PAPILLON
SYSTEMS

Automated Ballistic Identification System

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PAPILLON

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PAPILLON is pleased to offer the ARSENAL Automated Ballistic Identification System (ABIS) the use of which allows creating of electronic collections of fired bullets and cartridge cases, containing tens and hundreds of thousands of objects and achieving a new and higher level in the trace evidence analysis of fired specimens, included fragmented ones, when investigating firearms crimes.

Electronic databases, created in ARSENAL ABIS, and state-of-the-art communication networks open up possibilities for providing a remote access to ABIS databases to transmit information about bullets and cartridge cases, to carry out firearms checks and interregional data exchange.

ARSENAL
Automated Ballistic Identification System

rsenal

ARSENAL ABIS enables maintenance of two database sections:

▶ **Testfired Objects** section containing data on each representative bullet and cartridge case obtained through the actual firing of a firearm in a laboratory, i.e. firearm type and owner's name are known.

▶ **Evidence Objects** section containing data on specimens, bullets and cartridge cases, collected at crime scenes to be used as evidence.

Surfaces of bullets and cartridge cases (let's call them objects), with characteristic marks imparted to them from having been fired and extracted from firearms, are input into the ARSENAL database as digital images and automatically compared with those stored in the database.

Analysis of candidate lists produced by the system as a result of automatic matching allows experts, using various tools available in the ARSENAL for comparative examination, to make up a conclusion whether a specimen previously shot from the same gun as the target one, exists in the database or not, and thereby:

▶ to establish the gun owner's complicity in the crime if the newly testfired bullet (cartridge case) matches a bullet (cartridge case) stored in the Evidence Objects section of the database;

▶ to determine the gun, from which the evidence bullet (cartridge case) was shot, and its owner, if this bullet (cartridge case) correlates with a bullet (cartridge case) stored in the Testfired Objects section of the database;

▶ to link bullets and cartridge cases fired from the same gun, and to link different crimes thereby, if these evidence objects are identified as matches.

ARSENAL ABIS provides forensic experts with ample opportunities in image analysis allowing them:

▶ to determine the wear rate and condition of the bore, its individual characteristics, by examining marks imparted to the side surface of bullet;

▶ to determine the shape, size, positional relationship of the firearm mechanisms and particularities of their functioning by examining toolmarks produced on the cartridge case;

▶ to prepare examination worksheets and other types of reports relative to the objects under study.

ARSENAL ABIS OPERATION LOGIC

1 Alphanumeric data entry

2 Image capture

3 Automatic processing of images

4 Coding of surface images

5 Automatic processing of images

6 Automatic correlation

7 Candidate lists generating

8 Comparative examination of images

9 Verification of candidate lists

10 Generation of Hit Lists

FUNCTIONAL CAPABILITIES OF ARSENAL ABIS:

▶ Ability to generate data arrays (bullets and cartridge cases)

▶ Differentiation between types of firearm registration (military weapons, service weapons, special guns, etc.)

▶ Ability to store comprehensive descriptive and administrative information, forensic and other text data related to every object in the database (circumstances and/or reasons for registration, object and firearm characteristics, etc.)

▶ Imaging of the side of bullets, both the side and head of cartridge cases and surfaces of fragmented or deformed objects

▶ Automatic determination of striations or furrows on the bearing surface of a bullet caused by the leading and driven edges of the rifling in the barrel from which it was fired (error of determining the rifling pitch is 0.15 degrees and that of determining the land width is 0.015 mm)

▶ Interactive outlining of areas of significance available on the bullet side:
  ▶ Skid, or primary, marks
  ▶ Land impressions
  ▶ Groove impressions

▶ Automatic extracting of characteristic marks available on the cartridge case head:
  ▶ Firing pin impression
  ▶ Breechface mark

▶ Interactive labeling of characteristic marks available on the cartridge case head:
  ▶ Ejector mark
  ▶ Feed mark

▶ Interactive labeling of characteristic marks available on the cartridge case side:
  ▶ Extractor mark
  ▶ Slide hole mark
  ▶ Magazine edge mark at loading
  ▶ Magazine edge mark at ejecting
  ▶ Chamber wall mark
  ▶ Breech edge mark
  ▶ Cartridge loading mark
  ▶ Breechbolt bottom mark

▶ WSQ image compression for database storage

▶ 3-dimensional imaging and profile representation of objects' surfaces

▶ Automatic searches of the database

▶ Generating of candidate lists as a result of searches

▶ Retrieval and operation with database objects and candidate lists, comparative examination of images

▶ Print-out of information from the database

▶ Import and export of database objects through communications supporting IP-connection

▶ Distribution of database access rights and protection of information stored in the database and transmitted through communication channels

▶ Statistic reporting capability.

The first ARSENAL installations date back to 1995.

To date, single-machine and network systems of ARSENAL ABIS are in operation in 25 metropolises throughout Russia and at forensic laboratories in 13 countries: Azerbaijan, Albania, Bangladesh, Bosnia and Herzegovina, Iran, Kazakhstan, Mongolia, Nigeria, Poland, Trans-Dniester, Serbia, Zambia and Uzbekistan.

The ARSENAL ABIS is constantly being perfected focusing on the advanced scientific research and the latest achievements in the field of automatic ballistic identification, thereby improving the reliability and accuracy of automatic comparisons and providing forensic experts with finer capabilities and various tools for criminalistics examinations.

In the current version of ARSENAL, a whole series of technical solutions and innovations of PAPILLON has been realized providing its most striking novelties as compared with its previous versions and other ABIS systems supplied to the market by other vendors.

Developing the ARSENAL ABIS, PAPILLON is striving for finding such solutions that make the system remain affordable, in terms of its price, for widespread deployment, while increasing its value for end users in terms of its qualitative and operational characteristics.

▶ *The PAPILLON BS7 USB new versatile ballistic scanner*

IMAGE ACQUISITION IN ARSENAL ABIS

Images of ballistic samples in the current version of ARSENAL are acquired with a new versatile ballistic scanner PAPILLON BS7 USB. This new scanner like its forerunners has been designed and is being manufactured by PAPILLON. Its versatility consists in its ability to operate with both bullets and cartridge cases as well as with fragmented shells and deformed bullets.

The BS7 USB scanner provides automatic image scanning of the side of bullets taking a linear scan of the whole length (360°) and of the side and head of cartridge cases. Deformed and fragmented bullets are scanned in portions enabling a capture of particular areas of significance containing toolmarks imparted to samples from firearms.

There are no constraints imposed on the dimensions and shape of specimens to be scanned. Thus, specimens may have deformation of more than 3 mm and may jut out from the edge of fixing stands (for instance, cartridge cases relating to smoothbore shotguns).

A sensing element of the new PAPILLON BS7 USB is a linear CCD sensor consisting of 7,500 elements; the resolving power of the scanner is 2.7 micrometers.

Scanning is carried out in a slit mode. Efficiently realized, the algorithms of "splicing" make it possible to completely exclude artifacts when generating a resultant image of the surface by pasting together the linear fragments captured.

The BS7 USB is compact and mobile and it uses a standard USB interface enabling its easy attachment to any workstation of the ABIS, providing thereby flexible approach to the design and to the type of operational mode of the ABIS sites.

