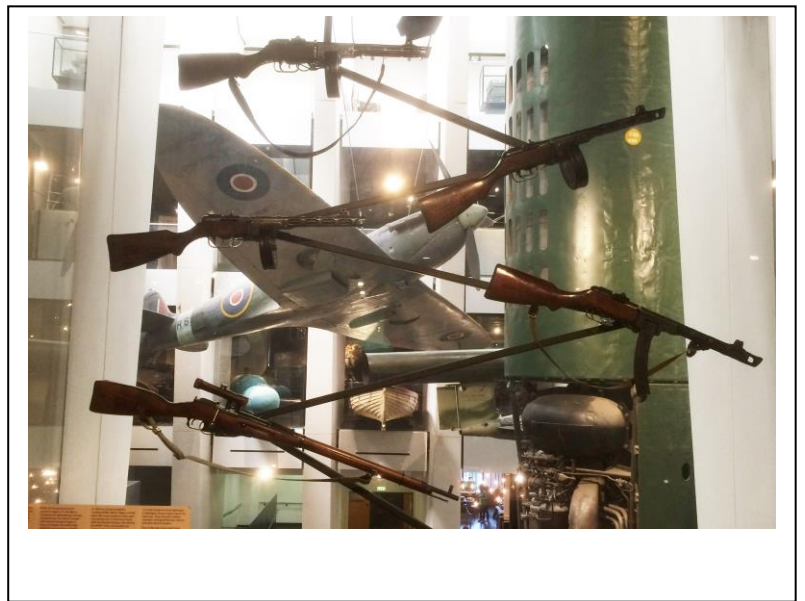


Law and Care

The relationship between contemporary
Nordic firearms law and conservation.



Viktor Klinge

**Uppsats för avläggande av filosofie kandidatexamen i
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Law and care: The relationship between contemporary Nordic firearms law and conservation.

Viktor Klinge

Supervisor: Ticca Ogilvie

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Author: Viktor Klinge
Supervisor: Dr Ticca Ogilvie

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ABSTRACT

The objective of this study is to research the care and storage of firearms requiring a license in various museums in the Nordic countries. With increasingly strict gun laws in place within Europe, the question is raised whether museums manage to find a balance between their country's gun laws and the conservation care, they would like to provide to their collections of modern firearms that fall under these laws. This study was inspired by an internship experience at the Swedish museum of Science and Technology, where the storage of firearms had not received some particular attention.

In order to investigate this question, both a questionnaire enquiry and face-to-face interview methods were used.

Although most museums were understandably cautious about providing certain types of information about such a sensitive part of their collections, a picture emerged of a pattern of care, which sought to manage the problems raised by the legal framework under which modern firearms may be kept by museums. This pattern of care appears largely to be shared by Nordic museums, even though no formalized standards exist for the care and conservation of this material in these countries. The example of a UK museum with a significant firearm collection, was included in order to test whether this common ground exists wider than the Nordic countries. As a final outcome of this research a set of recommendations for the care of modern firearms is presented, which brings together the result, which emerged from this research.

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Foreword

This thesis is the result of a long process of writing, surveying and interviewing, filled with setbacks and further obstacles appearing along the way. The feeling of seeing the final result in front of me cannot be described, but in a good way. I want to therefore thank all of you who have made this thesis possible.

I want to first thank my supervisor Ticca Ogilvie for all of her help. I would never have gotten this far without her help. Our meetings together discussing the progress of this thesis have been invaluable and I couldn't have completed this thesis without them.

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I also want to extend my thanks to Christina Halldén Tengnér, Armémuseet, and Claes Johansson, security chief at SMHA, for taking time out from their schedules and allowed me to interview them. In fact, I want to thank everyone who took time out of their schedules to answer the surveys that were sent out to respective museums. This thesis couldn't have been completed without your help.

Lastly, I want to thank my family, friends and fellow students, for helping me and supporting me when I felt down and felt like I was going nowhere with this thesis. Now, when I stand here with a completed thesis in my hand, I know that your assistance has been invaluable, like everything else. Thank you all!

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1. Approach

1:1 Introduction and background

With stricter gun laws being invoked all over the Nordic countries (Sweden, Norway, Denmark and Finland, Iceland is excluded), it is becoming more difficult to acquire weapons that have potential to cause harm to our society (European Parliament 2017). While this is a good thing, one can't forget the importance firearms has played during human history, and consequently the importance to preserve this record in our museum collections for future generations. With gun laws becoming stricter, we have to ask whether this is affecting how museums are able to care and give access to these collections. Many museums store and display weapons from very recent conflicts (Hageby 2015). These weapons have seen active use and are still usable, and as such they are governed by modern laws. While these laws have been put into place for a reason, the question remains, are the laws making it more difficult to care and conserve these objects? This is what this paper is going to try to answer.

This study was inspired by my internship at the Swedish museum of Science and Technology, when I saw the way they approached the storage of their collection of firearms requiring a license to own. I was present at the time when their new storage system for firearms was first installed. The emphasis in the new storage system was on improving security, but did not extend to improving the storage environment or materials. The reason for this was that the new laws required further controls to access the collections, whereas the usual economic restrictions common to museums in this age applied to any aspirations to provide more conservation oriented preventive care measures. Recognizing that the museum had to prioritize the law, above conservation considerations. Then my question arose if other museums, that had similar collections of firearms, had to prioritize in the same way. I then sought to find out more about this topic and to see how each museum that focus on firearms handles this issue.

1:2 Problem

It is obvious that museums in all countries must meet certain legal requirements, when it comes to managing hazardous collections that include functional firearms. Furthermore, it is necessary to remember that all museums are on a budget and that budget has to be spent on the items most central to its primary missions. When it comes to hazardous objects, like firearms, the first priority clearly must be the safety of those objects, so that neither staff nor visitors, may be harmed by them. But this being so, what is left for the care of the firearms themselves. It is possible that modern firearms receive a lesser amount of care because of what they represent to most people? Because firearms were designed to kill and are made of what appears to be very recent materials, it is possible that they are seen as a lower priority for conservation care as a result? Most museum specialists in firearms would agree that they deserve to fall under the same preservation criteria as any other object. A firearm can rust, rot and corrode like any other object made out of the same materials, and in fact many of their modern materials make them more vulnerable than historic object, consequently their conservation and storage can prove to be difficult. Throughout the Nordic countries, firearms must be kept locked up to prevent theft, and the number of people allowed access to them

must be strictly reduced and controlled. As with the Museum of Science and Technology in Stockholm, not all museums have the luxury of providing climate controlled vaults in which the firearms can be stored. And where access to these collection is reduced, they may receive less regular attention from curators and conservators than other collections, increasing the likelihood of eventual deterioration. Furthermore, because of the museums budget restrictions, they may not be able to afford any special care for the firearms, increasing the hazard risk for the one maintaining the weapon. So how do Nordic museums specializing in modern firearms collections handle these issues?

1:3 Central issues of investigation

The issues presented to us in this investigation are:

- a) How are modern weapons handled at museums i.e. storage, conservation and handling, in accordance to the law?
- b) Does the law affect the conservation of modern weapons in any negative ways?
- c) If so, have museums managed to find ways around these problems?

These are the questions that this investigation will attempt to answer.

1:4 Delimitations

This study will restrict itself to the relationship between conservation and the law in the matter of the handling of modern firearms within museums. Private organizations and collectors, like Svenska Vapensamlarföreningen (SVEVAP) and Svenska Vapenhistoriska Samhället (SVH), lie outside the remit of this study. Museums within the Nordic region are the focus of this study, however museums outside this region will be brought in where differences and similarities appear significant to the purpose of this investigating.

1:5 Methods applied

Three methods of approach were applied to the investigation of this question on the care of modern firearms and the law. First, an investigation of the source literature currently existing on the subject. Second, a questionnaire sent to museums in the Nordic countries with significant arms collections, and third, a one-to-one interviewing of curatorial and conservation staff with a responsibility for modern firearms collections in museums.

It became clear that the amount of reference literature on the subject of the care of modern firearms collections in museums, is rather limited. Material was therefore brought together from a variety of other sources: legal, industrial, military, and firearm interest groups. This lack of literature on the subject is what suggested the need to develop a set of recommendations for the care of modern firearms coming out of this investigation, which can be shared with museums in the Nordic area.

One-to-one discussions with curators and conservators about their concerns about modern firearms collections were clearly the best way to obtain detailed information about the issues and solutions that they deal with. The original intention was to visit the Armémuseet (The Swedish Army Museum) in Stockholm, Sweden, Sotamuseo (The Finnish War Museum) in Helsinki, Finland, and Tøjhusmuseet (The Royal Danish Arsenal Museum) in Copenhagen, Denmark. In the end however, it was only possible to meet with staff from the Armémuseet, as the other two organizations were not able to make time for a meeting during the period available for this research. This visit proved very valuable in the large amount of information that was collected.

The questionnaire did not yield as much in-depth information as the visit, but it still gave a broad perspective on the subject of the handling of modern firearms at museums. The survey included a short introduction and a series of questions under four categories of enquiry: their collection, transportation and display, conservation and storage, implementing the law.

1:6 Source material and source criticism.

There does not appear to be a study like this one in the published literature. In the process of investigating my research questions, a number of useful texts were consulted that proved in different ways connected to this study. Relatively few of these dealt with the situation in Nordic countries however.

In researching the subject, five areas of enquiry were looked at: firearm laws in Nordic countries, the construction of each of the main types of modern firearms, the materials of modern firearms, the conservation measures for firearms, and the ethical framework guiding the care of modern firearms in museums. The most important sources for this study were documents explaining the process of conservation of firearms. Very few of these appear to exist. One of the most informative of these was *Caring for Your Collectible Firearms* (Wicklund 2017), published by National Rifle Association (NRA) Museums. The text is an instruction manual, directed towards both museums and private collectors, and provides a quantity of guidance on both the risks to firearms and methods for their optimal conservation and storage. Most of this matched closely with what the conservators at the Swedish Army museum reported doing with their collections. The text deals with such things as coatings on firearms, a subject that is often overlooked.

Another article that was particularly helpful is *Corrosion and Conservation of Weapons and Military Equipment* (Jegdic 2012). The text goes into detail on the conservation and corrosion of military equipment at the military museum in Belgrade. Although their investigation focuses mostly on equipment stored outside, it is nevertheless a valuable source of knowledge about the risk of deterioration of this type of object. Another valuable source of information laying out the issues of conservation care of firearms is *The Conservation of Firearms from the Oriental Armoury* (McArthur 2016). In this article, the author explains the conservation procedures used at the *The Wallace Collection, London* for the functioning firearms that are stored and on display. The article explains the process and safety procedures required when conserving fully functional firearms that may be loaded. Many of the techniques laid out in this article were confirmed to be the same as those used by the Nordic museums surveyed as part of this research. In general, the primary source literature, such as these examples mentioned, confirmed that there is a level of international consensus on what the issues are for

modern firearms in museums collections and how they should be dealt with. How this is affected by different laws within countries still requires investigation.

Secondary sources consulted in researching this thesis included law texts and instruction manuals, as well as the websites of each of the museums to whom a questionnaire was sent. Law text proved valuable because, to be able to get an in depth view on how the law affect conservation, it is necessary to understand the law and why it is the way it is. One revealing text consulted was the Swedish law text *En Skärpt Vapenlagstifning* (Thalén & Lejon 1999), written and published by the Swedish Justice Department. This text explains how and why the Swedish law on firearms is like it is. Another helpful text proved to be *Firearms-control Legislation and Policy* (The law Library 2013). This international text reviews and compares the different firearm laws of many countries, including the main firearm laws of the European Union, and particularly interesting was the explanation of how Norwegian weapon laws were changed after its terror attack of 2011. A literature source called *Firearms and the law* (Fortson 2015) was particularly helpful as it went into detail on the subject of firearms in museum and private collections and how the law influences museums procedures. This text focusses on UK museums only, which leaves the subject of how Nordic laws affects the care procedures in Nordic museums still to be investigated.

Military handbooks were an unexpected source of useful information, perhaps not so surprising as many Scandinavian military museums have a direct contact with the nation's armed forces. One example of such a handbook is the Swedish armed forces own handbook called *Försvarmakten: Handbok Säkerhetjänts Vapen och Ammunition* (Eksell & Keisu 2007). This text, approved by the Swedish armed force museums committee, not only talks about how active explosives and live ammunition should be handled, but also how they should be stored. A British text which appeared likely to be useful, was *Rationalizing hazardous collections* (Ratcliffe 2012), which includes a discussion on functional firearms along with other dangerous items stored in museum collections. Unfortunately it does not really go into detail on the issues that museums have to deal with day to day basis in the care of modern firearm collections, which makes it a less valuable source for the research question of this thesis.

In general, there are rather few texts which serve as a resource for the conservator or museum professional requiring advice on the best way to work with modern firearms, while keeping within the legal requirements. The largest amount of useful information for this thesis was gathered through personal interviews with conservators and other museum professionals and the questionnaire sent out to museums with arms collections. From these less of the ideal and more of the day to day practical issues and solutions emerged.

2. Constraints governing the care of modern firearms collections

2.1 Professional and ethical guidelines.

The way museums operate is affected by many different factors. These include social interests, economic resources, traditions and professional agreements. Each museum's mission varies and the laws of the country decide what the criteria for an officially registered museum are. For example in Sweden, current regulations state that registered Swedish museums must commit to society, through the sharing of knowledge, cultural experience and freedom of thinking and decisions. Such factors as these do not directly affect the way they care for their firearm collection, however, common to all Nordic museums is the requirement to follow regulations and ethics of the International Council of Museums (ICOM) in the preservation, storage, and provision of access to their objects.

While the museums that I have researched all show a strong commitment to ICOM, they have a more active cooperation within the International Committee of Museum and Collections of Arms and Military History (ICOMAM). ICOMAM's mission is to develop a worldwide network within the study of arms and military history. While the emphasis of its published work focusses largely on arms history, the Swedish museums I contacted valued the exchange of knowledge on conservation and collection care matters that comes along with belonging to the network.

ICOM and its various committees, such as ICOMAM, are responsible for promoting codes of ethics covering access to and the preservation of collections. These are meant to serve as guidance and models for the policies developed by individual museums for their collections in respective member country.

Museums are encouraged to avoid tampering too much with their working objects, in order to avoid risking destroying valuable information and knowledge. This guidance is aimed towards collections of working objects, such as firearms. The citations are from ICOM.

“The collections policy may include special considerations for certain types of working collections where the emphasis is on preserving cultural, scientific, or technical process rather than the object, or where objects or specimens are assembled for regular handling and teaching purposes. (See also 2.1)” (ICOM 2013 p. 4)

One of ICOM's main missions with museums is promoting the spreading of information and knowledge to the public.

“The museum should establish and apply policies to ensure that its collections (both permanent and temporary) and associated information, properly recorded, are available for current use and will be passed on to future generations in as good and safe a condition as practicable, having regard to current knowledge and resources” (ICOM 2013 p. 5)

In the case of museums' firearm collections however, some caution is required about the sharing of confidential information about this type of potentially hazardous collection.

“The museum should exercise control to avoid disclosing sensitive personal or related information and other confidential matters when collection data is made available to the public” (ICOM 2013 p. 5)

Perhaps the most important area of guidance ICOM provides for museums in its code of ethics is in the area of the importance of investing in preserving objects in order to achieve the preservation of the information they hold. This include both the preventive and active conservation of their collections.

“Preventive conservation is an important element of museum policy and collections care. It is an essential responsibility of members of the museum profession to create and maintain a protective environment for the collections in their care, whether in store, on display, or in transit” (ICOM 2013 p.5)

In the case of modern firearms collections, these can be somewhat neglected along with other modern industrial objects, either because they are thought not to be as at risk because they are not as old as historic firearms, or because it has been noticed that the industrial collections generally are perceived as lower value than art and historical collections.

