Discs make the difference

Introduction

My name is Han Fey and I am from the Netherlands, one of my hobbies is collecting high security (pad)locks from all over the world. I have been collecting locks for 20 years now and I have at the moment about 1900 locks, that's why Bob Dix asked me to write something about a part of my collection, because I have a lot European locks which are probably not common in the States. A large part of my collection exists of (security) locks from about 1920 up until now.

I want to discuss Abloy. Especially Abloy, because I find these locks the most ingenious in design of the locks that I have in my collection. This is because they contain relatively few moving parts and yet, are very hard to pick or drill. Abloy locks do not have pins and springs to cause malfunction through dirt, moisture, poor weather conditions like in conventional locks. Instead, a series of disc tumblers rotate in a cylinder. The Abloy cylinder is called virtually pickproof. I have about 80 different Abloy locks in my collection; I selected some of them to tell something about in this article.

In this first article I want to discuss Abloy in common and I want to tell some details about the Classic system till the High Profile. In a next article I want to write about the Disklock and concluding with the Protec system.

The history of Abloy

ASSA ABLOY (In Common)

In 1994 the ASSA Abloy group was founded. The two Scandinavian companies ASSA (a Swedish company and Abloy (a Finnish company) merged. They started with 4700 employees and they now have 30.000 employees worldwide. This also because they have acquired several other companies worldwide.

The Abloy story

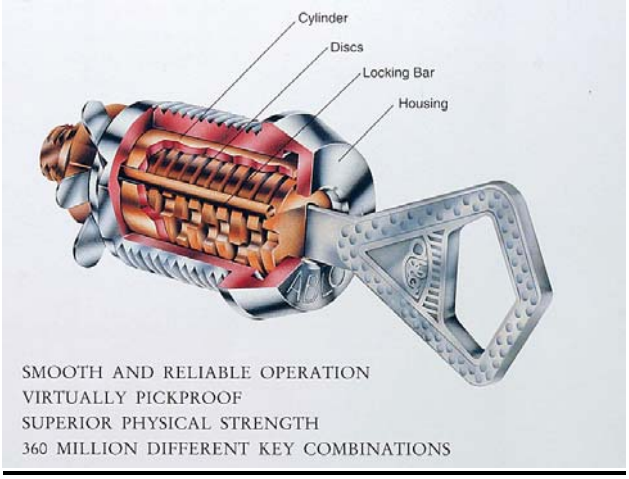
The Abloy success story began in 1907 when Emil Henriksson developed a key operated lock cylinder, the design of which is still used in current production classic locks. Emil was an office clerk who worked with the old register machines which employed the usage of discs. Seeing this principle he expanded it to develop a lock system using discs. And so, the Classic was born. His first lock had 11 discs. Newer systems that Abloy has developed are still based on this principle and essentially, they work the same.

The word Abloy actually is an abbreviation of some kind, AB stands for "ÄktieBogalet" which means corporation in Swedish. The L in the middle means "Lukko" which is Lock in Finnish. And the Oy it has the same meaning as AB but then in Finnish, Oy stands for "OsakeYhtio". It used to be Ab Lukko Oy as you can see in history, but probably got shorter while speaking Abloy.

One of the first Abloy padlocks.

Abloy technique, the name to turn to.

All Abloy locks – regardless of type- work on the same unique principle of rotating detainer discs. These detainer discs are slotted in one of six angular positions to offer up to 360.000.000 different combinations with the common 11 discs.



