

Marking, Record-Keeping, and Tracing of Small Arms and Light Weapons :

Contribution to the Third Session of the
Preparatory Committee to the United Nations
Conference on the Illicit Trade in Small Arms
and Light Weapons in All Its Aspects
(New York, 19-30 March 2001)

Ilhan BERKOL
Frédéric SCHUTZ
Michel WERY



Groupe de recherche
et d'information
sur la paix et la sécurité
Rue Van Hoorde 33
B-1030 Bruxelles – Belgique
Tél.: 00.32.2/241.84.20
Fax : 00.32.2/245.19.33
E-mail : admi@grip.org
Website: www.grip.org

Summary

Part I : State of International Initiatives

- 1.1. The necessary components of an effective international system for the tracing of small arms and light weapons (summary)
- 1.2. State of international institutional initiatives for the traceability of small arms and light weapons
 - 1.2.1. Regional initiatives
 - 1.2.2. Protocol against the illicit manufacture of and trafficking in firearms
 - 1.2.3. Initiatives within the framework of the Prepcom of the U.N. Conference
 - 1.2.4. Perspectives

Part II : Marking techniques

- 2.1. Marking : A Precondition for Tracing
- 2.2. Marking Techniques
 - 2.2.1. Stamping
 - 2.2.2. Laser Engraving
 - 2.2.3. Radio Frequency
- 2.3. Double Marking Technique
- 2.4. Marking Ammunition
- 2.5. Conclusion

References

Part I: State of International Initiatives

By Michel Wéry

1.1. The necessary components of an effective international system for the tracing of small arms and light weapons (summary)¹

The United Nations commission of inquiry attempting to determine the origins of weapons having arrived in Rwanda in violation of the international arms embargo produced very scanty results, at a disproportionately high cost in terms of the effort expended. At the present time, embargoes on small arms and light weapons imposed by the international community are very frequently violated due to the absence of any possibility of identifying, and therefore prosecuting, the persons responsible. Putting an end to the impunity of arms traffickers would certainly be a powerful preventive measure with regards to such traffic.

To accomplish this, it is essential to establish an international system effectively assuring the traceability of small arms and light weapons and their ammunition². This would imply an appropriate marking of all such weapons and ammunition, with an appropriate registration of all legal transfers, as well as an appropriate data exchange and management (tracing).

Adequate **marking** must, at a minimum, consist of a unique serial number permitting the rapid identification of the country and manufacturer of origin. It would also be desirable for such marking to include the first importing country, particularly when the latter has declared itself to be the end user. Technically, such marking must not affect the quality of the weapon, and must be cheap. Simultaneously meeting the requirements of simplicity and indelibility would imply the desirability of applying both a traditional marking³ (capable of being easily read by local security forces), and an indelible marking³ containing the same information. If the visible marking were eradicated, the duplicate, absolutely reliable, marking would still be available. The second part of the present report presents a summary of reliable techniques. Among them, laser marking has the particular advantage of being easily applicable to both weapons and ammunition.

The **registration** of transfers in light weapons and ammunition is only adequate when it permits the collection and processing of the necessary data for a reconstitution of the entire past history of a weapon in terms of transfers of ownership. It is also crucial to the cross-referencing of information to identify the pathways repeatedly utilized by arms traffickers. For this purpose, the centralization of all information relating to small arms and ammunitions in a central register, based on national registers, appears essential. This kind of centralization would also permit data protection on a durable basis. The information to be registered would include: the contents of the marking (here, the use of symbols is

¹ For additional details, please see the special report : "GRIP's Contribution in view of an international tracing system of small arms and light weapons", by I. Berkol, M. Wéry and F. Schütz, January 2001.

² In the present report, the terms "light weapons" and "weapons" are used rather generically, covering small arms and light weapons.

³ Or which cannot be eradicated without rendering the weapon inoperative.

certainly an obstacle), a description of the weapons or ammunition involved, and details of the transaction (date, names of shipper and consignee, points of departure, arrival, and transit). A harmonized, universally applicable system would greatly facilitate the registration and processing of data.