The scanner is supplied with ad hoc accessories including a special holder for cartridge cases to capture images of cartridge case heads and three kits of stands for scanning the side of objects, namely:

▶ Magnetic stands for objects with magnetic properties,

▶ Adhesive-coated stands for objects of nonmagnetic material,

▶ Plastic-coated stands for fragmented and deformed objects.

The device is easy-to-use. Rather simple operation of positioning and centering objects, no special requirements to initial orientation of cartridge cases when scanning their heads, maximum automation of the scanning process control — all these factors enable even ordinary staff to carry out, after they accordingly instructed, the said procedure and thereby to free the forensic experts from this type of chores.

It is especially important at the opening stage of the ABIS running — at data input, when creation of electronic databases often demands more staff to enter thousands and tens of thousands of bullet and cartridge case specimens within a tight time frame.

## Technical Features of PAPILLON BS7 USB vs. PAPILLON BS7

| Scanner Model	PAPILLON BS 7.00.3 USB	PAPILLON BS 7.00.3
CCD-sensor	7500 elements	5000 elements
Resolving capacity (2D)	2,7 microns	4 microns
Resolving capacity (3D)	25 microns	37 microns
Maximum depth of scanning	12,4 mm	12,4 mm
Field of vision	20 x 20 mm	20 x 20 mm
Caliber of bullets/cartridge cases	from 5,45 to 25 mm	from 5,45 to 25 mm
Average time of bullet scanning	3 minutes	3 minutes
Average time of cartridge case head scanning	▶ 3 minutes (2 ring lighters) ▶ 20 minutes (2 ring lighters + 8 sectors)	▶ 3 minutes (2 ring lighters)
Land width measurement error	0,015 mm	0,015 mm
Rifling pitch measurement error	0,15°	0,15°
Power supply (DC voltage)	12 V	12 V
Power consumption	40 W	40 W
Dimensions	390 x 258 x 216 mm	330 x 258 x 216 mm
Weight	13,5 kg	13,5 kg
Interface	USB 2.0 (480 Mbps)	PCI (ad hoc grabber)

The scanner uses several diverse modes for illuminating objects:

▶ side surfaces of bullets and cartridge cases, fragmented shells and deformed bullets are scanned using oblique (indirect) lighting,

▶ heads of cartridge cases are scanned using the following lighting conditions:

▶ direct and diffuse ring lighting,

▶ 45°-sectored lighting at different angles.

So, for a cartridge case head there can be captured either 2 (in direct and diffuse ring light) or 10 images.

1 Bullet side scanning in oblique light

2 Deformed bullet scanning in oblique light

3 Cartridge case head scanning in ring light

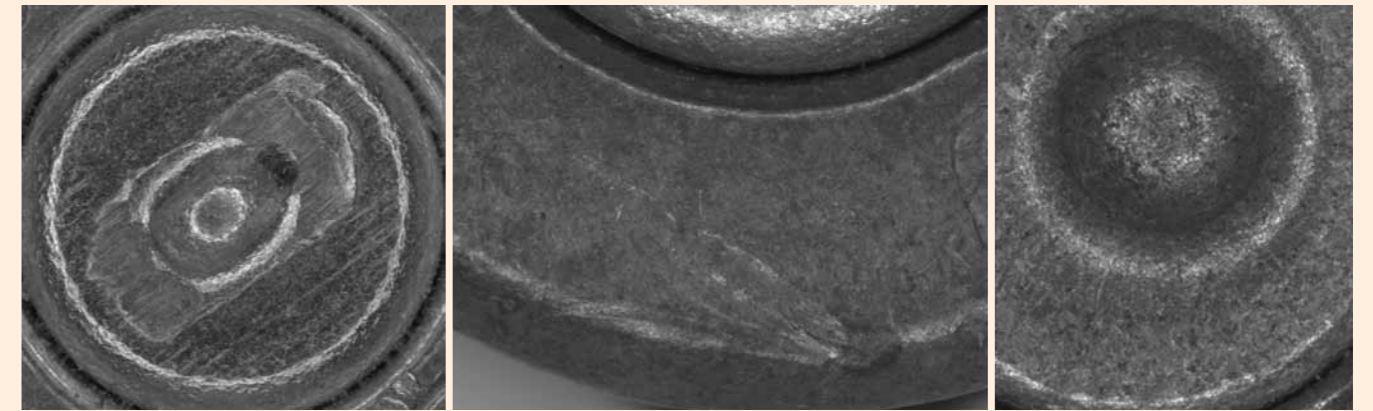**4** Cartridge case head scanning in sectored light
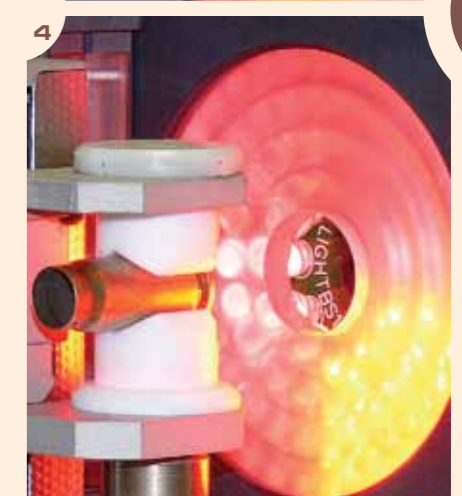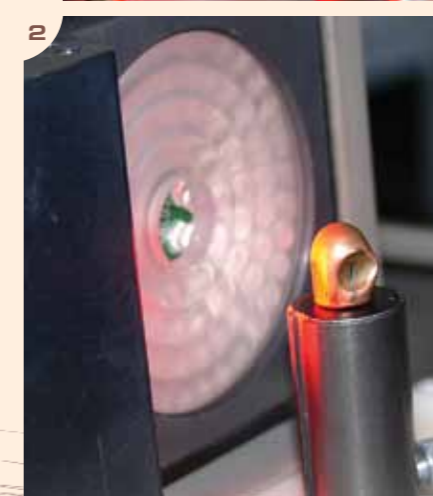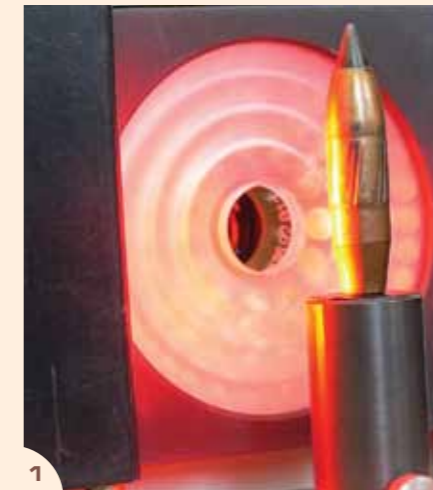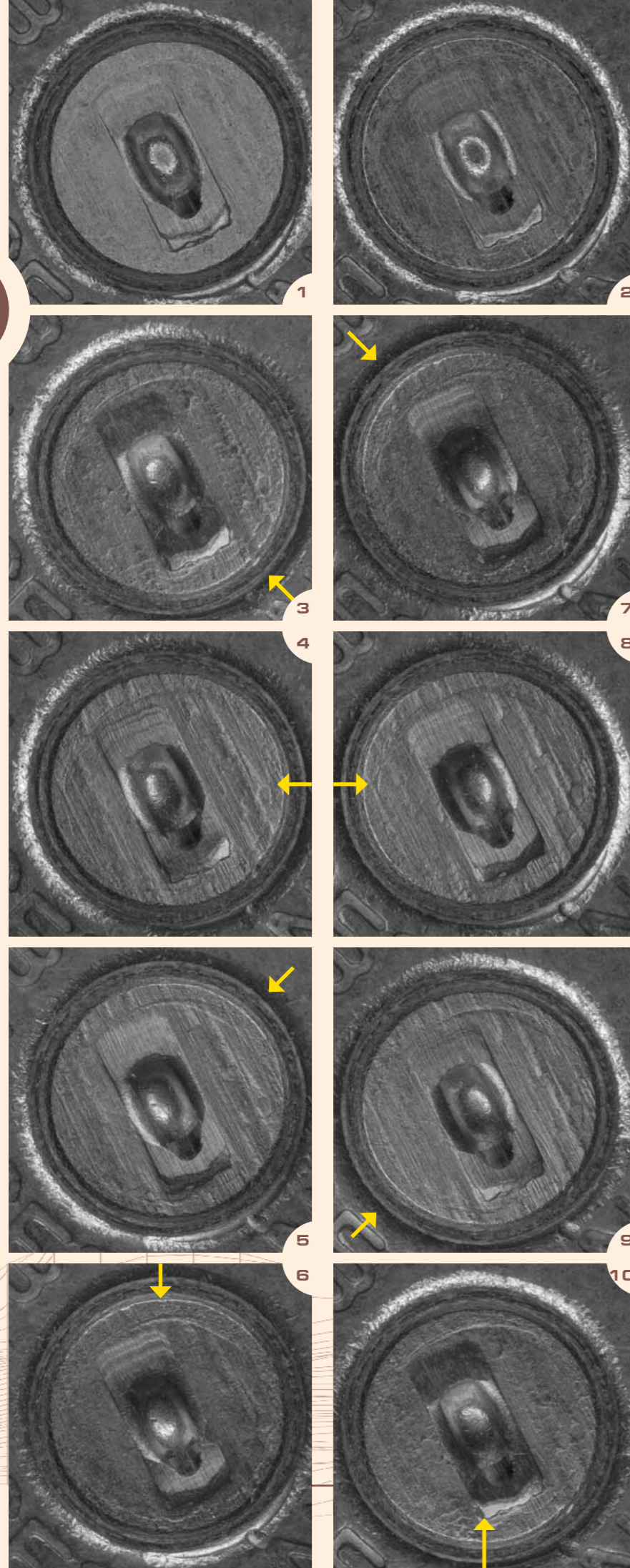
This new approach to the method of case head scanning (sectored light has been introduced in the latest versions of ARSENAL ABIS) is conditioned by the following reasons:

▶ Lighting by sectors in full circumference is as much orientation-independent as ring type of illumination, i.e. it uniforms the process of input regardless of initial orientation of the object.

▶ Lighting by sectors allows for more complete shadow picture of the surface, which is very helpful for both visual analysis of images and automatic matching.

▶ Firing pin impressions, breechface and ejector marks captured using sectored lighting conditions are more informative and visually more legible.

▶ Sectored lighting weakens accidental characteristics, i.e. those imperfections or irregularities produces accidentally during manufacture.

▶ In some countries, the use of ring lighting is protected by patents. In this case, our users are free to choose whether to purchase a license to use the said lighting method or to make use of the sectored lighting.

NOTE: *With this special lighting technology - sectored lighting — the ARSENAL system has greatly improved the results of automatic comparison of breechface marks on cases pertaining to high-powered cartridges. Considerable improvement is gained also in automatic correlations of ejector marks. As for the rest cases, the automatic matching results are similar to those gained at scanning in ring light. In view of the aforesaid and considering that scanning in sectored light takes rather much time thereby increasing the time needed for inputting an object and carrying out automatic comparisons, the sectored lighting conditions are expedient to use in some particular cases, viz. for cartridge cases pertaining to firearms normally utilizing high-powered cartridges (e.g. TT) and to those imparting some specific toolmarks to a cartridge case (e.g. Glock's firearms).*
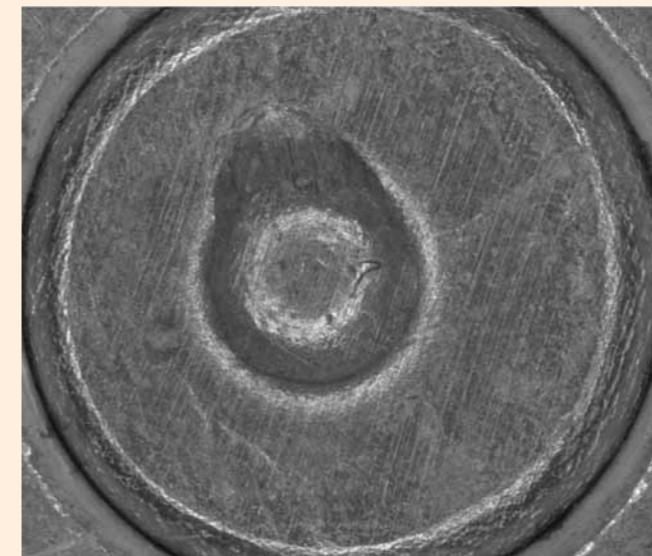
▶ **1,2** *Image of cartridge case head captured in ring light*

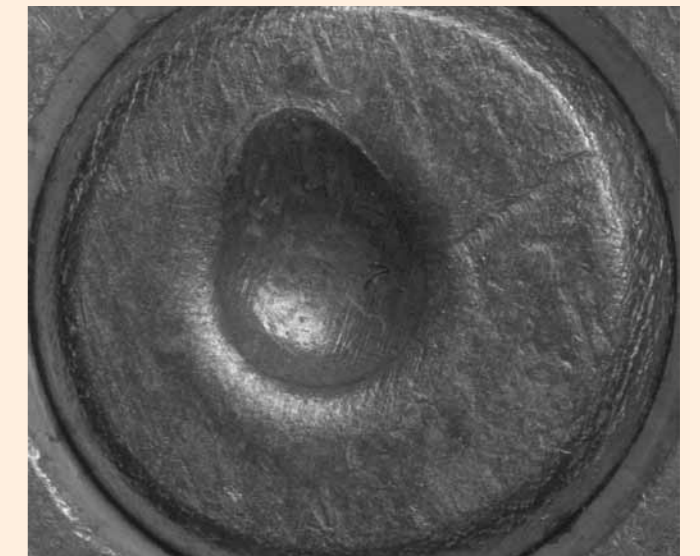▶ **3-10** *Image of cartridge case head captured in sectored light*

