

## **CHAPTER 6**

# Weapons Identification: Other Small Arms and Light Weapons

## Introduction

This chapter examines various types of small arms and light weapons that differ from conventional, modern examples. It begins with an overview of improvised and craft-produced small arms and light weapons, including the various sub-categories of these weapons. The chapter then examines the capabilities of improvised and craft-produced weapons and explores various means of identification. It goes on to present an overview of converted and reactivated arms, and of improvised and craft-produced ammunition. Finally, the chapter sets out the main characteristics of muzzle-loading firearms.

## Improvised and craft-produced weapons<sup>137</sup>

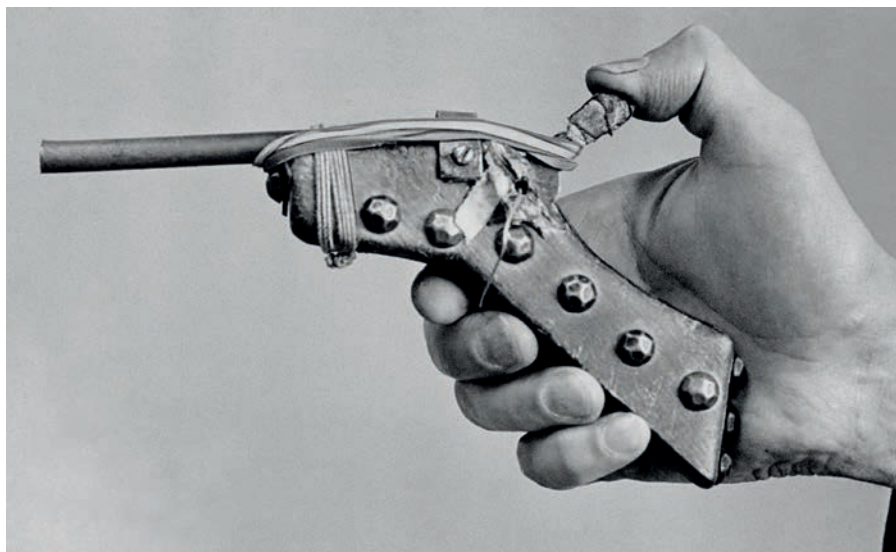
Improvised and craft-produced small arms and light weapons comprise a sizable percentage of weapons seized in domestic law enforcement operations in many countries, and have appeared in numerous conflict zones. Consequently, it is important for journalists and researchers to have a solid understanding of these weapons and how to identify and track them. They are commonly acquired and used by individuals, criminal gangs, and insurgent groups when commercial alternatives are not available. They vary in sophistication and quality from crude, improvised, single-shot guns to semi-professionally manufactured copies of conventional firearms. While craft producers are not manufacturing advanced guided light weapons, such as man-portable air defence systems (MANPADS) or anti-tank guided weapons (ATGW), other types of light weapons are produced with some regularity. These weapons include mortars, anti-materiel rifles, recoilless guns, and grenade launchers.

Many craft-produced and improvised weapons offer illicit users the added advantage of being difficult to trace. A lack of registration, misleading or absent markings, and an unusual forensic profile impede or obviate the various methods for tracing illicit small arms and light weapons commonly employed by authorities. Most improvised weapons have no serial numbers or other markings used to identify and trace their factory-built counterparts, and few, if any, are registered

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<sup>137</sup> This section draws extensively upon the Small Arms Survey report *Beyond State Control: A Guide to Improvised and Craft-produced Small Arms and Light Weapons* (Hays and Jenzen-Jones, 2018). Please refer to this publication for more information.

**Image 6.1** A crude improvised ‘zip gun’ with a barrel fashioned from a length of car antenna



Source: Paul Bernius/*New York Daily News* archive via Getty Images

with authorities. Others are marked with false serial numbers; this and the unusual forensic profile of many improvised and craft-produced weapons complicate criminal investigations.

The barrels of many improvised weapons lack rifling, or have internal diameters that are too large to reliably leave firing marks on discharged projectiles. This makes it difficult or impossible to establish that bullets or pieces of shot recovered at a crime scene were fired from a specific weapon. Indeed, given the challenges in producing rifled barrels with limited tooling or expertise, many such firearms are constructed using readily available household products instead of purpose-built firearms barrels. Gas piping, motor vehicle aerials (antennae), and bicycle frame tubing are all regularly used as barrels for improvised firearms (see Image 6.1). Well-connected groups may be able to obtain barrel blanks with pre-cut rifling (see Box 6.4), but for many criminal purposes, rifling is unnecessary.<sup>138</sup> Shotguns are generally smooth-bore weapons by design, and even pistol

<sup>138</sup> Barrel blanks are unfinished barrels which are already rifled, allowing a craft producer to avoid a difficult part of the manufacturing process.

barrels, which are routinely rifled by commercial manufacturers, do not actually require rifling for effective use at very short ranges. Producers of improvised weapons may not consider the additional accuracy afforded by rifling worth the time, effort, and additional cost.

The use of so-called ‘ghost guns’ is now perceived by some as an effective method of evading law enforcement, even that of developed nations (CBS Sacramento, 2016). Detecting manufacturing or conversion activity is also difficult. Since essentially anyone can produce components or even complete improvised or converted firearms in their home, using innocuous materials and common machinery that lack a ‘paper trail’, they often remain undetected until long after their products reach their prospective users. While conventional tracing requests are almost never successful for these types of weapons, there are alternative means of identifying and tracking such weapons. Identifying distinctive characteristics shared by craft-produced weapons can help to identify particular illicit gunsmiths or manufacturing operations, for example (Hays and Jenzen-Jones, 2018).

It should be noted that not all users of improvised weapons are criminals. For example, in the United States, unlicensed ‘backyard gunsmith’ hobbyists operate within the law (provided they do not transfer their products); engaging in the same activity in the United Kingdom, however, would be a criminal offence.<sup>139</sup> There is little direct crossover between licit and illicit users other than the potential sharing of designs via the Internet or print publications. However, the most viable methods for designing and building improvised firearms tend to prevail in both spheres, giving rise to a degree of commonality across user groups (Hays and Jenzen-Jones, 2018).

### *Types of improvised and craft-produced small arms and light weapons*

Broadly speaking, these weapons can be broken down into three subcategories. In ascending order of sophistication, these subcategories of small arms and light weapons are: improvised and homemade; craft-produced; and semi-professionally produced (Hays and Jenzen-Jones, 2018).

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<sup>139</sup> This is, of course, a matter of context and politics. Improvised and craft-produced firearms were extensively produced and used by resistance groups in Nazi-occupied Europe in the Second World War, but also by terrorist groups operating in Northern Ireland in the late 20th century. See, for example Hays and Jenzen-Jones (2018).