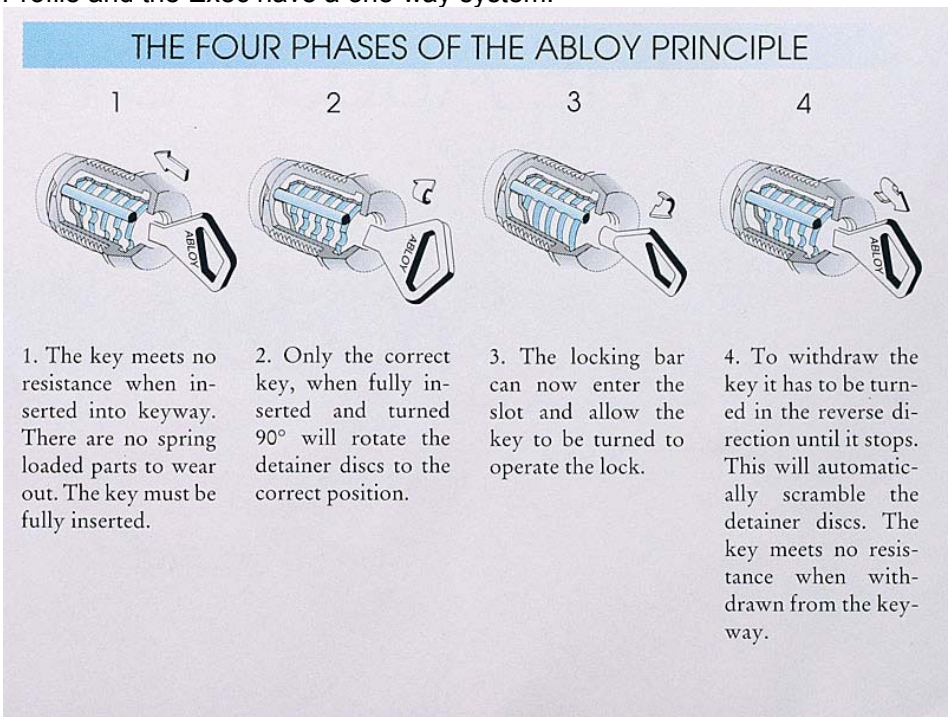
The 4 mentioned parts:
- Cylinder
- Discs
- Locking bar
- Housing

comprise the substantial parts in the first Abloy cylinder.

Later on, Abloy's cylinder design became more complex, with the inclusion of locking bars and return bars. In my next article, I will discuss more about the working of these parts.

PRINCIPLE OF CYLINDER OPERATION (The turning point)

All Abloy locks from the older ones, up to the modern Protec have the same cylinder operation as depicted in the following “The four phases of the Abloy principle”. The main difference is that the Disklock Pro and the Protec have a two-way system whereas the Classic, Profile and the Exec have a one-way system.



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Explanation Phase 2

The most important step of this process is phase 2. It is here, that the cylinder is in fact unlocked. Disc tumblers rotate 90° in a clockwise or counterclockwise direction to allow a sidebar to drop, clearing the housing so that the cylinder can rotate. In the first 90° of rotation, the gates must be aligned. The discs have correct gates under different angles in the discs (18° for the Classic, the Profile and the Exec, and 15° for the Disklock and Protec). For example: After a 18° rotation of the key, the discs with number 2 starts rotating. Disc number 1, makes a full rotation of 90 ° in order to be aligned properly, so it will start rotating at once. Disc number 6, is not being rotated at all, so the key is cut very deeply. With usage of the correct key and the 90°rotation, the side bar falls into the aligned groove and thus, disengages the cylinder from the housing.

Overview used discs

Below is a picture of some of the discs that I could find in my collection, This picture is just to provide an idea of the variety of the discs that you can find in Abloy locks. To the right are the names of the systems that the discs belong to. Most modern Abloy locks contain the 11,8 mm outside diameter discs, and are therefore interchangeable with Abloy's other more contemporary lock designs.

Ø 11,8 mm

Ø 15,4 mm

Ø 13,5 mm

Ø 11,8 mm

Disklock Pro

Protec

Exec

Classic

+

Profile

Differing Styles Of Discs In Abloy Locks

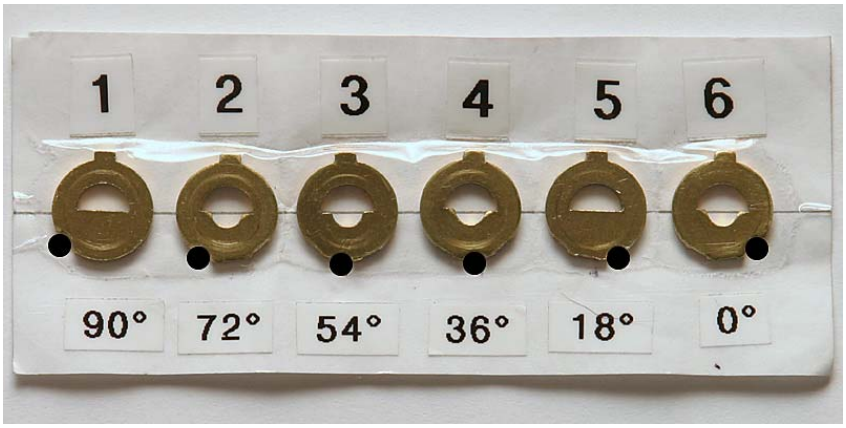
The CLASSIC-System in common.

