helmet Standard (1981) 6. HOSDB 2017 Body Armour Standard (2017) 7. Gost R50744-95 Armoured Clothing Classification and General Technical Requirements (2017)
Ballistic Material/Equipment Standards
<ol style="list-style-type: none"> 1. NIJ 0108.01 Ballistic Resistant Protective Materials (1985)
International Ballistic Standards
Personal Body Armour and Helmet Standards
<ol style="list-style-type: none"> 1. VPAM BSW 2006 Ballistic Protective Vest 2. VPAM KDIW 2004 Stab and Impact Resistance 3. VPAM HVN 2009 Bullet Resistant Helmet with Visor and Neck Protection 4. NATO STANAG 2920 Ed.3–AEP 2920, Ed. A,V1 Procedures for the Evaluation and Classification of Personal Armour Bullet and Fragmentation Threats
Ballistic Material Standards
<ol style="list-style-type: none"> 1. VPAM PM 2007 Bullet Resistant Plate Material 2. VPAM BRV 2009 Bullet Resistant Vehicle 3. VPAM ERV 2010 Explosive Resistant Vehicle 4. VPAM ARG 2012 Materials and Structures to Avoid Bouncing and Rebounding Projectiles 5. EN 1522 Windows, Doors, Shutters and Blinds–Ballistic Resistance–Requirements and Classification 6. EN 1523 Windows, Doors, Shutters and Blinds – Ballistic Resistance – Test Method 7. EN 1063 Security Glazing Testing and Classification of Resistance against Bullet Attack 8. NATO STANAG 4569 Protection Levels for Occupants of Logistic and Light Armoured Vehicles

1.1. The Most Widely Used National Ballistic Standards

1.1.1. National Institute of Justice Ballistic Resistant Material Standards

Although the NIJ (National Institute of Justice) ballistic resistant material standards specify a minimum ballistic protection performance requirement for U.S. law enforcement officers according to the national ballistic threats; these standards have become the most popular ballistic resistant material standards among the different countries' law enforcement agencies and military units. The NIJ 0101.04 (2001), NIJ 0101.06 (2008) and NIJ 0101.07 (standard is still in draft version, will be enforced in 2019) standards are prepared for determining the protection levels of handgun and rifle threats, and the NIJ 0115.00 (2000) standard is focused on the spike and knife threats for body armours. The NIJ 0106.00 (1981) standard is focused ballistic protection of helmets. And NIJ 0108.01 (1985) Standard prepared for other ballistic protective material such as shields, glass etc. (NIJ 0101.04. 2001), (NIJ 0101.06. 2008), (Greene and Horlick et al. 2018:1), (NIJ 0115.00. 2000), (NIJ 0106.00, 1981), (NIJ 0108.01. 1985)

Even though NIJ 0101.06 (2008) Ballistic Resistance of Body Armour standard supersedes the NIJ 0101.04 (2001) Ballistic Resistance of Personal Body Armour standard, some of the law enforcement agencies prefer to use NIJ 0101.04 standard. In addition, the NIJ 0101.07 Ballistic Resistance of Body Armour standard will supersede the NIJ 0101.06 (2008) Ballistic Resistance of Body Armour standard in 2019. According to the changes in threats (mass, velocity, kinetic energy, and design of the projectiles; the general trend is upgrading the protection levels), the specifications of protection levels are changed in each version of the standards (Greene and Horlick et al. 2018:1).

Table-2. NIJ Ballistic Resistance Body Armour and Material Threat / Protection Levels (Table is abbreviated)

Threats	Bullet Mass (grams)	NIJ 0101.04		NIJ 0101.06		NIJ 0101.07		NIJ 0106.00		NIJ 0108.01	
		Protection Level	Bullet Velocity (m/sn)	Protection Level	Bullet Velocity (m/sn)	Protection Level	Bullet Velocity (m/sn)	Protection Level	Bullet Velocity (m/sn)	Protection Level	Bullet Velocity (m/sn)
.22 LRHV	2,6	I	320±9	-	-	-	-	-	-	-	-
.380 ACP	6,2		312±9	-	-	-	-	-	-	-	-
.22 LRHV	2,6	-	-	-	-	-	-	I	320±12	I	320±12
.38 Special	10,2	-	-	-	-	-	-		259±15		259±15
9×19mm	8	II	332±9	IIA	373±9	-	-	-	-	-	-
.40S&W	11,7	A	312±9		352±9	-	-	-	-	-	-
9×19mm	8	II	358±9	II	398±9	HG1	398±9	IIA	332±15	IIA	332±15
.357 Mag	10,2		427±9		352±9		436±9		381±15		381±15
9×19mm	8	-	-	-	-	-	-	II	358±15	II	358±15
.357 Mag	10,2	-	-	-	-	-	-		425±15		425±15
.357 Sig	8,1	-	-	III A	448±9	-	-	-	-	-	-
44 Mag	15,6	-	-		436±9	-	-	-	-	-	
9×19mm	8	II	427±9	-	-	HG2	448±9	-	-	III	426±15
44 Mag	15,6	I A	427±9				436±9				426±15
7,62×51mm	9,6	II I	838±9	III	847±9	RF1	847±9	-	-	III	838±15
7,62×39mm	7,8	-	-	-	-		725±9				-
5,56×45mm (M193)	3,6	-	-	-	-	990±9	-	-	-	-	-
7,62×51mm	9,6	-	-	-	-	RF2	847±9	-	-	-	-
7,62×39mm	7,8						725±9				
5,56×45mm (M193)	3,6						990±9				
5,56×45mm (M855)	4						950±9				
30-06AP	10,8	I V	869±9	IV	878±9	RF3	878±9	-	-	IV	869±15
Backface Signature						44mm					
Test Distance						5 meters For Level I, IIA, II, and IIIA					
						15 meters For Level III and IV					

