Programme of Action on Small Arms and Light Weapons

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Discussion paper

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1. The implications of recent developments in small arm and light weapon manufacturing, technology and design for effective marking, record-keeping and tracing – *potential challenges*

1a. Materials

1. Until the third quarter of the twentieth century, small arms were generally made of steel, wood and Bakelite, a liquid resin. Wood and Bakelite were used for manufacturing non-essential parts, such as handgrips and buttstocks, with all other parts typically made of steel. Since then, aluminium, titanium and other metals have come into use, and plastics were introduced in the late 1970s and early 1980s for making shells and receivers.

2. In recent years, plastics and polymers started to be used more often these days in the production of firearm frames and receivers. Polymers provide lower cost, lighter weight, resistance to moisture, ergonomic design and thermal neutrality. However, they offer less tensile strength than steel or aluminium and are potentially more susceptible to accidental damage. Plastics are cheaper in general, but it is more expensive to customize them to specific SALW requirements.

Implications for the Programme of Action and International Tracing Instrument

1. With the advent of a greater range of materials used to manufacture weapons, the durability of markings should not be compromised. Producers should be careful to select the most fitting marking technology for each material, maintaining the highest standards in permanence and indelibility.

2. For weapons made of polymers, such markings as manufacturer name and logo can be applied directly in the cast or mould at the time of manufacture. Serial numbers cannot be included in the cast since each weapon requires a unique serial number.

3. Because of the physical characteristics of polymers, traditional stamping methods of weapon marking cannot be used once the weapon is assembled. Moreover, stamping can be recovered on metals when erased, due to structural changes stamping effects on sub-layers of stamped metals. For polymers, laser marking or, with some limitations, micropercussion (or dot peen stamping) are relatively suitable marking solutions.

4. An alternative for marking polymer weapons is to add a metallic insert or tag in the main plastic component, on which markings can be added, although in some cases, the metallic insert can be removed with different degrees of damage to the weapon.

Points for consideration

1. How to ensure that manufacture and post-manufacture marks applied to polymer parts are in line with the marking provisions of the ITI, for example through the insertion of a metal plate or tag in the frame or receiver? And how can we ensure the marking is recognised even if removed?

2. How should the following be addressed[1]: depth of the insertion; plate dimension and location; marking method; and the duplication of marks?

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[1] Some suggestions are found in the International Small Arms Controls Standards (ISACS 05.30).

3. How would manufacturers of polymer frames and receivers be included in small arms control discussions and initiatives, in particular those relating to firearms marking, record-keeping, and tracing?

1b. Modular Weapons

1. Currently, the wide spectrum of operational needs for which armed forces are prepared has led to the development of modular weapons design for military rifles. A rifle can now consist of a core section, primarily the upper receiver, onto which can be attached an array of other parts essential to the operation of the weapon to obtain different configurations suited for different purposes or missions.

2. Modularity is increasingly become a feature of a number of military-style weapons. Until recently, military small arms configuration had been fairly straightforward, with each model of weapon having one calibre, one design and one configuration. While it was possible to add accessories to the weapons, these did not change the fundamental technical configuration and marking procedures.

Implications for the implementation of the Programme of Action and the International Tracing Instrument

1. The fact that modular weapons can be fitted with different components, including from other weapons, could result in different serial numbers appearing on different parts of the same weapon, increasing the risk of misidentification.

2. Modularity allows for temporarily changing a weapon's calibre, a fundamental characteristic for its identification. In such cases, the same serial number, if marked only on the receiver or other component, can be associated with different calibres.

3. However, it could also be maintained that a modular weapon found with more than one serial number actually provides more potential clues to enable a successful trace. In this connection, it is important to note that the International Tracing Instrument prescribes the application of a unique marking to an essential or structural component of the weapon, such as the frame **and/or** receiver, **and also** encourages the marking of other parts of the weapon, such as the barrel and/or slide or cylinder.[2]

Points for consideration

1. The ITI recommends that States apply the mark:
   'to an essential or structural component of the weapon where the component's destruction would render the weapon permanently inoperable and incapable of reactivation, such as the frame and/or receiver'
   The application of marks to more than one part of a firearm is a widespread practice, encouraged also by the ITI:
   'States are encouraged, where appropriate to the type of weapon, also to apply the marking prescribed in subparagraph 8 (a) above or other markings to other parts of the weapon such as the barrel and/or slide or cylinder of the weapon, in order to aid in the accurate identification of these parts or of a given weapon'. (para. 10)

   How to apply the ITI to the marking of modular weapons?