Tracing operations could then be conducted easily, rapidly, and effectively, through the international register. Of course, it would be important to ensure that the confidentiality of the information, and to determine the conditions under which such tracing operations (which would necessitate an inquiry) were to be conducted.

1.2. State of international institutional initiatives for the traceability of small arms and light weapons

1.2.1. Regional initiatives

a) Inter-American convention:

In November 1997, the Member States of the Organization of American States (O.A.S.) signed the "Inter-American Convention against the Illicit Manufacture and Traffic in Small Arms and Light Weapons and Ammunition, Explosives, and other Related Materials". This was the first international initiative of its kind. Nevertheless, to date, a number of Member States, including the United States, have not yet ratified this Convention.

→ Contents relating to traceability:

- To apply the marking during manufacture;
- A recommendation that Member States exchange information and engage in mutual co-operation.

b) OSCE document on small arms and light weapons

The document was adopted on 24 November 2000 by the Member States, in plenary session.

→ Contents relating to traceability:

- The related provisions apply to small arms and light weapons, defined as portable weapons manufactured or modified in conformity with *military* specifications to serve as lethal instruments of war;
- It is incumbent upon each participating State to determine the exact nature of the marking system;
- All weapons manufactured on the territory after 30 June 2001 are to be permanently marked in such a way as to permit the investigating authorities to determine at least the serial number of the weapon, the year and country of manufacture, and the manufacturer;
- The Member States are required to take steps, insofar as possible, and within the limits of their competence, to ensure that all small arms manufactured under their authority outside their territory shall be marked in the same manner;

- All small unmarked arms discovered within the framework of current stock management will be destroyed or marked;
- Exact and detailed records of small arms and light weapons held by the participating States, manufacturers, and importers are to be kept and retained for as long as possible;
- The participating States shall, before 30 June 2001, proceed with an exchange of information on the various national marking systems applied in the manufacture and/or importation of small arms and light weapons.

1.2.2. Protocol against the illicit manufacture of and trafficking in firearms

Concluded at Vienna within the framework of the Economic and Social Council of the United Nations (ECOSOC) on 2 March 2001, this protocol is legally binding in nature, and therefore constitutes the legal basis covering all the Member States of the United Nations. The objective of this protocol is to combat transnational organized crime. The arms concerned therefore exclude arms manufactured for military use, as well as transfers of non-military arms by the States.

→ Contents relating to traceability:

- During manufacture, the States shall apply: (i) either a unique marking including the serial number, country or place of manufacture, and the name of the manufacturer (ii) or an alternative marking consisting of simple geometric symbols in combination with an alphanumerical or numbered code, permitting ready identification of the State of manufacture (art. 9);
- A unique marking is to be applied to all imported weapons if the weapon does not yet bear such a marking. Furthermore, if the weapon already bears a unique marking, a simple marking permitting identification of the country of importation, and, whenever possible, the year of manufacture, shall be added. This principle does not apply to temporary imports (art.9);
- When there is a definitive transfer of a weapon to civilians, an appropriate marking has to be applied, permitting identification, by all other States, of the country making the transfer (art. 9);
- The States shall encourage the armaments industry to develop measures against the removal or alteration of markings (art. 9);
- To keep all records concerning the manufacture, exportation, and transit, for a period of ten years (art. 8);
- To establish a national contact point for purposes of police co-operation. Such co-operation shall be essentially bilateral (art. 14 et 15);
- To provide for the criminal punishment of *individuals* guilty of illicit traffic, illicit manufacture, or falsification of markings, when such acts are transnational in nature (art. 5);
- To provide for technical and financial assistance in certain cases (art. 18).

1.2.3. Initiatives within the framework of the Prepcom of the U.N. Conference

a) *Reflection document and working document by France and Switzerland presented at the Prepcom:*

In March 2000, France and Switzerland presented a common reflection document at the Prepcom (Preparatory Committee of the United Nations on the Illicit Trade in Small Arms and Small Calibre Weapons in All Its Aspects), entitled "Contribution to the Implementation of an International Action Plan for the 2001 Conference on the Marking, Identification, and Control of Light and Small Calibre Weapons" (A/CONF.192/PC/7). This was supplemented, in January 2001, by a "working document", relating to the implementation of a tracing mechanism.