1.1.2. United Kingdom Home Office Body Armour Standard (2017)

United Kingdom Home Office had used the HOSDB (2007) (Home Office Scientific Development Branch) standard for ten years. But then, Home Office Centre for Applied Science and Technology (CAST) prepared a new body armour standard and it enforced in July 2017. Although the HOSDB Standards were prepared for UK Law Enforcement agencies, these standards have also been used by Commonwealth countries. The main differences from 2007 are stab (knife and spike), ballistic threats and protection levels determined in the same document in 2017 version of the HOSDB standard. The other important difference of the 2017 version when compared to 2007 version is the female body armour specifications and test methods that are mentioned in 2017 version (Payne, Rourke et al. 2018:20).

Table-3. HOSDB Ballistic Resistance Body Armour and Material Threat / Protection Levels

Protection Level	Threats	Bullet Mass (grams)	Bullet Velocity (m/sn)	Max. mean BFS (mm)	Single shot BFS limit (mm)	Test Distance (m)
HO1	9×19mm FMJ	8	365±10	-	44	5
	9×19mm JHP	8	365±10	-	44	
HO2	9×19mm FMJ	8	430±10	-	44	5
	9×19mm JHP	8	430±10	-	44	
HO3	7,62×51mm	9,3	830±15	25	30	10
	7,62×39mm	7,9	705±15	25	30	
HO4	7,62×51mm SAKO Powerhead	10,7	820±15	25	30	10
SG1	1oz Solid Slug	28,4	435±25	25	30	10
Special	.357 Magnum SPFN	10,2	390±10	-	44	5
	.357 Magnum Rem. R357M3		455±10	-	44	
Special	5,56×45mm (SS109)	4,01	920±15	25	30	10
Special	5,56×45mm (LE223T3)	4,01	750±15	25	30	10

Table-4. HOSDB Stab Resistance Body Armour and Material Threat / Protection Levels

Protection level		Energy level E1		Energy level E2		
Energy (J)	Maximum penetration at E1 (mm)	SPL at E1 (mm)	Energy (J)	Maximum penetration at E2 (mm)	SPL at E2 (mm)	
KR1	24.0	8.0	9.0	36.0	20.0	30.0
KR1 + SP1	24.0	KR1 = 8.0, SP1 = 0	KR1 = 9.0, SP1 = 0	36.0	KR1 = 20.0, SP1 = N/A	KR1 = 20.0, SP1 = N/A
KR2	33.0	8.0	9.0	50.0	20.0	30.0
KR2 + SP2	33.0	KR2 = 8.0, SP2 = 0	KR1 = 9.0, SP2 = 0	50.0	KR2 = 20.0, SP2 = N/A	KR2 = 30.0, SP2 = N/A

1.1.3. Gost R50744-95 Armoured Clothing, Classification and General Technical Requirements standard

Gost R50744-95 Armoured Clothing, Classification and General Technical Requirements standard was enforced in 27 February 1995 and its 4th version was published in 01 January 2017 by National Standard of the Russian Federation. Besides Russia the Gost R50744-95 standard is widely used among the former USSR countries (Eurexcert, 2019).