2. How should the different combinations of calibre and barrel length be reflected in a record of the weapon?

3. Should each configuration have its own separate record indicating its specific characteristics? Or, perhaps more practically, should there be only one general record associated with the serial number on the relevant section of the receiver (either upper or lower), possibly with a list of all of the possible configurations for that weapon or other options should be found?

[2] Paragraph 10.

1c. Production

1. Originally, Three-dimensional (3D) printing, or “additive manufacturing” technology, has been used mainly in architecture, industrial design and biotechnology. To perform a print, a machine reads the design from a 3D-printable file and lays down successive layers of liquid, powder, paper or sheet material to build the model from a series of cross sections. These layers are joined or automatically fused to create the final shape. After manufacturers mastered the production of small arms mainly made of polymers, it was a relatively small step to use 3D printing to produce such weapons. Now, even 3D printing using metals is an option, though the weapon’s reliability, produced this way, is not high for the moment – however, one should keep in mind that a weapon might be used only once, eventually firing only one shot, to achieve a devastating illegal result.

2. Specialized, high-end 3D printers have an associated cost that, at present, would put them out of reach of most individuals. However, technological improvements will likely decrease the cost of high-end 3D printers. Likewise, the development of new materials for use in 3D printing could allow for the future use of these materials with lower-end printers.

Implications for the Programme of Action and the International Tracing Instrument

1. Of particular concern with respect to the illicit trade in small arms and light weapons is the availability of 3D weapon printing technology and materials for criminal and terrorist activities.

2. At the moment, weapon theft or purchase on the illicit market may require less effort that printing an effective, reliable weapon. But this could change: once production costs decrease and quality increases, 3D printing may become a lucrative alternative for small-scale illicit weapon manufacturing and sale in the future.

3. Important to note is that 3D printing is not the only method to make weapons at home (ANPAM 2015). Sophisticated craft weapons are being made in various regions of the world.

Points for consideration

1. Experts have highlighted that it is not easy to build a functional 3D weapon. What is needed includes a design; a mathematical model of the design; knowledge of and access to suitable materials; access to a suitable 3D printer; knowledge of finishing and assembly; and testing (ANPAM 2015).

2. However, experts have also said that there are practically no technical limits that make home manufacturing of firearms impossible (ANPAM 2015).

3. The added challenge of 3D printing is that it makes possible a virtually *undetectable* weapon for criminal use (Jacobs, 2015).

4. In light of the above, how should the expected increase of public accessibility to 3D printing processes and materials affect the regulation of the manufacture of weapons?

2. The implications of recent developments in small arm and light weapon manufacturing, technology and design for effective marking, record-keeping and tracing – *potential enhancements*

1. The International Tracing Instrument[3] requires that unique markings are applied to small arms and light weapons at the time of manufacture, including the name of the manufacturer, the country of manufacture, the serial number or any alternative unique user-friendly marking with simple geometric symbols in combination with a numeric and/or alphanumeric code, which would permit ready identification by all States of the country of manufacture. The Instrument also requires, to the extent possible, that appropriate simple markings be made on each imported weapon that will permit the identification of the country of import and, where possible, the year of import.

2a. Laser technology

2. Polymer materials cannot be marked using traditional stamping whereas laser markings can be applied that do not damage the structure of polymers. The use of laser technology permits the marking of all kinds of surfaces through burning by oxidization. As there is no physical contact between the tool used to make the marking and the object to be marked, this technology can be used on a large spectrum of parts and components, including very small ones. Laser-marking machines have also become cheaper and are reportedly more reliable.

3. Some manufacturers prefer to mark polymer weapons by embedding a metallic insert in the main plastic component, on which (additional) markings can be added.

Points for consideration

1. Illicit owners of small arms frequently attempt to erase the markings of weapons. Obliterated markings originally made by stamping in steel can often be recovered using acid etching, as the original marking usually leaves a trace beneath the surface of the steel, invisible to the eye.

2. Laser marking often leaves no deformations of the crystalline structure of the material, be it polymer or steel. Obliterated laser engravings are therefore more difficult to recover. Relief polishing and reflected light stereomicroscopy can, in certain cases, successfully reveal obliterated serial numbers originally marked by laser.