→ Contents of the latter:

■ On the national level:

- marking of *all* light weapons "in an adequate and unique manner", upon manufacture, and the destruction, or marking, in the same manner, of all inadequately marked weapons;
- creation of registration systems ensuring the gathering and processing of determined information by the authorities;
- ensuring that all marking and registration systems permit unequivocal identification of the countries of authorized manufacture and importation.

■ On the international level: the States undertake to co-operate by responding, in a precise manner, to requests for information originating from other States or from the U.N. (in the case of embargo violations), while taking care to preserve an adequate level of confidentiality.

b) *Bamako Declaration on the common African position on the proliferation, circulation, and illicit trafficking in small arms and light weapons.*

Document of the Organization of African Unity, adopted on 1 December 2000, within the framework of preparation for the United Nations Conference of July 2001.

→ Content relating to traceability:

- To conclude, on a voluntary basis, bilateral agreements with neighbouring countries with a view to the creation of a common and effective control system including, in particular, the registration of small arms and light weapons;
- A movement towards regional harmonization relating, among other things, to standards of marking;
- A commitment to regional efforts relating, in particular, to training and the exchange of information, as well as support to common initiatives intended to contain and reduce illicit traffic.

c) *Action plan of the European Union:*

On 14 December 2000, the European Union presented the Prepcom with a verbal note accompanied by the text of its action plan for the United Nations Conference of July 2001 (document A/CONF.192/PC/21).

→ Content relating to traceability:

■ On the national level:

- A requirement that all light weapons bear a marking considered to be adequate, reliable, universally recognized, and feasible at reasonable cost, permitting determination of the origin of the weapon (unique serial number of each weapon, manufacturer and place of business, year of production);
- The marking or destruction of all unmarked weapons, which could be collected or seized, or removed from existing stocks;
- The establishment of national registration of weapons owned by lawful authorities, covering all aspects of production, stocks, and transfers. The States should retain all such data for a long period of time, at least 50 years, while furthermore taking steps to prevent the loss of such arms.

■ On the sub-regional, regional, and international levels:

- The development of standards permitting the adoption of a common marking system which could be universally applied in order to facilitate international co-operation in the tracing of weapons illicitly marketed or transferred;
- A consideration of additional regional or sub-regional instruments or codes of conduct with a view, in particular, to the establishment of measures of transparency, such as systems of registration and data gathering agreements, as well as mechanisms for the exchange of the available information.

d) *Draft action plan to prevent, combat, and eradicate the illicit trade in small arms and light weapons in all its aspects.*

This working document (often called "L4"), was drawn up by the Chairman of the Prepcom, Ambassador Carlos dos Santos, and distributed on 9 February 2001. This is a fundamental document within the framework of the United Nations conference, since it will be used as a basis for discussions at the third Prepcom meeting (19-30 March 2001).

→ Contents relating to traceability:

- General principles:
- To develop international arrangements and a legally binding instrument to enable timely and reliable tracing by relevant authorities (II § 35);
- Mutual co-operation by the States in the tracing of illicit small arms and light weapons, in particular, through the strengthening of mechanisms based on the exchange of information. Such co-operation shall include all measures already anticipated in legally binding international, regional, and inter-governmental instruments (III, § 11).
- On the national level:
- To ensure that adequate and reliable markings will be applied to all small arms and light weapons during manufacture (II § 5);

