

# International hard ballistic standards

## Vehicle armor

### NIJ Standard 0108.01

Armor Type	Test Ammunition	Nominal Bullet Mass	Suggested Barrel Length	Shot Distance	Required Bullet Velocity	Number of Test Specimen	Test Specimen Size	Required Hits per Armor Specimen	Permitted Penetrations
I	.22 LRHV Lead	2.6 g 40 gr	15 to 16.5 cm 6 to 6.5 in	5 m	320 ± 12 m/s 1050 ± 40 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
	.38 Special FN Lead	10.2 g 158 gr	15 to 16.5 cm 6 to 6.5 in	5 m	259 ± 15 m/s 850 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
II-A	.357 Magnum JSP	10.2 g 158 gr	10 to 12 cm 4 to 4.75 in	5 m	381 ± 15 m/s 1250 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
	9mm FMJ	8.0 g 124 gr	10 to 12 cm 4 to 4.75 in	5 m	332 ± 12 m/s 1090 ± 40 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
II	.357 Magnum JSP	10.2 g 158 gr	15 to 16.5 cm 6 to 6.5 in	5 m	425 ± 15 m/s 1395 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
	9mm FMJ	8.0 g 124 gr	10 to 12 cm 4 to 4.75 in	5 m	358 ± 12 m/s 1175 ± 40 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
III-A	.44 Magnum Lead SWC Gas Checked	15.55 g 240 gr	24 to 26 cm 9.5 to 10.25 inch	5 m	426 ± 15 m/s 1400 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
	9mm FMJ	8.0 g 124 gr	50 cm 20 in	5 m	338 ± 15 m/s 1090 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
III	7.62mm 308 Winchester FMJ	9.7 g 150 gr	56 cm 22 in	15 m	838 ± 15 m/s 2750 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
	.30-06 AP	10.8 g 166 gr	56 cm 22 in	15 m	868 ± 15 m/s 2800 ± 50 ft/s	1	min. 30.5x30.5 cm <sup>2</sup> min. 12x12 sq in	5	0
Special Requirement*									

**Particularities:**  
\* These items must be specified by the user. All of the items must be specified.

- Test relevant parameters:**
- Angle of incidence: no greater than 5°
  - Impact at least 5 cm (2 in) from a previous hit or the edge of the test specimen.
  - Condition the test specimen at a temperature of 20 to 28°C (68 to 82°F) for at least 24 h prior to test.



### RUSSIA - GOST R 50744-95

Class	Type of Weapon	Calibre (mm)	Ammunition Type	Mass [g]	Shot Distance [m]	Bullet Velocity [1] [m/s]	Max. BFD [mm]
<b>Special class</b>							
S	Knife	-	-	-	-	49 ± 1 Joule	-
S1	Hunting Rifle	18.5	Leadcore	34.0 ± 1.0	5 ± 0.5	400 ± 10	17
S2	FSP	-	Steel Sphere Ø 6.35 mm	1.05	-	V 50(N2)	-
<b>Main class</b>							
BR1	9mm APS	9x19	Fe Core, 57N1815	5.9	5 ± 0.1	335 ± 10	17
BR2	SR-1 Vector	9x21	Lead Core, 7N28	7.93	5 ± 0.1	390 ± 10	17
BR3	Jargini Pla	9x19	Hardened Fe Core, 7N21	5.2	5 ± 0.1	455 ± 10	17
BR4	AK04	7.62x39	Hardened Fe Core, 7N10	3.5	10 ± 0.1	895 ± 15	-
	AKM	7.62x39	Mild Steel Core, 57N231	7.9	10 ± 0.1	720 ± 15	-
BR5	Dragunov SVD	7.62x54	Hardened Fe Core (PP), 7N13	9.4	10 ± 0.1	830 ± 15	-
	Dragunov SVD	7.62x54	Armor Piercing (AP), 7B23	7.9	10 ± 0.1	810 ± 15	-
BR6	DSW-96	12.7x108	Armor Piercing (AP), 57B2342	48.2	50 ± 0.5	830 ± 20	-

**Particularities:**  
(1) Bullet velocities measured 3 ± 0.1 m behind the muzzle. Fragment velocities measured 0.75 m in front of the target.  
(2) Exact procedure and Steelball described in GOST 3722.