3. How best to choose which marking method to employ or what additional marking methods can be used?

2b. Micro-stamping

1. High-precision micromarks have the advantage of not being easily detectable for those wishing to erase them and can be applied at locations on a weapon where they will be difficult to erase. Moreover, by micromarking the firing pin of a weapon, an imprint can be made on each fired cartridge that could aid forensic evidence collection for criminal investigation.

2. Critics point to the ease with which identifiers can be circumvented or destroyed. Criminals can also replace part producing the micromark (such as the firing pin) with ordinary ones, or use household items to deface the identifiers. Placing identifiers on several components in the same firearm would mitigate, but not entirely resolve this problem.

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[3] Paragraph 8.

Points for consideration

1. The International Tracing Instrument requires markings to be clearly visible on weapons. Can microstamping, whether on the weapon itself or by imprinting the cartridge from markings on the firing pin, be used under the International Tracing Instrument?

2. With the advent of modular weapons, would the additional micromarking of parts and components enhance traceability?

3. Microstamping technology, when applied on the firing pin, provides a possibility of identifying a weapon through a recovered cartridge only, that is, without the need to be in possession of the weapon itself. Should this be an addition to weapon-tracing options?

2c. Technologies for stockpile management

1. The PoA provides that UN Member States should ensure that their security forces 'establish adequate and detailed standards and procedures relating to the management and security of their stocks of these [small arms and light] weapons'. These standards and procedures are to include 'physical security measures; control of access to stocks; inventory management and accounting control … [and] accounting and control of small arms and light weapons held or transported by operational units or authorized personnel' (PoA, para. II(17)).

2. Barcodes, radio frequency identification and biometrics – for example, finger print recognition – all come under the umbrella of automatic identification and data collection technology. Such methods electronically identify objects, collect data on them and enable data to be entered automatically into record-keeping systems. Recently, such technologies have been adapted to a range of applications related to small arms and light weapon stockpile management so as to improve identification, safety and tracking.

(i) Barcodes

1. A barcode encodes information in a visual pattern that a machine can read and store. A barcode reader, which consists of a light source, a lens and a light sensor, recognizes the barcoded weapon and analyses the barcode's image data and sends the barcode's decoded content to a computer, linked to a database of information.

(ii) Radio-frequency identification

1. Radio-frequency identification technology has two main components: a tag or label, embedded in the weapon, and a separate reader. The tags transmit data to the reader, which converts the radio waves to readable data. In this way, it is similar to barcoding in that data from a tag or label is captured by a device that stores the data in a database. The tags have an advantage in that they can be read from locations on the weapons outside the line of sight, whereas barcodes must be accessible by an optical scanner.

2. Token-based applications using radio-frequency identification require the user to carry an additional physical item, such as a ring, watch, card, or bracelet, to enable the system to operate. These tokens may be carried or worn by an authorized individual. Such token technologies enable a communication channel between the specific weapon and its matching token. In the case of a non-match, the weapon's firing mechanism will not be enabled.

(iii) Biometric technologies

1. Biometric technologies use the unique features of individuals as the key to identify authorized users. Examples of biometric technologies which can be applied in arms manufacturing include the recognition of an individual's fingerprint, palm print, voice, face or dynamic grip on a weapon. Electronic sensors or

readers are used to collect biometric data and compare them with those of authorized users stored in a computer memory.

2. With fingerprint technologies, users place their finger on a sensor to initiate authorization. The reader is typically placed in an area on the weapon that is easily accessible with little or no conscious effort by the user, such as on the grip where the finger normally rests. Once the fingerprint is scanned, it is compared with an internally stored list of fingerprints of authorized users. If a match is found, the firearm is enabled; otherwise, it remains locked.

3. Furthermore, arms storage devices and containers are now available whereby weapons can only be removed after entering a code number or scanning a fingerprint, or by way of a radio-frequency identification application. In this way, it is possible to track and document which individual has used which specific weapon, when and for how long.

4. Similarly, portable gun locks can be inserted into the barrel or cartridge chamber of weapons and digitally locked to ensure secure storage or transport.

Points for consideration

1. **Record-keeping and stockpile management:** For the purposes of the International Tracing Instrument, does automatic identification and data collection technology have the potential to take record-keeping, particularly of active stockpiles, to a more advanced level? For example, by automatically recording the moment when weapons are taken out of a facility by specific personnel, it is possible to significantly enhance stockpile accounting and security?

