small arms survey

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Marking of Firearms and Ammunition

At the core of the international community's interest in the marking of firearms and ammunition is a desire to improve tracing and stockpile security worldwide. Successful weapons tracing relies on three key practices: marking, record keeping, and international cooperation.

These three practices are intrinsically linked; effective marking establishes a unique link between a firearm and a record; clear and accurate records allow states to reconstruct the history of a weapon; and established protocols for cooperation allow states to send and receive responses to international tracing requests. In short, appropriate marking is the first essential step to achieve effective tracing.

International requirements for small arms and light weapons marking

Marking has featured in international efforts to curb the illicit small arms trade since the late 1990s.[1] Universal requirements for marking are outlined in the International Instrument to Enable States to Identify and Trace, in a Timely and Reliable Manner, Illicit Small Arms and Light Weapons, also know as the International Tracing Instrument (ITI). According to the ITI, marks are to be:

- placed on an exposed surface;
- conspicuous without the need for technical aids or tools to see them;
- easily recognizable and readable; and
- durable and, as far as technically possible, recoverable (UNGA, 2005, para. 7).

In addition to prescribing in general terms the physical characteristics of weapons markings, the ITI indicates the kind of information the markings must or should contain. At the time of manufacture, this includes:

- the name of the manufacturer (required for states with alphanumeric marking systems);
- the country of manufacture, in numeric and/or alphanumeric code (required for all states);
- the serial number or other unique marking (required for all states);
- the year of manufacture (encouraged);
- the weapon type/model (encouraged); and
- the calibre (encouraged) (UNGA, 2005, para. 8a).

In addition, weapons are 'to the extent possible' to be marked at the time of import with the following information: country of import, where possible the year of import, and a unique marking (for unique identification) if one is not already present (UNGA, 2005, para. 8b).

Marking technologies: which to use?[2]

As indicated above, although the ITI prescribes the physical characteristics and content of markings, it specifies that the choice of marking *method* 'is a national prerogative' (UNGA, 2005, para. 7).[3] In practice, the choice of marking methods is broad, with several technologies available for weapons. In general terms, for a marking method to be effective, it should:

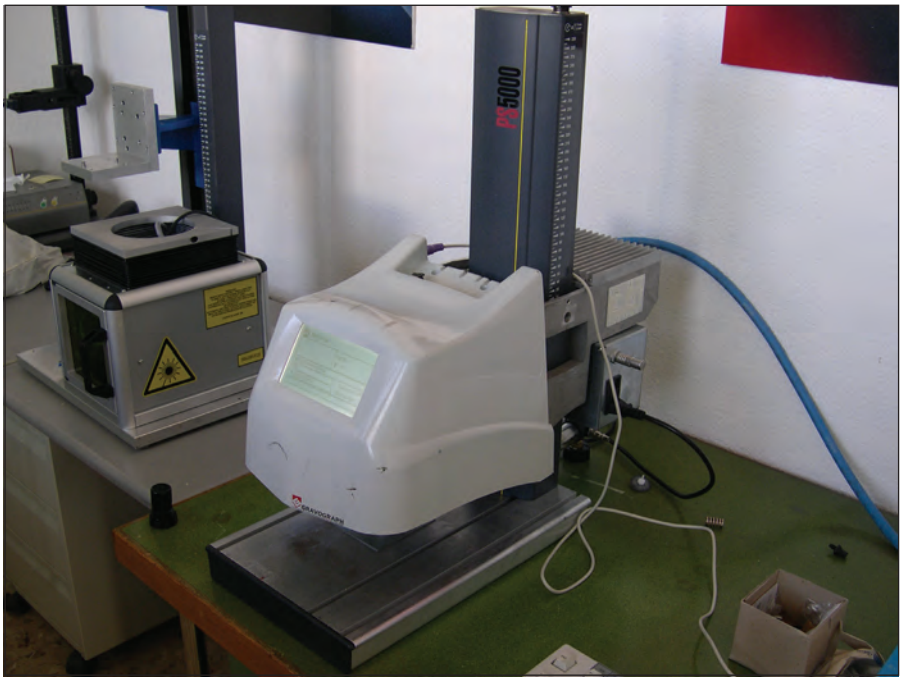
- avoid damaging the performance and technical quality of the weapon, which is a particular concern in post-manufacture marking;
- be easy and quick to use;
- preferably be able to apply marks to several components using a single machine;
- result in a readable, durable, and—where possible—recoverable (in case of defacement) mark; and
- have an acceptable cost per unit produced or marked.[4]