## Improvised and homemade small arms and light weapons

This subcategory is defined primarily by the scale of production and the limited expertise and resources available to the maker. These are the simplest weapons that expel a projectile that an investigator is likely to encounter, and will be visibly crude and mechanically simple (see Image 6.2 for a particularly crude example). Improvised weapons are typically conceived and fabricated at home or under field conditions, and without access to modern machine tools. As a result, they are much less capable than their factory-built counterparts. Generally speaking, improvised and homemade small arms and light weapons are limited to single-shot firearms, and simple mortars, grenade launchers, and recoilless weapons (Hays and Jenzen-Jones, 2018).

A firearm can be reduced to two critical components: a barrel and a firing mechanism. At its most basic level, a barrel is simply a tube that is able to accept a projectile or cartridge of a particular size and is capable of withstanding the pressure of the expanding gases that are generated when the weapon is fired.<sup>140</sup> Some improvised firearms are very crude. For example, a ‘slam-fire gun’ consists of two metal pipes (a ‘barrel’ piece and a ‘breach’ piece), one of which slides within the other, and a fixed firing pin at the rear of the breach piece (see Image 6.3).<sup>141</sup> When the user pulls the barrel piece sharply back against the breach, the cartridge inside is fired. In this case, the crude weapon is simply the host for the more advanced technology embodied in the ammunition. Ammunition needs to be of a sufficient quality to repeatedly, reliably, and safely discharge shots. Many of these simple weapons fire shotgun cartridges because they are cheap and widely available. They are also relatively safe, as they generate relatively low gas pressures (Hays and Jenzen-Jones, 2018).

<sup>140</sup> The first hand-held firearms were forged or cast metal tubes with a sealed rear end (‘breach’) and a drilled vent (‘touch-hole’) to permit ignition of the black powder charge inside. The propellant was muzzle-loaded along with a spherical lead ball, and a hand-held piece of slow-match was used to ignite the charge. Some improvised firearms continue to follow this antiquated pattern (ARES, 2017; Hays and Jenzen-Jones, 2018).

<sup>141</sup> The fixed firing pin is equivalent to the firing pin or striker found in a conventional firearm. This is normally ‘cocked’ to the rear against a spring and released by pulling the trigger to fire the cartridge. In the mechanically simple slam gun, the whole rear portion of the weapon is manually slid back and then quickly forward to achieve the same effect.

**Image 6.2** An especially crude improvised muzzle-loading handgun, featuring a barrel crafted from a heavy machine gun cartridge case



Note: The weapon is fired by touching a match to a hole toward the top rear of the case. This weapon was seized by British forces during the Cyprus Emergency in the 1950s.

Source: Jonathan Ferguson/ARES

**Image 6.3** Slam-fire shotguns seized from a makeshift workshop used by a gang in Buenos Aires, Argentina



Source: Minutouno.com/Buenos Aires Police



**Image 6.4** A crude hand-made percussion lock mechanism fitted to a muzzleloading 'Dane gun' produced in Plateau State, Nigeria

Source: Small Arms Survey

Other improvised weapons are somewhat more sophisticated and effective. Producers in Nigeria and Ghana combine smooth-bore barrels with various breech mechanisms to make break-open cartridge shotguns. Such weapons are often referred to as 'Dane guns', although this term is applied to a range of similar weapons. The barrels on some of these weapons are made from repurposed metal tubing, such as motorcycle suspension forks. A skilled craftsman is often able to make multiple weapons a day from readily available, locally-sourced material. Many 'Dane guns' straddle the 'improvised' and 'craft-produced' categories. Some are simple, comparatively ineffective muzzle-loading percussion weapons (see Image 6.4) while other weapons identified as 'Dane guns' are higher-quality firearms that more closely resemble factory-produced shotguns (CAST et al., 2003; Hays and Jenzen-Jones, 2018).

Identifying the origins of improvised firearms is often difficult. As illustrated by numerous images in this chapter, some superficially resemble their conventionally-produced counterparts, while others look nothing like firearms. A cursory inspection of their components, which often include pieces of pipe, lumps of metal, and a variety of found objects such as tools or toys, is often sufficient to reveal their improvised origin, but tracing them to a particular producer can be challenging. Most lack markings of any kind, and spotting distinctive production patterns often requires technical expertise and familiarity with the materials and production practices used by local improvised firearms makers. It is best to engage the services of a specialist when in doubt (ARES, n.d.; Hays and Jenzen-Jones, 2018).

## Craft-produced small arms and light weapons

Some individuals and small groups produce weapons that are more advanced than the improvised weapons described above. These craft-produced weapons require a higher level of skill and access to specialized tools and equipment. They are closer approximations of their commercial counterparts than improvised weapons, but are still visibly crude. They are likely to be roughly made, with sharp edges and crude means of construction including large nuts, bolts, rivets, welds, etc. (see, for example, Image 6.5). These features are occasionally found on facto-

**Image 6.5** A conventionally-produced M3 sub-machine gun (top) and a Luty style sub-machine gun (bottom)



Note: The Luty style sub-machine gun was produced without the use of any original-purpose firearm components. Note the comparative similarity of many of the features of these two sub-machine guns.

Source: N.R. Jenzen-Jones/ARES



ry-made firearms, notably wartime expedient designs such as the British Sten, or on ‘last-ditch’ military weapons produced by factions with limited or dwindling access to critical resources (for example, Nazi Germany and Imperial Japan). However, such weapons are relatively rare and well known, and thus are readily distinguishable from ‘true’ craft-produced weapons (Hays and Jenzen-Jones, 2018). Many craft-produced weapons are cruder even than the most basic military firearm mass-produced in a properly-equipped factory. Even with access to basic machine tools, edges of craft-produced weapons are likely to remain indistinct, with uneven angles and undulating surfaces where they ought to be flat. Markings, when they are actually applied, are often roughly stamped to unequal depths using individual letter stamps (see, for example, Image 6.10).

In recent years, craft producers have gained access to relatively high-quality materials and equipment that were formerly the preserve of the commercial firearms industry or other specialized sectors. These items include high-strength steel tubing, bar, and sheet metal stock; computer numerical control (CNC) machining tools; and additive manufacturing (3D printing) technologies (see Box 6.1) (Hays and Jenzen-Jones, 2018; Jenzen-Jones, 2015d). As a result, individuals and groups with basic online research skills and access to basic tools are able to manufacture viable homemade small arms. These weapons range from single-shot firearms to shotguns, sub-machine guns, and rifles. Some light weapons, such as mortars, are also relatively easy to craft produce since they are based on relatively simple operational principles (Hays and Jenzen-Jones, 2018).

