Ballistics ▪ Stab ▪ Impact

Test Equipment Catalogue

May 2023

Biokinetics

Contents

NOTE: All specifications are subject to change.

Overview

The following catalogue outlines some of Biokinetics' custom test fixtures and tools for facilitating testing to military and law enforcement armour standards established by various organizations for assessing ballistics performance of protective systems. Typical applications and associated organizations and performance standards are listed below.

Testing Applications

• Body armour	• Vehicle armour	• Combat/tactical helmets
• Transparent armour	• Tactical shields	• Structural/architectural materials
• Wound ballistics	• Forensics	• Ballistic resistant blankets

Organizations

Law Enforcement:	**Military:**	**Standards Bodies:**
• NIJ	• US DOD	• ASTM
• HOSDB	• MIL	• CSA
• RCMP	• NATO	• UL
• FBI	• STANAG	

Performance Test Standards

• NIJ 0101	Ballistics Resistance of Body Armour	• AEP-55 Vol. 1	Light Armoured Vehicles
• NIJ 0106	Standard for Ballistics Helmets	• MIL-STD-662F	V50 Ballistics Test for Armour
• NIJ 0108	Ballistics Resistant Materials	• AEP-2920	Ballistics Test Methods for Personal Armour Materials and Combat Clothing
• NIJ 0115	Stab Resistance of Personal Body Armour	• MIL-STD-662F	V50 Ballistics Test for Armour
• HOSDB Publication No. 39/07/C	Body Armour Standards for UK Police (2007) Part 3: Knife and Spike Resistance	• UL 752	Bullet Resisting Equipment

Ballistics Testing Equipment

The activities related to ballistics testing and evaluation are commonly expressed as **Internal Ballistics** (study of propelling the projectile internal to the weapon), **External Ballistics** (study of projectile flight from muzzle to target), and; **Terminal Ballistics** (study of the projectile with the target including armour and wounding effects). The ballistics testing equipment presented in this catalogue relate to these areas of focus and is complemented by additional tools to address sample preparation and data analysis.

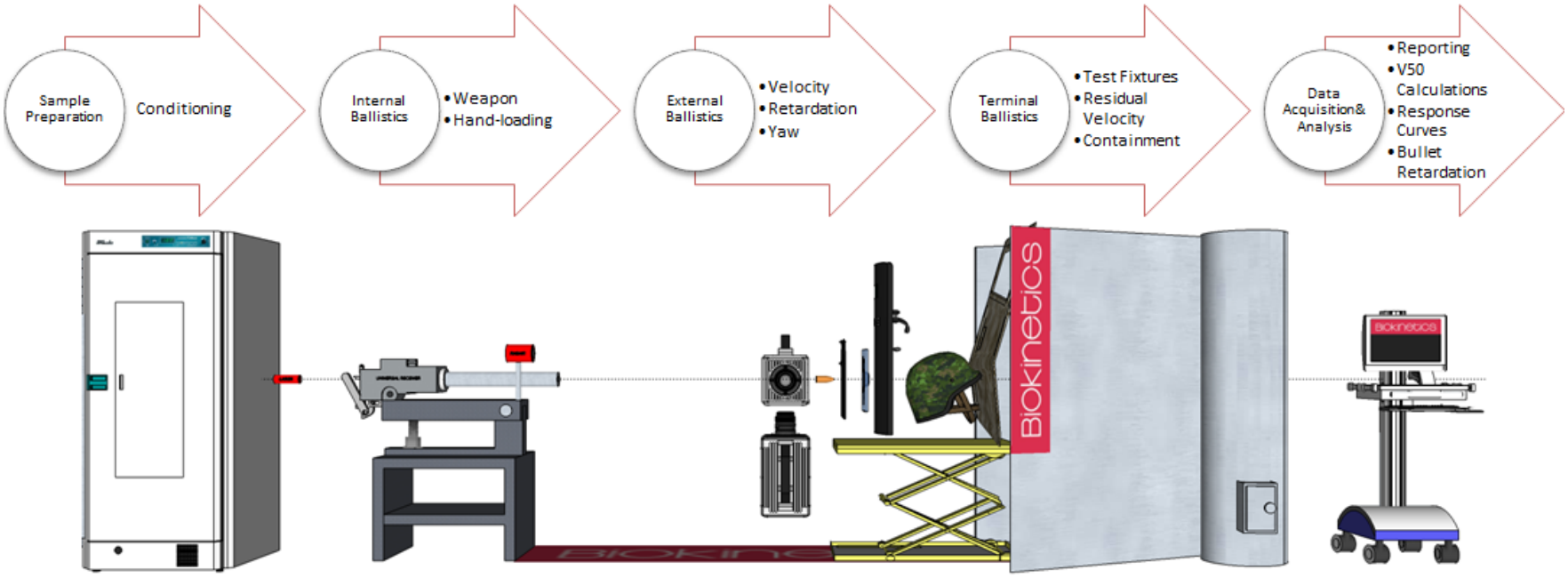
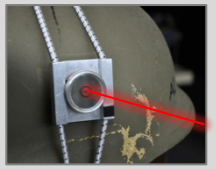
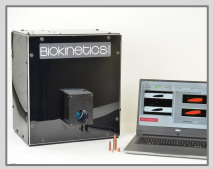
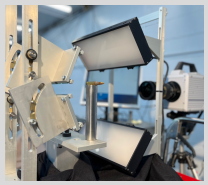
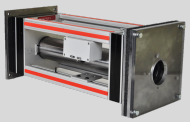