Table-5. Gost R50744-95 Armoured Clothing Threat / Protection Levels

Protection Level	Threats	Bullet Mass (grams)	Bullet Velocity (m/sn)	Max. BFS (mm)	Test Distance (m)
BR1	9×18mm 7N21	5,9	455±10	17	5
BR2	9×21mm 7N28	7,93	390±10	17	5
BR3	9×19mm 7N21	5,2	455±10	17	5
BR4	5,45×39mm 7N10	3,5	895±15	-	10
	7,62×39mm 57N231	7,9	720±15		
BR5	7,62×54mm R 7N13	9,4	830±15	-	10
	7,62×54mm R 7N13 (API)	7,9	810±15		
BR6	12,7×108mm 57BZ542	48,2	830±25	-	50

1.2. The Widely Used International Ballistic Protection Standards

1.2.1. VPAM Ballistic Protection Standards

One of the international ballistic protection standards is VPAM (Vereinigung der Prüfstellen für angriffshemmende Materialien und Konstruktionen – The Association of Anti-Attack Materials and

Constructions) established in 1999 by five official audit institutions of European countries on ballistic tests. The founder countries of VPAM are Austria, Belgium, France, Germany, Netherland, and Sweden. VPAM ballistic protection standards focus on both civilian and military ballistic resistant materials. According to specifications of the ballistic resistant material or armour, the test procedures are determined in a detailed way for each type of material and armour in the different VPAM standards. But the threats and protection levels are separately determined in the VPAM APR 2006 standard (VPAM APR 2006 Allgemeine Prüfgrundlagen für ballistische Material-, Konstruktions- und Produktprüfungen - General Basis for Ballistic Material, Construction and Product Testing). All of the VPAM ballistic resistant materials and armours test standards reference the VPAM APR 2006 standard for threat and protection levels (bullet type, mas and velocity) (VPAM,2019).

Table-6. VPAM APR 2006 General Basis for Ballistic Material, Construction and Product Testing Threat / Protection Levels

Protection Level	Threats	Bullet Mass (grams)	Bullet Velocity (m/sn)	Test Distance (m)
1	.22 Long Rifle	2,6	360±10	10
2	9×19mm FMJ	8	360±10	5
3	9×19mm FMJ	8	415±10	5
4	.357 Magnum	10,2	430±10	5
	.44 Magnum	15,6	440±10	
5	.357 Magnum	10,2	580±10	5
6	7,62±39mm M43	8	720±10	10
7	5,56×45mm (SS109)	4	950±10	10
	7,62×51mm M80	9,55	830±10	
8	7,62×39mm API (BZ)	7,7	740±10	10
9	7,62×51mm AP	9,7	820±10	10
10	7,62×54mm R API (B32)	10,4	860±10	10
11	7,62×51mm Tungsten Carbide AP	8,4	930±10	10
12	7,62×51mm Tungsten Carbide AP	12,7	810±10	10
13	12,7×99mm AP	43	930±10	-
14	14,5×114mm API	63	911±10	-

While VPAM BSW 2006 “Ballistic Protective Vest”, VPAM KDIW 2004 “Stab and Impact Resistance” and VPAM HVN 2009 “Bullet Resistant Helmet with Visor and Neck Protection” standards are regarded as personal ballistic protection; VPAM PM 2007 “Bullet Resistant Plate

Material” and VPAM ARG 2012 “Materials and Structures to Avoid Bouncing and Rebounding Projectiles” standards are associated with ballistic protecting structures; VPAM BRV 2009 “Bullet Resistant Vehicle” and VPAM ERV 2010 “Explosive Resistant Vehicle” standards are related with armoured vehicles (VPAM,2019).

1.2.2. NATO STANAG 2920 AEP Ed.3 Standards

NATO STANAG (Standardization Agreements) 2920 AEP Ed.3 "Personal Armor and War Clothing for Ballistic Test Methods" standard was published in June 2015 and replaced the 2nd edition of STANAG 2920 AEP (2003). This standard has a structure and classification logic different from all other existing ballistic protective material standards. (Bolduc, Jager, 2016:25)

Table-7. NATO STANAG 2920 AEP Ed.3 Threat / Protection Levels

Protection Level	Calibre (mm)	Class	Bullet Mass (grams)	Minimum Core Hardness	Core Mass [g]	Acceptable Projectile
A Lead Core Projectile	9×19	A1	8,0±0,1	-	-	NATO Stanag 4090
	4,6×30	A2	2,6±0,1	-	-	RUAG FMJ SX
	5,56×45	A3	3,6±0,1	-	-	FN SS 92 / M193
	7,62×51	A5	9,3±0,1	-	-	NATO Stanag 2310
	Emerging threats	A _{Special}	-	-	-	N.A. Specify
B Mild Steel Core Projectile	4,6×30	B2	2,0±0,1	40 HRC	0,2±0,1	RUAG AP SX
	5,56×45	B3	4,0±0,1	40 HRC	0,4±0,1	NATO Stanag 4172
	7,62×39	B4	7,9±0,2	40 HRC	3,6±0,1	M43 PS
	7,62×51	B5	9,6±0,1	40 HRC	-	-
	Emerging threats	B _{Special}	-	-	-	N.A. Specify
C Hard Steel Core Projectile	7,62×39	C4	7,7±0,3	60 HRC	4,0±0,1	API BZ
	7,62×51	C5	9,5±0,1	60 HRC	4,6±0,1	FN P80
	7,62×54	C6	10,4±0,5	60 HRC	5,3±0,1	R B32 API
	7,62×63	C7	10,7±0,1	60 HRC	5,2±0,1	M2 AP US Arsenal
	Emerging threats	C _{Special}	-	-	-	N.A. Specify
D Tungsten Carbide (WC) Core Projectile	9×19 AP	D1	5,7±0,1	70 HRC	-	MEN AP
	5,56×45	D3	3,4±0,1	70 HRC	2,2	M995
			4,0±0,1			MEM AP DM 31
	7,62×51	D5	8,2±0,1	70 HRC	5,9	M993 Nammo AP8
Emerging threats	D _{Special}				N.A. Specify	