### Box 6.1 3D printing and improvised firearms

Although still a relatively new technology, 3D printing—also known as additive manufacturing—has opened up new possibilities for craft-produced firearms. It is now possible to produce a viable, multi-shot firearm using polymer (plastic) 3D printing alone, though most homemade 3D-printed firearms are still bulky and inferior to their conventionally-made counterparts (Hodgkins, 2015). More promising firearms designs combine 3D-printed components and assemblies with traditionally-made metal components. This approach minimizes the number of complex components that need to be machined while retaining strength and durability where these attributes are needed most.<sup>142</sup> In the future it may be possible to completely bypass traditional manufacturing, producing viable firearms entirely from metal components made on 3D printers. While additive manufacturing technology for ‘printing’ metals exists, prices are currently prohibitively expensive and the firearms produced via this method to date offer no substantial practical advantage over conventional firearms (see Image 6.6) (Jenzen-Jones, 2015d).

<sup>142</sup> That is, in pressure and/or load-bearing parts such as the barrel, bolt, and upper receiver.

- **Image 6.6** A copy of the 1911A1 self-loading pistol produced using the direct metal laser sintering (DMLS) method of 3D printing



Note: While a perfectly functional handgun, it costs substantially more than a conventionally-produced equivalent.  
Source: Solid Concepts

There are several ways to distinguish 3D-printed firearms and components. Weapons and other objects produced from polymers using additive manufacture are light in weight by comparison with the very robust glass-reinforced plastics used in commercial firearms production. Firearms which are 3D-printed come in a wide array of colours, but pure white and black are the most common. Depending on the printing process used, some 3D-printed firearms have tell-tale lines where the layers of polymer are laid down by the printer, although the lines will be hard to detect in properly finished weapons.<sup>143</sup>

Low-level craft production is widely employed by non-state actors and criminals. Sub-machine guns are an example of craft-produced firearms that are frequently encountered in many parts of the world. These guns are frequently seized by police and military forces throughout Latin America and Africa, and in Australia, Israel, and elsewhere (Hays and Jenzen-Jones, 2018). Some craft-produced sub-machine guns are semi-professionally produced

<sup>143</sup> Examples include 3D-printed firearms in which the exterior surface has been heat-treated in order to strengthen the otherwise weak and brittle plastic.

**Image 6.7** A still from an Islamic State propaganda video showing a craft-produced light cannon chambered for 23 × 152B mm being used against Shia militia targets<sup>144</sup>



**Image 6.8** A Soviet S-5 rocket (top) and an improvised shoulder-fired rocket launcher (bottom)



Note: A PGO-7V type optical sight from an RPG-7-pattern shoulder-fired recoilless weapon has been added.

Source: US Army, National Ground Intelligence Center (NGIC)

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144 Source withheld.

(see Box 6.2) and are standardized to some degree, while others are made by individuals or small groups in residential properties and are consequently of lower quality. In Brazil, the proliferation of these weapons has been substantial. In a 2011 study of weapons seized in São Paulo, 48 per cent of recovered sub-machine guns were homemade rather than commercially manufactured (Hays and Jenzen-Jones, 2018; Instituto Sou da Paz, 2014, p. 27).

### Box 6.2 'Artisan' production

The term 'artisan production' may be thought of as a useful modifier in describing particularly high-quality firearms which are produced outside of regular industrial manufacturing. The lack of skill and quality control evident in craft-produced weapons found in the field distinguishes them from high-quality weapons made by professional artisans and firms specializing in producing made-to-order firearms in small quantities for commercial sale (which would otherwise be considered 'craft produced').<sup>145</sup>

The distinction is not always clear-cut, however. In less economically developed countries, 'artisan' gunsmiths produce arms of many kinds, some high quality, but others indistinguishable from the 'craft-produced' weapons described in this chapter. The reason for the overlap is that firearm production is still—despite advances in mass production and materials—essentially based on 19th century engineering techniques. These weapons can be replicated or approximated by anyone with access to a small machine shop, or even in some cases by hand.

The relative ease of production means that artisan craftsmen in developing and newly-industrialized nations often make firearms which resemble craft-produced arms, for profit and/or as part of local historical and cultural heritage (Hays and Jenzen-Jones, 2018). Manufacture of such arms typically takes place in areas without local or national regulations governing the production and sale of firearms, or where regulations are difficult to enforce.

Individual gunsmiths may be skilled local blacksmiths and engineers, or may be brought up manufacturing firearms as a family trade. They typically work from a dedicated manufacturing workshop which may be equipped with common workshop equipment capable of producing simple craft-produced firearms chambered for modern cartridges. In the case of traditional black powder weapons, primitive forge facilities may instead be found (ARES, 2017; Hays and Jenzen-Jones, 2018).

Individual craftsmen of the Khyber Pakhtunkhwa region in Pakistan, famous today for their copies of modern designs, have been copying and hybridizing firearms of all types for nearly 200 years, and still sell copies of obsolete weapons (Ahmad, 2012; Jenzen-Jones and McCollum, 2015).

These workers produce a wide variety of firearms, from crude weapons akin to those described above, to well-finished handmade examples, to close copies of commercial self-loading arms (see Image 6.9).

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<sup>145</sup> These commercially-made craft-produced weapons are also distinguished by being subject to legal registration and tax requirements, strict marking practices, and proof testing (or at least some form of corporate accountability for quality and safety assurance) (Hays and Jenzen-Jones, 2018). As such, these weapons are not considered in this chapter.

At the more prolific and skilled end of the spectrum, workers in regions such as the Khyber Pakhtunkhwa and Danao, in the Philippines, represent part of a larger scale semi-professional activity (Hays and Jenzen-Jones, 2018). Many artisan makers produce weapons for illicit purposes as well as for licit (or at least legally tolerated) ones.

It thus becomes clear that the difference between 'artisan-made' and other craft-produced weapons is, in many respects, contextual. While the term is not particularly useful for classifying weapons, it remains a useful descriptor.

**Image 6.9** A Pakistani craft-produced bolt-action rifle chambered for the 7 × 57 mm cartridge, which superficially resembles an AK-type rifle



Source: N.R. Jenzen-Jones/ARES

## Semi-professional production

Semi-professional manufacturing operations are defined by their ambition as much as by any technical sophistication. Semi-professionally produced weapons are sometimes considered a subset of craft-produced examples, representing the higher end of the complexity spectrum, and blurring the lines between craft-produced and industrially-produced weapons. Some of the end products may be similar or even identical to craft-made equivalents, but the production process is more complex, the pace of production faster, and the scale larger. The range of semi-professionally produced weapons is also often broader and the quality superior to that of other improvised and craft-produced weapons.