2. If no resources are available for applying new technologies, what are the challenges to the continuation of adequate record-keeping through traditional means – in particular through hand-written filing systems?

3. **Marking:** According to the International Tracing Instrument,[4] all marks required to be on an exposed surface, conspicuous without technical aids or tools, easily recognizable, readable and durable and, as far as technically possible, recoverable. On the basis of the International Tracing Instrument, how should barcodes and similar technologies, which often require an additional reader or external device, be best utilized?

4. **Tracing:** Since barcodes or radio-frequency identification tags can only be read with accompanying external devices, weapons found outside the area of their last legal use may not be easily identified with this technology. How should this be taken into account in weighing the pros and cons of implementing this technology?

5. Are there opportunities, as some Member States have indicated, for the further application of marking and tracing technologies, allowing for the remote localization of weapons, time limits or remote control of their functioning, in order to counter high risks of diversion or misuse?

6. **Operational use:** What are the challenges that biometric technologies can pose to operational capabilities of a security unit?

2d. Weapons tracking technologies

1. Tracking systems exist for all kinds of commodities. Some, like automatic identification and data collection technologies, utilize readers and can therefore only be used in specific locations. Others, like global positioning systems (GPS), employ satellite navigation and allow for the global tracking of items.

[4] Paragraph 7.

2. A GPS receiver locates satellites and deduces an item's location. For effective calculation, a clear line of sight to four or more satellites is required. Originally designed for military use, there are now wide civilian uses for GPS.

3. GPS technology has been used for the monitoring and tracking of shipping containers carrying weapons, which can also provide data on an opened door or vibrations from a break-in attempt. Sustained information on the location of such containers makes it harder to steal or covertly reroute them.

Points for consideration

1. According to the International Tracing Instrument,[5] tracing is the systematic tracking of illicit small arms and light weapons found or seized on the territory of a State from the point of manufacture or the point of importation through the lines of supply to the point at which they became illicit.

2. Tracking the geographic location of weapon shipments is a different type of tracing activity that may complement the Instrument. It is of relevance in particular in the context of improving arms export control systems. Should this be considered in the context of the full and effective implementation of the International Tracing Instrument?

Additional points for consideration - keeping the ITI up-to-date

1. ***The International Tracing Instrument is a valuable global agreement on a topic with considerable technological implications. To ensure its continued relevance, the Instrument could be strengthened by taking into account new developments in technology to enhance weapon marking, record-keeping and tracing.***

2. ***Would there be value in agreeing to draft in the future a document supplementary to the Instrument, such as an annex, which would reflect the implications of recent technical developments in the marking, record-keeping and tracing of small arms? Would there be alternative measures to ensure the continued relevance of the ITI?***

[5] Paragraph 5.

3. The transfer of technology and equipment, as well as capacity-building, in particular training, for the full and effective implementation of the Programme of Action and the International Tracing Instrument

3a. Strategy for the acquisition and implementation of technology

1. National choices for the acquisition and application of weapons-related technologies ideally derive from clear priority-setting in a country's national policies on small arms. Where one government would focus on improving national record-keeping practices by putting in place automatic identification and data-collection technologies, another might identify the laser marking of its stockpiles as the most pressing activity, while the third can focus on improving traditional stockpiling and record-keeping practices.

2. A well-planned strategy would pay careful consideration to which stakeholders need to be engaged to render the applications of the technology a success and which processes are affected by each technology.

3. Different countries have different capacities for absorbing technology. The least developed countries or those in or emerging from conflict often struggle with such integration processes. In these situations, there is a real danger of technology acquisitions not being used or providing the right fit.

4. It is important for policy to be developed and assistance provided on the basis of existing developmental realities, including adequate infrastructure and the availability of human resources.

5. Most importantly, decisions concerning the acquisition of new technologies should take into account how these will interface with the existing and potential future technologies of relevant institutions. For instance, acquiring weapons fitted with radio-frequency identification may require an overhaul of existing procedures and support technology.

6. The diverse, compartmentalized character of data collection on weapons used by different government agencies within the same country is often an element in need of adjustment to fully harness the potential of new technologies. For example, data linked to barcodes and other machine-readable codes marked on weapons can sometimes be accessible only to one specific agency.