Figure 1: A typical ballistics test range with capability areas indicated. **(Equipment shown is for illustrative purposes only)**

Targeting and Measurement

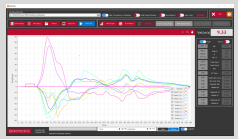
Ballistics testing requires repeatable and reproducible projectile strikes in terms of impact location, obliquity, speed and yaw. Biokinetics has developed custom tools, measurement sensors and analysis software to meet the exacting requirements of today's ballistic performance standards and research needs. Emphasis is placed on their ease of use, accuracy and traceability where applicable.

	Item	Description	Overview	Specifications	Standards
TARGETING AND MEASUREMENT	BLT	Ballistics Laser Targeting System 	The through-bore sighted laser provides accurate targeting of the bullet and works with the obliquity mirror to ensure that the angle of incidence remains within specifications. The line-of-fire established by the in-bore laser is also used as a reference for assessment of the projectile yaw with Biokinetics' YawBox™.	• Stand-alone support placed behind the universal receiver • Through bore laser beam with multi-axis micro-adjust alignment system for precise targeting	NIJ 0101.06, HOSDB 39-07 B, AEP-2920, MIL-STD-662F, NIJ 0106.00
	BOM	Ballistics Obliquity Mirror 	Ballistics impacts onto curved surfaces of combat helmets or hard armour torso plates must be perpendicular to the surface to prevent projectile upset and varying interactions with the armour system. Biokinetics provides a quick means to attach and visually assess the obliquity when paired with the laser targeting system.	• Reflecting mirror with quick attachment system • Compatible with flat and curved surfaces • Obliquity accuracy < 0.5°	NIJ 0101.06 NIJ 0106.01 NIJ 0108.01 MIK-STD-662F
	BYS	YawBox™ 	The YawBox™ is a ballistics yaw sensor that provides an easy to use device to capture images of a projectile in flight and instantly determine the yaw angle and shot location, all relative to the line-of-fire. The machine vision camera, strobe LED lighting, self-contained trigger system and custom software are fully integrated for ease of use. The system is certified to traceable standards.	• Yaw angle accuracy of ± 0.5° • Fragments: FSP, RCC 2-64 grain • Bullets: < 50 caliber • 150-1500 m/s (1000-5000 ft/s)	NIJ 1010.06, MIL-STD-662F ASTM E3062
	BYV	Yaw-HSV™ Pro 	Yaw measurement of bullets and fragments captured on high-speed video or still images can be easily determined with the Yaw-HSV Pro software. Features include calibration of the field of view, removal of background images, dust and speckle handling and filtering for optimization of the projectile image. Two orthogonal views are required along with optional calibration grids. Yaw is measured relative to the true bullet trajectory or camera reference frame. Velocity is also calculated when using video images.	• Yaw angle accuracy typically better than ± 0.5° but depends on bullet image size, resolution, quality and field of view. • Better than 30 seconds to calculate yaw from image loading to analysis. • No bullet templates needed.	NIJ 1010.06, MIL-STD-662F ASTM 3062

	Item	Description	Overview	Specifications	Standards
		OpenBox™ 	Mirror system to collect orthogonal ballistic projectile and fragment images with a single video or still camera. The mirrors are adjustable for different camera configurations and are easily replaced in case of spall damage. Yaw angle calculation, projectile speed, mirror setup, image corrections and system verification is provided with Biokinetics' Yaw-HSV™ Pro software. Reference jigs and surrogate projectile provide precise alignment and system verification. Integrated high-intensity LED backlight system results in even backlighting of the projectile for good image accuracy.	• Adjustable frame with two mirrors and high-intensity LED backlights. • Can be placed adjacent to strike surface. • Fragments: FSP, RCC from 2 to 64 grain. Bullets: ≤ 50 caliber. • Yaw-HSV™ Pro software required for setup and yaw analysis.	NIJ 1010.06, MIL-STD-662F ASTM E3062
	BST	SpeedTube™ 	Speed measurement of small-medium caliber ballistic projectiles up to .50 caliber and fragment simulating projectiles (2 gr – 64 gr). Integrated dual HD speed gates with consistency and error checking in software. Software displays the speed and stores the results with time stamp and shot count, sensor and strike velocities per AEP 2920, listing of prior test data, visual indicators for fair shots. User selected results can be directly pasted into worksheets or documents.	• Uncertainty ± 0.12% (k=2) • Consistency ± 3 m/s (10 ft/s) • Sampling ± 0.0125 µs (80 MHz) • Gate separation 433 mm (17 in).	NIJ 1010.06, MIL-STD-662F ASTM 3062