### VPAM - APR 2006

Test Level	For comparison		Weapon (example)	Cartridge	Calibre	Ammunition and Projectile				Number of Test Specimen	Test Specimen Size	Minimum number of shots		
	DIN EN 1063 (BR)	DIN EN 1522/23 (FB)				Type	Mass [g]	Manufacturer Type	Shot Distance [m]			Bullet Velocity [m/s]	Triangle Shooting (1)	Multihit Test (2) (optional)
PM 1	BR 1	FB 1	[Image of Rifle]	22 Long Rifle	L / RN	2.6 ± 0.1	Winchester	10 ± 0.5	360 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 2			[Image of Pistol]	9mm Luger (F)	FMJ / RN / SC	8.0 ± 0.1	DAG, DM41	5 ± 0.5	360 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 3			[Image of Rifle]	9mm Luger (F)	FMJ / RN / SC	8.0 ± 0.1	DAG, DM41	5 ± 0.5	415 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 4 (*)			[Image of Rifle]	.357 Magnum	FMJ / CB / SC	10.2 ± 0.1	Geo	5 ± 0.5	430 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 5			[Image of Rifle]	.44 Rem. Mag.	FMJ (copper) / FN / SC	15.6 ± 0.1	Speer	5 ± 0.5	440 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 6			[Image of Rifle]	7.62 x 39	FMJ / PB / FeC	8.0 ± 0.1	PS cold hardened	10 ± 0.5	720 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 7 (*)			[Image of Rifle]	223 Rem. (F)	FMJ / PB / SCP	4.0 ± 0.1	MEN, S5109	10 ± 0.5	950 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 8			[Image of Rifle]	.308 Win.	FMJ / PB / SC	9.55 ± 0.1	MEN, DM111	10 ± 0.5	830 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 9			[Image of Rifle]	7.62 x 39	FMJ / PB / HCl	7.7 ± 0.1	core 4.1 hardness 65 HRC	10 ± 0.5	740 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 10			[Image of Rifle]	.308 Win. (*)	FMJ / PB / HCl	9.7 ± 0.2	core 4.0-0.2 hardness 62 ± 2 HRC	10 ± 0.5	820 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 11			[Image of Rifle]	7.62 x 54 R	FMJ / PB / HCl	10.4 ± 0.1	core 5.3 hardness 63 HRC	10 ± 0.5	860 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 12			[Image of Rifle]	.308 Win. (*)	FMJ / PB / WC	8.4 ± 0.1	core 5.9	10 ± 0.5	930 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 13			[Image of Rifle]	.308 Win. (*)	FMJ / PB / WC	12.7 ± 0.1	core 5.58 hardness 130HV 10	10 ± 0.5	810 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
PM 14			[Image of Rifle]	.50 Browning	FMJ / PB / HCl	43.5 ± 0.5	core 35.0 hardness 55 ± 2 HRC	10 ± 0.5	930 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16
			[Image of Rifle]	14.5 x 114 (*)	FMJ / PB / HCl	63.4 ± 0.5	B 32	10 ± 0.5	911 ± 10	3	500 x 500 mm <sup>2</sup>	3 (*)	3 (*)	16

**Particularities:**

- On a test specimen 3 shots have to be fired with a hit distance of 120 mm to each other. Any single impact must not be closer to the inside of the clamping frame than 75 mm. At the test of inhomogeneous specimen as ceramic panels the hit triangle may be enlarged to hit three single plates in their centres.
- On the test specimen 3 impacts are defined which have a distance to each other of 3 times the diameter of the calibre (tolerance + 5 mm). The border of the multihit impact group must have a minimum distance of 120 mm to any impact of the triangle shooting. Any single impact must not be closer to the inside of the clamping frame than 75 mm.
- The calculation of the ballistic limit value V50 has to be carried out according to the method VPAM KNB paragraph 6.4.3 of the VPAM - APR 2006.
- For inhomogeneous test specimen (e.g. ceramic panels) the multihit test is only carried out for information purposes.
- For inhomogeneous test specimen (e.g. ceramic panels) the V50 ballistic limit test is only carried out for information purposes.
- For inhomogeneous test specimen furthermore 3 gaps as shown in attachment 2, fig. 4.1 and 4.2 of VPAM - PM 2007, are tested. The test centre defines the high risk areas of other inhomogeneous test specimen.
- Test barrel with a transition of 7.5 mm.
- In these steps both calibres are to use.
- Twist rates 178 mm ± 5%.
- Twist rates 254 mm ± 5%.
- Arbitrary shot distance. Appropriate hits have to be ensured in terms of velocity, oscillation and impact point.
- Twist rates arbitrary.

**Test relevant parameters:**

Ambient temperature: +20 ± 3 °C.  
Relative humidity: 65 ± 10 %.  
Test specimen temperature: +20 ± 3 °C.  
Angle of impact: 90° (°NATO) and, if indicated, other angles defined in the product specific guidelines.