While the ammunition, velocities and projectile specifications are defined for each specific protection levels in other ballistic protection material standards, in 2920 AEP Ed.3 standard, only the projectile specifications (shape, morphology, mass, diameter, materials etc.) are defined.

NATO STANAG 2920 AEP Ed.3 standard focuses on the V_{Proof} (Ballistic Limit) and V_{50} Ballistic tests and the national authorities can define the minimum V_{proof} according to the technical specifications of armour or ballistic protection materials. The main factor of defining the V_{Proof} and V_{50} velocity is the risk analysis of national authority. 2920 AEP Ed.3 standard gives an opportunity to have a protection against different projectiles and different V_{proof} and V_{50} threat levels based on the risk analysis of the national authority on the armour. AEP Ed.3 standard provides with a chance to have a protection against the different projectiles and the different V_{proof} and V_{50} threats, based on the ballistic risk analysis of the national authority on the same armour design. Additionally, the national authority has a chance to lightening the armour weight with this standard (Bolduc and Jager, 2016:25).

1.2.3. European Standard DIN EN 1522 and 1523 Ballistic Resistance standards

European Standard DIN EN 1522 and 1523 Ballistic Resistance standards are for windows, doors, shutters and blinds and these standards are complementary documents. While in the European Standard DIN EN 1522 standard the threat levels are determined for windows, doors, shutters, and blinds; the test methods are explained in the European Standard DIN EN 1523 standard (European Standards EN 1522,1999-02), (European Standards EN 1523,1999-02).

Table-8. European Standard DIN EN 1522 Threat / Protection Levels

Protection Level	Threats	Bullet Mass (grams)	Bullet Velocity (m/sn)	Test Distance (m)
FB1	.22 LR	2,6±0,1	360±10	10±0,5
FB2	9×19mm	8±0,1	400±10	5±0,5
FB3	.357 Magnum	10,2±0,1	430±10	5±0,5
FB4	.357 Magnum	10,2±0,1	430±10	5±0,5
	.44 Rem. Magnum	15,6±0,1	440±10	5±0,5
FB5	5,56×45mm(SS109)	4±01	950±10	10±0,5
FB6	5,56×45mm(SS109)	4±01	950±10	10±0,5
	7,62×51mm	9,5±0,1	830±10	10±0,5
FB7	7,62×51mm AP	9,8±0,1	820±10	10±0,5
FSG	12/70 Gauge Brenneke Slug	31±0,5	420±10	10±0,5

1.2.4. European Standard DIN EN 1063 Ballistic Resistance standards

European Standard DIN EN 1063 Security Glazing Testing and Classification of Resistance against Bullet Attack standard is developed for transparent ballistic armours. Different from European Standard DIN EN 1522/1523 standards, the threats and protection levels with test methods are mentioned together in the European Standard DIN EN 1063 standard (European Standards EN 1063,2000-01).

Table-9. European Standard DIN EN 1063 Security Glazing Testing and Classification of Resistance against Bullet Attack Standard Threat/ Protection Levels

Protection Level	Threats	Bullet Mass (grams)	Bullet Velocity (m/sn)	Test Distance (m)
BR1	.22 LR	2,6±0,1	360±10	10±0,5
BR2	9×19mm	8±0,1	400±10	5±0,5
BR3	.357 Magnum	10,2±0,1	430±10	5±0,5
BR4	.44 Rem. Magnum	15,6±0,1	440±10	5±0,5
BR5	5,56×45mm(SS109)	4±01	950±10	10±0,5
BR6	7,62×51mm	9,5±0,1	830±10	10±0,5
BR7	7,62×51mm AP	9,8±0,1	820±10	10±0,5
SG1	12/70 Gauge Brenneke Slug (1 Shot)	31±0,5	420±10	10±0,5
SG2	12/70 Gauge Brenneke Slug (3 Shots)	31±0,5	420±10	10±0,5

Even though European Norm 1522/1523 and European Norm 1063 Standards developed for ballistic protected structures (windows, doors, shutters, blinds and glass), nowadays these standards has also been used for the armoured civilian and law enforcement vehicles.