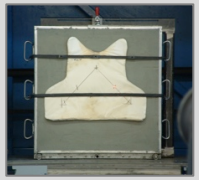
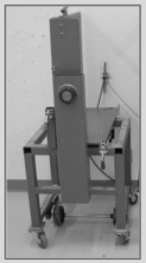
Data Collection and Analysis

Executing ballistics test programs for research, compliance or quality control is a multi-faceted activity with documentation, methodological, analytical and certification requirements to comply with performance test standards, operating procedures, and quality management systems. Biokinetics has created custom software tools to facilitate both the routine and complex tasks encountered in ballistics testing. Briefly these involve workflow software, testing aids, statistical analysis tools, data acquisition systems and calibration aids.

	Item	Description	Overview	Specifications	Standards
DATA COLLECTION - ANALYSIS	BWS	TestFlow™ 	Workflow software for the collection and documentation of ballistics testing to meet the requirements of body armour performance standards (e.g. NIJ 0101.06). Includes range set-ups, threats and load profiles, test programs, test conditions, armour configurations and instrumentation. The technician is guided through the data collection and management processes with intuitive menus and forms along with automated reports. Includes clay calibration, label verification, P-BFS, V50 and Vproof ballistic limit assessments. TestFlow™ is empowered by a database for archiving and query of all test setups, configurations, test programs and inventory tracking.	• Equipment and test facility configuration documentation. • Threat component and configuration documentation with inventory tracking. • Client and project management. • Ballistic sample and configuration and conditioning. • Up-down test requirements guided automatically per NIJ or AEP 2920.	NIJ 0101.06 AEP-2920
	V50A	V50 Assist™ 	V50 Assist™ provides a standardized process for collecting and documenting V50/ballistic limit testing required in body armour performance standards (e.g. AEP/AEP-2920, NIJ 0101.06, MIL STD 662F). The software simplifies V50 studies from start-to-finish by recommending the next shot velocity using common firing procedures (AEP/AEP-2920, NIJ 0101.06, Modified Langlie, 3POD2, Delta), providing an intuitive user interface to simplify user input and minimize user errors, dynamically computing common ballistic limit parameters including plotting and confidence intervals, and automated generation of customizable Microsoft Excel® reports. More advanced analysis capabilities are available in the Research Edition suited to survivability/lethality studies.	• Firing procedures: AEP/AEP-2920, NIJ 0101.06, Modified Langlie, Delta/Ladder, 3POD 2.0. • Plot types: Firing Sequence, Charge Calibration Yaw vs Strike Velocity, Logit, Probit. Gompit, Scobit, Weibull, Yawgit, ULR, EAR, APR, DOP, Vresidual, BFD, triple plot (ULR, Logit, EAR with APR).	NIJ 0101.06 AEP 2920 MIL-STD-662F
	BioDAQ-V9	BioDAQ™ 9.0 	BioDAQ provides injury analysis software with functionality for data acquisition, head injury metric determination for TBI and mTBI applications. Sensor setup, data collection, signal conditioning and reduction is provided and is well suited to instrumented test surrogates using the 9-accelerometer array or DTS angular rate sensors. Data is exported to a text file and Excel® in raw and filtered forms. The software can also be used as a general-purpose data acquisition and processing system for a wide variety of sensors, whether for research, evaluation or measurement purposes.	• Head injury metrics: G_{max}, SI, HIC, HIP, peak angular acceleration and velocity, DAMAGE • Helmet performance: HARM (Head Acceleration Response Metric)	

Fixtures and Tools for Ballistics Clay

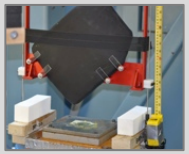
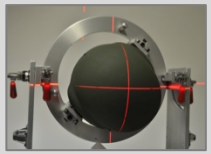
Biokinetics provides a suite of custom fixtures and tools to facilitate testing with the clay backing used in military and law enforcement armour performance standards. The clay backing requires careful preparation, verification and handling during ballistics testing. Biokinetics' clay preparation and repair tools address the need to obtain consistent ballistic clay backings for repeatable and accurate assessment of armour performance. Tools are provided for preparing the clay box face as well as for transporting clay blocks (weighing approximately 81 kg or 179 lbs) to the test site, repair station or calibration tower. Ballistics clay firmness must also be verified for each test and requires temperature conditioning to meet specifications as verified by indentation tests with a steel ball impactor. Verification testing is simplified with the clay trolley allowing rotation and placement of the clay box beneath the clay calibration station. Temperature control is also provided with industries first heating blanket for on-site conditioning. Finally, the clay block mounting fixture helps align and clamp the clay block to the target table while the clay trolley allows for its transportation to the conditioning area or clay press for repair. The clay handling equipment is further described below.