“The museum should carefully monitor the condition of collections to determine when an object or specimen may require conservation- restoration work and the services of a qualified conservator-restorer. The principal goal should be the stabilization of the object or specimen. All conservation procedures should be documented and as reversible as possible, and all alterations should be clearly distinguishable from the original object or specimen” (ICOM 2013 p.5)

When it comes to the Nordic countries, while they follow the ethics of ICOM, some countries also have different approaches when while handling firearms collections at their respective military heritage sites. In Sweden, the collective museums that work with military and arms are called Statens Försvarshistoriska museer (The National Swedish Museums of Military History) and are all connected to the Swedish military history heritage (Militärhistoriska arv). Swedish defense museums have their own set of codes of ethics and regulations that they follow. A few items within this code of ethics refers directly to firearms collections. Translations underneath are by me.

”2§ Myndigheten ska särskilt...

(the Authority in command shall...)

1. vårda, förteckna, vetenskapligt bearbeta och genom nyförvärv berika de samlingar som har anförtrott myndigheten.

(Cherish, list, scientifically process and through acquisitions enrich the collections that have entrusted to said authority)

2. hålla ett urval av samlingarna tillgängligt för allmänheten samt driva och stödja utställningsverksamhet och annan pedagogisk verksamhet.

(Keep a selection of collections available to the public, to make exhibit activities and other educational activities)

3. stödja samlingar av militärt art i Sverige.

(Support military collections in Sweden)

4. främja studier och forskning i ämnen som tillhör verksamhetsområdet, och...

(Promote studies and research in subjects belonging to the activity area, and...)

5. verka för ökan(!) kunskap grundad på forskning och samverkan med andra, exempelvis universitet och högskolor, och förmedla kunskap inom sitt verksamhetsområde. Förordning (2011:1561).

(Seek for increased knowledge based on research and collaboration with others, such as universities and colleges, and convey knowledge in its field of activity. Regulation (2011: 1561).)” (Kulturdepartementet 2007)

Norway’s museums codes of ethics are largely similar to those in Sweden, but they have a code designed especially for the country’s own defense museums, most notably, Forsvarsmuseet (The Armed Forces Museum of Norway) in Oslo. Their code of ethics requires that defense museums must work in direct contact with the groups in which the knowledge originates from, to make sure that the knowledge is told in the most correct and

in the most non-offensive way, and to be ready to change this information in request.
Translations underneath is by me

- ”Arkiv og museum skal på ein engasjerande måte skapa og formidla kunnskap i direkte samhandling med dei aktørar og grupper som kunnskapen gjeld. Dei skal vera ein offensiv og kontaktsøkjande samarbeidspartnar som har legitimitet, styrkje og mot til å forfekta bestemte verdiar der det er naudsynt
(The archives and museum are to an engaging way, create and disseminate knowledge in direct interaction with those actors and groups from where the knowledge originates. There should be one offensive and contact-searching partner who has legitimacy, strength and courage to deny certain values that where wrong.)”
- ”Arkiv og museum sine brukarar må definerast breitt og femna ulike segment i samfunnet, og evna å gje stemme til samfunnsgrupper som ikkje maktar å gjera seg gjeldande i samfunnsdebatten.
(Archives and museums users must be defined wide and accept different segments in the community, and be able to give voice to social groups that cannot be heard by their own power in the community debate.)”
- ”Arkiv og museum skal ha medvit om den samfunnsendrande krafta som ligg i kritisk og undersøkjande kulturformidling, og skapa fellesskap basert på utforsking av erfaringar, kritisk refleksjon og meningsutveksling.
(Archives and museums must be aware of the social change and force that lie in the critical and investigative culture and society based experience exploration, critical reflection and knowledge exchange.” (Brekke & Slettvåg 2009 p. 5)

This is a requirement for a wider definition of access to military collections than other countries.

Denmark has been a leader in the development of ICOM’s code of ethics, but has no special requirement that relate directly to modern firearm collections. The code of ethics of the Finnish Museums Association (Suomen Museolitto) is also identical to that of ICOM.

2.2 Firearms law in each of the Nordic countries

Sweden, Norway, Denmark and Finland each has different laws concerning the ownership, transporting, and the use of weapons, including firearms. What defines a firearm under European law, which is shared by all the Nordic countries, is best explained by the Ministry of the interior of Finland, who is responsible concerning policing, emergency management and national security. A firearms is defined as...:

“...a tool with which bullets, pellets or other projectiles or incapacitating substances can be fired with the help of powder gas pressure, explosion pressure of primer mass or of other explosion pressure so that it may cause danger to people. The following tools are not deemed firearms unless they can, without special knowledge and skills, be converted into tools with which bullets or pellets can be fired so that it may cause danger to people:

- 1) Nail machines designed and manufactured to be used in construction work;
- 2) Tools designed and manufactured to be used in life-saving or for a scientific or industrial purpose of use. Provisions on the rendering of a firearm permanently unfit for use are laid down by decree.” (Ministry of the interior, Finland 1998)

Sweden

In Sweden, gun ownership is regulated by Vapenlagen 1996:67, and this includes museums. Vapenlagen applies to all kinds of firearms and ammunition and also to items that are on the equal level of firearms, such as start and signal weapons loaded with cartridges. According to Swedish law, firearms include all weapons that fire bullets, pellets, harpoons and other projectiles and utilize either gunpowder, carbonic acid charge, compressed air (or something similar) as propellant (Svensks författningssamling 1996:67). The same laws and regulations that covers firearms, also applies to a number of other weapons-related objects found in museums, such as non-functioning firearms, signaling weapons, crossbows, tear gas canisters, silencers, stun guns etc.

As with the general public, for a Swedish non-state owned museum to own a weapon, they must hold a permit. They also require a permit to transport, repair, and disposal of firearms in their collections. Exclusions to this are weapons that use either carbonic acid cartridges (not charges), air or springs to propel a projectile and are intended for target practice. While private ownership of automatic and semi-automatic firearms is prohibited by law, museums may hold these in their collections under special regulations. These laws apply to modern firearms dating after 1890, because weapons manufactured before that is considered antiques. Historic firearms from before this date do not have the same legal restrictions placed on them and thus are treated differently in museum collections.

To meet the criteria for legal gun ownership within Sweden, museums, like private owners, must be able to show that they are able to keep them secured at all times and accessible only by a limited number of authorized personnel. Weapons must be stored in approved secure weapon lockers or similarly approved secure storage rooms. Museum storage for modern firearms must pass police inspections. Transportation of modern firearms requires a special license granted only for the day of transport, and those transporting the weapons must meet training and security requirements. Weapons are only allowed in public areas, for example, when placed on display in a museum, if appropriate security measures are in place, and an inventory is lodged with the police (Svensks författningssamling 1996:67).

Norway

Firearms regulations in Norway are similar to those in Sweden, except for the fact that a wider range of weapons are included under the category of controlled firearms, and the regulations or private ownership are more restrict. Museum collections are excused from some of these tighter controls surrounding what types of firearms may be owned or acquired.

(...The police directorate may dispense with the prohibition on the acquisition of firearms that are prohibited pursuant to sections 5, 6 or 7. Such dispensation shall not be given before the person can prove that he or she has managed her existing collection in a satisfactory manner over a longer period. In addition, dispensation can only be granted when the weapon is within their specifics collecting area, and the weapon is either particularly rare or has a special historical value. For patron collectors, the police chief may, upon application, dispense with the ban on certain ammunition types in section 8...)” (Justic- og beredskapsdepartementet 2009).

Norwegian law makes an exception for those firearms which “...has been permanently rendered unusable. The same applies if, due to age or construction, the weapon cannot be used as a firearm, nor can it be relatively easily remedied or remodeled so that it can be used to shoot.)” (Justic- og beredskapsdepartementet 2009).

Norwegian law is explicit about the type of storage required (FG Skadeteknikk approved weaponlocker or police approved vault). Weapon and ammunition must be stored separately, and where there are more than 25 weapons in a collection, it is required by law

to have an approved burglary alarm directly connected to an alarm center. Transportation of firearms must be conducted empty of ammunition, and the weapons must be concealed to avoid theft. They are also to be under constant supervision. This also applies to replicas, air guns and decommissioned firearms.

Finland

In Finland, firearms collections are governed by the Firearms Act of 1998, revised to comply with the European Firearms Directive. Finland has much more relaxed firearm laws than Sweden and Norway, although it follows the European Firearm Directive, since joining the EU in 1998. Although, what defines a firearm in Finland is similar to both Sweden and Norway. No types of firearms are banned outright for ownership in Finland.

“...A permit for an automatic firearm, grenade launcher, mortar, breech-loading cannon or for a firearm of a corresponding structure and purpose of use, for a missile or rocket-launcher system or for a component of these weapons may be granted only if the purpose of use notified by the applicant is a show, filming or a corresponding presentation or keeping in a museum or collection. A permit for the above mentioned firearms or their components may, for a special reason, also be granted for work where a weapon is necessary.” (Ministry of the interior, Finland 1998).

Requirements for storage of weapons in Finland are likewise similar to storage laws in both Sweden and Norway. Finland is currently reviewing its firearms storage regulation to meet the EU standard EN 14450. EN 14450 is a series of EU approved storage units for firearms, exact requirements depending on the firearm type and quantity.

“A firearm shall be stored in a locked place or otherwise locked, or so that a component belonging to the firearm is stored separate from the firearm. Even when stored like this, a firearm or firearm component may not be stored in a place where it can be easily stolen.

If a specially dangerous firearm or a total of more than five pistols, revolvers, self-loading single-shot rifles or other self-loading single-shot firearms as referred to in section 6(2)(12) are to be stored, they shall be stored in a secure, locked cabinet under the decree of the Ministry of the Interior. A secure cabinet is not, however, required if the police department for the area in which the storage facilities for firearms are located has approved the facilities. (601/2001)” (Ministry of the interior, Finland 1998).

Denmark

Firearm laws in Denmark is governed by “The Weapons and Explosives Act of 2007” (Våbenloven) and follows the same directives and regulations given by the European Firearms Directive. In Denmark, laws are somewhat stricter, and a license is required to own any type of firearm at all.

Gun storage in Denmark varies according to what organization has the responsibility for the weapons. For privately owned weapons, the owner are allowed to keep the weapons at their residence, if the owner are able to store them in an approved gun cabinet or vault, according to Våbenloven (BEK nr 1248 af 30/10/2013). Governmental owned weapons has to be marked with an International Tracing Instrument (ITI) and records have to be kept in order to make it easier for cooperation in weapon tracing. Governmental storage also requires to have a direct alarm link to local law enforcement (Denmark – Gun Facts, Figures and the Law 2007).

3. Controlled Weapons & their Materials

3.1 Categories of modern firearms

The firearms that are controlled by the law in Nordic countries are those that date from after 1890. While there are an enormous amount of different variants of firearms around today, an understanding of the main groups of firearms presented in museum's modern firearms collections is necessary in order to recognize the appropriate levels of care they require. Firearms tend to be grouped by the design and operation of their firing mechanisms. This section will provide a description of each category of modern's firearms that are covered by modern gun laws in Nordic countries, and how their mechanism work. Their respective materials will also be covered as well, in order to understand the types of deterioration typical to each of their needs for specific maintenance and storage conditions.

Handguns

Handguns include all short-barreled firearms that are designed to be fired with only one hand. The early flintlock pistols, were the forerunners of modern handguns. The two most common handgun sub-types in modern use are revolvers and semi-automatic pistols.

Revolvers, also called Wheel Guns, are repeating handguns, which use a revolving cylinder containing multiple chambers (Appendix 3) and at least one barrel for firing. After a round is fired, the hammer (Appendix 3) on the weapon is cocked and the next chamber in the cylinder is aligned with the barrel by the firearm, either manually or by rearward movement of the trigger. Revolvers ammunition has to be reloaded a single bullet at the time. A revolver can be both break action, when the barrel of the firearm is hinged much like a door to have easier access to the cylinder, or swing-out, where the cylinder swings out on the side of the firearms for reloading. The most common material used in making



Figure 1. A Colt Single Action Army first generation revolver, made during the late 19th century. This type of revolver uses a swing-out function on its chamber.

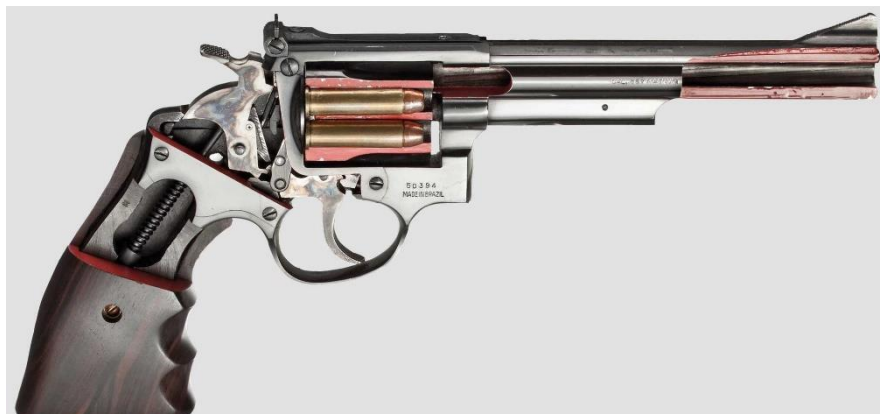


Figure 2. The inner workings of a Taurus .357 Magnum Revolver. This modern revolver shares the same mechanical design as the first revolvers of the 19th century.

revolvers is steel, which makes up for most of the body (or “frame” as it is called) and the mechanism of the firearm. Aluminium is used on more modern versions of the firearm, to decrease weight and cost. This material replaces some part of the frame, but the moving parts remains steel, because of the materials durability. Wood, rather than metal, was originally incorporated in the grip (Appendix 3), for comfort. Today, wood has been mostly replaced by plastic, thanks to its cheaper and easier manufacturing. However there are still revolvers made using wood (Tong 2011). In Nordic countries, revolvers have been categorized as hunting firearms, although their use through time has been more for personal protection and military use.

Unarguably one of the most popular categories of firearms in the world, has been the **Semi-automatic Pistol**. The pistol, in contrast to the revolver, uses the energy of a fired



Figure 3. Colt M1911, made in 1911, is a series of handguns still widely used today and has been the forerunner of modern handgun designs. On the back of the grip, there is a safety press one has to hold down to be able to cock the hammer and then fire.

cartridge (the recoil) to cycle the action (Appendix 3) of the firearm and advance the next available cartridge into position for firing. Pistols therefore require magazines (Appendix 3) to load their ammunition, instead of single loading like on a revolver. The first designed semi-automatic handgun was the Schönbergen-Laumann 1892, but the first pistol to gain any commercial success was the Hugo Borchardt C 93 (Kinard 2003). Similar to the revolver,

the main material used to construct pistols is steel, used in the frame of the firearm. These days, aluminium is used almost more commonly for this purpose. Wood was a popular choice for the grip in the past, but has today mostly been replaced by plastic (Tong 2011). On more modern pistols, since the 1980’s, the entire body is now made out of plastics, like for example on the Austrian Glock series of pistols.

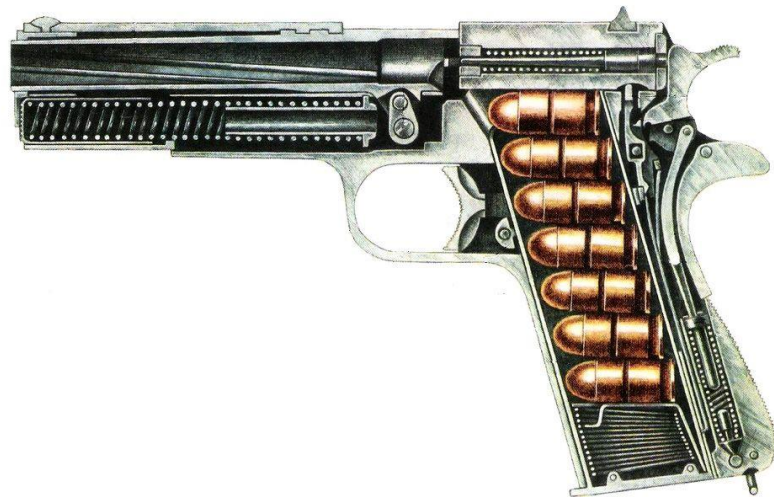


Figure 4. Artist drawing of the inside of a working Colt M1911.

