



Ypenburgse Boslaan 2
 PO Box 480
 2501 CL The Hague

www.tno.nl

T +31 88 866 8000
 KKW@tno.nl

Laboratory for Ballistics
 Research (LBR)

Visiting address:
 Ypenburgse Boslaan 2
 2496 ZA The Hague

TNO project no

060.51781/01.15.01

Date

12-10-2022

Reference

22OD256

Customer reference

22106

Contact

J. Jansen

E-mail

jessica.jansen@tno.nl

Direct phone no

+31611508310

Author report

Test report

22REP00334

Standard **NIJ 0101.06**
 Class **IV**
 Assignor Top Protections B.V.
 Manuscriptstraat 1
 1321NP Almere
 Netherlands
 Contact Mr. O Liang

Sample results

Experiment	Passed	Customer sample reference
22MB03178	✓	Body armour plate

The Standard Conditions for Research Instructions given to TNO, as filed at the Registry of the District Court and the Chamber of Commerce in The Hague shall apply to all instructions given to TNO.

Project manager

J. Jansen

Test report number 22REP00334
Assignor Top Protections B.V.

Definitions

Angle of Impact [°]:

The angle between the projectile trajectory and the perpendicular to the plane tangent at the point of impact on the target. The angle of incidence and target obliquity may be used with the same meaning.

Areal density [kg/m²]:

The mass of an armour component or material per unit area.

Ballistic Test Method:

A method used to assess, in a scientific manner, the resistance to complete penetration provided by a material against a ballistic threat.

Barrel twist:

The rate of spin inside a rifle barrel given in turns per mm.

Class:

The ballistic threat characterized by its material composition, shape, and size.

Complete Penetration (CP):

The perforation of a target, by a projectile being used to test it.

Delamination:

The separation of a panel into layers in the thickness direction.

Experiment:

A number of shots to complete a level in a standard.

Fair Impact:

An impact that meets the specified conditions of velocity, angle of impact, yaw, and position within the tolerances defined for each condition.

Fragment Simulating Projectile (FSP):

A projectile of a specific material, shape, and size for ballistic test firings so that the effect of typical munition fragments can be simulated.

Impact Velocity [m/s]:

The velocity of a projectile at the instant of impact.

In conjunction (hard armour):

A hard armour (plate) to be used and tested in front and parallel with a soft armour component.

MB number:

Unique TNO code for an experiment.

NATO angle [°]:

Complementary angle of the obliquity angle. Thus, a projectile fired perpendicular to the armour surface has 0° NATO obliquity.

Partial Penetration:

The incomplete or non-perforation of a material by the projectile being used to test it.

Target obliquity:

A measure, normally in degrees, of the extent to which the impact of a projectile on an armour material deviates from a line perpendicular to the target. Thus, a projectile fired perpendicular to the armour surface has 90° obliquity (or 0° NATO).

Obliquity Angle [°]:

Angle between the normal to the target surface and the projectile trajectory or line-of-flight.

RH [%]:

Relative Humidity, is a measure of the water vapor content of air.

SA number:

Unique TNO code for a given sample.

SC number:

Unique TNO code for a sample composition. E.G. a hard armour plate in combination with a soft armour vest.

Spall:

The material detached and ejected from a layer of armour material from the rear surface of the armour. Spall can be produced by a completely penetrating or partial penetrating impact of a projectile on armour.

Stand-alone (hard armour):

Hard armour to be used without a soft armour component.

Strike face:

The surface of a test target designed to face the attack of a ballistic threat.

Target:

Material sample, component, personal armour item, or a combination of soft armour and hard armour being tested. Unless specified otherwise, a target shall include all features (trauma liner or other designs) meant to mitigate the effects of ballistic impacts.

Target Distance [m]:

The distance between the muzzle of the test launcher barrel and the strike face of the target.

Unfair Impact :

An impact that does not meet the specified conditions of velocity, angle of impact, yaw, and position within the tolerances defined for each condition.

V50 [m/s]:

The velocity at which the probability of complete penetration of the target material with a given projectile equals to 0.5.

Vproof [m/s]:

The velocity at which the probability of partial penetration exceeds a minimum value for the given projectile and target at the required confidence level.

Witness Sheet:

Material located behind and parallel to the target which is used to detect perforating projectiles or spall.

Yaw [°]:

Projectile yaw is the angular deviation of the longitudinal axis of the projectile from the line of flight.

Yaw Angle [°]:

The maximum resultant angle between the main axis of the projectile and its trajectory (velocity vector) irrespective of plane at the moment of impact.

Test report number 22REP00334
Assignor Top Protections B.V.

1. Summary

The sample has been tested according to 'NIJ 0101.06 ' level 'IV'

The impact partially penetrated the sample and the measured clay indent depth was within the prescribed range.

For full certification, more samples are prescribed for testing in NIJ 0101.06.

2. Description test method

Establishing the ballistic protection capacity of bulletproof materials according to the requirements specified in the NIJ standard 0101.06. To this end, the bulletproof sample was attached to a plastilina block and tested to determine to what extent the requirements concerning the ballistic protection and the indentation in the plastilina (so called trauma) are met. The depth of the indentation in the plastilina is then determined.

3. Experiment details

Experiment No.	: 22MB03178
Experiment date	: 22-09-2022
Standard / class	: NIJ 0101.06 / IV
Backing	: Roma no. 1 clay
Experimental facility	: TNO, LBR, Small Calibre Firing Range KKW 1
- Ambient temperature before test	: 19.3 °C
- Ambient temperature after test	: 19.3 °C
- Ambient Relative Humidity before test	: 48% RH
- Ambient Relative Humidity after test	: 49% RH
Weapon	: UZ 2002L (KKW1)
- Barrel length	: 650 mm
- Barrel twist	: 1:254 mm
- Cartridge case	: 7.62x63 mm
Projectile	: .30 AP M2
- Weight	: 10.65 g
- Calibre	: 7.62 mm
- Manufacturer	: Lake City Army Ammunition Plant
Shooting distance	: 10 m
Target obliquity	: 0° NATO

Test report number 22REP00334
Assignor Top Protections B.V.

4. Sample details

TNO sample no.	Customer sample reference	Arrival	Size (mm)	Avg. thick. (mm)	Weight (g)	Areal density (kg/m ²)
22SA03573	Body armour plate	08-09-2022	305 x 250	25.5	2831	37
#) Body armour plate Alumina+PE icw vest front						

Size, average thickness, weight, and areal density values are indicative.

#) All specifications of the materials are provided by the assignor.

TNO sample composition no.	Layer	TNO sample no.	Conditioning temperature (°C)	Conditioning humidity (% RH)	Minimum conditioning time (hrs)
22SC03477	1	22SA03573	21 ± 3	50 ± 20	24

Test report number 22REP00334
Assignor Top Protections B.V.

5. Results

22SC03477		NIJ 0101.06 - IV - .30 AP M2		
Shot	Valid	Impact velocity (m/s)	Indent depth (mm)	Result PP/CP *
KKW1 22SN05555	Yes	890	23.0	PP in plate

*) PP : Partial Penetration CP : Complete Penetration

Test report number 22REP00334
Assignor Top Protections B.V.

6. Pictures



Strike Face, sample 22SA03573 after test 22MB03178



Back Face, sample 22SA03573 after test 22MB03178