## Military armor

### NATO STANAG 4569 and AEP-55 Vol. 1 (Ed. 1)

Level	Ammunitions	KE Threat				Artillery Threat (FSP 20mm)															
		Accepted Test Projectiles		Attack Angle 1)		Minimum number of shots 2)		Attack Angle 1)		Minimum number of shots 2)											
		Name	Weight [g]	vproof (m/s)	Azimuth	Elevation	Phase 2: Main Area Ballistic Evaluation(3)	Phase 3: Structural Weak Area Evaluation(4)	vproof (m/s)	Azimuth	Elevation	Phase 2: Main Area Ballistic Evaluation(3)	Phase 3: Structural Weak Area Evaluation(4)								
5	25mm x 137 APDS-T	PMB 073 Overkon-Contraves	121.5 (150 with sabot)	1258 ± 20	± 30°	0°	12 (4) S1 (multi-hit tests) (6)	3 (single hit tests)	960 ± 20	0° - 360°	0° - 90° (8)	5 (single hit tests)	3 (single hit tests)								
4	14.5mm x 114 API/ B32	Russian 14mm API / B32 Barraclough SP157 82-5815 Chinese 14.5mm Type 56 US Army Research Lab. surrogate	64	911 ± 20	0° - 360°	0°	12 (6) S1 (multi-hit tests) (6)	5 (single hit tests)	960 ± 20	0° - 360°	0° - 90° (8)	5 (single hit tests)	3 (single hit tests)								
3	7.62mm x 51 AP (WC core)	Nammo APB Bulvar Carl Gustav FV AP M993 (US designation)	8.4	930 ± 20	0° - 360°	0° - 30°	22 (10) S1 (multi-hit tests) (6)	10 (single hit tests)	(770 ± 20) (7)	0° - 360°	0° - 30°	5 (single hit tests)	3 (single hit tests)								
2	7.62mm x 39 API BZ	Russian 7.62mm x 39 API BZ Chinese 7.62mm x 39 Type 56	7.77	695 ± 20	0° - 360°	0° - 30°	22 (10) S1 (multi-hit tests) (6)	10 (single hit tests)	(630 ± 20) (7)	0° - 360°	0° - 22°	5 (single hit tests)	3 (single hit tests)								
1	7.62mm x 51 NATO Ball	M80 (US designation) C21 (Canadian designation) DM41 (German designation)	9.65	833 ± 20	0° - 360°	0° - 30°	22 (10) S1 (multi-hit tests) (6)	10 (single hit tests)	(520 ± 20) (7)	0° - 360°	0° - 18°	5 (single hit tests)	3 (single hit tests)								
	5.56mm x45 NATO SS 109	SS 109 (Original design) M855 (US designation) DM11 (German designation)	4	900 ± 20			22 (10) S1 (multi-hit tests) (6)	10 (single hit tests)													
	5.56mm x45 M193	M193 (Original design)	3.56	937 ± 20																	