▶ *Characteristic marks on cartridge case head captured in ring light*
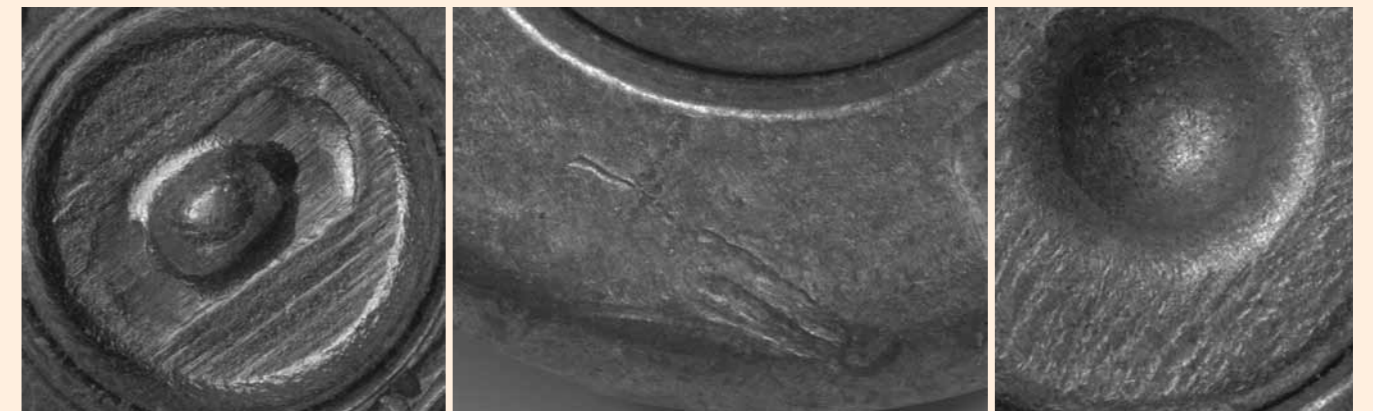
▶ *Characteristic marks on cartridge case head captured in sectored light*

▶ *Ring lighting*

▶ *Sectored lighting. Mechanism marks get more clearly visible while accidental ones faint.*

| Number of case sets: 30 Number of cartridge cases: 90	▶ *Example of improved efficiency of automatic correlations in case of breechface marks captured in sectored light vs. ring light (cartridge cases 7,62x25 fired from TT gun)*	
Light Conditions	Ring	Sectored
True candidate is number 1 on the candidate list	27,5%	68,89%
True candidate occurs in the top 10 correlations presented	57,5%	90,56%
True candidate occurs in the top 20 correlations presented	68,61%	95,00%
True candidate occurs in the top 50 correlations presented	91,39%	99,44%

Scanning in sectored light considerably increases the time needed to enter a particular specimen of cartridge cases into the system.

To reduce the expenditure of time for capturing images of cartridge case heads referring to the same batch, PAPILLON engineers have invented an ad hoc semi-automatic unit of a revolver type enabling continuous scanning and this device is currently being implemented.

The new PAPILLON BS7 USB scanner has an advanced automatic engine for calculating the lighting level, which lowers over-illumination on images thereby allows to avoid information losses caused by it.

The scanner is equally efficient when operating with objects made of different materials — reflection power is given consideration at calculating light exposure.

▶ *On the left:*
loss of information
in overexposed zones

▶ *On the right:*
new lighting mechanism enables you to avoid information losses
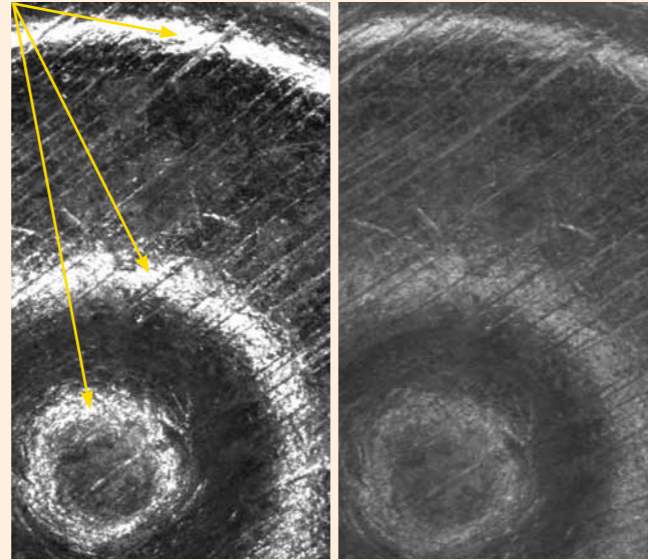
Acquisition of high-quality images is ensured by automatic layer-by-layer scanning of the surface to a full depth of its deformations.

Every next layer is scanned with the optical system focal depth changed by one increment.

The scanning depth value is assigned by an operator according to the extent of object deformation.

After all layers are captured, the best fragments are automatically selected from all the generated scans and then collated into a single sharp image of the object.

Algorithms of PAPILLON exclude artifacts of "splicing" and ensure high-quality resultant images.

▶ *Resultant image of the bullet side*

3D IMAGING OF THE OBJECT SURFACE

In initial stages of development of the ABIS market, all the systems offered to customers at that time used solely two-dimensional (2D) methods of forming, comparing and examining digital images.

Later, some of the systems, including ARSENAL, delivered an opportunity to acquire and utilize spatial (3D) information on surface topography.

This trend in the ABIS technology is very promising to raise the performance of automatic comparisons in the ABIS and to provide additional capabilities for visual analysis.

Implemented in the ARSENAL ABIS, the layer-by-layer scanning technology — to a full depth of indentations, striations and other deformations of the object — makes it possible to obtain both the high-quality 2D image and spatial 3D information about the object surface. The information acquired enables a synthesis of 3D models and surface profiles. These data also benefit automatic matching.

The more rigorous method of obtaining 3D information on bullets and cartridge cases in ballistic systems is that one consisting in gauging surfaces using confocal sensors. The said technique is practiced by the developers of the Forensic Technology IBIS system, Canada (IBIS BRASSTRAX-3D for cartridge cases and IBIS BULLETTRAX-3D for bullets). The new modules deliver to users the enhanced capability for synthesis and visual analysis of 3D models of surfaces and characteristic marks. According to available information, the results of automatic correlations get improved as for some certain types of characteristic marks and for some particular types of firearms. With all its benefits, the said method has a substantial drawback — it is very expensive.

The designers of PAPILLON are also exploring the possibilities of perfecting the selectivity of automatic correlations through high-precision measurement of bullet and cartridge case surfaces using confocal sensors. But the question of introducing such the equipment into the ARSENAL ABIS has not been considered yet — and it won't, at least, until it can be declared with confidence that this high-cost technology does provide a qualitative leap forward in efficiency of automatic matching in the ABIS.

We believe that at present the traditional 2D technology, improved and creatively adapted to the needs of the ARSENAL ABIS, yields results comparable to those produced with the confocal scanning, whilst the 2D method is incomparably cheaper. The resources of this technology are far from being exhausted. Great and attainable potential for increasing the accuracy of the matching process consists in:

▶ *further refinement of the optic scheme of the ballistic scanner for more precise gauging of the surface relief,*

▶ *use of new types of illumination for scanning bullet samples (lighting at different angles),*

▶ *developing and application of new techniques for matching images.*

Solutions to these tasks are currently being implemented.