	Item	Description	Overview	Specifications	Standards
FIXTURES FOR CLAY	BCB	Ballistics Clay Box 	Both soft armour and hard armour plate systems are commonly tested on ROMA Plastilina® clay for assessing their ballistic limits (V50), perforation performance and back-face signature (P-BFS). Biokinetics provides a sturdy metal box to meet military and law enforcement ballistics performance test standards that is integrated with the Clay Trolley and conditioning system for seamless operation in the range.	• Robust aluminum frame with roller wheels for use with the clay trolley • Clay filled – ready to use	NIJ 0101.06, HOSDB 39-07 B, AEP-2920, MIL-STD-662F, Military Armor Specs
	BCBFSV	Ballistics Clay Back-face Signature Vernier 	Many body armour test standards require the measurement of back-face signature to determine the level of potential trauma to the wearer. This is obtained by measuring the indentation into the clay that supports the armour. The depth tool indexes with the Clay Box to provide a stable platform from which to measure the back-face signature without disturbing the clay surface.	• Point measurement of BFS • Clay Box reference measurement	
	BCT	Ballistics Clay Trolley 	The trolley facilitates transportation of the clay box from one area of the range to another. The tilting support platform also facilitates the repair when using the Clay Press and assists with clay calibration using the Clay Calibration Station.	• Pivot mechanism for clay block packing and calibration • Solid floor casters for movement over smooth surfaces • Sturdy steel construction	

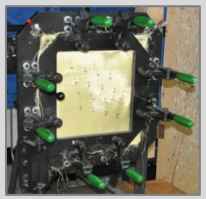
	Item	Description	Overview	Specifications	Standards
	BCP	Ballistics Clay Press 	As the clay block is used in testing, repairs and replacement of the clay must be conducted. For larger repairs, this can be a long and arduous task. The clay packing station improves the time and effort for repairs. When the clay box is mounted on the Clay Trolley, it can be directly moved into the Clay Press to repair holes or to fill the clay box with ROMA Plastilina®. This station is also used with various molds to shape the clay for back-filling curved hard armour plates.	• Standalone, mobile frame • Pneumatic press • Manual pneumatic controls • Suitable for soft or hard armour clay back-fills	
	BCBS	Ballistics Clay Box Support 	This support frame integrates with the clay box to provide lateral and angular adjustments when mounted on the test platform (providing height adjustment) thereby allowing for any point to be targeted.	• Integrates with Target Table • Locking mechanism to secure clay boxes	
	BCBK	Ballistics Clay Knife 	After filling the clay box with ROMA Plastilina® or repairing the surface, the Clay Knife will index onto the edges of the Clay Box and provide a flat smooth surface level with the edges of the box.	• Steel blade • 2 handles for easy use	
FIXTURES FOR CLAY	BCCS	Ballistics Clay Calibration Station 	When used in conjunction with our Clay Trolley and Clay Box, the drop height is fixed at the required distance facilitating quick and repeatable calibrations. A targeting laser and magnetic ball release further ease the calibration process.	• Frame for holding steel ball • Laser alignment • Remote magnetic ball release	NIJ 0101.06, HOSDB 39-07 B, AEP-2920, MIL-STD-662F, Military Armor Specs
	BCHB	Ballistics Clay Heating Blanket 	These heating blankets provide maximum flexibility with ease of installation and placement anywhere within the facility. These also allow the temperature for each clay box to be optimized to ensure the correct stiffness for calibration, especially useful when different clay batches are used.	• Digital PID temperature controller • 865 Watt consumption • up to 50±0.6° C (122±1° F) • ETL/CSA certified	
	BCBT	Ballistics Clay Box Table 	Configured to integrate with our Clay Trolley and secure the clay boxes in place when used with the Clay Heating Blankets. The steel table is robust for repeated use.	• 75 x 75 cm (min)	

Fixtures for Ballistic Armour

Ballistic armour requires special preparation, pre-test conditioning, clamping, spall containment and witness media fixturing depending on the specific test standard and requirements. Biokinetics has developed a number of fixtures and tools to facilitate test sample preparation and compliance with the test requirements whether it involves body armour, helmets, vehicle armour, shields or materials. Many tools have been developed for specific test standards with attention to ease-of-use, intended function, integration with complimentary tools and quality. Further details are provided below.