1.2.5. NATO STANAG 4569 Protection Levels for Occupants of Logistic and Light Armoured Vehicles Standard

NATO STANAG 4569 Protection Levels for Occupants of Logistic and Light Armoured Vehicles Standard determined and standardized the protection levels and threats. In order to express the test procedures and additional threats in detailed, the Allied Engineering Publication 55 Procedures for Evaluating the Protection Level of Armoured Vehicles (AEP-55) was prepared. AEP-55 (Allied Engineering Publications) is composed of four volumes. The first volume is about kinetic energy ballistic threats, the second volume is about mine threats, the third volume is on the IED (Improvised Explosive Devices) threats, and the fourth volume is focusing on the anti-tank rockets and missiles. The last volume of the NATO STANAG 4569 hasn't been published yet, the standard preparing studies have still been continuing. (NATO Standardization Agency, 2012)

Table-10. NATO STANAG 4569 Kinetic Energy and Artillery Threats and Protection Levels

Level	Kinetic Energy Threat	Reference – Artillery - Threat
1	Weapon: Assault rifles: 7.62 and 5.56 mm, Ammunition: Ball Distance: 30 m Angle: azimuth 360°; elevation 0-30°	Artillery 155 mm Estimated range of burst: 100 m Azimuth 360° Elevation: 0° – 18°
2	Weapon: Assault rifles, 7.62 mm Ammunition: AP steel-core Distance: 30 m Angle: azimuth 360°; elevation 0-30°	Artillery 155 mm Estimated range of burst: 80m Azimuth 360° Elevation: 0° – 22°
3	Weapon: Machine Gun and Sniper rifles, 7.62 mm Ammunition: AP tungsten carbide and AP hard steel-core, Distance: 30 m Angle: azimuth 360°; elevation 0-30°	Artillery 155 mm Estimated range of burst: 60 m Azimuth 360° Elevation: 0° – 30°
4	Weapon: Heavy Machine Gun, 14.5 mm, Ammunition: AP Distance: 200 m Angle: azimuth 360°; elevation 0°	Artillery 155 mm Estimated range of burst: 25m Azimuth 360° Elevation: 0 - 90°
5	Weapon: Automatic Cannon, 25 mm Ammunition: APDS and APFSDS Distance: 500 m, Angle: frontal arc to centreline: ± 30° sides included; elevation 0°	Artillery 155 mm Estimated range of burst: 25 m Azimuth 360° Elevation: 0 - 90°
6	Weapon: Automatic Cannon, 30 mm Ammunition: APFSDS and AP Distance: 500 m, Angle: frontal arc to centreline: ± 30° sides included; elevation 0°	Artillery 155 mm Estimated range of burst: 10 m Azimuth 360° Elevation: 0 - 90°

Table-11. NATO STANAG 4569 Grenade and Blast Mine Threats and Protection Levels

Level	Grenade and Blast Mine Threat		
1	Hand grenades, unexploded artillery fragmenting sub-munitions, and other small anti-personnel explosive devices detonated anywhere under the vehicle		
2	2a	Mine Explosion pressure activated under any wheel or track location	6 kg (explosive mass) Blast AT Mine
	2b	Mine Explosion under belly	
3	3a	Mine Explosion pressure activated under any wheel or track location	8 kg (explosive mass) Blast AT Mine
	3b	Mine Explosion under belly	
4	4a	Mine Explosion pressure activated under any wheel or track location	10 kg (explosive mass) Blast AT Mine
	4b	Mine Explosion under belly	

2. THE BALLISTIC THREATS THAT ARE AROUND TURKEY AND NEIGHBOURING REGION

Turkish law enforcement forces and army have had high-level armed conflict experience against terror organizations in urban areas and rural/mountain terrain conditions for the last three decades. In this period, the counter-terrorism operations against PKK/YPG and ISIS have been conducted by Turkish Gendarmerie, Police, and Army in Turkey, Iraq, and Syria.

Due to Turkey’s geographic location, the terrorist organizations have advantages to access easily both western and eastern countries' weapons and ammunition, and this situation widens the threat spectrum that the Turkish security forces encounters. These terrorist organizations intensively use 5,56×45mm AR-15 series and 7,62×39mm AK47 series assault rifles, 7,62×51mm and 7,62×54mmR infantry rifles, sniper rifles, light machine guns, and 12,7×108mm and 14,5×114mm heavy machine guns. One can clearly observe the same for the ammunition supply. The terrorist groups obtain the different type ammunition from different sources. Additionally the terrorist organizations produce the ammunition, IED and weapons in

Syria and Iraq. In some cases the ammunition and weapon production became so sophisticated (Conflict Armament Research, 2016:7). For instance, the tungsten carbide armour piercing bullets are produced from civilian engineering tools, which are provided from the internet. Additionally, the anti-material rifles or sniper rifles are produced from 12,7×108mm and 14,5×114mm calibre heavy machine gun barrels (McCollum, 2017).