Classic (18° rotation)
The key blanks are widely available, as the system has not been patented for many years, it's a one way system, used for padlocks, cam-locks and furniture locks. You can recognize this system by the D-shape of the keyway.

Some details
- The Classic system has cylinder ranging from 5 up to 11 discs. There are over 360 million different key combinations with 11 discs.

- Washers are necessary to guarantee individual rotation of the discs.

- Discs for padlocks can be mirrored, so there are only 3 different discs. Variation in the gates is after each 18° rotation. So on 0°, 18°, 36°, 54°, 72° and 90° there can be a true gate in the disc. You can see jumping the gates 18° in the picture. The number above is the number of the cut / disc.



Discs number 1 - 6 used in Classic padlocks.

- There are discs with an extra half circle cut out, this is done to increase the pick-resistance. If you put tension on the cylinder and then start manipulating the discs individually with a pick tool, the shape of this pick tool must be of that kind, that you can move it forward and backwards in the keyway, between the already properly aligned discs. The tip of the tool which manipulates the discs has a special shape, to move “freely” between the already rotated discs. The extra round cut in some discs makes it harder to manipulate these discs with that tool, because the tip of the picktool can rotate freely in the extra cut half circle. These discs with extra cuts are placed at random locations.

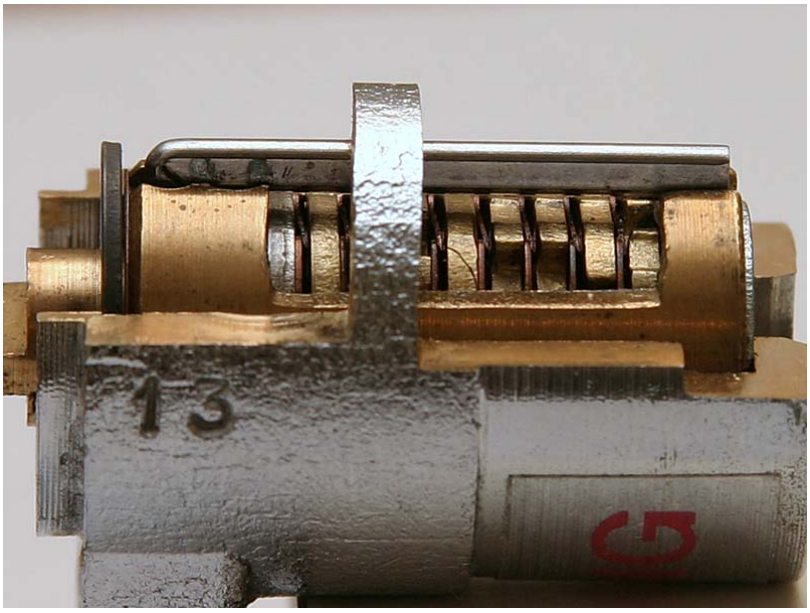
- The front disc of the ordinary Classic must be always free spinning for two reasons. The first reason is for anti-drilling protection purpose. The second has an anti-lock pick purpose. If somebody wants to pick the Classic and the front disc should not spin freely he has some advantage, because the front disc is now always aligned properly (it rotates 90°) if he puts tension on it. If a lock picker puts tension on the first combination disc, because the front disc is correctly free spinning, he probably rotates this first disc in the wrong position, this will be the disc number 1 position (the odds are 1 to 6). The first combination disc is the disc behind the front disc.

- There are square and round gates possible in the Classic / Profile discs. The discs with the round gates are for padlock use (a round locking bar, on the right in the picture). The discs with the square gates are for use in furniture locks, these locking bars are L-shaped and are square (first and second from the left in the picture). The modern systems like the Exec (the second from the left), Disklock Pro and Protec (in the middle) all contain L-shaped locking bars.

Locking Bars Used in Differing Abloy Systems

- If you drill a hole in the front on the position where the locking bar is, you can remove the locking bar (note: If the locking bar is removed, the cylinder is open). The L-shape of the locking bar prevents pulling out the locking bar.

In the cut-away (my first Abloy cut-away) you can see clearly the position of the locking bar and see that it's useless trying to pull out the locking bar.



Cut-away to show the L-shaped locking bar.