3b. Assessing requirements

1. Any strategy to improve national marking, record-keeping and tracing practices should start with a plan for adequate practices using existing means such as data recording and filing by hand. The task force to conduct such an assessment of existing conditions and their implementation, as well as issue conclusions, can be intra-governmental, for a more comprehensive result. If the conclusion is that an investment in new technology is essential, key components would include an assessment of needs and the current state of technology in all relevant government agencies. Here, it is important to assess if the current technology is indeed inherently insufficient for reaching the goals set.

2. Acquisition decisions should be made on the basis of not only needs and record-keeping capabilities, but also suitability and whether the new technology can evolve with changing requirements.

3. For instance, in cases where there is frequent personnel rotation, a technology that uses external tokens or identification codes for authentication may be more practical than biometric technologies.

4. New technology should also be applied in areas other than the purchase of new weapons and storage facilities. The first step in addressing the illicit trade in small arms must be towards the illicit weapons that are already in circulation around the world; new technology should therefore include the possibility

of retrofitting weapons that already exist in national stockpiles, for instance, with new features that enhance tracking and management.

3c. Acceptability and applicability

1. When considering the purchase or transfer of technology, it is important to consider the acceptability of recurring costs, including electricity, fuel transport, maintenance, spare parts and personnel, while taking into account other environmental variables.

2. Other non-material acceptability considerations may include the compliance of the technology with national regulations and with regional and global instruments and commitments.

3. In terms of applicability, technical considerations may include questions related to the durability of the technology, conditions for application, if the technology affects the integrity or functionality of the weapon, and if weapon markings can be easily obliterated. The technology also needs to be as reliable as possible.

3d. Implementation of the technology

1. Implementing a new technology nationally can be a large task that could be piloted first at an appropriate facility. During the pilot phase, operating problems and logistical challenges could be reviewed and potentially solved before the full-scale implementation of the technology.

2. Personnel training and on-the-job monitoring in a pilot phase could also help to address common issues and questions posed by staff before the wider deployment of the technology. After its full-scale implementation, a regular review of the use of the technology is also useful.

3e. Sustainable assistance

1. Technological advances tend to increase complexity and uncertainty, make end users dependent on specialized experts and build new knowledge hurdles for potential adopters of technology.

2. To help overcome such hurdles, a contract between donor and recipient entities may need to go beyond the provision of equipment. For instance, after the provision of automatic identification and data collection technology to a recipient country, it is paramount that in-house expertise be made available or developed in the event that a barcode reader or other technology should malfunction. Developing such sustained in-house expertise, and agreeing on the provision of external expertise and services as an interim measure, can be part of a technology transfer arrangement.

Points for consideration

1. Technologies that could enhance effective marking, record-keeping and tracing should be selected after careful consideration of the context and capacities of the technological, regulatory and service environment in which the new applications will become functional.

2. As a result of such an assessment, which could be undertaken at the national or regional level, the retrofitting of existing weapons with new technologies could be a valuable measure for addressing the challenge of existing weapons at risk of diversion.

3. The full and effective implementation of the PoA and the ITI does not call for technologically-advanced approaches. If barriers to effective implementation exist for a pen-and-paper approach to record-keeping, these barriers may also exist should sophisticated technology be emplaced, and the respective barriers may be tackled first.

4. When new acquisitions of arms become inevitable, selecting weapons equipped with newer technological applications will help diminish the dangers of weapons becoming unaccounted for, provided that the appropriate record-keeping and other weapons management procedures are in place.

5. Where assistance and cooperation on these matters is planned, donor and beneficiary States may wish to make use of guidance parameters for the transfer of equipment, covering such areas as the sustainability of the assistance, including such recurring costs as training, electricity and fuel, and whether regional harmonization, that is, the provision of compatible equipment, should be considered.

6. Regional groups of States interested in using these technologies are encouraged to discuss collectively the possibilities and limitations of the technologies and may choose to develop a harmonized regional approach. The United Nations regional centres for peace and disarmament stand ready to support such efforts where needed.

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Sources:

Report of the Secretary-General on “Recent developments in small arms and light weapons manufacturing, technology and design and implications for the implementation of the International Instrument to Enable States to Identify and Trace, in a Timely and Reliable Manner, Illicit Small Arms and Light Weapons” (A/CONF.192/BMS/2014/1)

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