All of the major marking methods in current use take one of two approaches: (1) deformation or (2) removal of material. As shown in Table 1, both categories have distinctive strengths and limitations (Persi Paoli, 2010). 'Deforming' marking methods, such as stamping and dot peen (see Figure 1), apply the mark by deforming the surface either through impact or by compression. 'Material removal methods', also referred to as 'engraving methods', carve the material, either mechanically or with the use of a laser beam (laser engraving) (see Figure 2).

Users need to consider several factors before purchasing marking equipment. Firstly, the suitability of a particular technology will depend

on whether marking is to occur at the time of manufacture or post-manufacture. Marking technologies also vary as a function of the type of material or the specific part or component to be marked. Users also need to consider such characteristics as speed, the durability of resulting marks, and purchase and operating costs (Persi Paoli, 2010). Table 1 illustrates the strengths and limitations of the four primary weapons-marking technologies.

Figure 1 **Dot peen marking**



In this pneumatic dot peen-marking machine the air is supplied through the blue pipe. The user interface includes a built-in liquid crystal display and an external keyboard (i.e. a standard computer keyboard).

Photo courtesy of GravoTech GmbH, Switzerland.

Figure 2 **Laser engraving**

Since laser-marking machines such as this one apply marks without any physical contact, the firearm does not need to be locked to avoid movement during the marking process. Once the object to be marked is positioned, the safety cabinet needs to be closed before the marking begins.

Photo courtesy of GravoTech GmbH, Switzerland.

Marking of ammunition: a primer

Generally speaking, the purpose of ammunition marking[5] is similar to that of firearms marking: identification, classification, and record keeping to ensure traceability. Individual small arms cartridges are not, however, normally marked with unique identifying information. Instead, most of the information vital for tracing purposes is found on the packaging, which only allows for the identification and tracing of the packages (ammunition lots). Although this often makes it impossible to uniquely identify (and trace) a specific item of ammunition, existing, non-unique ammunition marks can be used to identify patterns of procurement and transfer (Bevan, 2008, p. 45).

In contrast to weapons marking, which is governed by instruments such as the ITI, there are no universal standards for ammunition marking. What standards there are apply to particular regions and ammunition types. These include the Permanent International Commission for Firearms Testing standards for civilian ammunition (for Europe) and NATO regulations for military ammunition (for NATO members in the Euro-Atlantic region) (CIP, 1991; NATO, 2008).

Current ammunition-marking practices

Ammunition marking, especially for small calibres, must be able to deal with the limited dimensions and fragility of the relevant item. Stamping remains the most commonly used method of marking. Marks (also known as 'headstamps') are applied to the rim of the cartridge cases using press stamping (see Figures 3 and 4), while roll stamping is used for marks applied to the sides of the cases (Persi Paoli, 2011, p. 7). With this method, marks are applied early in the production process before the case is charged with the primer and other components.

Recently, producers have started using laser-marking techniques to mark ammunition. This new technology allows producers to overcome the space and pressure limitations of the traditional ammunition-marking

Table 1 **Strengths and limitations of marking methods**

Marking method and price	Strengths	Limitations
Stamping Price range for entry-level models: USD 5,500–6,800	■ Recoverability of the mark (highest probability among marking methods) ■ Low price	■ Not recommended for post-manufacture marking ■ Potentially damaging to fully assembled firearms ■ Does not work on plastics
Dot peen or micro-percussion Price range for entry-level models: USD 6,800–9,000	■ High speed ■ Low price ■ Low stress on components	■ Low resolution of the mark ■ Very noisy process ■ Not optimal on plastics ■ Need to lock the object to mark
Mechanical engraving/scribing Price range for entry-level models: USD 16,000–19,000	■ High quality of the mark ■ Quiet process	■ Relatively low speed ■ Need to lock the object to mark ■ Frequent maintenance of the cutter to ensure the quality of the mark ■ Not optimal on plastics ■ Marks are not recoverable if altered
Laser engraving Price range for entry-level models: USD 41,000–48,000	■ High speed ■ High quality of the mark ■ Marks both metals and plastics ■ Does not require locking systems ■ High automation capacities ■ No physical contact with the object during the marking process and resulting possibility of marking assembled firearms ■ High precision even on extremely small surfaces	■ High price ■ Marks are not recoverable if altered ■ Special safety requirements: use of a safety cabinet limits the size of the object that can be marked; if a safety cabinet not used, additional safety measures need to be taken to protect the operator and isolate the room