The similar wide spectrum is seen on the IED and mine threat. The armoured vehicles are produced according to protection standards and all of the vehicles have a protection limit, however in general, the explosive load of IED is over the protection limits. The terrorist organizations produce themselves explosives for IED in the field with fertilizer (ammonium nitrate, calcium ammonium nitrate), fuel oil and fabrication military or civilian explosives. In order to cause the maximum damage on the target, they use explosive as much as possible. Due to this reason, the main threat for the security forces is IED attacks for both the armoured vehicles and the infantries.

The main actor of weapon and ammunition production was ISIS in Syria and Iraq between July 2014 and November 2017 (Conflict Armament Research, 2017:5). ISIS built the production plants for weapons, ammunition, IED, remote control weapon systems, UAV and UGV (Friese, 2016:40). After the ISIS's defeat in the region, all of these arsenal and the production plants were captured by PKK/YPG and PKK/YPG used ISIS's arsenal against civilians and security forces in Turkey (Haber7.com, 2018).

In addition to threats caused by terrorism, the other source of threat diversity is the local ballistic threats faced in public security duties by law enforcement officers. For instance, shotguns and handguns are the main local ballistic threats to law enforcement officers in Turkey. According to 2018 firearms registration statistics, the licensed firearms number was 2.640.450 in Turkey. The seventy percentage of 2.640.450 licensed firearms are the shotguns (TNP, 2018). And the most common calibre handguns

(mentioned in Table 12) in Turkey is the twenty-nine point five percentage of the licensed firearms. Furthermore, in the organized crime incidents, the 7,62×39mm calibre assault rifles AK47 with the M43 type ammunition are also used commonly in Turkey.

Table-12. The Most Common Calibre Handguns in Turkey

Calibres	Percentages of calibres in the licensed firearms	Calibres	Percentages of calibres in the licensed firearms
.22 LR	0,06%	.357 Magnum	0,46%
6,35×15,5mm	0,27%	.357 Sig	0,017%
7,65×17mm	7,1%	.40 Calibre S&W	0,07%
9×17mm	0,05%	.44 Rem. Magnum	0,011%
9×19mm	19,2%	.45 Calibre Colt	1,62%
.38 Calibre Special	0,67%	Total Percentage	29,5%

Besides the widening spectrum of threats, another challenge that the current international and national ballistic resistant material standards face is that the test methods does not fully comply with the real-life attacks and threat conditions. For example, the test distance of rifle threat test is among 10 meters, 15 meters and 30 meters in different national and international standards. However, it is experienced that the rifle assaults occur in between 5 to 10 meters in the urban warfare conditions. Even though the advised shooting range of RPG is between 100 meters to 300 meters, it was reported that the RPG attacks occurred less than 50 meters range in urban warfare conditions.

The law enforcement officers face with the “contact shot”, “close impact shot” and “armour-edge shot” threats in public order duties. The contact shoot test method is only covered by VPAM Standards but none of the international and national ballistic protective material standards cover the “close impact shot” and “armour-edge shoot” threat. These threats are

the main differences between classic military operations and urban warfare or public order duties.

3. THE NATIONAL BALLISTIC TEST CENTRES

The independent national ballistic test centre, internationally accredited according to the EN ISO / IEC 17025: 2017 General requirements for the competence of testing and calibration laboratories, will increase the efficiency of the research and development process of firearms, ammunition and ballistic protective materials as well as provide a certification for these products.

In addition to the above-mentioned issues, the national ballistic test centre will have a critical role in the preparation of national ballistic protective material standards, in particular validating and implementing the test methods within the framework of national and regional ballistic threats. The ballistic test centre facility should be capable of performing the tests of body armour, armoured vehicles, ballistic resistant equipment, firearm, and ammunition up to minimum 14,5×114mm calibre, with the original gunpowder load.

CONCLUSION

The changing nature of regional conflicts has also led to changes in the threats that the security forces (army and law enforcement agencies) face. The effectiveness of the existing ballistic resistant material standards that are unable to adapt to changes in threats has begun to be questioned. Turkey and its neighbouring countries host a wide spectrum of threats. During the counter-terrorism operations carried out by security forces both at home and abroad, the risk of a wide spectrum of threats situation has been accepted in the field.