- The content of such markings should be unique and should identify the country of manufacture, and also provide information that enables the national authorities to identify the manufacturer and serial number (II § 5);
 - The expeditious destruction or adequate marking of all inadequately marked arms, which would be collected or seized, and prevention of the manufacture, stockpiling, and transfer of inadequately marked weapons (II § 6);
 - To ensure that comprehensive and accurate records are kept, for as long as possible, on the manufacture, holding and transfer of small arms and light weapons. These records should be organized and maintained in such a way as to ensure that accurate information can be promptly retrieved and collated by competent national authorities (II § 7);
 - To ensure accountability for, and the effective tracing of all weapons owned and issued by the State (II § 8);
 - To make public or submit relevant regional and international organizations, in accordance with their national practices, information on, inter alia : (a) weapons having been confiscated and destroyed; (b) national laws and regulations, and processes that impact on the prevention and reduction of the illicit trade in small arms and light weapons; (c) any other relevant information, such as illicit trade routes and techniques (II § 22).
- On the international level:
 - Regional organizations should establish and/or build upon established partnerships to share resources and information on the illicit trade in small arms and light weapons in all its aspects (III § 5);
 - States are encouraged to use the facilities of Interpol, in particular through the timely and complete provision of information to its Weapons and Explosives Tracking System (IWETS) database or to any other database that may be developed (III § 9);
 - States undertake to exchange information on their national marking systems (III § 12), and to co-operate to examine technologies which are both affordable and accessible to all producers (III § 10).

1.2.4. Perspectives

A number of regional and international initiatives relating to traceability have been drawn up since 1997. The recently concluded Vienna Protocol is a major achievement, since it is legally binding, and covers all United Nations Member States. The Protocol is nevertheless based upon another approach, and reflects a very different philosophy from that of the United Nations Conference of July 2001. While the latter is intended to eradicate the illicit trade in small arms in all its aspects, and is based on a perspective of *armaments control and disarmament*, the objective of the Vienna Protocol relates solely to *transnational organized crime*.

It is not, therefore, surprising that the measures set forth in the Protocol are far from being adequate to permit effective struggle against illicit trade ; all small arms for military use are excluded from the very outset, the Protocol is aimed solely at repressing the illegal activities of organized individuals, etc.

The United Nations Conference of July 2001 is a historical opportunity to lay the groundwork for a binding international system enabling the traceability of all small arms. A successful show of support to, at the very least, the general principles proposed in the

draft action plan of the Chairman of Prepcom, Ambassador dos Santos is therefore essential (II § 35 et III § 11).

In the longer run, some crucial issues nevertheless remain to be resolved, in the sense that these issues will strongly determine the effectiveness of any international traceability system. In particular:

- Does the system involve all small arms and ammunition?
- Are already existing weapons to be marked, and if so, how?
- Will there be a duplicate marking, that is the only to meet simultaneously the requirements of being easily read and indelible ?
- Will a confidential international register be created for the purpose of centralizing all the information? Such a register would enable : (i) great improvements in the quality and rapidity of tracing, (ii) the cross-referencing of individual items of information, and, therefore, the identification of traffickers routes, while providing (iii) a backup data register in the event of damage to the national registers.
- Would the data be kept, at the very least, throughout the lifetime of the weapon?
- What are the criteria under which the decision would be taken to conduct a tracing operation?
- Would technical and/or financial assistance be available to assist the economically poorest countries in meeting their commitments?

Part II : Marking Techniques

2.1. Marking : A Precondition for Tracing

Tracing is a procedure that is applied for a wide array of products, ranging from banknotes to cars. Firearms are no exception to this rule. Tracing firearms would enable to pinpoint those responsible for the illicit use of small arms and ammunition, and contribute to the struggle against their trafficking and proliferation as well as their harmful effects in armed conflicts.

In our previous works [Berkol, 2000 ; Berkol, Wéry and Schütz, 2001], we examined the instruments enabling a given firearm's path to be tracked, such as marking, registering and tracing. Figure 1 shows that tracing is directly dependent on the very presence of marking—unique to each manufacturer—and how decipherable it is. Tracing should enable criminal examination, a determining element in the struggle against organized crime and illicit trafficking in arms.