Semi-professional production operations typically employ multiple skilled workers capable of producing relatively modern firearms, including high-quality copies of commercial weapons. Some larger operations make use of standard industry techniques and equipment, while smaller workshops do most work by hand using relatively primitive equipment. Both types of operation produce a large number of firearms which are usually supplied in bulk to one or more



distributors, often for profit. One exception, noted in a number of conflict zones, is non-state actors who manufacture light weapons: these are typically intended for use in combat, and profit is rarely a primary motive.

While there is no sharp distinction between traditional commercial manufacturing and semi-professional production, the latter is usually not licensed by local and national authorities and is thus generally considered illicit. Weapons made by semi-professional producers are not often registered with national authorities and sales of these items are not usually reflected in government records (Hays and Jenzen-Jones, 2018). Such weapons end up on both illicit and legitimate local markets.

Commercial finishing techniques such as bluing or Parkerizing, hardening of components, and the presence of (often falsified or counterfeit) markings are typical of weapons in this category. Barrels may also be rifled, or, as with artisan-level production, may be cut from commercial barrel stock. Many of these

**Image 6.10** Markings on an AK-type self-loading rifle craft produced in Pakistan



Note: The general fit and finish is quite good, and a superficial inspection would suggest that most toolmarks are fairly typical. A closer inspection, however, reveals questionable markings, including poor alignment and spacing of characters (a common sign of hand-stamped markings), unusual phrasing (PAKMADE), and a calibre marking ('CAL222') not normally associated with AK-type rifles.

Source: N.R. Jenzen-Jones/ARES

**Image 6.11** An AK-type self-loading rifle craft produced in Pakistan, without the typical fire selector markings



Source: N.R. Jenzen-Jones/ARES

weapons are effectively high-quality copies of their commercial counterparts, produced without a licence, registration, or other requirements. As a result, it may be difficult or impossible for inexperienced researchers to identify these weapons as craft-produced. It is best to contact specialists if the weapons bear any signs of craft production. Such evidence includes rough finish, unusual markings, crude furniture, lack of rifling, an irregular shape, and proportions that differ from factory-built weapons of the same type. Other signs of craft production include short barrels, strangely shaped handguards, and non-standard selector markings.

The provenance of most semi-professionally produced firearms is also much more difficult to establish. As noted above, their production and sale are not typically recorded in a way that is accessible to authorities, and they are not likely to be licensed. Conventional markings are likely to be absent, false, or misleading, and the significance (if any) of other locally-applied markings may be difficult or impossible to establish (see Box 6.3).

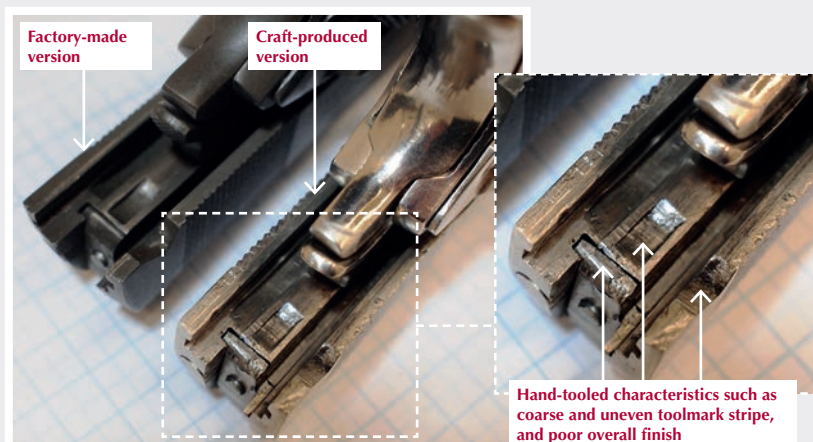
### Box 6.3 Counterfeit weapons

Many semi-professionally-produced craft weapons are counterfeits of commercial arms, intended either to pass as real and dupe the unwary, or simply to provide a more readily available or affordable alternative to factory-built firearms. In either case, these weapons are frequently marked with false or misleading manufacturer and model markings (Hays and Jenzen-Jones, 2018).

Semi-professional production, including the production of counterfeit weapons, is commonplace in and near the Pakistani town of Darra Adam Khel. Weapons produced in the region include copies of modern self-loading service rifles, many of which are said to be useful in combat. Darra-made weapons have been used by Taliban insurgents as well as by private militias and government personnel in both Pakistan and Afghanistan (Ahmad, 2012; ARES, n.d.).

Aside from Darra, the Philippine city of Danao is perhaps the best-known hub for counterfeit firearms. These weapons are sufficiently well made to deceive local law enforcement, and to attract buyers on the international market (Pavlovich, 2016, p. 8; see Image 6.12). The illicit industry in Croatia is similarly prolific, though its products are far from direct copies (ARES, 2015b; ARES, n.d.). Croatian weapons such as the Zagi M91, and the spuriously-marked ‘TEC9’ derived from it, are nonetheless made to an extremely high standard, equivalent to that of many commercial factories (Hays and Jenzen-Jones, 2018). Many of the gunmakers in these regions might also be regarded as artisan makers (see Box 6.2). The scale of their operations also likely varies, from hand manufacture to organized low-level mass production.<sup>146</sup>

**Image 6.12** Exposed slide portion of a craft-produced copy of the Colt 1911 produced in Danao, the Philippines (right), displaying characteristic toolmarks compared with a genuine factory-made example (left)



Source: Steven Pavlovich

<sup>146</sup> Interviews with confidential law enforcement and intelligence sources.



**Image 6.13** An example of the illicit Croatian design typically marked 'Intratec TEC9', seized in the United Kingdom



Source: Jonathan Ferguson/ARES

### *Identifying improvised and craft-produced firearms*

Designers and producers of improvised and craft-produced small arms and light weapons (such as producers of converted weapons, see below) make use of a wide variety of original-purpose (factory-produced) firearm components (both lethal and less-lethal in nature). They also convert non-firearm components such as lengths of pipe and other plumbing supplies into parts for firearms. Many parts and even complete weapons are fabricated from supplies that are readily available at hardware stores or other commercial and domestic suppliers (Ferguson and William, 2014; Hays and Jenzen-Jones, 2018).<sup>147</sup> As with 'real' firearms, the most important components are the pressure-bearing parts, primarily the barrel and bolt. It is imperative that these items be sufficiently robust to prevent the weapon

<sup>147</sup> As seen in the designs of Philip A. Luty, which have proliferated across the globe for nearly 30 years (Ferguson, 2017b). Luty described his designs as 'expedient', but this should not be taken to imply ease of manufacture or status as an 'improvised' weapon. They are sufficiently sophisticated to require considerable skill to produce, and are definitively 'craft-produced' weapons.

from failing catastrophically and potentially injuring the user (Ferguson and Jenzen-Jones, 2014a; Ferguson, 2017b). This may be an issue with host weapons made from alloys and plastics not intended for use in firearms. Zinc alloy and ABS plastics are commonly used in blank-firing weapons due to their lower cost. When live ammunition is used, breech pressures increase dramatically, and the component parts may fail—often critically—after only a few shots (King, 2015, p. 3).