▶ *3D image of the cartridge case head in the ARSENAL ABIS*

1

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3

4
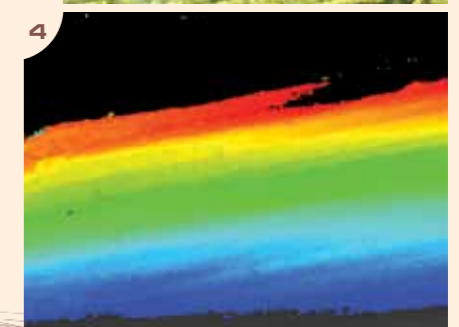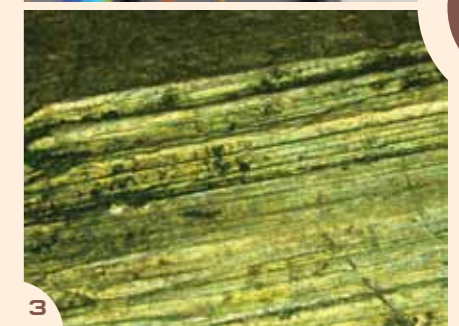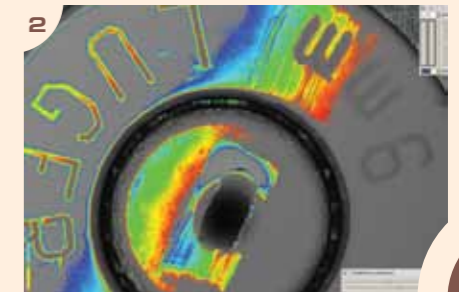
▶ 1, 3 *Surface image generated using a confocal sensor*

2, 4 *Surface profile represented in pseudo color*

IMAGE CODING AND AUTOMATIC ALGORITHMS IN ARSENAL ABIS

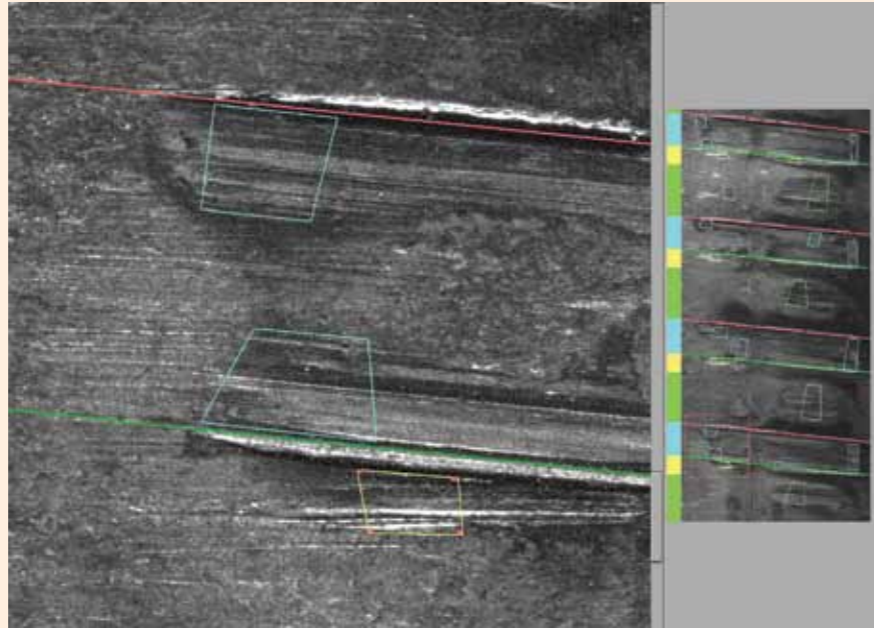When carrying out automatic processing of captured images, the system defines:

▶ *for bullets* – the rifling angle and land width, position of both the driving and trailing edges,

▶ *for cartridge cases* – position of the firing pin impression and breechface mark, outline of the head and primer area.
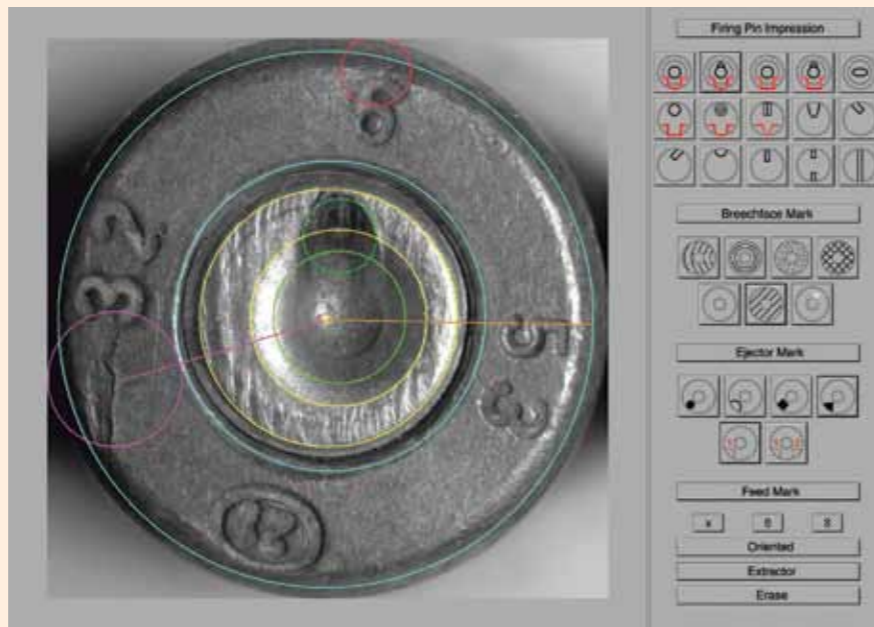
The interactive coding program allows the user to highlight other characteristic marks available on the images (image coding):

▶ *for bullets* – primary (skid) marks and areas of significance within the land and groove impressions on the bearing surface caused by the rifling in the barrel,
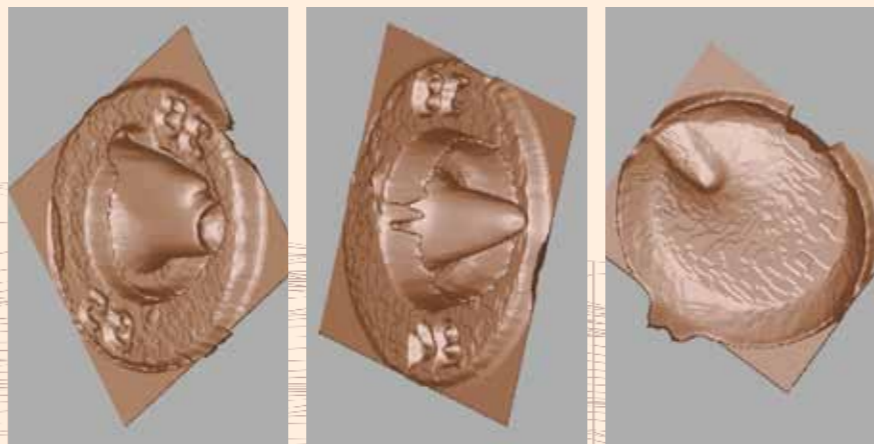
▶ *for cartridge cases* – toolmarks imparted to cartridge cases from having been loaded in, fired and extracted from firearms (the system enables the visualization of 12 types of characteristic marks).

Characteristic marks are outlined with quadrangles or circles colored according to the types of impressions. If necessary, the operator can correct the boundaries and position of those characteristics that were automatically defined and highlighted by the system during processing. There is a useful mode for superposing the surface profile on the image allowing the more accurate coding of characteristic marks. ARSENAL allows for automatic control over the accuracy of coding.

When coding characteristic marks on a cartridge case head, the forensic expert is allowed to choose any from the images obtained in diverse lighting conditions, viz. that one which presents the specified area of significance more legibly.

To expedite searches and to improve selectivity, ARSENAL provides the option to describe design features of the firing pin and ejector as well as peculiarities of surface treatment of the breech face of a particular firearm relevant to the case.