In particular, due to the conflicts and civil wars in Syrian and Iraq, weapons and munition warehouses of these countries' armies were plundered by local gangs, PKK/YPG, and ISIS terrorist organizations. This

new reality has caused Turkey to face with extensive usage of NATO and former Warsaw Pact weapons during its fight against terrorism against Turkish security forces. Unlike other countries, preparing the ballistic resistant material standards separately for the law enforcement agencies and the army in Turkey is too difficult, because of the fact that both of the security forces face with the same ballistic threats inside and outside of the country; in the other words there is not a difference in the ballistic threats between the law enforcement and the army in the urban warfare conditions. Additionally, organized crime organizations can provide and use the military weapons, especially the 7,62×39mm calibre (with M43 type bullet) AK47 assault rifle, in the urban area against the law enforcement officers.

In these ballistic threat circumstances, the efficient ballistic protection levels and test methods that comply with real conflict conditions should be determined in the ballistic body armour standard and ballistic resistant material/vehicle standards. During the determination of the threat levels, the calibre distribution of licensed firearms and seized firearms, and conflict wound (number of gunshot wounds, the location of the wound, wound cavity etc.) information and statistics should be taken into consideration.

According to firearms statistics, some of the calibres in the threats do not seem realistic. For example, the ratio of .44 Magnum calibre cartridge and handgun is generally low in the community (Table-12), but this calibre is always determined as a threat level in west countries' ballistic body armour standards. It is because the protection level is designed for measuring two different protection mechanism, the first bullet penetration resistance and the second backface signature* (deformation) in the ballistic body armour standards. The 9mm FMJ Parabellum and 357 Sig bullets are for determining the performance of armour against penetration and .44 Rem. Magnum and .357 Magnum bullets are for measuring the backface signature protection performance of armour.

Ballistic protective standards must have a flexible structure in order to provide protection against the ballistic threats of the real conflict conditions

and to be effective for the new threats. The 3rd edition of the STANAG 2920 Standard, developed by NATO in accordance with this requirement, is a good example of the flexible ballistic protective material standards. In the present case, the threat/protection level determination methodology of the 3rd edition of the STANAG 2920 Standard will also be the right choice for Turkey's National Ballistic Resistant Material Standard; only the structural characteristics of the projectile, such as mass, diameter, bullet core hardness, and material specifications should be determined in the threat/protection level.

With respect to V_{50} or V_{100} tests request, the minimum impact velocity, and kinetic energy should be determined by the national ballistic test centre, but according to threat risks, the tender institution may increase the bullet impact velocity. According to the ballistic threats of the Turkish army and Law Enforcement Agencies, at least the threats that are mentioned in Table-13 should be take part in the Turkish National Ballistics Resistant Material Standard.

Table-13. The Draft Ballistic Threats of Turkish National Ballistics Resistant Material Standard

Handgun	Rifle	
22 Long Rifle	5,56×45mm SS109	7,62×54mm R B32 API
9×18mm 7N21	7,62×39mm 57N231	7,62×51mm Tungsten Carbide AP
9×19mm	7,62×51mm M80	7,62×63mm AP (.30-06 M2)
9×21mm 7N28	7,62×54mm R 7N13	12,7×99mm AP
.357 Magnum.	7,62×39mm BZ API	14,5×114mm API
44 Rem. Magnum	7,62×51mm M61 AP	12/70 Gauge Brenneke Slug

The three critical test method should be added to the standard for law enforcement agencies' body armours: the first is "Contact Shot", the second "Armour-Edge Impact Shot" and the third is "Close Impact Shot".

a. Contact Shot: In the contact shot test, the muzzle of the firearm or test barrel full contact to body armour surface, and at least three shots will

be performed in the right angle. In the contact shot test, check for the only perforation while the backface signature will not be measured. The similar test method is mentioned in the VPAM BSW 2006 Ballistic Protective Vest Standard. Because of the fact that the contact shot treat is very common in the public order duties for law enforcement officers, this test method is critical.

b. Armour-Edge Impact Shot: In the existing ballistic protective vest standards, the test impact point must be at least 76mm from the edge of the ballistic protective package to be considered valid. However, under the real conditions of armed conflict, the bullet is likely to hit closer than 76mm to the edge of the ballistic protective package. Therefore, the armour-edge impact test should be defined in the ballistic protective vest standards. In the armour-edge impact test, the impact point must be 30 ± 5 mm from the edge of the ballistic package and these shots should be repeated on seven different sides of the vest. In this test procedure, the Backface Signature will not be measured, only the perforation will be checked.