Source: Persi Paoli (2010, p. 10)

Figure 3 **Stamping using combined-action machines**

The case enters the machine as it appears on the right of the photo and exits with the marks and the lodging for the primer, as on the left. Photo courtesy of Fiocchi Munizioni. © Giacomo Persi Paoli

Note: In this process, stamping is added together with the primer lodging. In this particular example it is possible to note that this case has been marked in accordance with NATO standards and features an additional mark indicating the lot number .

method and to apply the marks after assembly is complete, just before ammunition is packaged and delivered to the customer. While laser technologies may or may not eventually replace traditional stamping practices, they can in any case be used to add complementary or item-specific information to fully assembled rounds, such as the lot number or even information about the purchaser (Persi Paoli, 2011).

Despite the lack of universal standards and allowing for regional and sub-regional differences, it is possible to identify certain types of information that are typically found on cartridge-based ammunition: identification of the producer (through letters, symbols, or numbers), calibre (especially on civilian ammunition), year of production (especially on military ammunition), special symbols to identify specific technical standards (as in the case of NATO ammunition), and, in some cases, a number identifying the production lot of each cartridge.

The role of ammunition packaging[6]

Among other things, the boxes in which ammunition is packed, and on which relevant information can be marked without space or technical constraints, allow for tracing (Persi Paoli, 2011). While marked information varies substantially, depending on whether the ammunition is military or civilian in nature, at a minimum all ammunition

Figure 4 **Examples of case marking**

Left: a case for a .308 Winchester cartridge with (above) and without (below) the primer.

Right: 6.35 mm cases (above) with primers; an example (below) of a case marked according to NATO standards: NATO symbol, producer's ID, and year of production.

Photo courtesy of Fiocchi Munizioni. © Giacomo Persi Paoli

packaging is marked with information relating to quantity, type, calibre, and lot number (including manufacturer ID). Taken together, this information allows for the unique identification of the ammunition contained in a specific box or package.

Improving traceability: the issue of lot marking

The possible introduction of an obligation to include lot numbers on individual cartridges has been a key topic in the international debate regarding ammunition control and management. Proponents of lot marking argue that it would facilitate the tracing of ammunition, particularly for cartridges that are removed from their boxes. Opponents cite increased production costs and question the practical benefits such a measure would bring to actual tracing (Persi Paoli, 2011, p. 8).

Conclusion

Marking is a fundamental element of any tracing system. It allows for the unique identification of weapons and the establishment of associated records. Several different technologies can be used to mark weapons, but they tend to be suited to specific applications and materials. The choice of marking technology thus depends on the user's needs and priorities. Standards for marking ammunition are much less developed than those that apply to weapons and are not of universal application. Nevertheless, new technologies, especially laser marking, could facilitate the development of such standards, or at least increase the traceability of ammunition by enabling more relevant information to be marked on small-calibre cartridges. ■

Notes

1 For an overview of the various instruments and provisions, see Persi Paoli (2009).

2 For more information on weapons-marking technologies, see Persi Paoli (2010).

3 In 2014 the UN secretary general will issue a report at the 5th Biennial Meetings of States of the UN Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects that considers new developments in technology related to marking, record keeping, and tracing (UNGA, 2012, Annex II B(3)).

4 These criteria are drawn from Berkol (2010) and author correspondence with Ilhan Berkol, November 2010.

5 For the purpose of this study, unless otherwise specified, the expression 'ammunition marking' refers to the marking of both individual cartridges and ammunition packaging.

6 For further information on marking practices for packaging, see Persi Paoli (2011).

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For more information on weapons marking, please visit: <http://www.smallarmssurvey.org/?marking-record-keeping-tracing.html>

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