▶ *Bullet circumference coding screen*

▶ *Cartridge case head coding screen*

▶ *3D image rendition available at coding reveals peculiarities of the firing pin construction*

Images in ARSENAL are compressed using the proprietary method of WSQ image compression certified by the USA FBI.

ARSENAL ABIS uses a pinpoint algorithm for image recognition, the base of which is proved by many years' practice and experience of use of the PAPILLON automated fingerprint identification system (PAPILLON AFIS).

The probabilistic algorithms of matching compensate for random distortions of significant characteristic marks, occurring on deformed and fragmented exhibits.

Having been devised by PAPILLON's engineers and employed in the current version of ARSENAL ABIS, the method of consolidating 2D and 3D information improves the search selectivity when comparing cartridge cases by firing pin impressions.

The similar strategy is currently being elaborated in respect of breechface and ejector marks.

Upon the results of comparative trials between ARSENAL ABIS and IBIS, developed by Forensic Technology (Canada), that were conducted by the Forensic Science Service (FSS) UK, in 2002, a conclusion was drawn that ARSENAL ABIS is not inferior to IBIS FT in the respect of main search performance data but is much cheaper in price.
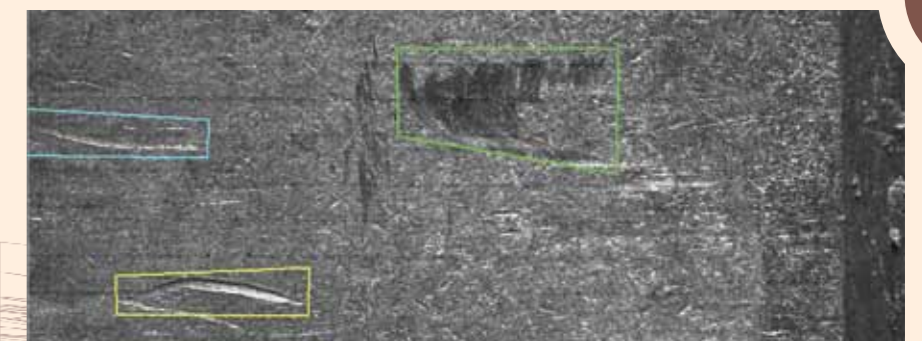
We consider that this reported price-quality ratio as to the two systems still remains in force.
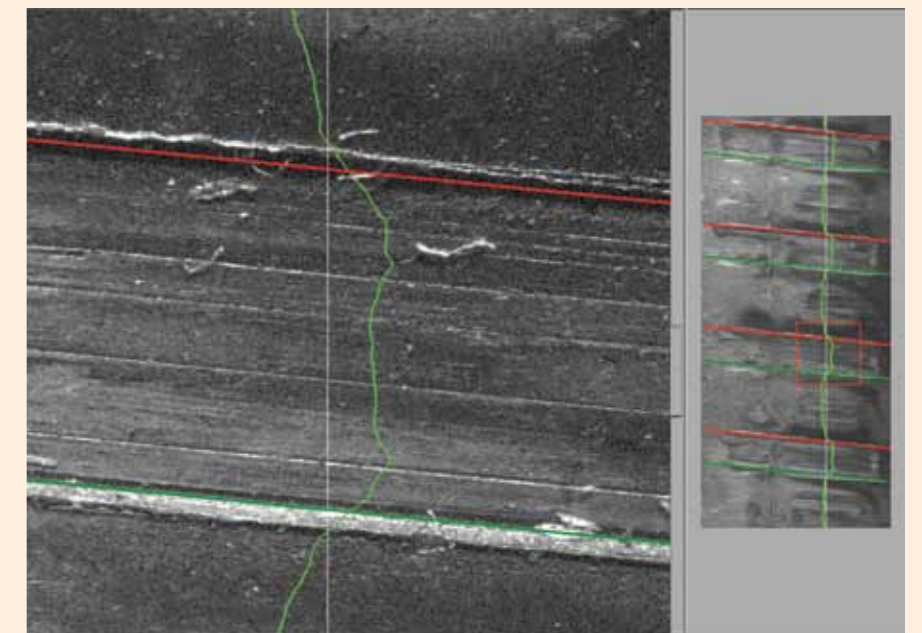
▶ *Profile superimposed on bullet circumference*
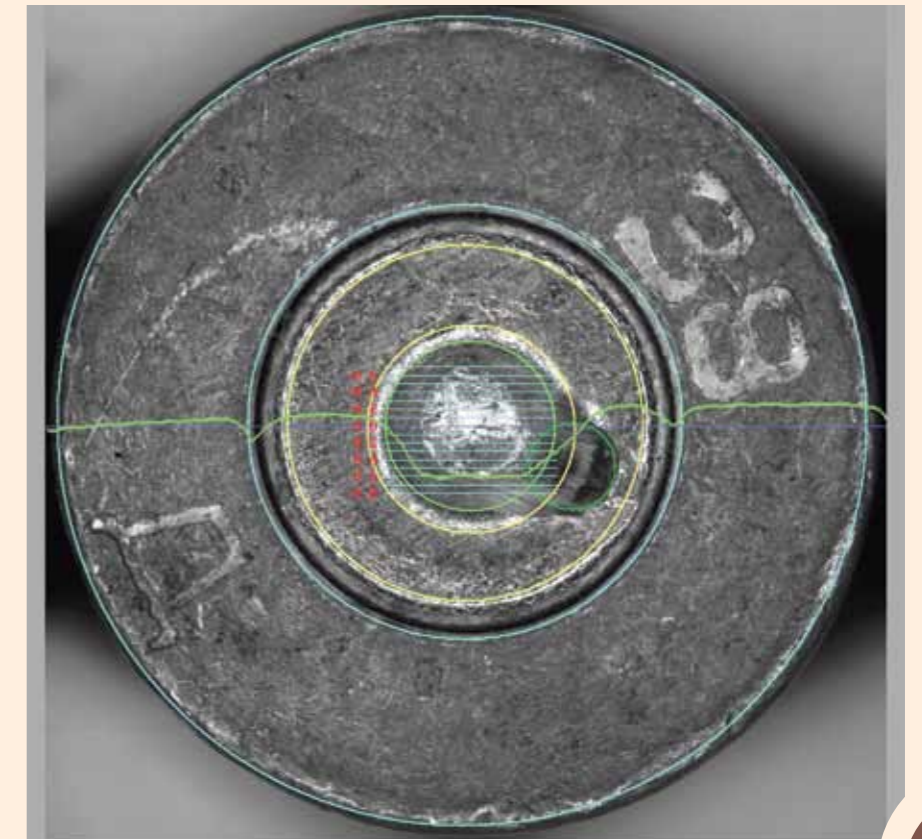
▶ *Profile superimposed on image of cartridge case head*

▶ *Areas of significance marked on cartridge case side*

Primordially, the ARSENAL ABIS was designed to run the Linux operating system.

For more ease of use and to comply with users' demands regarding an operating system to be employed and to sustain a flexible approach to configuring software-hardware complexes, it has been decided to implement some interactive program modules to be used by experts as cross-platform applications for both Linux and Windows operating systems.

The Database Viewer application in AR-SENAL is the first cross-platform module now available for operation. Currently being devised is a cross-platform program of scanning and that of coding.