For use with sufficiently low-pressure ammunition, barrels and bolts are also adapted from commercially available tubing, typically steel or even copper alloy. Loyalists in Northern Ireland made improvised sub-machine guns out of square-shaped steel tubing commonly used in the furniture industry.<sup>148</sup> The use of unmarked furniture tubing made it difficult for authorities to identify and dismantle the facilities at which these and other weapons were manufactured. Less commonly, makers and especially converters obtain pre-rifled barrel blanks from the commercial trade. Barrel blanks require a certain level of skill to install, even in a simple blowback-operated pistol, as a chamber must be precisely machined and hand-finished (Ferguson and Jenzen-Jones, 2014a; Hays and Jenzen-Jones, 2018).

Rarely, designers may also devise accessories that are similar to commercially-manufactured items. As previously noted, accessories are items that are attached to small arms or light weapons and increase the weapon's effectiveness or usefulness, but they are not essential for the basic, intended use of the weapon (Grzybowski, Marsh, and Schroeder, 2012, p. 245). The most common improvised accessories are simple sound suppressors (see Image 6.14), which often comprise only a single expansion chamber, unlike more complex commercial designs. Like the improvised weapons to which they are attached, these items are relatively ineffective and arguably mainly for 'show' (Ferguson and Jenzen-Jones, 2014a). Prominent examples of improvised sound suppressors are those supplied with so-called 'assassination kits' that European authorities have seized with converted Baikal pistols. The kits consist of a pistol with a threaded barrel, a sealed sound suppressor, and ammunition, often all contained in a plastic carrying case (Linning, 2016).

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<sup>148</sup> They also created hybrid firearms from genuine Sterling sub-machine gun parts that were stolen from British authorities (Shea, 2007).

**Image 6.14** A 6P42 series traumatic pistol, itself a design originally based on the lethal-purpose Makarov PM, illegally converted to fire 9 × 18 mm lethal-purpose ammunition and fitted with a sound suppressor



Source: Maxim Popenker

## Converted and ‘reactivated’ weapons

### *Overview of converted weapons*

In most cases, converted weapons are lethal-purpose weapons which have been made by modifying a replica firearm, a non-lethal firearm, or a less-lethal firearm (King, 2015, pp. 8–9). Converted weapons include those based on: blank-firing firearms; less-lethal weapons including ‘traumatic’ weapons and less-lethal launchers;<sup>149</sup> and flare guns, which have been modified to fire lethal-purpose (‘live’) ammunition. The term also includes some types of modification to deactivated weapons (see below) (Ferguson and Jenzen-Jones, 2014a). There is significant overlap between improvisation, craft-production, and conversion.

Blank-firing firearms include alarm guns and starter pistols, which are typically noise- and flash-producing replicas of real firearms. So-called ‘traumatic’ handguns are a type of less-lethal weapon that are designed for self-defence purposes and fire ammunition containing rubber balls or irritants, such as ‘pepper

<sup>149</sup> For example, 37 and 38 mm less-lethal launchers have been converted by several non-state actors to fire lethal-purpose 40 × 46 mm ammunition, such as high-explosive rounds (ARES, n.d.; ATF, 2010).

spray' (oleoresin capsicum) (Ferguson and William, 2014).<sup>150</sup> Traumatic handguns are, broadly speaking, the most suitable for conversion since they have barrels that permit the passage of a projectile (unlike many alarm guns and starter pistols). Gas alarm guns without barrel occlusions are also highly prized for conversion. For this reason, the Baikal IZH-79-8 and IZH-79-T handguns which have historically been readily available in the UK – where their sale or possession is in fact illegal – are commonly recovered there (Ferguson and William, 2014; King, 2015, p. 9).<sup>151</sup>

Traumatic pistols are functionally identical to the broader category of 'front-venting' blank-firing handguns, in which propellant gases are vented forward, out of the barrel of the device. Front-venting blank-firing types may prove more difficult to convert, as they are only required to vent propellant gases and often feature deliberate barrel occlusions to prevent the passage of solid projectiles. Generally speaking, top- or side-venting types, which typically feature a substantial metal occlusion permanently integrated into the barrel and extending back into the chamber area, are substantially more difficult to convert. There are other methods used to impede the conversion process (Florquin and King, 2018). These reflect a concerted effort to prevent illicit conversion (Ferguson and William, 2014; Hays and Jenzen-Jones, 2018).

It should be noted that given sufficient will and expertise, essentially any non-lethal or replica firearm can be converted to fire live ammunition. Whether criminals will go to the trouble of converting an item depends on the level of skill required to achieve the conversion, and the cost and risk of converting weapons versus acquiring conventional firearms. In the UK, for example, most converted blank-firing handguns used in crimes are traumatic and front-venting types (typically illegal there); the corresponding rarity of legal top-venting types shows these models are seriously challenging for criminals to convert (Hays and Jenzen-Jones, 2018).

It is also important to note that a very basic conversion can be effected simply by cutting the existing barrel off at the chamber, and relying upon the chamber itself to generate sufficient pressure to project the bullet (Ferguson and William, 2014). While traumatic guns altered in this way are wildly inaccurate and less

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<sup>150</sup> Most are also capable of firing blank cartridges.

<sup>151</sup> The Baikal IZH-79-8 and IZH-79-T are also known as the 6P42 series.

powerful than a conventional pistol firing a commercial bullet, they can cause severe injuries at short range.<sup>152</sup>

Many of the technical requirements and manufacturing techniques used in the production of improvised and craft-produced small arms and light weapons also apply to the conversion of non-lethal and less-lethal weapons. However, converting blank-firing and traumatic pistols is often more attractive to criminals because the converted weapon, made largely of conventionally-manufactured components, may be of higher quality than available improvised and craft-produced weapons which have been built from scratch (Ferguson and William, 2014; Ferguson and Jenzen-Jones, 2014a). Blank-firing and traumatic pistols are also significantly less expensive than lethal-purpose weapons, in some cases costing ten per cent of the cost of a 'real' pistol (King, 2015, p. 8). Indeed, converted blank-firing and traumatic pistols are, worldwide, the most commonly recovered subcategory of converted or reactivated firearms (ARES, n.d.).