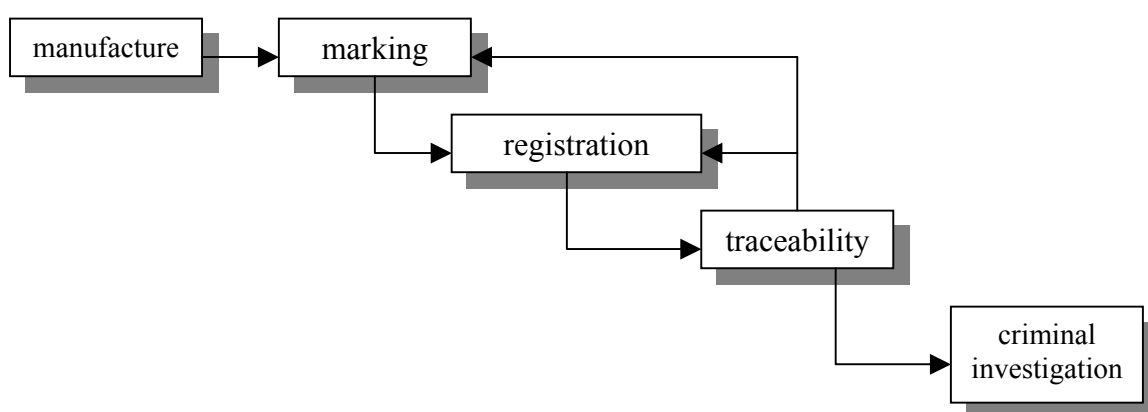


Figure 1 : Diagram illustrating the various steps in the overall process of tracing firearms.

Each serial number or code is an identifying marker, which makes each arm unique and distinctive. Adequate marking, therefore, is a prerequisite for optimal tracing. An arm that is not marked can neither be registered nor traced. The first step in this direction would thus be to focus on marking and define the elements it should contain. Next, a method for registering arms should be examined.

Marking is a pivotal step in the process of tracing firearms. These should initially be marked at manufacture with the minimum data required : a unique serial number that includes the year of manufacture, the country of origin and the manufacturer's name.

The firearm is then registered using this mark as a point of reference. Tracing is possible only if the arm's identifying data is recorded in a register that is preferably centralized and computerized. Information contained therein must fulfill certain requirements. First, the marking should be unique and distinctive, which limits the methods that can be used to mark serial numbers (this would exclude the method of casting in order to avoid any potential duplication). Next, the marking method should fulfill specific criteria :

1. it should not impair the quality of the arm's technical performance ;
2. it should be almost indelible, lasting and difficult to falsify ;
3. the cost by unit of production is not so high ;
4. it should be simple (easily applied in any country) and, preferably use the same method worldwide;
5. it should be applied on the arm's main part as defined as such by the manufacturer, and could also be applied to several other parts as well. Replacing the basic part should be prohibited with the exception of the standard exchange of the former part with a new one duly marked ; the register would be updated with the corrected information.
6. it should produce an inscription that is resistant to potential criminal obliterations and enable at least one marking element to be a point of reference in the register.

We mentioned in our previous works that current marking methods do not fulfill these requirements. These markings are easily removable, by filing or boring them off.

2.2. Marking Techniques

2.2.1. Stamping

A variety of marking techniques exist and should be examined so as to adapt one of these to firearms. The most commonly used method is stamping, which has the drawback of producing an easily erased marking. The same disadvantage applies for other techniques like casting, engraving and electrochemical methods.

Mechanical deformation would be an interesting solution. It consists of drilling tiny holes to mark the code in the arm's frame or receiver. This technique is administered using a Vickers' hardness tester to measure how much pressure to apply when drilling, a technique similar to stamping, but producing a marking rendered "invisible" by polishing it when the part is being finished. An approximate 0.5 mm-deep mark remains beneath the surface. For it to be visible again, a special chemical solution used for standard metallurgical tests is applied. The advantage to this method is that it is cheap and the hardness testing device is needed anyways for precision-production of the metal parts of small arms. The drawback is that this method can neither be used to mark smaller parts, as this could alter or destroy them, or to mark arms already in circulation.

2.2.2. Laser Engraving

To fulfil all the above-mentioned criteria, additional techniques should be proposed. One of the most advantageous solutions would be to use a laser (*Light Amplification by Stimulated Emission of Radiation*), which makes both relief- and depth-marking possible, depending on needs (Figure 2).