▶
On the left, it is a simultaneous view of all characteristic marks on a target specimen for which candidates are found in the database; on the right, these are potential candidates matching the impression highlighted on the left

ARSENAL ABIS **DATABASE VIEWER**
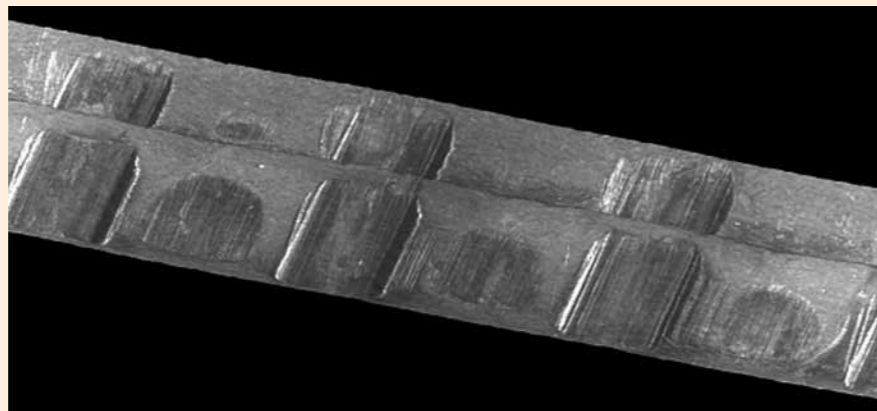
Database Viewer capabilities and tools:

▶ Retrieval of related text data, images of ammunition sample surfaces and characteristic marks; editing of alphanumeric data associated with any object stored in the database (including candidate lists).

Every event of editing related text data is logged in the system with an editing initiator's name, date and reason for editing indicated.

Many diverse facilities are available to assist in image viewing: scaling, repositioning and rotation of images on screen, quick move to the next (previous) outlined characteristic mark, adjustment of brightness and contrast, measurement of distances and angles, showing of marquee boxes and surface profiles.

▶ 3D rendering

The system is capable of generating several types of three-dimensional images. The operations of scaling and rotation are allowed for 3D images as well.
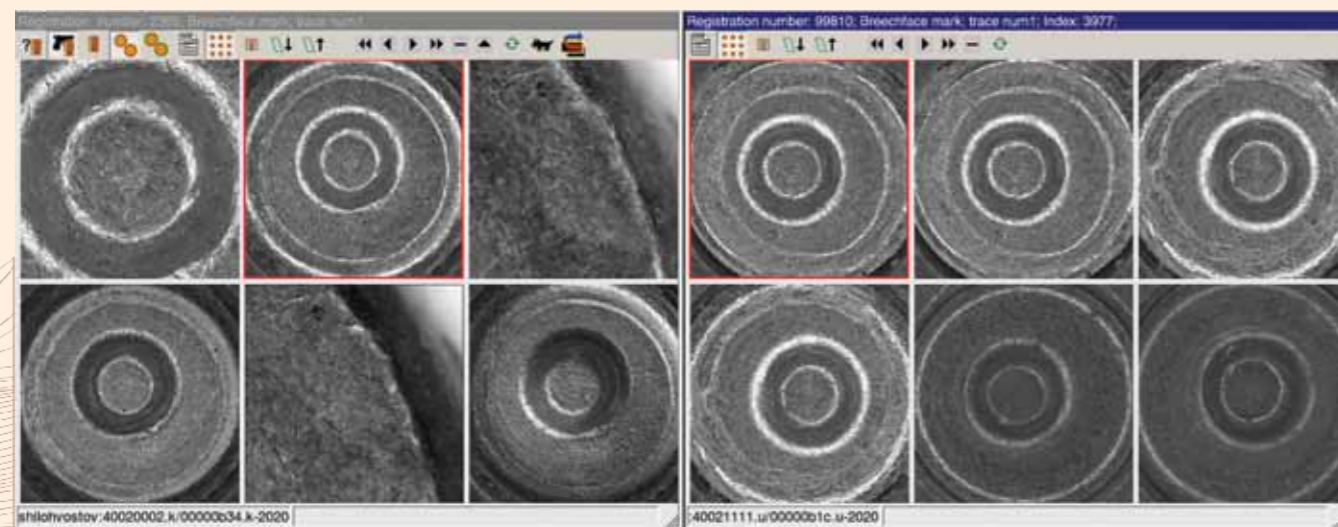

▶ *3D view of the bullet's circumference*

▶ Collating, filtering and other kinds of sorting as applied to lists of database records (including candidate lists)

▶ Seeking for an object or objects with specific properties in the database

▶ Viewing and verification of candidate lists

The system produces a single candidate list for a bullet sample.

For a cartridge case sample, a candidate list for every characteristic impression marked on its head is generated as determined by the matching process.

▶ Comparative analysis

Visual comparison is encouraged by the advanced tools for superimposing of either the complete views of ammunition samples or their certain characteristic marks or areas (in a side-by-side mode simulating a comparison microscope used by examiners) or by using the mode of overlaying when the upper of two images under study becomes transparent allowing the lower one to be seen through it. The said facilities are available to assist in both verifying and analyzing candidate lists and in viewing any two bullets/cartridge cases from the database collection.

The dividing line can be moved across the images to produce a split field image. There are some tools that provide better control over positioning and examining images, for instance, moving or rotating the images of two exhibits either separately or in a splicing mode, showing surface profiles.

Among the capabilities provided for cartridge case analysis, there is a special mode allowing for the comparison of depth maps (the lighter is the map of the image, the deeper is the indentation on the exhibit's surface).

▶ Hit lists

If upon closer examination the expert ascertains that the exhibits under study were fired by the same firearm, he declares their similarity by inserting them in a Hit List (such objects are assigned a maximum matching score and cannot be deleted from candidate lists).

▶ Repeated search of the database

The repeated search may encompass either all objects stored in the database or only those objects that match certain criteria specified (e.g. against those ones sorted by the incident date). The repeated search can be initiated against a particular section of the database (military weapons, service weapons, special guns, etc).