Globally, blank-firing weapons made in Turkey represent a substantial number of recovered converted firearms. Researchers have documented sales of converted Turkish-made blank-firing handguns, sub-machine guns, and rifles on illicit physical and online markets in six countries, and they have been used by criminal elements in dozens more, primarily in Europe and North Africa (ARES, n.d.; Jenzen-Jones and McCollum, 2017; Florquin and King, 2018). Blank-firing weapons produced in Croatia, Russia, Germany, and elsewhere are also still circulating globally, but in substantially lower numbers (ARES, n.d.).

In summary, the choice of conversion over improvisation or craft production is likely to be based upon the time and effort required to convert a given weapon, and the availability (licit or illicit) of the 'weapon' to be converted versus a conventional firearm. It is also contingent upon national laws, which may restrict the type of weapons available for conversion (Hays and Jenzen-Jones, 2018). There is also considerable psychological and prestige value attached to functioning weapons that closely resemble original purpose firearms. Not only do such weapons more easily pass as 'real' firearms to other criminals and potential victims, but they may better fit users' image of a firearm.<sup>153</sup>

152 A bullet fired from a traumatic gun without a barrel can penetrate several inches of ten per cent ballistic gelatine at contact distance (Channel 4, 2016).

153 Author interviews with senior UK intelligence and law enforcement personnel, April 2016.

## *Identifying converted weapons*

Generally speaking, blank-firing weapons, whether converted or not, are identified by the same types of physical characteristics and markings as conventional firearms. Most less-lethal and non-lethal weapons have markings that identify the make and model of the weapon, and often include a serial number as well. Other markings, such as a calibre designation, may also be present. It should be noted that some blank-firing weapons have ‘faux’ serial, batch, or lot numbers—that is, numbers that appear to be unique identifying marks, but that are actually identical across a batch, lot, or model of weapon (ARES, n.d.). It may be difficult for a non-specialist to determine whether a given example has been converted; possible indicators include visible toolmarks, ill-fitting or distinct barrels or barrel assemblies, welding or brazing, and the presence of lethal-purpose ammunition.<sup>154</sup>

## *Overview of reactivated weapons*

Reactivated weapons are deactivated weapons that have been wholly or partly returned to an operational state. Deactivated weapons are original-purpose (typically lethal) firearms that have been rendered ‘permanently’ inoperable, that is, incapable of discharging a projectile.<sup>155</sup> These weapons are often sold to collectors (EU, 2017; Jenzen-Jones, 2015f).<sup>156</sup> Deactivated weapons are frequently drawn from surplus stocks and are often old, incomplete, worn-out, or otherwise unsafe to fire, making it especially important to prevent a live round being easily chambered. The process of adapting properly deactivated weapons to lethal-purpose use is often called reactivation or conversion. The term ‘conversion’ is sometimes used to indicate that a weapon may not be ‘reactivated’ to its full, original capabilities, but may still pose a lethal threat (for example, when a deactivated rifled barrel is replaced with a functional, smooth-bore barrel. The weapon is no longer a ‘rifle’ and is therefore less accurate at longer ranges, but it is still potentially lethal) (Jenzen-Jones, 2015f).

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154 Brazing is a form of high-temperature soldering.

155 Such weapons may be described with terms such as ‘inert’, ‘drill-purpose’, ‘innocuous’, among others.

156 It is important to note that various armed forces retain weapons that have been rendered non-functional but that may not qualify in legal sense as ‘deactivated’. Typically, the intent here is to prevent soldiers from attempting to fire—or accidentally firing—live rounds in a training environment where live ammunition is not used for safety reasons.

There are also other types of weapons which are sometimes thought to fall into this category, including lethal-purpose weapons converted to fire only blank ammunition (so-called ‘acoustic expansion weapons’) and those converted to fire very small, low-power cartridges (often known as ‘Flobert’ calibres).<sup>157</sup>

Deactivation standards vary significantly, both by country and by type of deactivated firearm. Some national standards are much more rigorous than others. Prior to 2015, deactivation standards in Slovakia were lower than in other European countries (Jenzen-Jones, 2015f; Samuel, 2015).<sup>158</sup> The Slovakian government raised its standards after terrorists used deactivated Czech Sa vz. 58 self-loading rifles acquired in Slovakia in the 2015 Paris attacks, which also prompted changes in deactivation standards in other European countries (European Commission, 2016).<sup>159</sup>

### *Identifying reactivated weapons*

Non-specialists may readily confuse deactivated and ‘reactivated’ firearms with their original lethal-purpose equivalents (see Image 6.15). Signs that a weapon may have been deactivated include:

- the absence or modification of critical components, such as the bolt or barrel;
- working parts that are immobile;
- proof marks or other marking indicating that the item is a legally-compliant deactivated weapon; and
- welding or brazing.

Deactivated weapons that have been reactivated may be identifiable in a similar manner to converted blank-firing weapons. Signs of reactivation include visible toolmarks, welding or brazing, and the presence of lethal-purpose ammunition. In most cases, inspection by specialists is advisable.

Image 6.15 shows three PM model self-loading handguns. No. 1 is a fully functional factory-produced pistol. No. 2 was deactivated before being converted to fire lethal-purpose cartridges. No. 3 is a craft-produced copy, made by skilled gunsmiths in Pakistan. At first glance, the weapons appear identical.

157 For more details, see Florquin and King (2018).

158 See, for example, HMSO (2010).

159 For further details, see Florquin and King (2018).

**Image 6.15** Three versions of a PM-type self-loading handgun



Note irregularities in serrations on the hammer and safety/selecter and difference in marking style compared to No. 1 and No. 2.

Source: N.R. Jenzen-Jones/ARES



A closer examination of the physical features of the first and second handguns reveals key differences, especially when the two are disassembled. The most noteworthy difference is the barrel, which had been replaced with an unfinished copy. The third weapon can be differentiated from the other two by both its physical features and its markings, including irregularities in serrations on the hammer and safety/selector, differences in marking style and quality, looser tolerances, and inconsistent finish.

### Box 6.4 Capability

All of these weapons are, by their very nature, less capable than their factory-made counterparts. Both craft-produced and improvised firearms are often unreliable, inaccurate, and unsafe. Accurate rifled firearms are rarely within the production capabilities of those producing improvised or craft-produced small arms and light weapons, and so the majority of these weapons feature smooth-bore barrels (though they are often incorrectly dubbed 'rifles') (Hays and Jenzen-Jones, 2018).