Shotguns

Shotguns have historically proved some of the most popular weapons in the world, having been used by hunters, police and militaries. One of the most popular versions is the **pump action shotgun**. Pump action, also called Slide-action, refers to a mechanism on firearms, in which the forend (Appendix 3) can be moved forwards and backward in order to eject a spent round of ammunition and to chamber a fresh one, in a similar way to how the hammer works on a revolver. The first patent on pump action was issued in Britain, by Alexander Bain in the middle of the 19th century (Simpson 2003). The pump action is characteristic of shotguns manufactured by Winchester (Adler 2015). Pump-action shotguns, while uncommon, were used on the battlefields of Europe during the First World War, and thus can be found in many museum collections (Thompson 2013). Rifles and shotguns with pump-action feature are today mainly used by law enforcements around the world, including the Nordic countries, where the pump action shotguns is not legal as a hunting weapon.



Figure 5. Winchester model 1897, one of the most iconic pump-action shotguns during the last century. Became the forerunner of many modern designed shotguns.

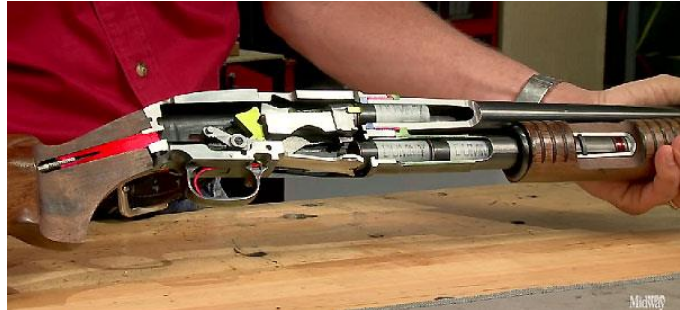


Figure 6. The inside of a Winchester Model 12 shotgun, using the same mechanism as the model 1897 and the same pump-action mechanism has been in use for over a hundred years.

The other type of popular shotguns is the **Break action** shotgun. The double barrel shotgun, where the barrels of the gun are hinged and lowered forward, is an example of this type of shotgun. Shotgun shells are loaded into the gun from the exposed barrels in the back of the gun. Break action shotguns became popular during the late 19th century, where they were used by farmers (particularly in America) to both hunt and to protect themselves. Even today, these weapons are still popular amongst hunters and weapon collectors. Break action firearms are considered hunting weapons with-in the Nordic countries.

The different types of ammunition used in shotguns are varied and depends on the use the gun is being put to. Museum collections may have examples of the buckshot shells, used for military combat, as well as slug shells, often used for hunting. Shotgun barrels may also have smoothbore barrels, where the inside of the barrel is left smooth, or rifled barrels, where the internal surface of the barrel has been rifled in a helical groove pattern. Rifling improves the



Figure 7. Common used break action function on a double barrel shotgun. The action is performed by moving the lever on top of the stock to the side.

aerodynamic stability and accuracy over smooth bore designs when firing a bullets. Smoothbore rifles are able to fire all types of shells.

The most common material used when making shotguns, both in the past and today, is steel, both on break action and pump action types. Steel is almost always used for the barrel and action. On pump action shotguns, wood is used for both the stock (Appendix 3) and the forend, while on break action shotguns, the wood is used mainly for the whole body of the gun, except for the barrel and receiver. Aluminium is used sometimes as well, but not as commonly. Plastic is also used on many pump action shotguns, replacing the wood, but has remained unpopular on break action shotguns. The reason for this is that it is felt that it tampers with the old style of the gun that has remained popular for so long.

Bolt and Lever Action rifles

Bolt Action refers to the mechanism on firearms, where the handling of cartridges into and out of the barrel chamber is operated manually by manipulating the bolt of the weapon directly via a handle, similar to the function of a pump action firearm. When the bolt is manipulated and pulled back, the spent cartridge is ejected and loads in a new cartridge when pulled back forward and closing the breech (Appendix 3). The most common type of bolt action is right handed, since most users are right handed, but there are left handed versions as well.



Figure 8. Gewehr 98 Bolt-Action rifle seen from both sides. Rifles like these were used by the German army during World War 1, and later used by Nordic armies all the way to the late 1980s. The weapon would later influence the Karabiner 98k, which would see extensive use by German forces during the next world war.

The first bolt action rifle was produced during the early 19th century by Johann Nikolaus



Figure 9. The inner workings of a Karabiner 98k, the upgraded version of the Gewehr 98, which saw heavy use by Germany and her allies during the Second World War.

von Dreyse, following the work on breech-loading rifles that dated back to the 18th century. Bolt action rifles have played a large part in military history, being one of the main infantry weapons during both world wars. Bolt action rifles still

serve amongst snipers and hunters in the modern age, thanks to their potential for superior accuracy, reliability, lesser weight and the ability to control loading of the cartridge. Bolt action rifles were soon superseded by semi-automatic rifles and later fully automatic firearms, thanks to their higher rate of fire (Zwoll 2003). In civilian use however, hunting rifles almost always have a bolt action function to operate and are the most common hunting firearm in the world. Various calibers (Appendix 3) of rifles exist, which differs in the size of ammunition they are able to fire. Almost every rifle uses rifling on the inside of its barrel to increase accuracy and speed of the bullet.

Lever-action refers to the firearm action, where a lever is located around the trigger guard area and is operated to load in a fresh cartridge into the chamber of the barrel and to eject a spent cartridge. Lever-action rifles are deemed inferior to bolt action, because of their more complicated mechanism and difficulty to disassemble for cleaning and repairs. The first lever-action rifles on the market were Colt's 1st and 2nd Model Ring Lever Rifles, produced during the early 19th century. Lever-action rifles played a large part during the "American Civil War" and what is referred as the "Indian Wars". By the time of the First World War, lever-action rifles had almost been completely superseded by Bolt action rifles, but remained in limited use (Lee 2011). Today, lever-action rifles still remain popular as hunting rifles, being the second most popular hunting tool right after Bolt action hunting rifles. When it comes to the materials bolt action rifles, steel has been the main material for the barrels and the receiver, while wood has been the main material for the body. Today, versions using plastic instead of wood are popular, but wood versions are still manufactured and used. Aluminum is used on modern guns to decrease weight. On lever-action rifles, most of the body and moving parts are made out of steel, with only the stock and forend being made out of wood. Plastic version are used today, but wood versions are more popular, because of their more historic appearance.



Figure 11. Winchester Model 1894, one of the most sold Lever-action rifles in the world and has influenced modern lever-action designs.



Figure 10. Artist rendition of the inside workings of a Winchester Model 1894.

Semi-automatic rifles

Semi-automatic rifles, also called self-loading rifles, are firearms that fires a single round each time the trigger is pulled. In contrast to fully automatic firearms which continuously fire rounds as long as the trigger remains pulled and there is ammunition left. The main operational mechanism for semi-automatic rifles are the use of gas, blowforward, blowback or recoil energy to eject a spent cartridge after the round has traveled down the barrel, in a similar way to pistols. This energy then chambers a new cartridge and resets the action, enabling another round to be fired once the trigger is pulled again. Semi-automatic rifles are of versatile design, meaning that they can be efficiently fed by a clip, internal magazine, detachable magazine or a combination of clip and magazine.

The first successful designs for semi-automatic rifles began in Austria, attributed by the gunsmith Ferdinand Ritter von Mannlicher, who unveiled his design during the late 19th century, called the Model 85. It took time before semi-automatic rifles became a staple within the military, they were however popular with the civilian market, particularly



Figure 12. American made semi-automatic M1 Garand, introduced during the middle of the 1930s and one of the most famous weapons of World War 2, seen on almost every photo of American troops from the war. The weapon were unique in its design that it didn't use a magazine, but instead a clip inserted on the top of the receiver. The clip couldn't be removed without emptying it, resulting in an iconic "Ping" every time the empty clip was ejected.

examples such as the Winchester model 1903 and Remington Model 8. Because of cheaper cost and easier manufacturing, the semi-automatic rifles did not replace the bolt action rifle in World War 1, only introduced by the American army later on in World War 2 (Smith 2013).

Today, semi-automatic rifles are still in use by modern law enforcements and are legal for hunting in Sweden.

Early rifles were made out of steel and wood. The steel making up the barrel and the receiver, and the wood making up the body, similar to bolt action rifles. In today's rifles,

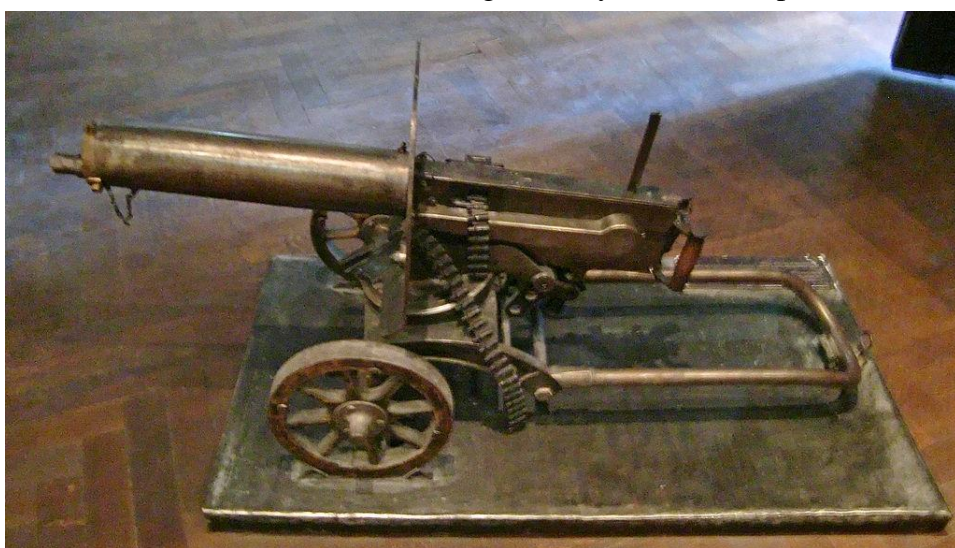


Figure 13. The inside of a M1 Garand.

the body mostly consists of plastic to decrease the weight, and for the same reason some parts are made out of aluminium. These parts are not however those that are required to sustain pressure or is being put under physical and mechanical stress when the weapon is operated (Smith 2013).

Fully Automatic firearms

An automatic firearm is a firearm that can continuously fire a projectile as long as the trigger is pressed or held and there is ammunition in the magazine or chamber. The operative principles of automatic weapons are the same as semi-automatic, as well as the mechanics, apart from the continuously loading of cartridges. The first weapon generally considered to be the first truly fully automatic firearm was the Gatling gun, which was a crank operated firearm with multiple rotating barrels that saw action during the “American Civil war”. Since that time, there have been numerous types of automatic weapons designed. One of the earliest types of automatic firearms was the **Machine gun**, and even the more modern trigger-actuated machine guns that are being used today, began to be developed during the late 19th century. Machine guns like the Maxim gun, Lewis Gun and Mg 08 “Spandau” saw extensive use during World War 1, and became the forerunners of modern machine guns. A common method to prevent overheating of machineguns were to cool them with water. This meant to have constant flow of cold water connected to the barrel to prevent it from melting. Because of the intense heat generated during the rapid rate of fire of World War II machine guns, they were developed with either air cooling



capabilities, with hollow barrel frames, or an easy to switch barrel when the gun became overheated. Today, machine guns are the still being widely used in every army all over the world.

Figure 14. Russian used Maxim gun, displayed at the Georgian National Museum, Georgia. The large barrel on the front was to allow water to flow around the smaller barrel inside, preventing it from overheating.

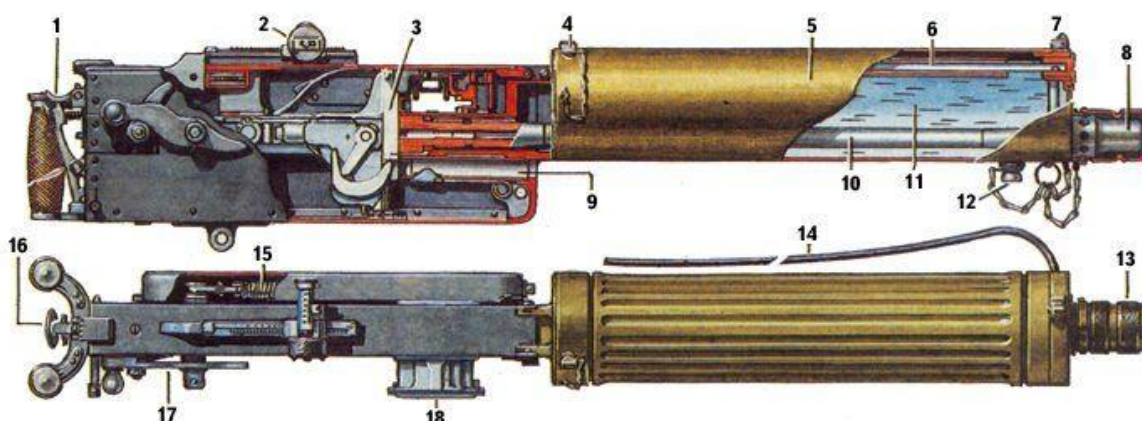


Figure 15. The inside of a Maxim gun, showing the cooling process and the fully automatic mechanism.



Figure 17. Thompson M1928 Submachine gun, made during the late 1920s. Firearms like these were popular amongst both gangsters and law enforcements during the prohibition era. Its updated cousins, the M1 and M1A1 would see extensive use during the Second World War by most allied nations.

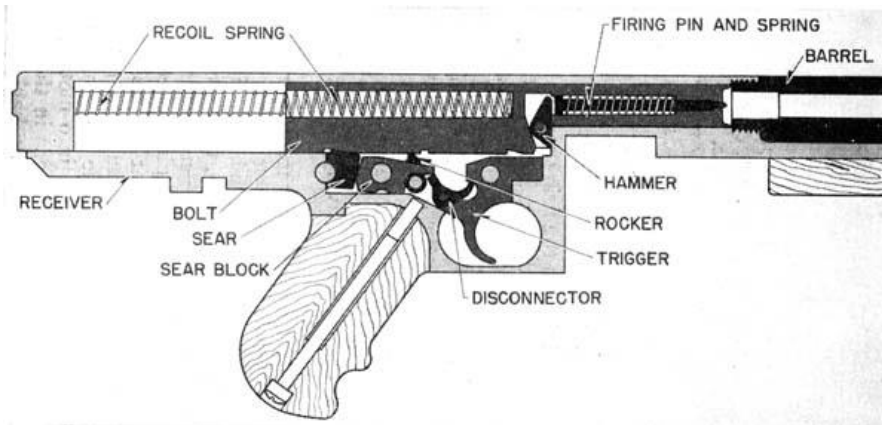


Figure 16. The inside of an Annihilator SMG, the earliest version of the Thompson and the forerunner of modern submachine guns, with its different parts highlighted. .

Up to the First World War, machine guns tended to be very large, and eventually these weapons became scaled down so that they could be carried by a single soldier in the field. For this reason these weapons were given the name **Submachine guns**, meaning smaller machine gun. During the Second World War, submachine guns saw extensive use by all modern armies, a famous example of which is the Thompson submachine gun. It also became

infamous in the hands of gangsters. (Cumpston 2008). Today, submachineguns continue to serve law enforcements, Special Forces and gangsters alike.



Figure 18. Sturmgewehr (STG) 44, the first mass produced assault rifle in the world, used by German forces during the Second World War.

Developed from the Submachine gun came the **Assault rifle**. Development of this type of weapon began in Germany during the Second World War, as the Sturmgewehr (STG) 44, the world's first mass-produced assault rifle (Hogg & Gander 2005). After the war, the Russian made AK47, the

world's most famous assault rifle, made its debut (Chivers 2013).



Figure 19. The Kalashnikov family of firearms, the most mass produced assault rifle in the world, with over a 175 million variants built and used by millions of people the world over.



Figure 20. The inside workings of an AKM, the more modern version of the AK 47. The upper part of the barrel is the cooling system, which pushes back the spring above the receiver and allows for heated air to escape from the top of the barrel.