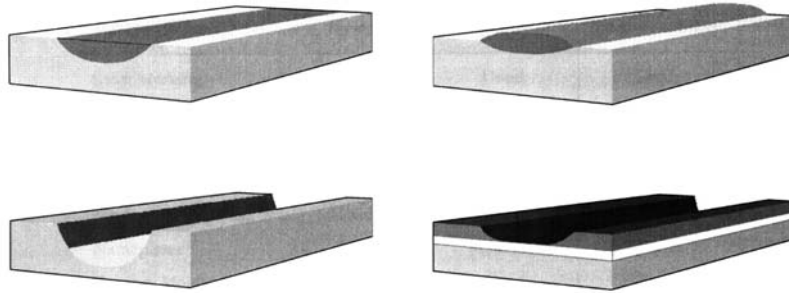


Figure 2 : Diagram illustrating the possible ways to implement laser engraving [<http://135.145.12.198/acrob.htm>].

Figure 2 shows sections of material that has been laser-engraved : surface marking ; depth marking (metal vaporization) ; relief marking (smelting) or layered-marking. The range of possibilities is important since no particular and specific method to mark firearms has yet been universally adopted. Laser provides a range of marking possibilities in comparison to the stamping technique : deep stamping could alter the support whereas laser marking can be as deep as 20 mm in the metal. Any attempt to remove the marking would thus ruin the firearm. Also, serial numbers could not be marked on smaller parts by stamping without damaging these as well. Moreover, laser marking could be used for arms already in circulation.

Laser engraving could be used to mark a serial number or to encode data, either in matrix or bar code form, for example.

a) Matrix Encoding

A data matrix is formed using a series of points to encode data (Figure 3). Three points outside the matrix delimit the relative position of each point. This reference enables a value to be attributed (a number or letter, for example) to each of the other points.

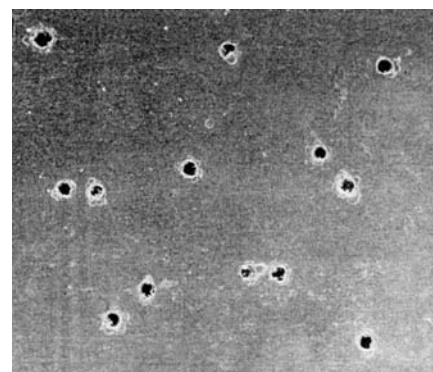
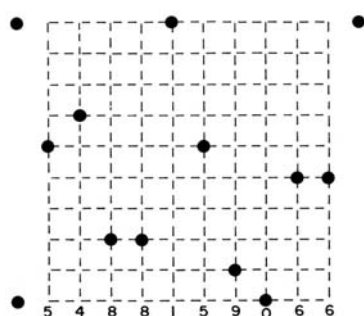


Figure 3 : Diagram illustrating : (left) a matrix code (number "5488159066") ; (right) a laser perforation on a surface [Polk et Giessen, 1975].

This type of coding would be interesting because it would render adding data for criminal purposes difficult. Few people have the equipment needed to do this. To effectively prevent any possible removal, the marking should be on an arm's basic part which would be destroyed if the marking were tampered with, and would render the arm inoperable.

The surface could be treated so as to render the marking visible solely under special lighting (ultraviolet or infrared). In this case, the surface would be sensitized for a specific wavelength (1064 nm, for example, the wavelength of a Nd:YAG-type laser⁴), and data would be laser engraved. Next, the marking can be covered in a layer of paint or by galvanization. The data could then be read under special lighting, and computer-enlarged (if need be) and decrypted.

b) Bar Coding

Bar code technology is part and parcel of the more general use of automatic identification, a field that also includes radio frequency. Bar coding is relatively well known since it is used on objects we are in contact with every day. The data is coded in a "symbology" consisting of a series of black and white bars (Figure 4). A special "player" reads and decodes the signal, which can be done from a distance ranging from a few centimeters to few meters.



Figure 4 : Bar Code representation.

Bar coding can involve several different kinds of symbologies, the most common being 39, 13 and PDF 417. These symbologies are international, enabling them to be read by a range of devices. The codes are read by scanning a light source over them (a scanner, for example) which is absorbed or reflected depending on whether reading a black or white bar. The light signal is then turned into an electronic signal and can be read by the device.