Improvised weapons and converted blank-firing weapons are often of particularly poor quality. In many cases, the metals used in these weapons are insufficiently strong for their intended purpose. Their weak construction obliges makers to employ low-pressure cartridges.<sup>160</sup> Use of these cartridges drastically affects the range, accuracy, and terminal effect of these weapons, though of course at close range these characteristics are less important. Even when carefully manufactured, the structural integrity of many improvised weapons remains a serious issue. Some remain intact for only a few rounds (Hays and Jenzen-Jones, 2018).

### Image 6.16 A typical pen-type zip gun



Source: Stills from a YouTube video<sup>161</sup>

However, some craft-produced weapons approach modern factory standards. Traumatic or blank-firing pistols converted using genuine barrel blanks compare favourably with lethal purpose equivalents, provided they are equipped with sights and thoroughly tested for function and accuracy

<sup>160</sup> Examples of low-pressure cartridges include 12 bore shotgun, .32 ACP, and .22 LR.

<sup>161</sup> Video details withheld on security grounds.

(Hays and Jenzen-Jones, 2018; Forgotten Weapons, 2017a). Their barrels are inherently far stronger than improvised barrels, since they are made for use in factory-made guns. Producers of converted firearms that use these materials are also likely to chamber the weapon for commercially available ammunition rather than improvised ammunition. The end result is a relatively potent, long-lasting weapon (Ferguson and William, 2014; Ferguson, 2014a). In other words, improvised, craft-produced, and converted weapons range in capability from practically useless to near parity with commercially available types. They should therefore be assessed on a case-by-case basis.

One significant complication of reliance on handmade components is a total lack of the interchangeability of parts, which makes it difficult for most users to carry out repairs. If a major component fails, the user is obliged to seek a craft-produced replacement, or to replace their weapon with a new one. This also affects the practice of disassembling a weapon before it is smuggled, which is a common technique employed by arms traffickers (Pavlovich, 2016, p. 11). When multiple weapons are disassembled and their parts become mixed in transit, a user may find themselves with a poorly functioning, non-functional, or even unsafe weapon when the parts are reassembled.

Firing improvised ammunition can be particularly dangerous to the user, especially as it may be used with factory-made weapons that are otherwise considered safe. While some hand-loaded cartridges are safe and reliable, others are outright dangerous. Out-of-specification cases and projectiles are likely to cause feeding issues, especially in self-loading firearms. The use of match heads and other unconventional propellants may result in the weapons not firing or other malfunctions.<sup>162</sup> An improperly loaded and/or chambered round may destroy a weapon and injure or even kill the operator. The combination of improvised ammunition and an improvised or craft-produced firearm is particularly dangerous, compounding the problems inherent in both (Ferguson and Jenzen-Jones, 2014a; Hays and Jenzen-Jones, 2018).

## Improved and craft-produced ammunition

The greatest activity in the area of ammunition improvisation or craft production is with light weapons. Non-state armed groups, which expend large quantities of ammunition for grenade launchers, mortars, recoilless guns, and rocket launchers in a typical conflict, are particularly likely to turn to craft production (Hays and Jenzen-Jones, 2018; see Image 6.17). Improvised mortar projectiles are fairly common in the Middle East and North Africa, and are manufactured and employed by a variety of groups (ARES, n.d.). Notably, the Islamic State has manufactured ammunition for mortars and other weapons on a quasi-industrial scale. Colombian militant groups (especially the Revolutionary Armed Forces of Colombia (FARC)) are also known for their activities in this area, which were directly influenced and facilitated by members of the Provisional Irish Republican Army (PIRA) (Hays and Jenzen-Jones, 2018).

<sup>162</sup> An example is 'hang fire', which is when there is an unexpected delay between the functioning of the trigger mechanism of a gun and the ignition of the propellant.

**Image 6.17** Improvised mortar projectiles converted from gas cylinders, Syria, 2013



Source: Molhem Barakat/Reuters

Given the wide range of improvised and craft-produced light weapons, the forms and natures of improvised light weapons ammunition are vast. Cartridges for cannon are rarely improvised due to their complex production requirements. Larger ammunition, including projectiles for grenade launchers, mortars, and recoilless weapons, are often crudely improvised, as are rockets. The accuracy of improvised ammunition produced for all types of light weapons is generally limited, and securing the required materials can be difficult. Producers of improvised light weapons ammunition often have to be able to produce or repurpose both high-explosives (either from commercial or bulk explosives, or from ‘harvesting’ explosives from military munitions or other sources) and low-explosive propellants (for use in propellant charges, rocket motors, etc.) (Ferguson and Jenzen-Jones, 2014a; Hays and Jenzen-Jones, 2018). More specialized functional types of ammunition are sometimes also improvised, including smoke, incendiary, and chemical weapons (ARES, n.d.).

In the case of small arms, there is a clear criminal preference for factory-made or reloaded ammunition, even where the street value for such ammunition is very

high (sometimes many times higher than commercial pricing).<sup>163</sup> Improvised firearms are typically designed around readily available cartridge types, due to the substantial difficulties inherent in producing functional cartridge cases, projectiles, and primers from scratch (Hays and Jenzen-Jones, 2018).<sup>164</sup> One alternative to lethal-purpose ammunition is converted non-lethal and less-lethal ammunition. Ammunition used in blank-firing and traumatic firearms, as well as in some nail guns, is sometimes modified with the addition of a projectile.<sup>165</sup> In many countries, blank cartridges are readily available (and often unlicensed), and contain charged and primed cases that require only the addition of a viable projectile for lethal applications. However, most available blank ammunition is made for purpose-built blank-firing weapons and is deliberately manufactured to different specifications than lethal-purpose ammunition. Generally speaking, this ammunition requires specific modifications to be fired from weapons other than converted blank-firing firearms (Ferguson, 2014a). Similarly, some blank ammunition for lethal-purpose firearms, including the blanks used in film and television, will not chamber in a blank-firing weapon without extensive modifications to the weapon.

For these reasons, craft production of ammunition and the modification of existing cartridges is often a last resort. Instead, local users may employ various crude methods to reload fired cartridge cases.<sup>166</sup> Reloading ammunition is relatively straightforward. The reloader simply punches out the expended primer cup from a cartridge case and reloads it with an improvised composition made from match heads, small percussion caps from a child's toy, or another impact-sensitive mixture. These improvised primers are reasonably reliable ignition sources. The reloader then makes a projectile and an improvised propellant charge from materials such as match heads or black powder extracted from fireworks (Hays and Jenzen-Jones, 2018). Projectiles are improvised in different ways, including

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163 Author interviews with confidential UK and European law enforcement sources, 2015–17.

164 Common calibres used globally include 12 gauge or .410 bore shotgun cartridges, .22 rimfire rifle cartridges, and centrefire calibres in the .38/9 mm range (Hays and Jenzen-Jones, 2018).