▶ Object recoding

This function is in demand when the expert has some doubts that the object is coded correctly. After the object is recoded, the reexamination is required.
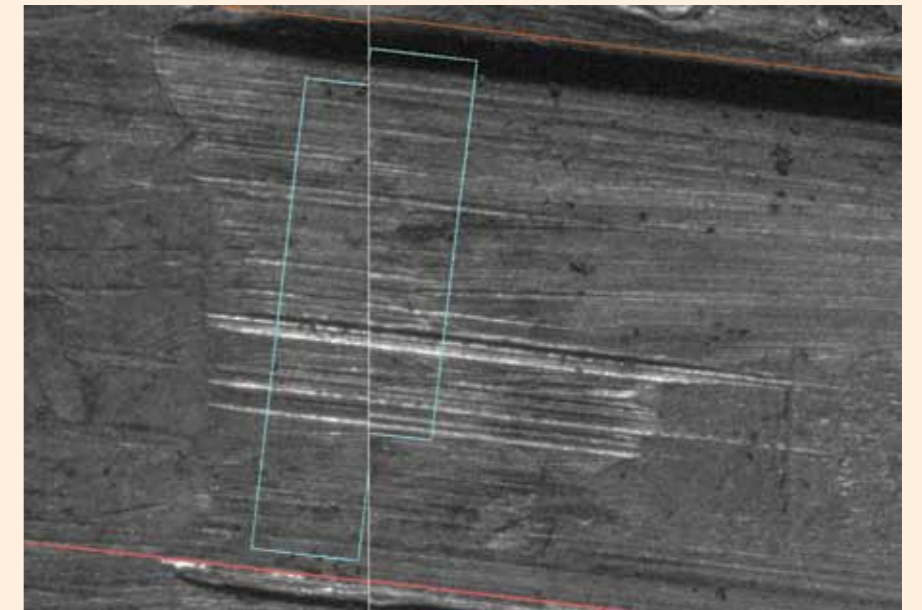
▶ *Side-by-side comparison of areas of significance on two bullets*
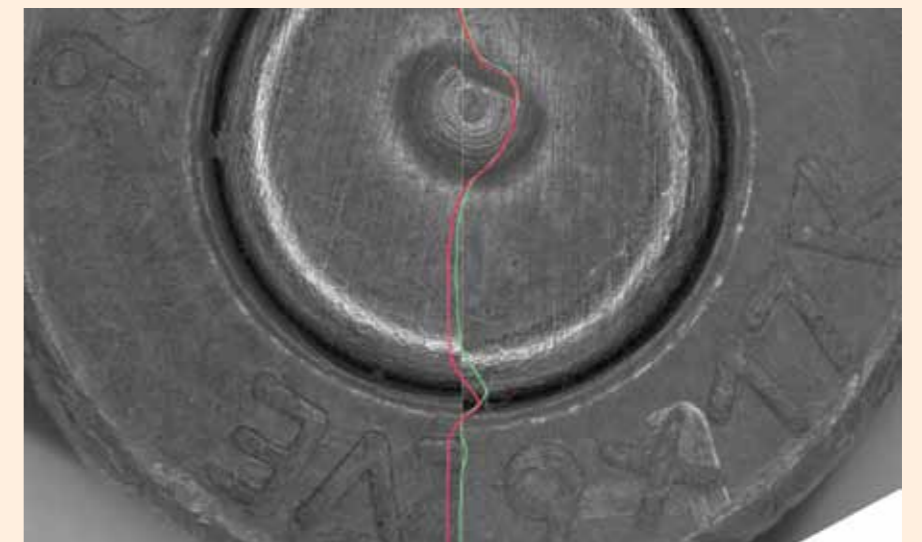
▶ *Side-by-side cartridge case comparison with surface cross-sections (profiles) superposed*

▶ Printing and reporting

Any information available in the database can be printed in a hard copy: images of entire surfaces and particular characteristic marks, 3D images, side-by-side viewer screens, related text data, lists of objects stored in database sections and candidate lists.

▶ Object removal

When deleting an object from the database, the date, time, reason for deleting and the name of an operator who deleted are recorded.

The recycle bin utility is used to recover objects deleted from the database by mistake. Operations of recovery or complete deletion from the 'bin' can be done by the system administrator only.

▶ Import/export of database objects

Import and export of ARSENAL ABIS objects through communications channels providing IP-connection enable remote transfer of data for inserting them into databases and for performing automatic searches as well as for organizing multilevel geographically distributed systems of firearm identification.

A single-machine ARSENAL ABIS station maintains a database of a 10,000 object capacity and sustains performance of all primary functions, viz. input of related text data and images, encoding, automatic correlations, verification of search respondents, and archiving.

A single-machine station is capable of functioning autonomously, i.e. off-line, or it can be a node within a networked system, or operating as a remote station within higher-level systems.

▶ *Configuration of a single-machine ARSENAL ABIS:*
  ▶ *PAPILLON BS 7 USB integrated ballistic scanner*
  ▶ *Computer*
  ▶ *Laser printer*
  ▶ *Modem (in case of remote application)*
  ▶ *Uninterruptible power supply*
  ▶ *PAPILLON ARSENAL software*

ARSENAL SYSTEM **ARCHITECTURE**

The ARSENAL ABIS configuration is determined by database record capacity, through-put required and a number of terminals needed for data entry and for operations with database objects.

The ARSENAL system has been designed to be effective in a Local Area Network (LAN) and over any other communication environment enabling IP-connection.

The system is based on a client/server architecture allowing workstations to independently request a server for a server's content or service function.

The following server functions are available in ARSENAL ABIS:

▶ maintenance of electronic collections of images related to database records

▶ accepting requests generated by workstations

▶ distributing computing (automatic correlations in the database)

▶ producing results of automatic correlations (candidate lists) and their delivery to re-questing workstations

▶ preparation of the text data part of ABIS database to be stored using an SQL DBMS.

The server functions are provided either by the resources of a single server unit or the tasks and workloads are partitioned between workstations.

The SQL-array is located on the server, if the server is a dedicated block, or on one of the workstations allotted for that purpose.

For large-sized databases, systems are configured using ad hoc computers (memboxes) for storing objects' images. In systems with a modest database capacity, workstations re-tain images.

To carry out searches in systems with high throughput requirements and large databases, process-specialized matchers are used.

The process of automatic comparisons is based on the parallel computing technology. The ARSENAL ABIS software allows for the use of several matchers as an integrated computational resource. In small-scale systems, all processing functions are distributed between workstations.

Operations of alphanumeric data entry, image acquisition and encoding, as well as analysis of candidate lists and examination of database objects are performed at workstations.

A modular design allows the system to be configured including an administrator's workstation enabling on-line control over the ABIS status and correlation performance, data archiving and system files backup, current monitoring and database management.

In 2011, PAPILLON released a mobile version of ARSENAL ABIS made to a special order by the Australian Federal Police (this collaboration began in 2010 with the provision of ARSENAL to the Australian Police for trial operation).

It is a totally mobile and stand-alone station fit into a functional and rugged transport case that can operate under all environmental conditions.

Being a full-featured ARSENAL ABIS workstation, it provides all the advantages of the ARSENAL software which guarantee accurate data acquisition and reliable maintenance of a local database and allows the expert to conduct ballistic examination in the field.

Mobile ARSENAL is also adapted for efficient operation in any vehicle.

▶ *ARSENAL ABIS Mobile Station*

ARSENAL ABIS **WORLDWIDE**

In 2008-2009, we have had the most massive supplies of the ARSENAL ABIS network systems abroad.

▶ *ARSENAL ABIS installed in the National Forensic Center of the Ministry of the Interior, Republic of Mongolia (rated database capacity is 100,000 objects):*
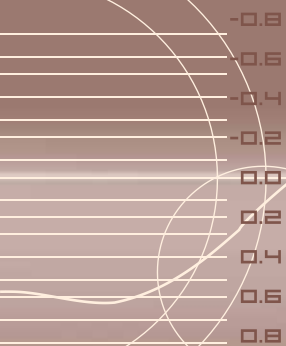▶ Central server ▶ Matcher ▶ 3 workstations each fitted with BS 7 USB ballistic scanners.

▶ *ARSENAL ABIS installed in Forensic Laboratory of the Criminal Investigation Department, Samara Police, People's Republic of Bangladesh (rated database capacity is 100,000 objects):*
▶ Central server ▶ Communications server ▶ 3 matchers ▶ 4 workstations each fitted with BS 7 USB ballistic scanners.

▶ *ARSENAL ABIS installed in Criminal Police of the Republic of Serbia (rated database capacity is 50,000 objects):*
▶ Central server ▶ Matcher ▶ 2 workstations each fitted with BS 7 USB ballistic scanners ▶ 2 remote stations fitted with BS 7 USB ballistic scanners and internal databases.

CONTENTS

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