The advantage of this type of code is that it can store a great amount of data on a relatively limited surface. This data can be modified or complemented by adding a new bar code, but this type of addition would weigh marking down.

This is important to note, for several reasons. The current method of stamping mostly produces a non-modifiable alphanumeric code. However, sometimes it is crucial to be able to add data when a firearm part is replaced (the barrel, for example), or for any other modification to a firearm's original serial number (for arms already in circulation, for example). There are two possible solutions : complementary data can be marked either on

⁴ NdYAG type laser (Neodymium, Yttrium, Garnet Alluminum) ; see <http://135.145.12.198/acrob.html>

the arm's original serial number (by adding a bar code if need be), or directly in a register instead.

2.2.3. Radio Frequency

Radio frequency is more complex, even if we commonly encounter its application in our every day lives (for theft prevention in supermarkets, for example).

A radio frequency label is composed of a microchip with large data-storage capability, and antenna. These components form what is called a transponder. Data can be retrieved using a special reader (portable or not). For optimal tracing of firearms, only designated officials would be able to read and/or modify data through the metal itself. Data could also be permanently "frozen" (marking). Hand-held reading devices can be used if need be. If necessary, the microchip could store data on the arm's every transaction. For long-term conservation, the microchip could be cast in the firearm during manufacture in a location known only to experts and any alteration would render the arm inoperable as the part serving as a matrix to the support would be destroyed.

The cost of adding this kind of tag should not cause an increase in the sales price of firearms. Moreover, introducing this microchip should neither destabilize the arm nor alter its operability. This chip would also be resistant to the physical strain that occurs when shots are fired (elevated temperature and pressure, shocks, etc.).

2.3. Double Marking Technique

To meet the criteria of simplicity and indelibility, this technique applies at least two markings to the firearm, either using the same technique or two different ones. The first would be applied using the traditional stamping method to mark basic data (readable by the naked eye directly at the scene of the crime by a police officer), while the second marking would be more sophisticated and indelible, decipherable only by competent authorities (retrievable on a needs basis ; falsification or attempts to access this mark would render the arm inoperable). This second kind of marking would be a safeguard ensuring that data required for tracing remain retrievable. For this effect, markings are administered on parts that are not easily removed once a firearm is manufactured, such as the ejector, breechblock or extractor using techniques like computer-assisted laser engraving or perforation which could mark a surface of just a few square millimeters without coming into contact with the material (Figure 5).

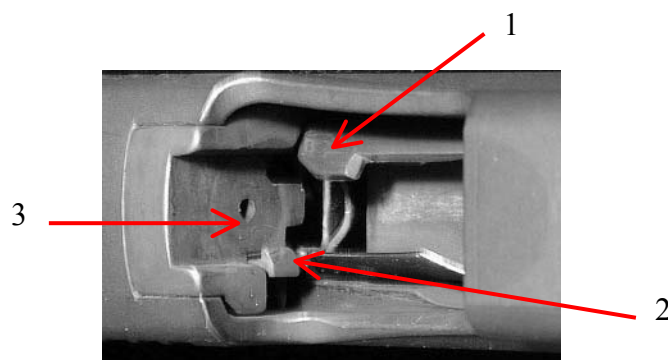


Figure 5 : Illustration of an ejector (1), extractor (2) and breechblock (3) on an SIG P220 semiautomatic handgun.

Laser equipment costs no more than traditional laboratory equipment and uses simple technology. In mass production, the cost per unit of production would be quite reasonable compared to the cost of subsequent falsification which would certainly not be profitable for traffickers and would put the firearm's performance at risk.

It should be noted that techniques other than laser technology could be used for basic marking, depending on the case, as long as they produce reliable results. Thus, for some type of firearms, duly applied stamping could be sufficient.

2.4. Ammunition Marking

For an efficient tracing of ammunition, a combination of two or more marking techniques should probably be used, as the data collected will be more or less complete depending on the point at which ammunition is controlled, that is, whether pre- or post-fire, and whether its original packaging is available. If the packaging can be retrieved, the information it displays should enable tracing the origin, the manufacturer and the contents' initial transaction.