165 Powder-actuated tools make use of controlled chemical combustion in much the same way as a firearm, employing specially-designed blank cartridges to act on either the head of a fastener (such as a nail) or a piston (which, in turn, strikes the head of a fastener), driving the fastener into the target material at very close range (Frank et al., 2012).

166 This is especially the case where certain calibres or types are in short supply, such as suitable big game hunting ammunition (Y-Man, 2013a; 2013b).

**Image 6.18** Improvised ammunition made by modifying conventional cartridge cases, signal blanks, and charges used by powder-actuated tool cartridges



Source: EkoCzao

the traditional methods of casting in a two-piece mould, or drop-forming from lead (Carman, 1955, pp. 173–74). Alternatively, they may be formed from metal, primarily steel, brass, or copper alloy, and may exhibit tell-tale toolmarks.<sup>167</sup> Projectiles are also made from, among other items, ball bearings, air rifle pellets, and steel reinforcement bar for concrete ('rebar') (see Image 6.18). The presence of these items may assist in identifying improvised ammunition (Ferguson, 2014a; Hays and Jenzen-Jones, 2018).

In developing nations, fired shotgun cartridges, which are designed to be disposable, are commonly reloaded with lead shot produced locally. The shot is typically made from existing sources, including discarded household items such as battery cells, and is sometimes poured into moulds or drop-formed using trees as substitute shot towers (Hays and Jenzen-Jones, 2018).

Improvised ammunition is often crude. Small-calibre improvised ammunition may feature:

- projectile types which do not match the case;
- cases or projectiles made from industrial or household materiel (for example, nail gun cartridge cases; ball bearings);
- crudely cast or machined projectiles;
- obvious signs of reloading or modification (cuts, solder, adhesives, etc.).

Improvised ammunition for light weapons also often appears crudely finished. Visibly hand-applied welding or brazing; extensive use of non-specialized external fasteners such as common bolts and nuts; low-quality or absent paintwork; repurposed industrial or household items (for example gas cylinders or industrial piping); and other rough and ready measures are signs that ammunition may be improvised.

<sup>167</sup> Some commercial hunting projectiles are also turned from copper alloy and other metals (Pergrine, 2015a; 2015b).

## Muzzle-loading firearms

### *Overview of muzzle-loading firearms*

Until the 19th century, the most common firearms were single-shot muzzle-loading weapons. Strictly speaking, ‘muzzle-loading’ simply refers to any gun that is loaded from the muzzle (front) of the barrel, or in the case of revolvers, the cylinder.<sup>168</sup> This category of weapons includes those that are loaded with rounds of ammunition other than self-contained cartridges, such as propellant powder and a bullet wrapped in paper or other combustible material (ARES, 2017). However, it also includes modern arms such as the Russian GP-series grenade launcher, which uses semi-caseless ammunition but is loaded at the muzzle, and ‘in-line’ muzzleloaders (see Image 6.19). Practically speaking, the term ‘muzzle-loading firearm’ is most often used to describe weapons that may be lethal, but are obsolete and rarely encountered in the field, such as muskets.

Muzzle-loading firearms remained common for decades—in economically less-developed countries—until the mid-20th century. Gunflints for flintlock arms (a type of muzzle-loading firearm) were exported from Britain to African nations until the 1960s (Whittaker, 2001). Even today, muzzle-loading firearms are still sometimes encountered in the field (ARES, n.d.). These weapons are typically craft-produced (see above) and used for hunting (including poaching), self-defence, and militia activity in economically less-developed countries (Hays and Jensen-Jones, 2018).

**Image 6.19** An American Michigan Arms Wolverine in-line muzzle-loading rifle



Source: Chuck Madurski via ARES

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<sup>168</sup> Muzzle-loading firearms are often colloquially referred to as ‘muzzle-loaders’ or ‘muzzleloaders’.

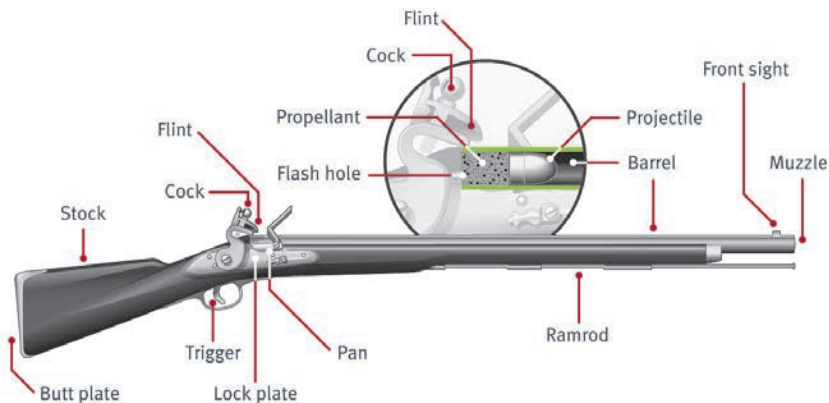


Elsewhere, antique muzzle-loading firearms and replicas are rarely used beyond recreational shooting by collectors and by hunters. In-line muzzle-loading guns were pioneered in the United States in the 1980s and targeted at the recreational hunting market (Sigler, n.d.).<sup>169</sup>

### *Identifying muzzle-loading firearms*

Muzzle-loading firearms may be either rifled or smooth-bore weapons, using various initiation methods including flintlock and percussion lock designs.<sup>170</sup> Fundamentally, they consist of the archetypal 'lock, stock, and barrel'. The 'stock' and 'barrel' are similar to those found on modern firearms. The 'lock' is the functional equivalent of the receiver in contemporary firearms, acting as a baseplate and housing for the mechanical parts of the weapon (see inset in Figure 6.1). In muzzle-loading designs the flint or percussion cap is separately located on the lock. While most muzzle-loading small arms make use of black powder, some modern commercial muzzle-loaders use smokeless propellant (Fadala, 2004).

**Figure 6.1** The parts of a muzzle-loading flintlock rifle



Note: The inset shows parts of a percussion lock.

<sup>169</sup> In-line muzzle-loading guns superficially resemble single-shot centrefire firearms, as they typically break open for priming, but not for loading of the main charge or projectile (these being loaded from the front of the barrel). They also employ a striker mechanism in line with the barrel of the weapon, rather than the traditional external lock (Sigler, n.d.).

<sup>170</sup> For a discussion of early firearms designs see also Butler (1971).

**Image 6.20** A producer's workshop with selected hand tools, Nigeria



Source: Gsell and Nowak (2018)

— **Authors: N.R. Jenzen-Jones with Jonathan Ferguson**