**Particularities:**

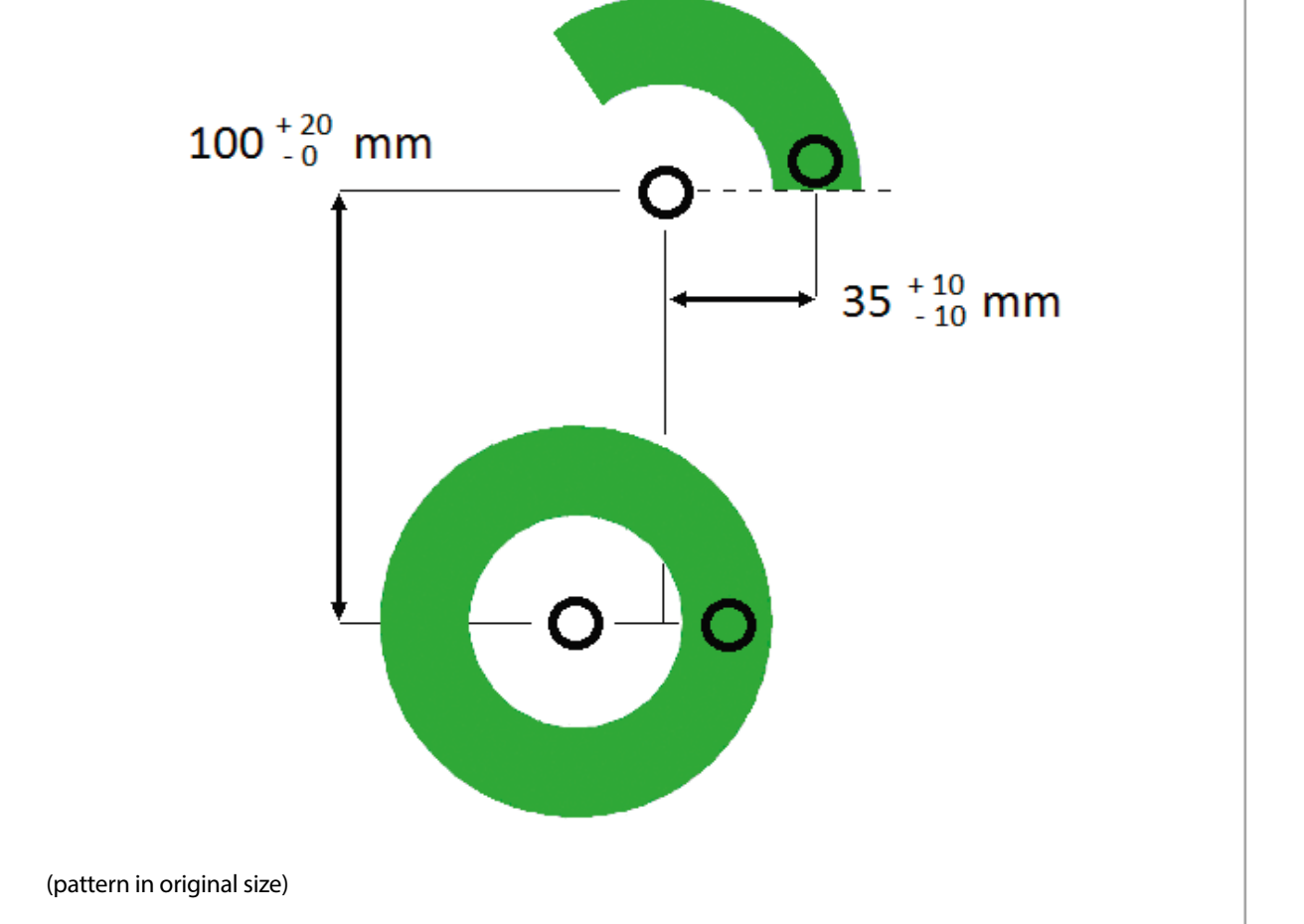
- Ballistic testing shall be conducted at the most severe impact condition allowable. Computation of this angle shall take into account the projectile attack angle in azimuth and elevation as well as the inclination of the armor panel on the vehicle.
- Minimum number of rounds for each projectile type and armor configuration that shall be used to assess the KE and FSP ballistic protection levels 1-5.
- All assessments shall be made using either fully engineered targets or vehicle targets to determine the ballistic resistance of the main surfaces of the armor panels.
- Vehicle targets are the best target samples for SWA evaluation. Fully engineered targets may be used as long as the SWA are constructed in the exact same manner as for the actual vehicle.
- Could be reduced to 10 shots for level 1 to 3, 6 shots for level 4 and 4 shots for level 5, if the back surface damage is judged by National Authority to give full confidence that further rounds will produce no CR.
- The multi-hit parameters for levels 1, 2 and 5 are defined in table B1, and illustrated in figure B1, for level 4 in table B3 and for level 3 in table B4 and figure B4 of AEP-55, Annex B.
- Any vehicle successfully assessed using the alternative requirements specified shall be classified as compliant with STANAG 4569 KE Level X (PARTIAL).
- No testing against Level 1 - 3 fragment threats is required by STANAG 4569, but is optional to the National Authority.
- It is mandatory to test at a 300 attack angle. Testing between attack angles of 300 and 900 is optional to the National Authority.

**Target Conditioning:**

- Prior to ballistic testing, each target should be pre-conditioned to a temperature of 20 ± 5°C and a relative humidity specified by the National Authority for at least 12 hours.
- The targets should be reconditioned once their temperature is no longer within the tolerance band of a 5°C.
- The National Authority may require testing under extreme environmental conditions. In this case, the requirement should take into account the climatic zones defined in STANAG 2895.
- The precise requirements shall be defined in a specification or technical description.



### STANAG 4569 L1 - L3 Multi-hit pattern



## Personal armor

### NIJ 0101.04 Level III in conjunction with III-A softpanel

Material	Endumax XF23
Weight app.	15.5 kg/sqm
Shots per insert	6x 7.62x51 Nato Ball

### NIJ 0101.04 Level III + in conjunction with III-A softpanel

Material	Endumax XF23 with AL203 ceramic strielface
Weight app.	25 kg/sqm
Shots per insert	6x 7.62x51 Nato Ball
or	6x 7.62x39 Mild Steel Core
or	6x 5.56x45 M193
or	6x 5.6x45 M855

### NIJ 0101.04 Level IV in conjunction with III-A softpanel

Material	Endumax XF23 with AL203 ceramic strielface
Weight app.	35 kg/sqm