Carbines are also a firearm category that has been in use since the 18th century. Carbines are scaled down versions of long rifles, like assault rifles or bolt action rifles, but not small enough to be classified as either pistols or sub machineguns. The U.S. made Colt Automatic Rifle (CAR) 15 is a family of carbines that was developed during the Vietnam War and is still in use today, as the M4 Carbine. Assault rifles and Carbines are the main firearm used by most militaries around the world.

Submachine guns, assault rifles and carbines mostly come equipped with a selective fire mode, where the weapon is capable of both automatic and semi-automatic fire. A new breed of automatic firearms, called **Personal Defense weapons (PDW)** became popular towards the end of the 20th century. PDWs combine the lightness and size of a submachine gun with the medium stopping power caliber of rifles (Cutshaw 2011). Fully automatic function can also be found on pistols, called machine pistols, and on shotguns, called automatic shotguns.

The earliest examples of automatic firearms consist mostly of steel, where if they had a stock, it consisted of wood. On more modern automatic firearms, plastic has replaced most of the wood and aluminium is used on some parts that once were made out of steel, to decrease weight

Fully functional fully automatic firearms are present in many museum collections and form the reason for enhanced security precautions and restrictions on use for these collections.

3.2 Conservator-assessed risks for modern firearms in museum collections

Firearms, composite objects

While firearms are dangerous tools in the wrong hands, they are still items that have played an important role in human history and as such are items significant in museum collections. Many collections around the world contains firearms and other weapons, displayed for the public to see or to preserve the knowledge. They are made out of similar materials to many other objects that are stored and displayed at these museums, however their working mechanisms, modern materials, and history of use can make their care needs more complex than other collections.

Materials

Firearms must be considered composite objects, as they are made out of more than one material, which makes their deterioration more likely and their care more complex in most cases. This is because not all materials have the same environmental requirements in order to keep them from deterioration, especially in the case where those materials are old and have seen heavy use. Designing storage conditions which take this into account can have a

significant effect on the preservation of the material. But this can be a complex thing for museums to achieve in practice.

Throughout history, firearms have been constructed from a combination of different materials. In general, the frames and moving parts of firearms, such as the hammer and receiver, have been made out of iron, steel and brass in older weapons. In more modern ones, aluminium has replaced these in order to decrease the overall weight of the firearm. When it comes to other parts of the gun, such as the grip, handguard and stock, wood has been the preferred material, because it is lighter than metal, making it easier for the user to hold. It has also been chosen because it is more easily acquired, easier to shape and carve, and cheaper to produce, compared to a weapon that is fully made out of metal. Wood is still in use on some firearms today, such as the Kalashnikov series of weapons, however most weapons today have exchanged wood for plastics, because it is even lighter, easier and cheaper to form. This change to plastic had a significant effect on the stylistic appearance of firearms. Early on, plastics were designed to replicate the look of wood, however later on they were valued for their own visual appearance as plastic.

Other materials, often overlooked that have been found associated with firearms are glass, feathers, bones and plaster. Although these materials have not played an important role in the function of the weapon, they have in their decoration. Examples of glass and plaster can be found on early Victorian era firearms, used by royalty and novelty. These weapons, while completely impractical and difficult to shoot with, conveyed an aura of wealth to surrounding people. Examples of feathers and bones can be found on old muskets and repeater rifles, used by Native Americans during the 18th and 19th centuries. They decorated their captured firearms, similar to the ways they decorated spears and clubs, including painting and tribal marks (Alchin 2012). Gilding is also found on a few weapons, although these are rare in modern firearms covered by EU and Nordic firearms law. An example of these golden weapons was Saddam's own collection of gold plated AK47s, found by American troops during the 2003 invasion of Iraq (Reuters 2007).

With so many components consisting of so many materials on a firearm, one has to plan ahead on how to handle and how to store them. When it comes to composite objects, like firearms, which consist of more than one material, there are two major factors one has to think about: How to balance environmental requirements of each material, and whether the presence of one material is a threat to the stability of another material that it is in close contact with. These are the factors which have caused the largest amount of damage to modern firearms, where not controlled. A further complication comes from the fact that firearms must be considered working objects, and a very small amount of deterioration of their active mechanisms can have a permanent effect on this aspect.

Iron

Iron, is the most common metal used in the construction of firearms. As pure iron, rather than steel, reacts very serious to high levels of humidity and begins to corrode. Iron, like other metals prefers a relatively dry environment in order to avoid corrosion. All forms of iron will start to corrode or rust once the relative humidity (RH) rises above 65% percent. While uncontaminated iron is stable at 50% RH, iron contaminated with salts, typical of a firearm that has been handled in use, will corrode at relatively low humidities. The reason for the easy corrosion of iron, is because of the materials inherent instability (Logan 2007). When pure iron is exposed to oxygen and water vapour, there is a transfer of electrons from the iron to the oxygen or water molecules. The iron act as reducing agent, giving up the electrons to the oxidizing agent (Oxygen and water), which gains the electrons from the

iron. This causes the metal to break down, or remineralize, forming rust on the surface of the firearm (Logan 2007). The reason why iron ore doesn't rust, is because that the iron molecules are bound to another form of material which share its electrons, thereby avoiding corrosion. This is one of the main features taken advantage of in the design of rustproof **Steel**, which appears in most firearms since as early as the 1960s.

Steel is iron combined with carbon. Steel is an interstitial alloy, meaning that the carbon atoms does not substitute any of the iron atoms, but rather are trapped in the spaces between the atoms of the crystal matrix of the material. By combining iron with carbon, which is a material willing to share its electrons, the stability of the resulting metal is increased. Even steel alloys however will corrode, particularly if it has come in contact with salts from handling. Once the salt is present, the rust will slowly form a crust on the surface of the metal, slowly converting the material into rust, breaking down surfaces and fusing moving parts.



Figure 21. Rust that has been formed on a Glock 18 that has been stored in to humid conditions. The rust has stained the plastic parts of the gun as well.

There are different ways to protect iron from further corrosion. The most obvious way is to protect the firearm from oxygen and humidity. The level of RH which is recommended for the storage of actively corroding iron below is 35% RH. This can be achieved by using desiccants or dehumidifiers in the storage areas. Where the firearm also has organic

materials as part of it, for example wood, this level of humidity may prove damagingly low for that material and other solutions must be looked for. One effective way that has been recommended for the protection of iron on firearms, is protective coatings. Coatings have often been used on objects that are to be put into storage or on objects that are sensitive to further corrosion. One thing that has to be taken into account is the potential for coating to affect the aesthetic integrity of the object (Logan 2007).

Most preservative and preventative methods suggested for the protection of the iron and steel on firearms, such as patent greases, oils and other preservatives are intended for short term protection and storage only, as they tend to begin to oxidize and thicken after their application. For long term storage, more inert materials such as microcrystalline wax are recommended (Wicklund 2017). Waxes generally take longer to degrade than oil, thanks to being more chemically simple and inert. Renaissance wax is a product often recommended by conservators for the use on iron and steel. Microcrystalline wax is also valued because of its neutral pH, which will not cause any corrosion on the surface of the material. Applied as a thin layer, the wax becomes an inert barrier between the material surface and the surrounding atmosphere. One of the drawbacks of using wax as a surface coating, is that it shouldn't be used on a firearm that may be used as a working object, and because it can have a tendency to attract dust. Dust can serve as a foundation for moisture and pollutants being trapped on the surface of the firearm, aiding the onset of corrosion. Regular dusting and the use of hand protection, such as gloves, to avoid any grease and fat from your skin coming into contact with the firearm, is the best way of preventing further corrosion (Wicklund 2017).

Aluminium

Aluminium, while not as durable as iron and steel, is used in firearms manufacturing, due to its light weight. There are almost no firearms that are completely made out of aluminium, but often small internal and external parts are made out of the material. Floorplates on hunting rifles and some handguards and bugger tubes on assault rifles are made out of aluminium (Sweeny 2011). What also makes Aluminium a widely used material, is its corrosion resistance. Aluminium resists corrosion, thanks to a self-induced protective oxide layer that forms rapidly when aluminium is exposed to air. Where aluminium has been hardened further by immersing it in a tank of acid solution and applying electricity, the result is an accelerated formation of natural oxides that produces a



Figure 22. Common pitting corrosion on aluminium that has been caused by chlorides.

synthetically hardened surface. (Sweeny 2011). Normally, if the oxide layer is damaged by an abrasive action, like scratching, it re-forms rapidly. The major corrosion factors with aluminium are salts such as chlorides that prevents the re-forming of this oxide layer and causes pitting on the surface of the material (Logan 2007).

As with iron and steel, aluminium can be kept stable by storing it in a dry, humidity-controlled

environment after surface cleaning which removes pollutants from handling. When cleaning aluminium, using abrasive cleaners are not advised, since they may remove the protective oxidized layer from the aluminium, and also alter its appearance, particularly where there is polished surfaces. If being stored for extended periods of time, it is recommended that the material should be covered in a protective coating, consisting of an inert oil or wax. Protection from dust and pollutants are likewise important (Aalco 2005).

Copper alloys

Next to iron and aluminium, copper alloys have made up for a fundamental part of firearms construction. One copper alloy of particular significance is **gunmetal**. Gunmetal, also known as red brass, is a type of copper alloy which consists of copper, tin and zinc. Proportions vary according to sources, but its composition appears to be in the area of 88% copper, 8% tin and 4% zinc. In modern firearms, gunmetal has largely been replaced as a construction material, superseded by steel, because of the material's lower cost and higher durability. Where it has been used, however, it far outperforms steel in terms of corrosion resistance in saltwater conditions (Young 2012).

Another alloy that has been used in firearms manufacturing is **brass**. Brass is a combination of copper and zinc. As with gunmetal, the propositions of brass differs depending on the exact types of brass alloy, each chosen for varying mechanical and

electrical properties (Logan 2007). While brass was not used in the construction of the firearms themselves, the materials does appear in bullets and cartridges. As with gunmetal, its selection is due to its strong resistance to corrosion. A brass cartridges head can be worked to harden to be able to withstand the high pressures the cartridges are exposed to, allowing the need for manipulation via extraction and ejection, without tearing the metal. Brass is still used commonly today to manufacture cartridges. Steel is also used to make cartridges, where reloading and reuse of the cases is not required.



Figure 23. Brass cartridges that has been exposed to chlorides and has started to form a crust of bronze disease on top.

Stable storage conditions for copper alloys are environment that are as free from ammonia, acids, strong alkalis, chlorides and sulphide gases, as possible. Copper alloys are all susceptible to corrosion from any of these. **Bronze disease** can affect the copper alloys in ammunition where chlorides comes into contact with

the metal. It appears as a light fuzzy green coating on top of the metal and once it has started, it is very difficult to stabilize. Objects that have been affected by bronze disease will require to be stored in an area with a relative humidity well below 35%, even after stabilizing conservation treatment (Logan 2007).

Wood



Figure 24. Dried wood that has started to mold. The White areas are fungus that has form on the surface and has slowly started to "eat" away the material.

Wood for the past five hundred years has been one of the main construction materials for firearms, not for any of the mechanical parts, but certainly for structural components. Wood has almost always formed such parts as the body, grip or forend on a firearm, allowing for more comfortable handling when in use. As mentioned

previously, wood has become rarer on firearms, having been replaced often by plastic. Wood requires more humid environments for its structural integrity, between 50% and 70% RH, which makes it less compatible with the metal components of firearms. Fortunately, the wood on firearms has usually received extensive seasoning and is from denser species of wood which are less reactive to moisture change. Therefore, as long as it is stored in a mid-range of humidity, such as 45-60% RH, and with low levels of fluctuation, it is unlikely to deteriorate. Wood is more likely to prove vulnerable to fungal and insect attacks, but keeping temperatures low and the humidity within this range, it also decreases the risk of this type of deterioration. It has in fact been suggested that firearms composed of wood and metals composites should be ideally stored in distinctly cold conditions, with temperatures of around -10 degrees Celsius (Rietz 1978).

Plastics

Plastics, are a relatively new material used in the making of firearms, in most cases it replaces other materials in order to lighten the weight of the firearm. Like with wood, plastics are not used in making any of the mechanical parts, but rather in forming the body, grip and forend that holds everything in place. Plastics are also used in making magazines instead of metal, despite its comparatively low strength. Plastics first came into use in firearms manufacturing in the early 1960s, and by the 1980s were a staple of the industry. The firearms company, Glock, made its name in the 1980s by introducing plastics to the construction of firearms, creating the Glock 17. Replacing as much of the steel and wood as possible. This was the first time plastic was used on such a scale on a firearm. The type of plastic used was a Nylon derivative, believed to be DuPont Zytel brand, glass-reinforced polyamide 66. Since then, plastic has come to replace wood in firearms construction, thanks to its lower cost and easier manufacturing standards (Danielsan 2017).

Plastics, are perhaps the most vulnerable to deterioration processes of all materials making up modern firearms. Plastic will begin to degrade under the influence of one or more of the common environmental factors, such as heat, light or chemicals like acids, alkalis and some salts. The degradation shows as cracking and chemical disintegration of the material, causing material instability which often shows as a tacky or sticky surface (Hayden & Webb 2013). Too moist or too dry conditions can cause chemical instability. Because it is highly likely that the plastics on firearms will have been exposed to a number of environmental extremes, when storing plastic composite firearms, the optimum temperature is thought to be between 4 to 26 degrees Celsius. Too high of a temperature



Figure 25. The decomposition of a plastic bottle. This process takes years, but damages on plastic surfaces takes much less time.

causes the plastic to become permanent stiffer or cause thermal degradation. To low temperatures will cause the material to become stiff as well, but not as damaging or permanent as high temperatures. Humidity levels should be below 75% and above 45-50%. Plastics must

also be protected from light, especially sunlight and any strong artificial light with a high ultraviolet content, as these catalyse chemical breakdown reactions. Already unstable plastics should be sealed in airtight containers or receive an oxygen barrier film to avoid oxidation of the material and to be supported in order to avoid deformation (Vipperman 2014).

Leather

Leather, has rarely been used in the construction of firearms, except for some attempt during the early days of firearms, it has however played a vital role in the handling of guns. Holsters and slings that have been used to carry firearms over the centuries to present day, have been made out of leather, thanks to its durability and shape ability. Leather, like wood and plastic, is an organic material and being such, is vulnerable to degradation if not protected from certain elements and handled correctly. Leather requires a mid-range of humidity for its fibres to stay flexible, and optimum environmental conditions of around 30-60% and a temperature around 10 to 20 degrees Celsius are recommended. If leather is stored in too hot and humid conditions, it will attract fungal or bacterial contamination, as well as insect attack. The atmosphere in the storage area should also be free from reactive chemical fumes, such as sulfur dioxide and ammonia, which leather is particularly susceptible to, as for examples in the case of red rot. Sunlight, both its UV and thermal content, are contributors to deterioration processes such as red rot and cross-linking of lubricating oils. Red rot in leather is visible as a strong smelling, powdery surface breakdown and is very difficult to stabilize once it has started. Embrittlement through loss of tannins and oxidation of lubricating oils leads to cracking of surfaces and loss of material (Dirksen 1997).



Figure 26. The effect of red rot on the leather casing of an old book. The leather is slowly broken down, causing cracks and a dried surface on the material.

Oils

It is not just the construction materials of firearms that must be considered when designing protective care measures for modern firearms. Oils have been used in modern firearms as part of regular maintenance, in order to assure that the gun is kept clean and to make it work as smoothly as possible. Oils are essential for any of the parts inside the gun that moves and grinds against each other, so that they don't get worn out due to friction. Gun oil has also been used as a cleaning tool to remove dirt and to form a surface protection against corrosion. There are different oils that have been used on firearms over the years, ranging from organic to synthetic oils. On modern gun lubricants and oils, the main ingredients used are most often ethanol, kerosene, oleic acids, amy acetate and ammonium hydroxide (Steve 2016). Drying oils are not preferred on firearms that are to be used, since the lack of lubricant qualities can severely damage the firearm, however they are used on



Figure 27. The inside of a Marlin 39 Lever-Action receiver. The metal has been stained because of failed removal of oil. Small traces of rust can be seen as well towards the rear end of the receiver.

firearms that are to be simply stored and then displayed, as in some museum for example. These drying oils forms a protective coating around the material, hindering any corrosion or decaying by stopping oxidation and any moisture from contacting the material. Oils require a dry environment with a low RH if possible. The preferred storage temperature for oil is around 5 to 30 degrees Celsius (Wicklund 2017).