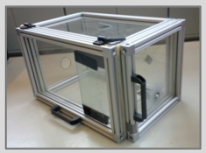
	Item	Description	Overview	• Specifications	Standards
FIXTURES FOR BODY ARMOUR	BAWI	Ballistic Armour Wet Immersion 	This immersion tank will fit all sizes of body armour manufactured according to NIJ 0101.06 and has an attachment for allowing the test samples to drain.	• Watertight reservoir with roller wheels • Support fixture for test samples • Drain spout	NIJ 0101.06
	BPEI	Ballistics Plate Edge Impactor 	The durability of ballistics plates from a free-fall edge drop can be assessed with the ballistic plate edge impactor frame and any twin wire drop tower.	• Supports any style ballistic resistant plate • Requires twin wire drop tower system or Helmet Impact Tower	DND Technical Standard – Bullet Resistant Plates for the Land Forces
	BHTF	Ballistics Helmet Test Fixture 	Assessing the ballistics performance of combat helmets depends partly on the variability of projectile targeting and obliquity. The Ballistics Helmet Test Fixture provides several functions to improve testing accuracy and speed. First, a flexible clamping system securely holds the shell allowing it to be shot at any location. Second, several adjustment points are provided to quickly obtain obliquity without having to change other adjustments. Third, a set of positioning jigs is provided to obtain accurate positioning of witness plates or clay behind the shell for shell back-face deformation measurements. Finally, a mold improves consistency of the clay ball witness shape.	• 4 degrees-of-freedom adjustment • Accommodates small to XL helmets • Positioning jig for witness plate and clay ball • Helmet mounted Obliquity Mirror • Witness plate holder • Clay ball holder, molding kit, calibration kit	AEP-2920, MIL-STD-662F
	BCH	Ballistics Clay Headform 	The clay headform is used as a ballistics penetration witness for combat helmets whether it is filled with clay or with metal plate inserts. The headform is integrated with a quick connect adjustable support base to facilitate shot obliquity requirements and for rapid removal.	• Metal construction • Neck mounted quick-connect • Translation, rotation adjustments • Fits on Target Table	NIJ 0106.01, HPW-TP-0401.01B, Armor Specs

	BAHR	Ballistics Attenuation Headform Rail 	The NIJ 0106.01 standard for ballistics helmets requires attenuation of the bullet impact within a global head acceleration tolerance. The rail system supports the rigid headform and allows it to translate as result of the bullet's momentum transfer.	• Twin rail system • DOT headforms • Uniaxial accelerometer	NIJ 0106.01

	Item	Description	Overview	• Specifications	Standards
FIXTURES FOR ARMOUR MATERIALS	BSAC	Ballistics Soft Armour Clamp 	This clamp is designed in accordance with AEP-2920 for ballistics limit testing to hold flexible armour textiles providing a measurable and repeatable tension across the soft armour test sample.	• 40 x 40 cm sample size (nom.) • 30 x 30 cm test area (nom.) • 8 clamping points with fabric tensioning adjustments • Fabric tension measurement tool • Adjustable witness sheet holder	AEP-2920, MIL-STD-662F
	BUAS	Ballistics Universal Armour Support 	Various sizes to support rigid armour materials. This universal support fixture provides angular and height adjustments when mounted on our test platform.	• Flat or curved plate • Steel construction	NIJ 0108.01
	BAC	Ballistics Armour Clamp 	Ballistics armour securement and controlled placement of witness plates is provided by the Ballistics Armour Clamp. It conforms to the EN 1063 standard and provides containment of behind armour spall.	• Aluminum box with hinged clamping frame • Witness plates top loaded through slots	EN 1063

Targeting Zone

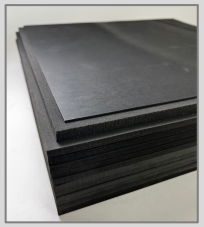
Support of the armour test sample and containment of the striking projectile and spall are common requirements found in the terminal ballistics zone. As a result, Biokinetics offers solutions to meet the requirements such as a clam-shell containment system that minimizes the structural burden compared to cladding solutions, reusable ballistic traps, a support table with unique adjustable mounting base for easy positioning of the test sample/clay block and even a containment chamber for armour systems containing nano-particles having potential health risks. Many options are available including witness plates, ricochet analysis, spall characterization and more.

	Item	Description	Overview	• Specifications	Standards
TARGET ZONE	BPC	Ballistics Projectile Containment 	The containment chamber is used to contain projectiles and spall from ballistics impacts to armour systems. The specific configuration allows the chamber to be moved forward over the Test Table providing containment from the rear and sides. An disposable front door contains forward directed spall and a bullet trap is integrated to capture the majority of penetrating projectiles.	• Containment up to 7.62mm AP • Interior (H x W x D): 190 x 105 x 130 cm • On roller wheels and rails • Hydraulic power unit for activation	NIJ 0101.06, HOSDB 39-07 B, AEP-2920, MIL-STD-662F
	BBT	Ballistics Bullet Trap 	Capture and containment of projectiles is provided by the bullet trap integrated with the containment chamber. It can be emptied and refreshed on an as-need basis.	• Up to 7.62mm AP • H x W x D: 20 x 20 x 48 cm	
	BTT	Ballistics Target Table 	A vertically adjustable platform is provided to support test samples and fixtures. Hydraulic control foot pedals make adjustments easy while a slotted top facilitates attachment of hardware and fixtures while providing lateral adjustability.	• Hydraulic lift table • T-slot top with pitch and yaw adjustment (not shown) • 63 x 80 cm (top) • Height adjustment: 42 – 130 cm	
	BNC	Ballistics Nano-particle Containment 	The nanoparticle containment chamber provides a sealed environment for ballistics testing of small test samples containing potentially hazardous particles. The chamber has clear front and side access panels, attachments for a HEPA vacuum (not provided) and mounts to the Target Table.	• Aluminum frame and plastic panels • Clear plastic spall liners can be added • Fits over test samples and fixtures	