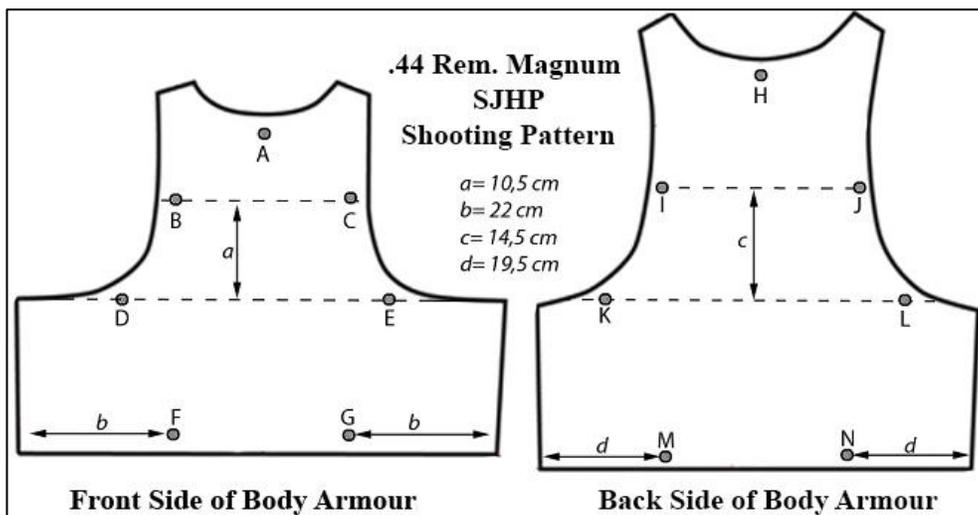


Figure-1. The Sample of the Armour-Edge Impact Shot Pattern

c. Close Impact Shot: In the case of armed conflicted at the close range, it is possible that the hits occur at very close points in successive shots carried out by attackers who have received good shot training. This situation is frequently experienced in urban warfare and public order duties. In the current ballistic body armour standards, the distance between the two shots should be at least 51mm in order to consider the test valid. If the distance is closer than 51mm, the test shot is considered invalid. This test procedure doesn't comply with real combat conditions.

Therefore, the "close impact shot" threat and test procedure must be defined in the ballistic protective vest standard to be prepared. In the close impact shot test, 3 shots should be made in a triangle pattern and the distance between the impacts should be 40 ± 5 mm. In these tests, the Backface Signature should not be measured and only the vest should be checked for perforation.

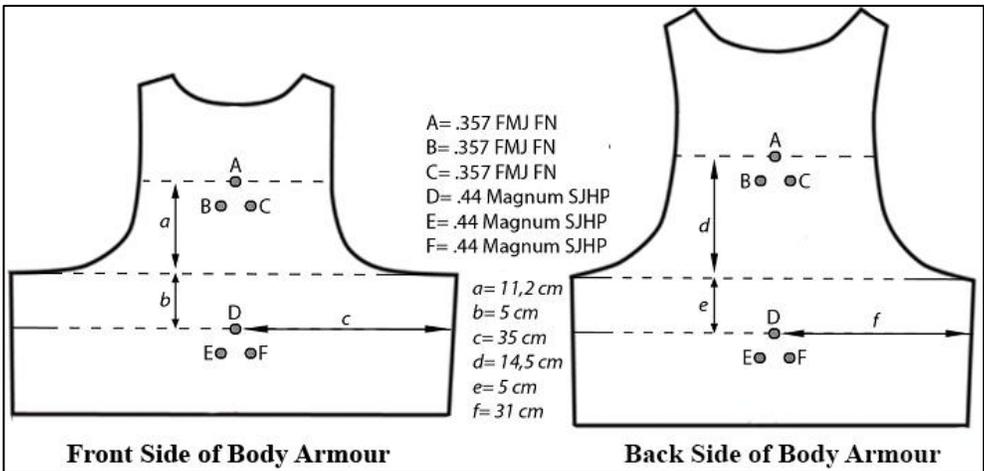


Figure-2. The Sample of the Close Impact Shot Pattern

Another important issue is the Conditioning Protocol of body armours. Because of the storage and usage conditions in the duties, the ballistic protection performance of body armours may be changed. In order

to ensure the protection in all conditions, the Conditioning Protocols are applied to the body armours. According to climate conditions of the country and using conditions, the conditioning procedures may be different. The most reliable conditioning protocols have to be defined in the standard.

Without having an independent national ballistic test centre, the reliable and effective national ballistic resistant equipment standard preparation will not be successful. The independence of the ballistic test centre is as important as technical competence. The term “independence” means that the ballistic test centre should not have direct or indirect organisational links with the manufacturers and a firm or union that dealing with export or import of arms, ammunition, and ballistic protective equipment. For this reason, the ballistic test centres are generally established within the governmental organization chart. Thanks to this organizational model, the ballistic test centre will be a national contact point of the international ballistic test centre and other countries’ ballistic test centres. Furthermore, the ballistic test centre will be a national certification centre and a national contact point for the international ballistic test centre and other countries’ ballistic test centres through this organization model.

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