Waxes

Waxes has been used to protect museum objects for many years and it is no different when it comes to firearms. Waxes not only clean of dirt and old oils, but also makes a protective coating for long term storages. Waxes are more protective and longer-lasting than oil and can resist skin oils and fats from human skin a lot more effective than either oil- or lacquer coatings. In the past, various beeswax preparations and petroleum waxes have been applied to firearms. At the present time, the wax type most often recommended by both conservators and gun owners alike, when it comes to firearms storage and conservation is a microcrystalline wax, one of the most popular being **Renaissance wax**, which is a blend of microcrystalline waxes in white spirit. These waxes are not appropriate for all materials, but is safe to use on metal objects without any problematic effects. They can also be used to regain a polish on wood components and to tune up finishes made out of lacquer. One of the negative sides of using wax, is that it may attract dust, and over time can become difficult to remove when an object needs to be cleaned. High temperature solvents may

then be required to remove waxes, which causes risks for the firearm materials themselves. This wax has also a very high humidity resistance, to up to 80% RH (Potterfield 2014).

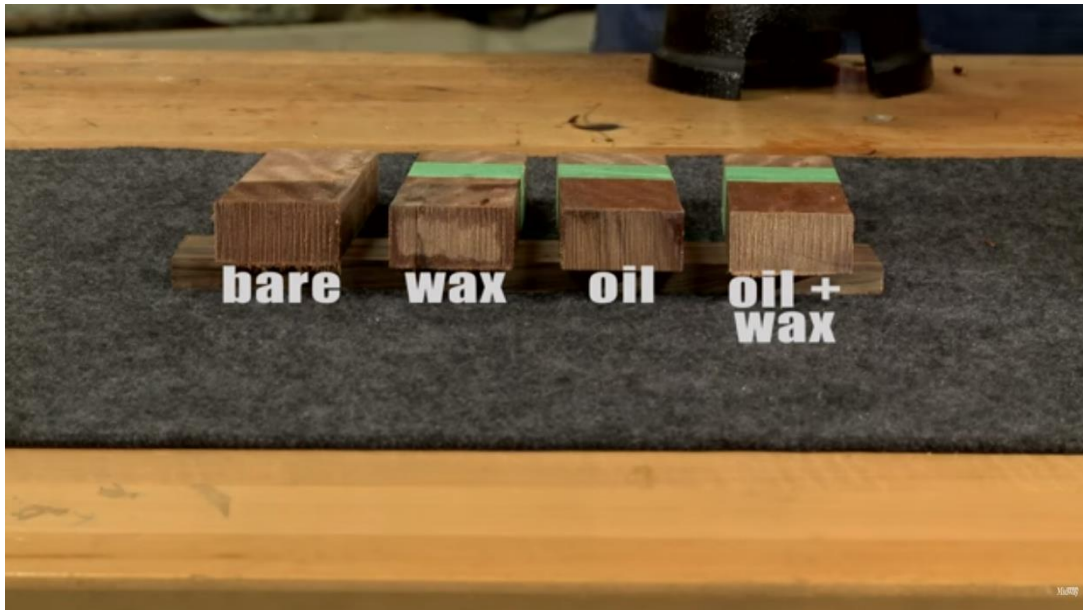


Figure 28. The affect waxes and lacquer coatings have on wood that has been exposed to high amounts of humidity. The bare wood is almost filled with water, while the oil and wax combination has repelled any humidity.

Lacquer

Lacquer finishes have been used on wooden stocks, grips and handguards on firearms from the beginning of firearms, to protect the material from the elements while in use. It has also been applied to firearms to improve the appearance. Lacquer finishes creates a smooth surface on wood, also hindering the chances of that splinters may come off. Lacquer has at times also been applied onto the metal surfaces of firearms (Brunello 1973). While not appearing as often on firearms in present day, because of wood being replaced by plastics, it can still be found on older firearms and guns that still use wood today. Lacquers are affected by light, which causes photodegradation, fading and discoloration of lacquers. Too

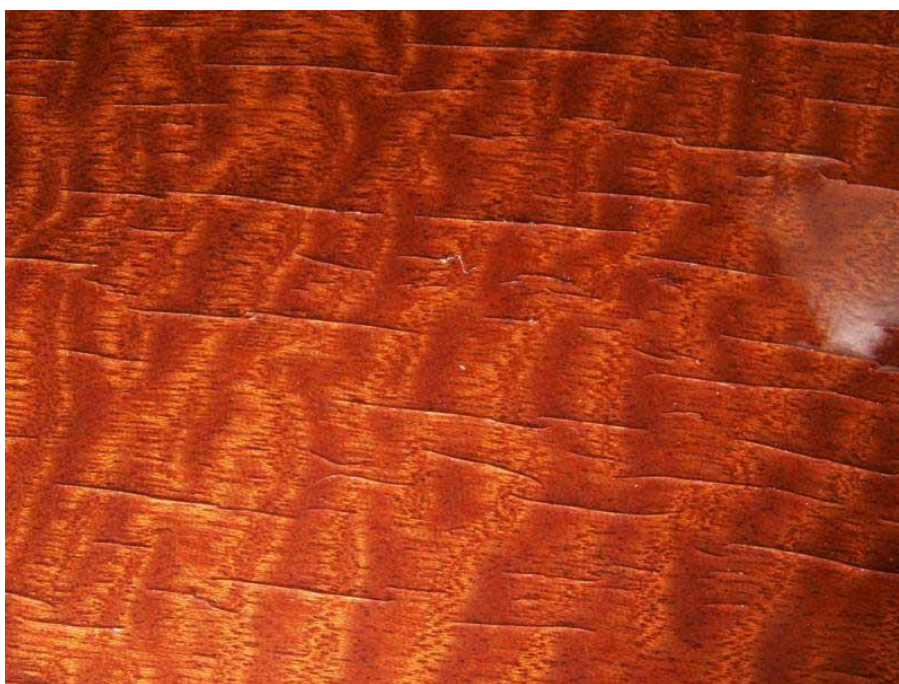


Figure 29. A cracking surface is one of the most common degradation types of lacquer, caused by photoodegradation.

high temperatures, along with to high amounts of moisture can cause thermochromatic change to the lacquer surface, which causes the material to change colour. Moisture can also cause blanching on the surface, whitening the surface from the formation of salts (Potterfield 2014)

4. Implementation

4.1 Selection of museums for the survey

As there is so little written in the conservation- and museumsliterature about the management and care of modern firearms collections and the law, it seemed important to obtain this information directly from the conservators and curators who are involved with firearms. It was clear therefore that the choice of museums would be important, selecting those which have a significant collection of modern firearms, and might be assumed to follow ICOM and legal regulations. My initial search made use of the internet, where it proved plentiful information existed on military themed museums in Nordic countries.

The most obvious first selection was the Swedish Army Museum. The Swedish Army Museum houses a large collection of firearms, thanks to its direct connection to the Swedish Armed Forces. The conservators that work at the Swedish Army Museum are part of the large circle of government owned defense museums that are part of Swedish military history heritage (Militärhistoriska arv), and have the task of maintaining all of objects in each of these museums. These museums include Arsenalen (The Arsenal), Flygvapenmuseet (Swedish Airforce museum) and Artillerimuseet (the Swedish Artillery museum). This was the museum, where I was fortunate enough to be granted an interview with the head metal conservator and their curator, who handles issues of collection and the law. During the interview and visit, I was able to ask all of the questions related to conservation and storage of firearms, which were on the questionnaire I developed, as well as additional ones that came up during our dialog.

Because of the limited time and limited resources for this project, I had to rely on email as the method of communication for the remaining museums that I approached to obtain the information I searched for. I limited my range to the Nordic countries, with two museums from the UK added to provide contrast or confirmation. Three other museums in Sweden were chosen. The first museum was Flygvapenmuseet (The Swedish Air Force Museum), located just outside of Linköping in Sweden. The Air Force Museum belongs to the same circle of museums as the Army Museum and has a small, but significant collection of firearms that originated from the Swedish Air Force, making them an ideal choice for the survey. Livrustkammaren (The Swedish Royal Armoury) in Stockholm was also contacted. While the Swedish Royal Armoury do not seem to have many modern firearms in their collection, they still have a large arsenal of old muskets and flintlock pistols, weapons that still fall under the legislation. A disadvantage here was that I was only able to send the questionnaire to their Collections department email. This meant that it was answered by someone who was not a conservator.

The other museum that was contacted was Beredskapsmuseet (The Swedish Preparedness Museum), a museum installed in an old bunker complex, located between Helsingborg and Viken in the southwestern part of Sweden. This museum was chosen because, they have a collection of modern firearms, however, these firearms are not theirs. In the last nine years, there has been a legal confrontation between the Army Museum and the Preparedness Museum over the ownership of their firearms. The Army Museum won this legal war in court a few years back and has since then transported the weapons from the museum to their storage in the Stockholm area. The Preparedness Museum is also not part of the

SMHA (Sveriges Militärhistoriska arv), and for this reason I felt it would be interesting to see whether they have other things to say about the conservation and storage of weapons than the Swedish Army Museum.

Three Norwegian museums were chosen. Forsvarsmuseet (The Norwegian Armed Forces Museum), located in Oslo was one. This museum, like the Swedish Army museum in Stockholm, has a close relationship with the national armed forces and receives a lot of objects from them. The museum covers the history of the Norwegian military history, from the Viking Age to the present. They have numerous exhibits exploring conflicts from the last century (1905-1940, World War Two and the Cold War to present) which display modern firearms, and was an ideal museum to ask about their conservation approach to weapons and their relationship with the law. The other Norwegian museum that was chosen was Rustkammare Trondheim (the Armoury of Trondheim). The Armoury of Trondheim is one of the oldest museums in Norway and houses weapons ranging from the Middle-Ages to the present, making them a good candidate. The final Norwegian museum selected was Norges Hjemmefrontmuseum (Norway's Resistance Museum). The museum is dedicated to the resistance fighters, who fought against the Nazi occupation of Norway from 1940 to 1945. The museum is installed in a building from the 17th century on the grounds of Akerhus Fortress in Oslo, adjoining the memorial of Norwegian patriots executed during the war.

Two further Nordic museums were chosen. The first was Sotamuseo (the Military Museum of Finland), located in Helsinki. The Military Museum has unfortunately closed down one of its main exhibits during the writing of this paper. It does however have two remaining, permanent exhibitions, concerning the military history of Finland from the 19th century to the present. The museum focuses heavily on the Winter War and the Continuation War with the Soviet Union during the Second World War, so it appeared a good choice given its large collection of World War Two and Cold War era weapons. The final museum chosen was Tøjhusmuseet (The Royal Danish Arsenal Museum) in Copenhagen, Denmark. With more than 8000 swords, pistols, armours, machineguns and other weapons, ranging from the early Viking Age to the present, it seemed like a perfect choice as the museum that would represent the Danish side of this issue.

Each of the museums chosen was sent a copy of a questionnaire containing twenty-three questions relating to the care and management of modern firearms and the law.

A questionnaire was also sent to two British museums who specialise in modern firearms in their collections. The choice to include two Non-Nordic countries museums, was made in order to test whether this common ground exists wider than the Nordic countries and if the methods used are the same as those in the North. The two museums chosen were first the Imperial War Museum in London. This museum specialises themselves in military equipment from the early 20th century and forward, making them an ideal choice. The second questionnaire was sent to the Royal Armouries, The National Museum for Arms and Armour in the United Kingdom. The Royal Armouries is located in three sites. Its historical base is the Tower of London, but also includes the Royal Armouries Museum in Leeds and Fort Nelson in Portsmouth. The reasons for choosing these two museums were because of earlier experience and knowledge about them and recommendations from my supervisor. I have also been to the Imperial War Museum and found that it was one of the most interesting museums I have ever been to.

4:2 Questionnaire design

The questionnaire was intended to function as a substitute to making visits to the selected museums, and interviewing the staff there. As with all questionnaires, the design and phrasing of its questions took a lot of thought.

I began the questionnaire with an introduction, whose purpose was to gain the interest from the museums and to reassure them that I was a reputable person. I told them about myself, my research question, and how I became interested in the subject. I included a letter of recommendation from my course leader, in which she argues persuasively about the importance of the survey and she asks that whoever is reading it to take some time to answer it as best as they can. I completed the introduction by mentioning that I would make available to them the results of the survey and the resulting bachelor thesis.

The difficult part about designing the survey, was asking the right questions. I needed to ask questions that would cover what I wanted to know, but I also needed to limit them to not that many questions. If there were too many questions, the museums might not have the time or the inclination to answer them. The questions also needed to be as simple as possible, so that the recipient would not feel they had to spend too much time answering the questions with complicated answers. I also had to keep in mind that some of the information I wanted to know might be confidential, and that some museums would not be allowed to give it out, so I had to be prepared to have a backup plan if these questions could not be answered.

I split the questions up into different categories, both to give the recipient an easier time understanding just what the questions were investigating, and also to make the survey look more welcoming and serious. The first category was simple general questions. Here I asked what their position in the museum was, and how many conservators the museum had working there. The purpose of these questions was to give more insight about the person who was answering and their level of knowledge about the care of modern firearms

The next category was about their collection of firearms. I was seeking to find out how many weapons they have, what category of weapons they mostly handle (weapons like rifles, pistols, grenades etc.), and what era or historic period they focus on. Then came question about the firearms, were they functional or not, and if they had been decommissioned, why? Here it was possible that the questions would be considered confidential, but I hoped that they would answer, since the question of decommissioning firearms is critical to conservation care.

The next category of questions was about transportation and display. The first question investigated how the firearms are displayed and what security measures have been taken in their display, particularly if they are functional. The next questions were about who has access to the collections of modern firearms, and how they meet legal requirements in transporting them. I had expected that these question would most of the time not be answered, since most of them are connected to confidential information, but was often surprised.

The third category of questions were about the conservation and storage of firearms. First I asked them about how they conserve their firearms. Since this question has a rather large answer, I made it clear that it did not have to be a thorough answer, but a general one, to confirm whether what they answered conformed the current conservation practice or was somehow different. The next questions were about the safety rules they had put in place and any special treatments they undertook for their firearms. Did they require any specialized chemicals or handling methods depending on what kind of weapon they are handling with (e.g. rockets or explosives). Then came questions about their storage and

security measures. Once again, as these questions have a high potential of being considered to confidential information, I was prepared that these questions might be ignored.

The final category concerned modern firearm collections and the law. These questions were as much directed towards the curatorial staff as the conservator. The first question was straightforward, asking if they felt that the law does affect the storage and handling of their collection of weapons. Other questions dealt with firearms licenses, does the museum or a conservator need to have one to be able to own or handle the weapons. Then came the last question, which I left as optional, about whether there had been any thefts that included firearms from the museum or one of their storages. The survey was twenty three questions long and took up three and a half pages (Appendix 1 & 2).

4:3 Response rate

It took some time before any of the museums answered and out of the eleven museums that were investigated, only four answered. It seemed likely that the reason for this was that many of their personal did not have the time to answer a survey. It may also have been the complexity of my questions. It would have been helpful to know which.

The first museum that answered was the National Museum in Denmark, representing the Royal Arsenal. The National Museum and the Royal Arsenal share the same conservation department and it was this department that answered through the National Museum. Perhaps because it is a large conservation department, they sent back my survey with a very satisfactory amount of information. There were however still some questions that they had not been able to answer. It took some more time before the second museum answered. It was the Air Force Museum. This museum sent back an almost completely answered questionnaire. The final museum to send back their questionnaire was Livrustkammaren. Compared to the others who had answered, Livrustkammaren was less specific in their answers, but still provided a satisfactory amount of information in answering the most important questions of the survey.