Behind Armour Effects Assessment Equipment

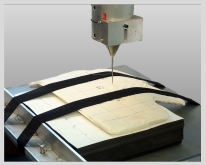
Biokinetics has developed specialized test equipment to evaluate the protective effectiveness and injury potential of ballistics armour systems for behind armour blunt trauma. The test surrogates are human-like in response and therefore provide a more accurate description of the dynamic loading event and interaction with the armour systems such as combat helmets, ballistics resistant vests and plates. While the test surrogates are being considered for use in product purchase specifications and standards, they are currently applicable to armour system research and development with many recognized and recommended by international agencies.

	Item	Description	Overview	Specifications	Standards
BEHIND ARMOUR EFFECTS	BLSH	Ballistics Load Sensing Headform 	While ballistics helmets stop bullet penetration, shell deformations may cause skull fractures and underlying brain injuries. The Ballistics Load Sensing Headform (BLSH) assesses the risk of blunt head trauma from ballistics shell contact and other types of blunt loading such as from less-lethal ammunition and head impacts. The headform, mounted onto a flexible neck, contains force sensors to measure contact force magnitude, distribution and impulse to assess injury risk.	• 3 ISO headform sizes for front/rear/left/right/crown sites • 5 clusters of 7 force sensors (2940 mm^2 total area, 22 kN working load) • Includes neck, adjustable support base, junction box, amps (16 ch), DAQ, BLSH software • Two Ballistics Limit Headforms • 8 skin pad sets for each size	AEP-2920
	BTTR	Blunt Trauma Torso Rig 	Blunt trauma to the torso can occur from bullet deformations when impacting body armour. The Blunt Trauma Torso Rig (BTTR) assesses the risks of blunt trauma based on dynamic loading effects. Injury risk can also be assessed for other types of blunt loading including less-lethal ammunition impact and blunt impacts on riot control gear and other protective equipment. The non-contact laser sensor measures dynamic chest wall defection to assess injury risk.	• Biofidelic torso membrane (511 mm dia., 762 mm tall) • Includes adjustable support stand, data acquisition system, BTTR collection and processing software • Single point non-contact laser (30 kHz, 200 mm useable range)	AEP-2920 CAN CSA Z617
	MLSH	Mandible Load Sensing Headform 	The Mandible Load Sensing Headform (MLSH) can be used to assess the level of impact protection provided by facial/jaw guards by assessing the jaw forces and head accelerations. Behind armour effects from ballistics impacts or from blunt force impact can be investigated. The articulating jaw and human-like compliance also make it suitable for studying mouth guards and helmet retention strap loads.	• Force sensors at the upper dentition and mandible joints (2.2 kN, piezoelectric) • Head mass and CG meets Hybrid III • Optional head acceleration sensors • Includes BioDAQ software	Helmet specs
	BLH	Ballistics Limit Headform 	The Ballistic Limit Headform is a sacrificial item that helps evaluate the ballistics limit of combat helmets in their as-worn condition with standoff. The elastomeric head captures any penetrating projectiles and can be used hundreds of times. It is similar in shape to the BLSH (size medium) and is intended to be used with the support brackets and neck provided with the BLSH.	• Elastomeric headform for ballistic limit assessment • Can be attached to the BLSH neck and base to meet obliquity requirements	AEP-2920

	Item	Description	Overview	Specifications	Standards
	BSP	Biofidelic Shoot Pack 	Under the auspices of TTCP LND (collaboration with AU, CDN, NZ, UK, USA) a ballistic armour support pack, having better biofidelity, was developed for realistic assessment of ballistics performance. It is a multi-layer foam pack representing the epidermis, dermis, and soft tissue to represent skin perforation resistance and bodily dynamic compliance. It is suitable for V50 and Vproof testing of lightweight fragmentation protective materials and can be configured to measure projectile residual velocity and absorbed kinetic energy of penetrating projectiles or fragmentation.	• Made to the specifications of the TP5 pack established by the TTCP LND for realistic compliance, perforation, and penetration resistance assessment. • Consists of epidermis, dermis, and soft tissue layers made of rubber and foam. Optional fibre board backing for $V_{residual}$ assessment. • Size L x W: 15” x15” (38 x 38 cm) • Certified for thickness, durometer, COR per approved specifications.	For assessing ballistic performance of protective fabrics or soft armour systems.