- The key number (10 digits) is coded, with the key code chart you can decode the key number to the cut number and reverse. The cuts vary from 1-6. The numbers in the key number vary from 0-9.

Just a short story about the discs

As some of you may know, there are a lot of false gates and notches on Abloy discs.

I once read a story, about somebody who could pick the Abloy Classic cylinder.
He said that he put tension on the cylinder and then manipulated/rotated a certain disc. When he rotated this disc he said he could feel the difference between the false and the real gates. By feeling that there was a false gate, a real gate and then again a false gate, he said he could determine which number of disc it was. For example he knew the disc could be disc number 3, and this he determined then in combination with the rotation.

I had already assembled and disassembled several Abloy locks and I thought the false gate were random placed on the discs. I took my Abloy box with discs and I sorted the discs from 1 till 6, then I started looking at how these false gates and notches were divided around the disc. I noticed then that for the same numbered disc there were till 4 different false gate layouts. As you can see on the picture. The length, the depth, the location and the number of the false gates varies on these discs. These are discs which were used in one batch. I had bought some padlocks and re-keyed them, and therefore these extra discs came free.

I looked also in other disc sizes and I saw the same, if you look in older discs the variety is bigger.

In my opinion to determine the disc number, with measuring the false and true gates is therefore not possible. I think though that measuring the angle may be possible.

View on the false gates / notches in Classic disc number 3

Classic seems to be pick-able with impression technique with a copper or aluminum rod with the right diameter. By making an impression key of it and gently turning in clockwise till it binds, the marks you should than file. Just like the way you make keys with the impression technique for the ordinary pin cylinders. But you need a lot of skill, time, and a bright full spectrum light in order to see the marks.

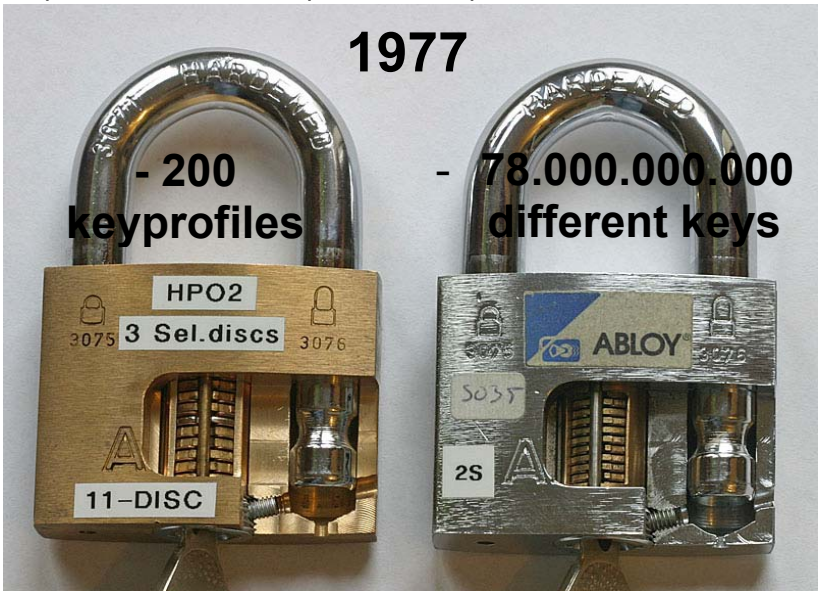
The Profile / High Profile in common

Profile (18° rotation)
In 1977 Abloy launched the Profile system, for company usage. It's a different keyshape then the Classic and uses bigger keys. You can recognize the profile on the C-shape of the keyway. There are from 5 up to 14 discs possible within this format.

In the picture below, you can see a Rimlock with a master key system using two systems together. The mono key (on the left) uses the Classic system (D-shape), the Master key (on the right) uses the Profile system (C-shape). Both keys can independently from each other open the lock.

Rimlock Master keysystem

High Profile (18° rotation)
Later on, Abloy introduced the High Profile system, a system that was developed for larger scale Master keying systems. They called it High Profile, because they also use the key shape as well as key cuts for the master key system. This makes it more suitable for master keying, because the various key shapes provide different levels of security. The following two padlocks are examples from systems used in Master keying systems. In the following part, I will try to explain the used techniques in these padlocks.



Two High security padlocks from the 70's.