While a lot of information was collected from these three museums, there were museums that didn't answer the survey, whose information could have been very fascinating and interesting to have. Despite sending reminder emails, no museum from Norway answered the survey, and neither Rustkammare Trondheim nor Hjemmfrontmuseet answered back. A closer contact with Forsvarmuseet proved possible, and eventually, the museum was able to report that they had sent the survey on to their conservators that worked with weapons but that they couldn't guarantee an answer any time soon. The Sotamuseo in Helsinki also did not send back their survey. They had forwarded it to their conservators, but none were free to answer it, because they were busy with a new exhibition due to open at the end of the year. These reasons were all entirely understandable, but eventually time ran out to collect more questionnaires from Nordic museums. The main regret around the low participation from the Norwegian and Finnish museums was because Norwegian ethics and firearms are different from Sweden, discussed in chapter 2 and Finland's laws are even more different than either Sweden or Denmark's. Amongst the British museums, only the Royal Armouries responded the questionnaire. They answered all the questions and painted a clear picture on how they take care of their collections of firearms.

4.4 Meeting with Armémuseet

While the questionnaire had been sent out to the different museums on the list, a meeting with the Swedish Army museum was arranged. This meeting consisted of one of the metal conservators and a security chief from SMHA. The questions asked during the meeting were the same questions given in the survey, although there was of course opportunity to go into a little more detail. During the visit, the information gathered would prove to be invaluable, when it came to getting a clear picture of the caring of firearms in Sweden. Both members of the staff were exceptionally generous with their sharing of information and answered all of the questions during the meeting.

5. Results

In the following sections, the results from the visits and the surveys are presented and discussed. The different questionnaire answers will be discussed in detail in separate sections. The questionnaire that was sent to the UK had different formulated questions than the questionnaires that was sent to the Nordic countries, resulting in different answers. Some of the questions were still the same and they will be discussed in this chapter (Appendix 1 & Appendix 2).

5.1 The museums responses

Going through the limited responses sent by the museums, the results of the survey, while vague, still showed a pattern when it is about the firearm handling at museums. There isn't an accepted standard within Europe when it comes to firearms and museums, meaning that each museum has their own methods when handling firearms in their collections. With the lack of a standard, this can cause unwanted damage to objects or even cause accidents with the people who are working these objects. Some museums have however tried to push for a standard to be approved within the European Union, when it comes to firearms and museums.

As mentioned in the chapters before, each of the questions in the survey was connected to different categories. Each of the categories in the survey were made so an in-depth view of the handling of weapons at museums were made. Each of the museums answered differently on each question and some museums were not even able to answer some questions. The reason for this was that these questions were connected to confidential information that the one who answered did not have the authority to share, which is understandable. Some of these questions ask about the security measures taken when storing their weapons and similar confidential questions.

First category: About you collections

The first category had questions about the museum's collections. On Question 4 "How many weapons does your museum collection have?" the answer varied. The Swedish Army museum and the Royal Arsenal Museum in Copenhagen answered that they have thousands of weapons in storage and on display (Informant 2 & informant 5). The air force museum however, answered that their weapon collection is only limited to about 20 weapons on display and a large number of weapons in storage (informant 4). Neither museum did give a number for how many were in storage. Livrustkammaren did not answer this question.

Question 5 "What category of firearms does your museum accept and what kind of weapons does it not (Ex. Rifles, pistols, grenades etc.)?" the museums answered differently, which is understandable, because some museums have a different focus on firearms. The Army museums and the Royal Arsenal gave similar answers. There is really no limit to what they collect. They collect just about anything that is related to military history, except for things that are radioactive, like nuclear weapons (Informant 2 & informant 5). The Army museum is very strict in what they accept, making their decision based on whether the object has any relevance to their collection or not. If an object has an

interesting story or is unique, the museum will accept the item and catalog it into their collection. Weapons that are not acquired into the museum's collection are destroyed. Metal items, like guns, are melted down, so that the metal can be reused (Informant 2). The Air Force Museum answered that they only accept firearms that are connected to the Swedish Air Force, which is understandable (Informant 4). Livrustkammaren did not answer this question.

For Question 6 "Which era/historic period is the focus of your museum's collection?" the answers varied once more. The Royal Arsenal collect items from all eras. Their collections include samurai swords to a German V-1 flying bomb from World War II (Informant 5). The Army museum has its focus on the Swedish Army's history, ranging from the Fifteen hundreds to the present day and into the future. The majority of items in the Army Museums collection is directly handed down from the armed forces of Sweden, when it is deemed obsolete or given as a gift of knowledge to the museum (Informant 2). The Air Force museum has limited its collection to around the 20th century, with items belonging to the Swedish Air Force from the 1940s to the 1980s (Informant 4). Livrustkammaren did not answer the question.

Question 7 and 8 moved into risky territory. The questions are as followed "Are any of your weapons functional?" and "if answered yes, why?" in that order. To protect the security of the museums, the information and the museums will not be mentioned together. Some of the museums did not answer either of these questions, but those museums that did answer wrote "yes". The reason why these museums have functional weapons is because if you plug it or weld it, you destroy its historical importance and also risk losing information and knowledge. Those museums wants their weapons to be in their original condition. If, however, they have a weapon on display that is plugged, they keep another similar one in storage, unaltered. Sometimes, however, the museum has only been able to get a plugged version of the weapon, but has accepted the weapon nonetheless, because of its historical importance and rarity.

The last question in this category was Question 9 "Are any of the weapons disarmed and if so, how?". Once again to protect the security and any confidential information connected to the museums, none of the museums will be mentioned to their respective answers. Some museums disarm their weapons in accordance to EU regulation and guidelines 2018/337 and 2015/2403. These regulations calls for the permanent deactivation of firearms. In accordance to the regulation, the deactivation procedure is to be done so to prevent the reactivation of the firearm with regular tools. This can be done by welding, bonding or by using appropriate measures with the equivalent degree of permanence. The museum can weld the bolts stuck or the bullet entry point shut. A piece of the pipe can been cut off from the inside, making the weapon useless. The deactivation of a weapon is also crucial in some aspects, as some museums cannot lend out weapons that are not disarmed, except to other government owned museums that follow the same weapon regulations. There is really no standard for how the deactivation and disarmament should be done, but the EU is currently pushing for a standard to appear at all European museums on how weapons should be disarmed with the help of police organizations.

Second category: Transportation and display

The second category had questions concerning transportation and display. Question 10, 11 and 12, "How are the weapons displayed, from a conservator's point of view? Light and humidity?", "What are your security measures for when you display your weapons?" and "Who has access to your collection of firearms?". Some of the answers to this question had

confidential information connected to it, so some museums weren't able to answer that question. No museum will be mentioned to their respective answer, to not link any of this information to a specific museum. Weapons that are put on display are placed behind thick, armored glass, which is only accessible by guards, not by museum personnel. This is to decrease the likelihood of theft of the firearms. It is the same procedure with both deactivated and fully functional firearms. The weapons are also wired in place, so that should someone destroy the glass (even if it is almost impossible by normal means) and break in, they will not be able to remove a weapon from the display case. They are attached with security approved wires, the information about their material composition are classified. There is also, alongside the security measures, a priority to place the items in climate controlled show cases, with a humidity of around 45-50% RH and a temperature of around minus 5 degrees Celsius, up to around plus 2 degrees Celsius. Other security measures taken by some museums are that they only display firearms that are so called empty shells or inert firearms. Empty shells means that none of their ammunition or cartridges are loaded, making them simply an empty shell. Inert firearms are the name often given to replicas or disarmed weapons. Inert firearms are often used for training purposes, to train people on the safety of firearms handling. Only selected individuals amongst the museum personal have access to the weapons. These people are those who work with the weapons regularly, in storage or on display. Any access made to the weapons is logged into the museum date-base, as a security measure.

On the last question of the category, Question 13 "How does your museum transport your weapons as safely as possible?" no museum will be mentioned. Some museums didn't answer this question as well, because the information were once again confidential. The amount of security taken when it comes to the transportation of weapons, if the weapon is to be either "borrowed" to another museum's collection or simply to be stored in an offsite storage. The security measures taken depends on the lethality, functionality and what class the weapon is. Fully functional assault rifles are handled with more care and security than broken down muskets, for example. An example of transport precautions undertaken by some museums is that if the weapons are still functional, the weapons are stripped into different pieces and then transported in more than one vehicle. The vehicles then drive towards their destination through different routes, to confuse any pursuer, if someone should plan to steal one of the weapons during the transport.

Third category: Conservation and Storage

The third category of questions were about the conservation and the storage of firearms at the museums. In Question 14 "How are your weapons conserved?", the museums responded similarly. The Army Museum answered that they handle the firearms as if they were any other object that consist of the same materials. The firearms are conserved according to their condition and the use they will be put to, as an example, if the weapon is to be put on display or stored, or if there is a serious case of corrosion on the object. The museum used gun grease to coat their firearms in the past, but not anymore. They instead now use wax to coat them, because of its long term efficiency on metals not exposed to wear (Informant 2). The Royal Arsenal response indicated that they work with their weapons in a similar way to the way the Army Museum operates. Many of their weapons are coated to protect them from corrosion, but instead of using wax like the Army Museum, their firearms are coated with weapon grease in storage. While on display, they are put in mostly well-controlled environmental conditions. They utilize common conservation methods used on the same type of materials in non-weapon objects (Informant 5). The Air Force museum answered that they treat their firearms with a special grease for weapons, meant for their machine guns and cannons, similarly to the other

museums (Informant 4). Livrustkammaren however answered that they follow a minimum intervention approach and resort mostly to mechanical removal of dust, dirt and corrosion. This is to preserve the original appearance of their firearms, since these firearms are part of the history of the Swedish Royal family. When however it is necessary for the preservation of the object, they coat their firearms in a protective, thin layer of oil (Informant 1).

On Question 15 and 16 “What are your safety rules when handling the weapons?” and “Is there any special chemicals that you use on your weapons?” museums answered differently. The Army Museum answered that the safety measures taken when handling the weapons depends on the weapons lethality and whether it may cause harm to the conservator in its current state, for example if it is fully functional and what kind of firearm it is. As mentioned on the previous question, they mostly recommend the use of waxes and grease on their firearms. They use abrasives for mechanical cleaning. What kind of abrasive they use depends of the surface of the material, but they mostly use petroleum products. They do not apply organic coatings to metal surfaces, as it can stain the material. Sometimes however, they are forced to use just such products, where there has been an earlier treatment. If the weapon has been treated with an organic compound earlier, they generally prefer to use a material that is the same as the original coating or use another coating, but risk changing the appearance. That is always a gamble (Informant 2).

The Royal Arsenal answered that they always check if the firearms are loaded before they start working on them. They always check this first, for safety reasons. They use cotton or vinyl gloves when handling the weapons, to avoid any fat or grease from bare skin staining the material. In removing earlier coatings and grease, they recommend a commercial degreaser from LPS Labs (Informant 5). The Airforce museum answered that their firearms are handled in a controlled environment by certain members of their staff, to minimize the risks of accidents involving those items. They don't use any special chemicals, apart from the greases mentioned in the question before (Informant 4). All of these answers paint a picture that is similar to how the Royal Armouries in the UK operates. This was also one of the questions sent to the UK. Rather than formal safety rules, they have their own set of best practice guidelines that they tend to follow. When they start working with a firearm, it is always assumed that each firearm they work on or handle could be loaded. As such they carry out safety checks on each firearm before starting to work. They give training to all new starters, who will be handling firearms, as to how to carry out these checks as well as how not to accidentally fire the weapons and they also stress the need to avoid touching components that are under tension. As a rule, they do not work on firearms if there is nobody else present in the laboratory, but if the weapon has been found not to be loaded then this is less of an issue. They also always ensure that they have access to appropriate personal protective equipment (Informant 3). Livrustkammaren did not answer this question.

In question 17 “Do you have weapons that has to be handled specially through special means? Disarmed explosives or rockets?” museums answered differently. To protect any confidential information, none of the museums will be linked to their respective answers. The museums tended to respond that disarmed firearms are handled and conserved like any other object, but that the same is not the case for hazardous objects. One of the most hazardous objects often found in firearms collections are live ammunition. From the museums that I have spoken to, they say that live ammunition is simply stored and not conserved. If a bullet begins to corrode, it is removed from the main collection and left alone, because of safety regulations. Hazardous objects are always separated from nonhazardous objects. A corroding bullet can be a massive health hazard. The reason why is that live ammunition still has gun powder in them, a material that can easily explode when ignited. Such accidents can remove a finger if it explodes in a hand. Explosives and

live ammunition are objects that museums collect as little of as possible, because of the likelihood that dangerous accidents like these could happen to the museum staff.

On Question 18 and 19 “How are the weapons stored?” and “What are your security measures for when your weapons are stored?” the response rate was mixed. To once again protect any confidential information, none of the museums will be linked to their respective answers. The firearms are stored in controlled climates in museums that can afford such storage, in order to prevent any corrosion of the materials. The climate is set to be ideal for the materials, which mostly consist of iron, wood and brass. Functional firearms are stored in weapon safes, to prevent any theft. The security measures taken for storage, depends on the lethality of the firearms. As mentioned earlier, fully functional assault rifles are handled with more care and security than old muskets. Only selected personnel from the museum staff have full access to the storages. These individuals are also never allowed alone into the storages, to further minimize any thefts. Further details provided on museum’s security measures will not be included in this thesis.

Fourth category: The Law

The last category of question in the survey was about the firearm laws and the museums thoughts about them. Question 20 “How does the law affect the storage and handling of your collection of weapons”, was answered similarly by all the museums. The Army Museum responded that it does not affect the conservation process that much, since the firearms are treated like any other object. The only areas that are affected by the law are storage, display and transport, as explained above in the different categories. This is logical, in that any owner of firearms (in this case the museums) who have the legal ownership of any functional firearm, still has to follow the same storage and transport laws and regulations as laid out in their respective host countries (See chapter 2 “2.2 Laws per respective country” for more information on the countries respective firearm laws) (Informant 2). The Royal Arsenal answered in a similar manner, in that the storage, display and transport of their firearms has to be handled according to the law, but when unloaded or deactivated, a firearm is treated like any normal object (Informant 5). The Air Force museum had a similar answer to these two museums, in that the storage and handling is affected, but not the conservation. The Air Force museum said that the museum follow FAP law (Fap 556-1) regarding weapons in museums. The law states that any functional weapon shall always be stored in an approved weapons locker or in a vault, welded in place (See Chapter 2 “2.2 Laws per respective country – Sweden” for more information) (Informant 4). The Royal Armouries (UK) answered that the law does not restrict their activities in any areas. They adhere to all regulations regarding movement and transport, but actual conservation treatments are relatively unaffected, provided work is being done in an access-restricted area. While they are more independent of the law, they still want to manage the risk their activities to ensure public and staff safety. In addition to the law they also have a number of sector standards to meet (Informant 3). Livrustkammaren did not answer this question.

On Question 21 and 22 “Does your museum require a license to keep your weapons?” and “Does a conservator require a license to handle the weapons?”, the museums once again answered similarly. The Army Museum answered that, when it comes to Swedish government owned museums, the requirement of owning a license is not needed. They still have to follow the same laws as any other owner of firearms, but since the museum is owned by the government and is connected to the Swedish Armed Forces, the museum is exempt from owning a license. Museums in Sweden that are exempt from owning a firearms license are museums that are state controlled or are part of a foundation, municipality or county. Any museums that do not fall under any these categories, are

excluded from that privilege. However, if the museum is to lend any firearms to a private owned museum, then the government owned museum has to acquire a license to be allowed to lend any firearm to said private museum. For private owned museums, a person on staff must be licensed, rather than the museum itself. Similarly to how the museum itself does not need to own license, conservator's doesn't need a license to be able to work on the firearms, if they are employed by the state museum. This is because according to Swedish law, people hired by the government does not need a license to handle government owned weapons, as are the weapons at the Army Museum (Informant 2). The case is a little different in Denmark, as the Royal Arsenal responded. In Denmark, the museum itself needs to own a license if it is to own a large collection of firearms. It doesn't matter if it is government owned or not. Conservators however, do not need to own a license, similar to Sweden (Informant 5). The Air Force Museum, being in the same circle of government owned defense museums as the Army museum, that are part of the Swedish military history heritage (Militärhistoriska arv), falls under the same laws and regulations as the Army Museum, in that the museums and conservators do not need a license, except if it is intending to lend any firearm to another museum (Informant 4). The Royal Armouries in the UK answered that their museum has to obtain a museums firearms license and a separate Section 5 authority for their modern firearms. To obtain the Section 5 license, they are required to be Arts Council England accredited. However, their conservators do not need a license, since their work is covered by the museums license (Informant 3). Livrustkammaren did not answer this question.