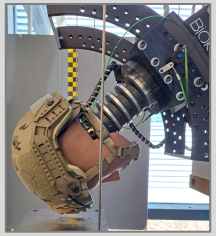
Stab Penetration Equipment

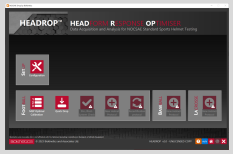
The resistance of body armour to penetration from commercial or street weapons, such as knives or spikes, can be assessed with the Stab Test Apparatus designed to meet international law enforcement and military standards. The system provides the ability to test soft and hard armour meeting the stringent specifications from the U.S. National Institute of Justice (NIJ) and the U.K. Home Office Development Branch (HOSDB). Recent enhancements were made to adapt to hand-made threats found in correctional environments and to improve testing variability. Add-on hardware for slash testing has also been implemented in anticipation of meeting the latest ASTM standard for slash resistance as based on the HOSDB test methodology.

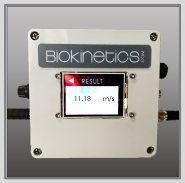
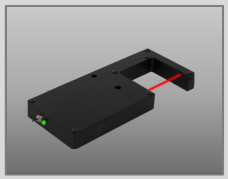
	Item	Description	Overview	Specifications	Standards
STAB PENETRATION	STA	Stab Test Apparatus 	The stab tower allows body armour, plates and shields to be assessed for penetration resistance. Complies with the NIJ Standard NIJ 0115.00 for commercial and correctional type threats being proposed in an updated version of the standard. Recent stab missile enhancements improve impact variability and ease of use. The test setup includes a threat holder magnetically released within the drop tower. Impact speed is measured with an optical gate and displayed on a computer with custom software. The indexed support table accepts NIJ foam backing materials and can be raised/lowered or inclined. Options are provided to meet VPAM specifications and a motorized version is also available.	• Drop tower with precise control of drop height with manual crank and pulley system (< 70 J impact energy) • Impact speed measured with dual beam optical gate • Custom software displays actual speed and energy • H x W x D: 5.8 x 1.2 x 0.9 meters • Optional VPAM and motorized kits	NIJ 0115.00 HOSDB 7/03/C PSDB 6/99
	STAB	Stab Backing 	The stab backing provides an assembly of rubber and foam sheet layers required to conduct stab penetration resistance testing according to the NIJ 0115.00 standard. Each pack is certified for conformance and are individually sealed.	• Meets NIJ 0115.00 for durometer and ball drop rebound. • Certificate of conformance provided with each pack. • Witness paper and sabot damping disks are included.	NIJ 0115.00

Head Protection Equipment

In addition to the ballistics evaluation of combat helmets, it is also important to assess the blunt impact protection afforded by the suspension/liner system, the retention system strength/elongation and helmet stability. Many military specifications have extracted requirements from motor vehicle helmet standards and are included in the descriptions below. Furthermore, the durability and integrity of combat helmet shells can be evaluated with Biokinetics' specialized test equipment. Ease-of-use and integration with software for measurement and analysis are fundamental to Biokinetics' equipment.

	Item	Description	Overview	Specifications	Standards
HEAD PROTECTION	HIT	Helmet Impact Tower 	Modern day combat helmets provide impact protection from falls, projectiles and help dissipate behind armour effects. The Helmet Impact Tower (HIT) can evaluate the impact performance of helmets under a wide range of test speeds and energies. Compliance with international standards for military, motor vehicle and sports applications is assured with the full complement of impact headforms, data acquisition and measurement systems. Biokinetics' custom Helmet Test Software (HTS) facilitates the process of testing by integrating data acquisition, test program management, data processing and reporting functions into an integrated application for blunt impact, retention and stability performance tests.	• Monorail drop tower with manual or motor assist (H x W x D: ~5.0 x 0.4 x 0.5 meters) • Includes impact and reference headforms (4 sizes, ISO/DOT types), • Includes anvils, penetrators, and calibration pads • High precision optical beam drop velocity measurement • Custom HTS software for test data collection, reporting and equipment integration	ACH specification ECH specification ANSI ASTM CPSC DOT SNELL
	HDC	Helmet Drop Carriage 	Developed for head impact studies involving linear and rotational kinematics in six degrees of freedom suitable with instrumented head forms (e.g., 3-2-2-2 or ARS). Extended range of impact sites and neck orientations are possible while reducing carriage interference of the helmet fitted with peripherals (e.g., NVG, mandible guards, comm systems). Helps maintain the contact point with the anvil for most orientations unlike pivoting cantilevered systems.	• Impacts to the crown, front, side, and rear are possible with available range of neck orientations: 0º 90º fore-aft, 0º 360º rotation. • Works with Biokinetics' square-tube drop tower. Full turnkey drop tower system available upon request. • Indexed adjustment points.	
	LI	Linear Impactor 	The study of impact protection under high speeds and energies is well suited with the Linear Impactor (LI). When paired with the test table and headform, the system can be used to study high severity head collisions, the performance of helmets or it can also be used to study body armour, vehicle armour, riot shields and personal protective equipment with additional test equipment. The system is available with an adjustable Linear Impactor Table and headforms for the measurement of translational and rotational head kinematics such as the Hybrid III NAP headform.	• Impact speeds up to 13 m/s • Impactor table with tilting headform support, translation rail and platform with vertical, lateral adjustments • Hybrid III NAP headform with linear and rotational acceleration sensing • Amplifiers, data acquisition and BioDAQ software	CAN CSA Z617 NOCSAE Linear Impactor Protocol NFL Linear Impactor Test Protocol