The lock on the left (3075 Brass)

As I stated before, master key system can be made with more gates in the discs, and also with keyshape control discs. These are discs with a special shaped keyway profile on the inside of the discs. The profile in the key must have a matching groove in the key, where the notch from the control disc fits in. Here is an example of a padlock cylinder with 3 keyshape control discs. The first disc (from the front), the seventh and the last disc are the control discs. These discs are silver colored and somewhat thinner. The thickness of one keyshape control disc and one washer is equal to one normal disc.

Discs with more gates.

I have seen discs with up to 5 gates. The discs showed here have a maximum of two gates. If you want to use a disc with the maximum six gates, you can use 3 washers, these have the same thickness as one normal disc.

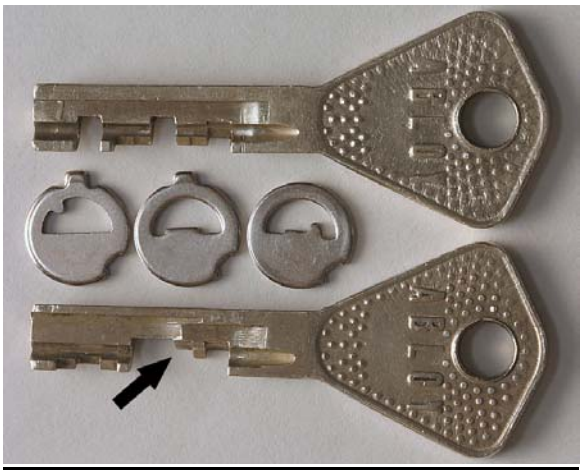
Masterkeysystem discs with more gates.

Selection High Profiles Keyshape control discs.

Here a picture of 5 different key shape control discs. You can divide the grooves on the discs on the outside of the key (the round part) and the inside of the key (the part were the key cuts are). I know from experience that there are at least 5 different grooves possible in the back of the key (both in depth and position), and there are at least 6 different key profiles possible on the inside of the key. That makes at least 200 different key shapes possible, with three selection discs.

Some Abloy keyshape control discs.

High Profile keys.
There are two keys with the lock; one key can only be inserted halfway (the key in the top), to demonstrate the function of these key shape control discs. On the picture you can see the difference in the keyshape profile. The arrow marks were the keyshape profile changes. The key below has more authorization then the key above. This padlock has the common 11-disc format.



Two different keyshape profiles used in ONE Master key system

Selection High Profile key shapes.
Here a picture of some frontal views of the (High) profile key shapes. On the left of the photo you can see the Profile key shape (C-shape).
More to the right you see some former protected High Profile key shapes. I say former protected, because the patent for these key shapes ran out as of 1999.

Some High Profile keyshapes.

The lock on the right 3075 (chrome plated)

This padlock has 14 discs and a special rounded key shape. This padlock is an Abloy lock from my collection with their largest number of key combinations. This is due to the 14 disc format. With this number of discs, the maker claims 78,000,000,000 (78 billion) possible combinations, that means that if we give every American (of which there are about 260.000.000 people) 300 keys each, one of these keys should fit. If you compare the discs with the lock on the left you can see that the discs in a 14 disc Abloy are thinner.

Special High Profile key.

This lock has also an extra security against the impression technique. On the matching key in the top, (numbered A42) there is a groove on the back of the key over the full length which makes it very hard to use this impression technique, with a half (copper) tube, because the tube must also be cut over the full length.

The two extra keys in the picture below I made to show the possible differences in the length of the grooves. The key in the middle (numbered A1543) has only a short groove in the top of the key and the key below (numbered 835) has no groove in the back at all.

Variable lengths of grooves in the back of the key.

A special keyset.
On the picture you see a special key set of two mirrored key profiles. One key is only suitable for opening a lock, the other one is only suitable for closing the lock. These keys seemed to be used in projects were somebody in the morning opens the door and in the evening somebody else locks the door. The set on the picture is for the General Manager who can open and close the locks with his unique keyset.

Opening and closing keys.

Closing Comments
This is my first story about the Abloy Classic, Profile and High profile cylinder systems. In my next article (should people be interested) I will cover more about the Disklock / Disklock Pro, Executive and their newest system, the Protec.

What I personally find clever about Abloy locks is that this High Profile system was introduced in 1977. This time frame being more then 25 years ago. Already at that point, Abloy already knew what High Security was about.

The before mentioned information is from what I noticed in my collection locks and what I heard from other sources, I can and will not be responsible for the contents of this article.