On the last question, question 23 "Has there been any theft that include firearms?" no museum will be specifically mentioned. Firearms are a constant target for thieves, because of their high value. Apart from armories and private owners, museums that collect firearms can also be targeted for theft. The museums were reluctant to answer this question. However records show that there have been thefts that include firearms in the past, which explains why the security measures have been increased over the years. The occasions have just been a few and there hasn't been any new thefts in the recent years.

6. Conclusion

When I began this thesis, the main issue asked were how are modern weapons handled at museums i.e. storage, conservation and handling, in accordance to the law and does the law have a negative effect on the museums capabilities in handling these weapons. After going through the answers given to me by the museums, the answer is both yes and no. The conservation itself is not affected, but storage, display and transport are. It is clear from the appraisal of the responses from the museums that one can see differences and similarities between how each museum handles their respective firearm collections. Because of the limited response to the questionnaire, it is difficult to determine whether there truly is a collective method on firearm's handling at museums. Nevertheless, from those museums that gave a response, a clear picture emerges of a shared approach to managing and caring for their modern firearms collections.

One thing that became clear is that there is no written standard on how to disarm firearms at museums, but we now know that the European Union is pushing to make a standard concerning that issue, and it would be logical to think that at some point in the future all museums in the EU will be following this standard. So we are left here with a mixed picture as far as whether the law affects the care of firearms in museums. Where a museum feels it has to disarm its firearms, harm is indeed done to them as part of following the law. But since the museums, which responded seemed to say that they did not disarm their modern firearms, it appears that there are choices a museum can make in this aspect of the law. Security measures appear to be how museums meet the requirements of the law as far as keeping their modern firearms safe.

The transportation issue were a little more difficult to get a clear picture of. Very few museums answered fully on how they transport their firearms, while the majority chose to not answer at all. Since so few museums answered, it is difficult to deduce if the museums share the same methods or not. The few methods that were given provided for transport do make sense. As explained, in the results section, the amount of security required to take when transporting firearms depends on the level of lethality. Museums agreed that firearms must never be transported in one piece or in the same vehicle, if the threat of theft is to be avoided. While it remains unconfirmed whether the other Nordic museums use the same methods, it would be logical to think that they at least use a similar method regarding transport. This shows that transport is largely affected by the security requirements needed to fulfill the law. These security requirements can affect the preferred transport storage concerning conservation.

On the topic of conservation, the conservators in respective museums answered that when it comes to conservation, they all treat the firearms like regular non-firearm objects. They use cotton or vinyl gloves to avoid staining the weapons with any oil and grease from their hands. The only differences noted between their conservation methods are the list of materials they appear to use. The Army museum in Sweden uses wax to coat their firearms, while the Royal Arsenal uses gun grease to coat them. The reason for these different selections of materials are probably because of different preferences when it comes to conservation. In none of the cases were the museums specific about what kind of wax or gun grease they were referring to. Conservators often use similar methods to each other, but different materials when conserving an object, so these results are not surprising. But this is an area that it would be interesting to look deeper into.

Livruskammaren displayed the biggest difference in how they approach treating their firearms, compared to the other museums. They expressed their ethic of wishing to interfere as little as possible with their weapons, and thus they restrict their treatments mostly to mechanical cleaning, rather than applying coatings. As mentioned, in the results chapter, their motivation to preserve the original appearance of their firearms, is because of their firearms have such an important historic connection to the Swedish Royal family. When however, it is necessary for preservation of the object, they coat their firearms in a protective, thin layer of oil. That they are using oil even further supports their use of minimum intervention methods, since oil is easier to remove than both grease and wax. This does not imply that the other museums do not clean their firearms using mechanical cleaning as well. In conclusion, the conservation is not that largely affected, since the objects are treated in the same way as non-firearm objects that has a large, historical value.

Few museums responded to the question about how they store their firearms, because they didn't want to discuss such a sensitive subject, but those who did respond said that the firearms are stored in an area with a controllable climate. Controllable climate means that they both can control and monitor relative humidity, light and temperature levels to assure that the environment around their firearms is as stable as possible.

Because most museums didn't want to discuss the manner of their storage security measures for their firearms collections, it was difficult to compare the approaches used by different museums. It is understandable why most of the museums didn't want to release this information. By going through the limited answers given to by the museums and the law text per respective country, one can see that the biggest influence that the law seems to have had is on this matter of the secure storage of firearms, and this seems to be a major thing that the museums share with each other. While the law does not affect the museums handling and conservation of their firearms as much as one would expect, it does affect the museums storage and exhibition greatly. The impact of these storage measures on the care of modern firearms appears mixed. Gun lockers do not meet the same high standards as modern museum storage cabinets. Restricted access to these firearms can also have the effect of meaning that they are checked up on less often, and so problems arising with the objects may not be caught so early.

Most of the museums which responded seemed to share the same approach when it came to display methods. Displays and exhibitions are what makes a museum, to showcase the objects and the knowledge and history behind them. But since it is clear that most museums prefer to have their firearms in working condition, because of the historical importance, strong security measures must be put in place to assure that none of the weapons are stolen. From the information gathered from the questionnaire, most museums share their methods in security, both on display and in storage. One thing that seemed to be shared between the majority of the museums also were that a security guard has to always be present when opening cases which contain modern firearms, to watch over the process of moving and handling the weapon so that no one either tries to run off with it or that no accident happens.

As mentioned above and in Chapter 2 "2.2 Laws per respective country", the laws are strict when it comes to storage and ownership. When comparing Swedish gun laws with Danish, there isn't that big of a difference. Apart from some minor differences between what types of firearms that are allowed for ownership. Storage conditions and display are in a similar faction. When it comes to ownership, In Sweden, state own museums does not need a license. This is the same for all the museums that are part of the SMHA. They do however need a license is if the museum is to lend a firearm to a privately owned museum that is not

part of the SMHA, then the museums require a firearms trading license. The Royal Arsenal didn't answer this thoroughly, but looking at the Danish firearms law, museums requires to own a license if it is to own and store a large collection of firearms. It doesn't matter if it is government owned or not. The reason for this is that the Danish firearms law is stricter than its Swedish counterpart, because of recent attacks concerning firearms in the country and neighboring nations. For comparison, the Royal Armouries, UK answered that their museum requires a license to own section 5 firearms, which include modern firearms, also because of recent attacks.

Conservators in Denmark however, do not require a license to work with the firearms, which is similar to conservators in Sweden that works with the firearms at similar museums. The same is said for the Royal Armouries, because their work is covered by the museum's license and they only carry out treatments of their firearms at the museum. Another big similarity between the Nordic and the British museums, seems that both have their own non written policies and standards on how to care, store and to assure safety for both the conservator and the firearm. The Air Force Museum, being in the same circle of government owned defense museums as the Army museum, that are part of the SMHA. This means that the Air Force museums also falls under the same laws and regulations as the Army Museum, in that the museums and conservators doesn't need a license, except if it is to lend any firearm to another museum.

These are the main differences between the laws for the museums in respective countries that answered. So in conclusion of these answers, the care and conservation of firearms at museums are not as affected as storage, transportation and display, which has to follow a series of security laws to allow the museum to own and display these firearms. This can have a negative effect on museums that does not have the resources to afford both security and good storage and display. Security always comes first.

7. Advice sheet

7.1 Recommendations for storing firearms

These recommendations are put together from all the information gathered from the museums during this study. All information has been collected from museum staff during the process of writing and from literature sources. Because there are relatively little information available to the conservator in the published literature, it is hoped that this advice sheet will provide helpful advice to anyone who lacks firearms expertise and wishes to care and conserve a firearm in an appropriate way.

While a general picture has now been established on how the museums care and store their firearms from the limited answers given, there are still some questions remaining. The lack of detail on the museums storage and handling from a conservator's point of view. This is what is going to be discussed in this chapter. The proper care, cleaning and storage of firearms. Firearms, while still being museum objects, have a couple of more issues when concerning their storage and handling. The issues are 1, protecting those who work with them, 2, keeping the guns themselves safe and 3, keeping them secure from thieves who either wish to use them or sell them. As mentioned earlier in the materials section in the "controlled weapons & their materials" chapter, the most common materials used on firearms are iron (steel) and wood. These two materials have complete opposite preferences when it comes to RH and light. Iron prefers areas where the RH is below 35%, to avoid the oxidation of the metal. Iron can remain stable to around 50%, but all forms of iron starts to corrode and rust when the humidity is above 65% (Logan 2007). Wood prefers an environment where the RH can be around 70%. If wood is stored in an area with a too dry climate, the wood will start to dry and will start too brittle and fall apart (Rietz 1978). To assure the best possible storage for composite objects, which consist of both materials, it is recommended to store them in areas with around a 45-50% RH to try and stabilize both materials (Informant 2). While it is difficult to stop any deterioration and corrosion of any material, storing any objects that consists of these materials like this will slow down their deterioration time. Firearms that consist of plastic parts prefer similar storage conditions as metals. Plastic parts should not be stored in an area where the humidity is not above 70-75% and not below 45-50%. Too humid, or too dry conditions, can cause chemical instability, which will cause the material to become more fragile and it will start to break down (Vipperman 2014).

When it comes to the conservation of the firearms themselves, there are multiple factors to consider when treating them. To be able to thoroughly clean it properly, it is important to disassemble the firearm to be able to clean all areas. A feature on more modern firearms are that they can easily be disassembled for cleaning by soldiers when in the field. On more antique firearms, disassembling is possible and doable, but it is more difficult than on modern firearms (Informant 2). Instruction manuals on how to disassemble certain guns can be found in various forms and places, ranging from military handbooks to the internet community. Disassembling a firearm makes it easy for any caretaker to treat both the inside and outside of the firearm (Informant 3). Each firearm is disassembled differently. Semi-automatic pistols can have its upper receiver removed to gain access to the parts within, while revolvers has to be unscrewed to loosen any parts. Bolt action rifles can have the entire barrel and bolt removed, while certain types of assault rifles takes of the entire upper receiver with barrel and all. When reassembling the firearm after caring for the inside with cleaning oils and waxes, always be sure that all the right parts are back in the

right places, especially if the firearm is to be used and fired later on. If a firearm is assembled wrong, it can cause the firearm to malfunction, which can cause a serious accident. While on the subject on cleaning the firearm, it is always important to try to remove as much residue as possible from the surface. The use of mineral spirits and bronze wool will remove any dirt and surface contaminants from metal, but is not recommended to use on organic surfaces like wood (Informant 3). The reason for using bronze wool instead of steel wool, is because steel wool makes it unfortunately very easy to impact adversely on finished surfaces. When you use steel wool, you are distributing small particles of steel all over the surface of the firearm and these particles can rust. The rust will then spread to the rest of the firearm, unless they are all removed. Bronze wool is softer than steel and will generally not cause scratching of surfaces or impact fine bluing (Wicklund 2017). On wood that has a finish, use diluted washing-up liquids and soft cloths to refrain from scrapping the surface (microfiber cloths). Avoid using too much washing-up liquid at the same time, since it can cause the finish to start bubbling and become glossy in appearance (Informant 2). Solvents that include tannic acid can be used on old wood, giving it a shiny appearance. Using gloves is important, since contact with human skin itself can cause serious stains if left unchecked for too long. Cotton gloves are recommended for firearms care, because of their ability to spot corrosion. The cotton gloves will show rust particles that has been caught on the surface of the gloves. The gloves will show the particles well before one's eyes as registered them. Latex and nitrile gloves work just as well and makes it easier to handle smaller parts of the firearm than fluffy cotton gloves, but it will be harder to spot surface corrosion, since it will not stick to the gloves like on cotton ones (Wicklund 2017). Oils and fats from human skin can eat away finishes and corrode and stain materials. The removal of fingerprints is therefore crucial if one is to avoid ruining the surface (Wicklund 2017).

As mentioned earlier, both in the materials section and by the museums themselves, coating a firearm in a thin layer of coating is an excellent way of deterring further deterioration (Informant 2). There are two different sorts of coatings that goes well to firearms, but each one is more preferable for different situations. For firearms that are to be regularly used, a simple coating of gun oil will suffice, since oil evaporates quickly and is not meant for long term storages (Wicklund 2017). On firearms that are meant for long term storage, waxing is recommended. One of the most preferred waxes used on firearms around the world, both by museums and private gun owners alike, is Renaissance wax (Wicklund 2017). Renaissance wax is a microcrystalline wax with a neutral PH that puts on a thin layer that will protect the material of the gun from surface humidity and acids. Waxing does however not last forever. It usually lasts for a couple of weeks to months, depending on the ideal storage conditions the wax coating is exposed to. To high temperature and humidity will melt away the wax coating faster, than low temperature and with a humidity around 40-50% (Informant 3). Only a thin layer is required to protect a firearm. For the best results, use cloths to put on the wax. The reason for the thorough cleaning of the gun is to make sure that no surface contaminants are stuck on the surface of the firearm before the wax is applied. They can cause trouble underneath, which will require one to remove the wax coating to manage the problem (Informant 5). After the firearms has been coated, make sure to dust it regularly. Dust serve as a foundation of moisture being trapped on the surface, which will speed up corrosion. Use clean, dry cloths to lightly wipe away dust. Do not use spray dusting products, which can contain acidic chemicals or leave an oil residue behind (Wicklund 2017).

When preparing for long term storage, always keep firearms decocked. A cocked firearm means that the bolt, receiver or hammer has been pulled so the firearm is ready to fire. Keeping a firearm decocked will relieve any stress put on the firearms inner parts, like for example on the weapons springs, which are crucial parts when it comes to the firearms

functionality (Informant 2). Avoid storing firearms in cardboard boxes, since these attract moisture. Gun safes are the most secure option for storing small collections of firearms, but for larger collections, armored vaults are recommended (Wicklund 2017). A dehumidifier can be used to control the RH in a relatively large room, if the room is closed off and the access to outside air is limited (Informant 2).

7.2 Further Directions of Research

The point of this study was to see if the law in respective country did make it more difficult to care for firearms at museums and this thesis might then provide some form of helpful guidance for those museums that did indeed have trouble with this. But nothing ever goes as planned. It appears that most Nordic museums do not feel that the laws around modern firearms get in the way of good conservation practice.

While the museums who responded did provide a great insight of the world of firearms conservation and their respective situation with their firearm collections, there were still museums who didn't answer some of the most important questions on the survey, questions about their storage and display. But these questions could be answered, by analyzing their other answers. Still, speculations had to be made, going from their limited answers and what each countries respective law says about the subject.

There remains the concern that some of the information provided by the museums may have been hastily pulled together by the museums and not reflect what actually happens there. It is furthermore difficult to check whether the information gathered is correct when it comes to firearms care, since there is next to no texts on the subject written by conservators for one to cross reference to. The majority of texts written about firearms care are written by gun owners and gun-enthusiasts. A text written by a conservator who focus on the care of firearms would be an invaluable contribution for gun owners and museums who handle such collections without having access to specialist conservation expertise.

Then there is the problem of what types of conservation materials museum are using. Each museum answered that they use either wax or gun-oil to coat their firearms, but they never said exactly what conservation materials they are using. A complete list of these materials could prove beneficial, both for private owners and conservators, when it comes to conservation of firearms.

Sending out this thesis to Swedish museums to consult with them whether the information gathered here is helpful is something that could or should be done, to see if this thesis has fulfilled its purpose. If there had been more time, more in-depth visits and interviews could have been conducted in several of the Nordic countries, so that more detailed information could eventually be shared within Nordic museums.