A cartridge case (or round) can be marked in a variety of ways through its five constituent elements: the projectile, the shell, the powder, the primer cap and the primer [Berkol 2000]. The basic elements to be marked should be predetermined for the most appropriate set of marking techniques to be applied.

In the same vein, marking should also be standardized, as there is currently a great variety of inscriptions on the shell bottom. Data should involve : a unique lot number including the year of manufacture, the code of the country of origin, the manufacturer code and possibly the code of the initial purchaser. Adding the date of manufacture, model and caliber would also be possible.

For the cartridge case and primer cap, any marking technique for metal parts can be used. Stamping and laser engraving seem to be the most recommended methods. Nevertheless, laser engraving has the advantage of being easily applicable, even after manufacture, without affecting the quality of the product's performance, and has a reasonable cost per unit of production.

Two problems can arise in terms of use: first, cartridges can be picked up after use so as to make them "disappear", second, used cartridges can be refilled with a different powder, and if they are used by a different end-user as well, establishing responsibilities would be complicated. These problems can be resolved by adequate marking of the powder or bullet.

Following the example of Switzerland's explosives marking system, the powder and primer in a cartridge could be marked by introducing chemical, fluorescent, radioactive or magnetic taggants. Three products, used to mark explosives, were recommended (Table 1).

Manufacturer	Product Name
3M Company	Microtaggants
Swiss Blasting AG (Bülach)	HF6
Plast Labor (Bulle)	Explotracer

Tableau 1 : Chemical taggants used in Switzerland to mark explosives
[Swiss Department of Foreign Affairs, 1999; Rouhi, 1995].

This "invisible" marking tends to hamper potential falsifications or obliterations of information. If such a strategy were adopted, a rigorous protocol on the sampling method should also be required. It should be pointed out that when a firearm is discharged, powder and primer residue are propelled (mainly) in the direction of the shot fired and are spread in the air. This makes it impossible to collect a sample. Only residue deposited on a target or remaining in the shell could be analysed to trace ammunition.

The issue of the cost in implementing this kind of marking system and its impact per unit of production should be further examined to determine its applicability for widescale production.

Remark

Chemical taggants can also be used to mark firearms ; they would be directly added to the arm's base material at manufacture and would enable manufacturer-specific codes to be marked⁵. This manufacturer's "signature" could help overcome the problem of falsification.

2.5. Conclusion

These suggested techniques are not ends in themselves, but should be applied in the general context of using double marking to guarantee the effectiveness of tracing. Double marking seems to be the best protection against criminal obliteration on condition that the second marking be applied on the small arm's basic part and in a location that is difficult to discern.

Among the various techniques, laser engraving appears to be the best-suited method for basic marking and should thus be combined with marking by traditional stamping. Nevertheless, other combinations are foreseeable and their fulfilling the adequate marking criteria should be studied in depth before implementing their widescale use in production.

On the other hand, it is highly recommendable that an international Agency, established within the framework of the UN, permanently centralises all recorded transactions and operates the controls and the follow-up of light weapons and ammunition. Endowed with a central headquarter, the Agency would act in connection with national offices depending

⁵ For example, the "rare earth" chemical elements, which are found in quantities of 14, taken 3 at a time, can provide numerous combinations. They can be mass spectrometry assayed.

on the States that would have adhered to it, for example by signing and ratifying an international convention.

We already emphasized the importance of the adoption of the principle of an international convention foreseeing such systems on the occasion of the United Nations Conference on Small Arms Trafficking in all its aspects [Berkol, Wéry and Schütz, 2001]. In order to find a definitive solution to the problem of marking, the Convention should be assisted with a commission, formed of industrials, experts and political representatives, that would examine in detail the universal marking method that would be applicable to the small arms in order to have a reliable tracing in the practice.

REFERENCES

Berkol I. : « Marquage et Traçage des Armes Légères », *Les Rapports du GRIP*, No. 2000/2, June 2000.

Berkol I., Wéry M. and Schütz F. : « Contribution du GRIP en vue d'un système international de traçage des armes légères », *Les Rapports du GRIP*, Special Issue, January 2001.