	Item	Description	Overview	Specifications	Standards
HEAD PROTECTION	HRTS	Helmet Retention Tester - Static 	The integrity of helmet retention systems is important to ensure that the head protection remains in place during impact. Biokinetics offers a range of retention testers to meet international standards whether they include dynamic or quasi-static load applications with dwell times. The DOT system is illustrated and is commonly referenced in combat helmet specifications.	• DOT system applies static load and measures chin strap displacement • Integrated with the HIT custom software to provide data collection and reporting capabilities • Other models available: HRTD, HRTQS to meet ASTM, CPSC, Snell, CSA standards	ACH specification ECH specification DOT
	HROT	Helmet Roll-off Tester 	Helmets may roll off of the head during impact if the retention system geometry or adjustment is poor or if the helmet fit is inadequate. The Helmet Roll-off Tester (HRT) evaluates the stability of the helmet on the head when subject to a lateral force experienced during impact or from a projectile. Biokinetics' range of roll-off testers meet many international standards for military, motor vehicle or sports applications.	• Various models available to apply static and dynamic loads • Standalone test systems with integrated HIT custom software to provide data collection and reporting capabilities	ANSI ASTM DOT SNELL
	BioDAQ V9	BioDAQ™ 9.0 	Biokinetics' Data Acquisition Software (BioDAQ) is well suited to general R&D experimentation providing integrated data collection, processing and reporting tools. Performance metrics specific to the head are provided including those with translational and rotational components acquired from headforms measuring the kinematics in all axes such as the Hybrid III NAP headform. New capabilities to estimate the rotational brain response (DAMAGE) and integrity of the measurements is provided for greater confidence in the measurements.	• Supports Biokinetics helmet test equipment and NAP headforms • Compatible with NI data acquisition cards for mixed sensor use • Calculates head injury metrics (e.g. Gmax, SI, HIC, HIP, GAMBIT, HARM, DAMAGE)	ACH Specification NFL Linear Impactor Test Protocol AEP 55 Vol. 2
	HFT	Helmet Fatigue Tester 	The Helmet Fatigue Tester evaluates the rigidity and shape retention of a combat helmet. The measurements provide valuable insight into the durability, resiliency and impact distributive effectiveness of a helmet when subjected to normal loading conditions. The system can replicate the performance requirements in many international combat helmet specifications.	• Includes electro-mechanically controlled platforms with custom software to control load, deflection and dwell times, all programmable • H x W x D: 1.6 x 0.7 x 0.6 meters	ACH Specification ECH Specification DND CG634 Specification
	HEADROP	HEADROP ™ 2.0 	Head trauma research under impact conditions may entail the use of NOCSAE headforms which are stipulated for use in sports standards for evaluating helmets. The headforms, however, require calibration and have historically involved several iterative steps with associated effort to determine the calibration factors. The HEADform Response OPtimiser (HEADROP™) testing software facilitates the 'calibration' routine with single drop testing functionality. Data can be exported to text files and Excel® (raw and filtered) or selected criteria can be automatically exported to the Clipboard.	• Works with standard NOCSAE headforms. • Requires an external velocity sensor input to the NI DAQ system, not included. • Works with National Instruments data acquisition (DAQ) equipment (not included) used to measure headform accelerations.	NOCSAE DOC ND 001

Item	Description	Overview	Specifications	Standards
VFD	Velocity Field Display 	Multi-purpose velocity display that measures, stores and displays velocity with popular single and dual beam velocity gate systems. The colour touch screen displays the result and is used for changing settings such as the units, flag width or the separation distance for dual source inputs and for display of the last three measurements.	• Inputs can either be single or double square pulse source of either 3.3 VDC, 5 VDC or 10 VDC. • 320 x 240 pixel, 2.4" (61 mm) colour touch screen for display and control. • Pulse sampled at 80 MHz.	ACH/ECH purchase spec. ANSI ASTM CPSC DOT SNELL
HLG-1 HLG-2	Light Gate 	The Light Gate measures the speed of a moving object such as required for helmet testing. The unit is available with a single laser beam for measuring the speed of a flag attached to the carriage and is also available with two laser beams to measure the speed of a moving object as it passes through the light gate. The gate requires a chronograph or Biokinetics' Velocity Field Display for speed determination.	• Speed measurements up to 100 m/s typical with a 50 mm flag. • Accuracy depends on the chronograph capabilities.	ACH/ECH purchase spec. ANSI ASTM CPSC DOT SNELL