The fact that none of the museums consulted in Norway or Finland responded to the surveys leaves a large blank in the information gathered about firearms handling and care across the Nordic countries. This thesis originally intended to cover all of the Nordic countries, but in the end, was only able to cover two out of four. This raises even further questions. As we have deduced, there are large similarities between Sweden and Denmark in firearms conservation, with only small differences between them. These differences being about the functionalities of the firearms and what tools respective museum uses to conserve these objects. But the question left standing is, is it the same in Norway and Finland? Is there as minor differences between the museums and their care as with Denmark and Sweden, or do they have completely different methods altogether? Since

there is no written standard in the Nordic countries when it comes to firearms care, it is difficult to see whether all countries have the same standard or not. A shared written standard would make an invaluable resource for conservators in museums with modern firearms collections. This could be an area for further research in the future.

8. Summary

The objective of this study was to research the care and storage of firearms requiring a license in various museums in the Nordic countries minus Iceland. With increasingly strict gun laws in place within Europe, the question is raised whether museums manage to find a balance between their country's gun laws and the conservation care that they would like to provide to their collections of modern firearms that fall under these laws. This study was inspired by an internship experience at the Swedish museum of Science and Technology, where the storage of firearms had not received some particular attention.

In order to investigate this question, both a questionnaire enquiry and face-to-face interview methods were used. The museums that were contacted were mostly limited to the Nordic countries, but two museums in the UK was included in order to test whether this common ground exists wider than the Nordic countries. A questionnaire was sent out to Livrustkammaren in Stockholm, Flygvapenmuseet in Linköping, Tøjhusmuseet in Copenhagen, Sotamuseo in Helsinki, Rustkammare in Trondheim, Hjemmfrontmuseet and Forsvarsmuseet in Oslo. The two English museums that were chosen were the Imperial War Museum in London and the Royal Armouries in Leeds. A meeting with Armémuseet in Stockholm was arranged to receive a more in depth view on the world of firearms conservation.

Although most museums were understandably cautious about providing certain types of information about such a sensitive part of their collections, a picture emerged of a pattern of care, which sought to manage the problems raised by the legal framework under which modern firearms may be kept by museums. This pattern of care appears largely to be shared by Nordic museums, even though no formalized standards exist for the care and conservation of firearms in these countries. In comparison to the Nordic museums, the Museum from the UK that answered, gave similar answers as their Nordic counterparts, apart from those topics that concern the differences when it comes to both parties different firearm laws.

The result from all the museums, was that the conservation process itself is not affected by the law, apart from hazardous objects like live ammunitions and explosives, that are instantly removed from the rest of the collection when they starts to corrode. Storage, display and transportations are the factors that are affected the most, in which security has to be a priority above everything else.

A few areas do show differences. For example, on the subject of whether a museum keeps its firearms in working order, some museums expressed a strong preference for this. Their reason for this is that they believe it is important to maintain their weapons in their original condition. The process necessary to disarm or decommission a modern firearm, can be seen as destroying parts of its history and legacy. Most museums described similar approaches to disabling firearms, which they claimed were standard in museums across Europe. These methods involve either welding bolts closed, thereby hindering any repeating or breech-loading of the firearm, making it impossible to shoot. Another way is to weld the inside of the bullet entry point, hindering the ejection of cartridges and rendering the gun useless. Both of these treatments are non-reversible. Unfortunately merely removing a part of the gun is not felt to be sufficient to disarm it, as it is so easy to obtain replacement parts for modern firearms. This can be proved when comparing to the information received from the Royal Armouries. The Royal Armouries does not want to

tamper too much with their firearms, since it fundamentally changes the nature of the object. They did not go into detail on how they disarm their firearms, but they say that a licensed gunsmith does the work and makes the weapon approved/proofed according to UK regulations for disarmed firearms. When it came to the Swedish defense museums that responded, it is perhaps not surprising to find that they all follow the same protocols for disarming weapons because of their participation in SMHA (Sveriges Militärhistoriska Arv), in which all of the museums that belong to this cooperation assist each other when it comes to tasks like disarming, storage and handling of firearms in their collections. With only Denmark being the only other Nordic country that answered, it was not possible to see if there were differences of approach in the military museums from other Nordic countries.

The Army Museum reported that they use abrasives consisting of petroleum products on metals. They rarely apply organic products onto metal parts of firearms, since they can stain metal, but they may have to use such products on objects that have been treated earlier with similar products. This means that they have to either use a similar product to retrain its current appearance, or use their regular products and risk changing the appearance of the object completely. The conservation is not that largely affected, since the firearms are treated as non-firearm objects.

It is also shown that the law in respective country states that any storehouse or magazine that holds a large collection of firearms, has to always have an alarm that is constantly linked to a law enforcement in the area. Any time the alarm goes off or that contact is lost with it, the police or a similar security force is notified by this. The amount of security and alarms also depends on the lethality and functionality of the weapons. Disarmed weapons, if not disarmed permanently, in which accordance to the law, they have to, can still prove to be a threat if someone manages to make the weapon functional again.

One the subject on display, the firearms are displayed in locked cases, reinforced with armored glass, access to the keys which is restricted to a very few people. Furthermore, the firearms are wired into place with security wires made of materials that are difficult to cut. To top it all off, only authorized personnel that works directly with the weapons are allowed to have any access to the exhibitions, meaning that not everyone in the museum personnel can remove the weapons from their cases. Each of these actions is put in place to reduce the chances of theft of modern firearms. More lethal and modern weapons are kept under still stricter security. Not all museums were willing to answer the questions related to this issue, but it would be logical to think that these measures are common to the majority of museums.

As a final outcome of this research a set of recommendations for the care of modern firearms is presented, which brings together the result, which emerged from this research.

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Informants:

- | | |
|-------------|--|
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| Informant 2 | Christina Halldén Tengné, Metallconservator, Armémuseum. Interview 3/4 2018. |
| Informant 3 | Lauren Mcghee, Conservator, Royal Armouries. Mail contact 30/4 – 16/5 2018. |
| Informant 4 | Linnea Holmberg Wensby, Curator of Collections, Flygvapenmusum. Mail contact 23/3 – 13/4 2018. |
| Informant 5 | Louis Lange Wollesen, Conservator, Nationalmuseet. Mail contact 5/4 – 13/4 2018. |

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Appendix 1 – The survey sent to the Nordic museums “Law and Care”

To whom it concerns

Hello, I send this survey to you, because I believe that you are in the position to help me.

My name is Viktor Klinge, student at the Department of Conservation at the Gothenburg University and I am currently studying my third and final year of the Swedish Conservation program. For my final year, I am to write an essay about a subject concerning conservation. For my essay, I have chosen the subject about the current gun laws and how they affect handling and conservation of both historic and more modern firearms at museums. This is a survey, with questions connected to my essay and I hope that you who is reading this introduction can take time to answer them.

This study was inspired by my internship at the Swedish museum of Science and Technology, when I saw the storage of their collection of firearms that requires a license to own. I happened to be there when they first installed the new storage system for their collection of firearms. I noticed that the firearms was simply stored in a safe that was in turn placed in a storage room with uncontrollable climate. The reason for this, is that it was the most secured way to store the weapons to make sure that no unauthorized person could access them. Recognizing that the museum had to prioritize the law, above conservation considerations. Then my question arose if other museums, that had similar collections of firearms, had to prioritize in the same way. I then sought to find out more about this topic and to see how each museum that focus of fire arms handles this issue.

My candidate study aims to research if the law is making it difficult for the preservation of weapons or not at museums. And if it does, are there museums that have found a legal way to handle the situation. This study is conducted to share the knowledge with others. If there are museums that have found a legal way to work around the problem, that knowledge would prove useful to other museums that has specified themselves in the same category of cultural heritage.

Attached to this introduction, there are multiple questions connected to my study, in which I hope that you who is currently reading this can answer. The questions that are asked are all connected to the law and the conservation of weapons. If you wish for your name to remain anonymous, that is okay, as long as you mentioned what museum you work at. Please answer the questions as well as you can and return the survey before 6/4 2018. When you are finished, please send the answered survey back to my email address. The email address is linked below.

If you have any further questions, you can contact me either by my E-mail address:
gusklingvi@student.gu.se

Or through my phone number: 0705496603

Thank you so much for your participation

Viktor Klinge



INSTITUTIONEN FÖR KULTURVÅRD

Rekommendation

Viktor Klinge är student på Konservatorsprogrammet vid Göteborgs universitet, årskurs 3.

Som examensarbete har han valt att göra en undersökning om hur man förvarar vapen lagligt men också i enlighet med konserveringsrutiner.

Som kursansvarig för kandidatkursen på Konservatorprogrammet vill jag varmt rekommendera denna undersökning.

Enkäten är en viktig förutsättning för att uppsatsen ska kunna genomföras, och Viktor och jag ber Dig som mottar enkäten att ta den tid det behövs för att svara.

Göteborg 2018-03-21, i tjänsten

Charlotta Hanner Nordstrand

Ph.D., Assoc. prof.
Göteborgs universitet, Institutionen för kulturvård,
Box 130, 405 30 Göteborg
Tel. 031-7864718, +46(0)707-979415
e-post: charlotta.hanner.nordstrand@conservation.gu.se
www.conservation.gu.se

Questions:

Questions marked with a ☒ are high priority questions that I need answered.

General questions:

1. What is the name of the museum that you work at?
2. What is your position at the museum?
3. How many conservators work at your museum?

About your collections:

4. How many weapons does your museum collection have (don't have to be an exact number)? (Optional)
5. What category of firearms does your museum accept and what kind of weapons does it not (Ex. Rifles, pistols, grenades etc.)?
6. ☒ Which era/historic period is the focus of your museum's collection?
7. Are any of your weapons functional? (Optional)
8. If answered yes, why? (Optional)?
9. Are any of the weapons disarmed and if so, how?

Transportation and display:

10. ☒ How are the weapons displayed from a conservator's point of view? Light and humidity?
11. What are your security measures for when you display your weapons? (Optional)
12. Who has access to your collection of firearms? (Optional)
13. How do you transport your weapons as safely as possible? (Optional)

Conservation and storage:

14. ☒ How are your weapons conserved (don't have to be a thorough answer)?
15. ☒ What are your safety rules when handling the weapons?
16. ☒ Is there any special chemical or method that you use on when conserving your weapons?
17. Do you have weapons that has to be handled specially through special means? Disarmed explosives or rockets? (Optional)
18. ☒ How are the weapons stored from a conservator's point of view? Light and humidity? Don't have to have security details.

19. What are your security measures for when your weapons are stored? (Optional)

The law:

20. How does the law affect the storage and handling of your collection of weapons?

21. Does your museum require a license to keep your weapons?

22. Does conservators require a license to handle the weapons?

23. Has there been any theft that includes firearms (Optional)?

Now you are finished, thank you so much for your time.

Appendix 2 – the questionnaire sent to the British museums

Name of conservator
Position title
Name of the Museum
Address of museum

Date

Dear...

I am contacting you to ask if you would consider answering a questionnaire related to the care and storage of firearms in your museum.

I am a conservation student in the Department of Conservation at Gothenburg University, currently completing my third and final year of the Swedish conservation program. For my bachelor thesis, I have chosen to investigate the subject of how current gun laws in Europe and Scandinavia affect the handling and conservation of both historic and more modern firearms in museums.

My interest in this subject was inspired by experiences during my internship which seemed to suggest that sometimes a museum had to prioritize the law above conservation considerations. I sought to discover if I could find out how different museums approach the care of their firearms collections and whether the law is making this more difficult. Further, I would like to discover how museums find ways around any difficulties raised. As the final part of my thesis work, I propose to develop a recommendation for the care and storage of firearms that can be used for Swedish collections.

The questionnaire is attached and I have also attached a reference from my course supervisor to establish who I am.

If you have any questions about the questionnaire, I would be very pleased to be contacted, either by email:
gusklingvi@student.gu.se

Telephone: +46705496603

I recognize that you are very busy and therefore thank you very much for any time you find to contribute to answering my questions.

Sincerely

Viktor Klinge



INSTITUTIONEN FÖR KULTURVÅRD

Rekommendation

Viktor Klinge är student på Konservatorsprogrammet vid Göteborgs universitet, årskurs 3.

Som examensarbete har han valt att göra en undersökning om hur man förvarar vapen lagligt men också i enlighet med konserveringsrutiner.

Som kursansvarig för kandidatkursen på Konservatorprogrammet vill jag varmt rekommendera denna undersökning.

Enkäten är en viktig förutsättning för att uppsatsen ska kunna genomföras, och Viktor och jag ber Dig som mottar enkäten att ta den tid det behövs för att svara.

Göteborg 2018-03-21, i tjänsten

Charlotta Hanner Nordstrand

Ph.D., Assoc. prof.
Göteborgs universitet, Institutionen för kulturvård,
Box 130, 405 30 Göteborg
Tel. 031-7864718, +46(0)707-979415
e-post: charlotta.hanner.nordstrand@conservation.gu.se
www.conservation.gu.se

Questions marked with a ☒ are of higher priority for my research, so if you only have time to answer a few questions, I would be grateful if you could focus on these ones.

About your firearms collections:

1. What categories of firearms does your museum accept and what kind of firearms does it not accept into its collections?
2. Are any of your weapons functional?
3. Are any of your weapons disarmed and if so, how?

Transportation and Display:

4. Do you have a security policy which guides the transportation and display of your firearms? (If it is acceptable to share a copy with me for the purposes of research, I would be very grateful)
5. Are there restrictions on access to your collections of firearms? (Details of your policy would be helpful)
6. Do you as a conservator observe any ways in which these security measures and control of access to the firearms collections compromise the conservation care of stability of the firearms? (some examples would be very helpful)

Conservation and Storage:

7. ☒Do you have a formal set of safety rules for handling the firearms during conservation, and would you be willing to share the details of these?
8. Do you have firearms that have to be handled specially through special means during conservation procedures? Disarmed explosives and rockets?
9. ☒What storage conditions are you able to maintain for the storage of your firearms collections? Do these meet what you would normally recommend, as a conservator?
10. Are the special security measures in place for the firearms, which restrict what treatments you can give the weapons?

The law:

11. ☒How much of an impact would you say the law has on the quality of care you as a conservator are able to give the firearms at your museum?
12. ☒Does your museum require a license to keep your firearms? What categories require licensing of different levels?

13. Do conservators require a license to handle the weapons during care and conservators?
14. How has the law of firearms affected the access you are able to provide to these collections for the public, research or educational activities?

Your answers are very much appreciated. Thank you so much!

Appendix 3 – Lexicon

Action – The action includes all the moving parts that load, fire and eject the firearms shells or cartridges

Barrel – the part of a gun that a bullet is fired through

Bayonet – A long sharp blade that is fixed onto the end of a rifle

Bore – A unit for measuring the inside of a gun barrel

Bolt – The part that blocks the rear of the chamber while the propellant burns and moves to facilitate the loading of cartridges.

Breach – The breach is the area of the firearm that contains the rear end of the barrel, where the cartridge is inserted

Cartridge – The ammunition used in modern firearms. A cartridge consists of a bullet (the projectile), a case (holds everything together), propellant, the rim (which provides the extractor on the firearm a place to grip the casing to remove it once fired) and the primer, which ignites the propellant.

Calibre – The width of a gun barrel, used in measuring most firearms in the world (ex. 9mm, 7.92mm, 12.7mm etc.)

Chamber – The part of the gun where you put the bullets

Clip – A container for bullets in some older types of firearms that allowed the gun to be loaded and fired more quickly

Gauge – The width of the barrel of a gun, used when measuring shotguns (ex. 12 Gauge, 20 Gauge etc.)

Grip/Stock – The part of the firearms that one grasps to be able to pull the trigger.

Hammer – The part of a gun that pushes against the bullet to make the explosion when you pull the trigger

Forend – The front part in which the user grasps to hold onto the firearm

Magazine – The container that contains the ammunition of the firearm and in which feeds them into the gun

Safety catch – A function used on modern firearms that makes them unable to fire by pulling the trigger

Sights – The part of a gun or other piece of equipment that you look through in order to aim

Trigger – The part of a gun that one pulls to make the gun fire