The ASSA d12 and some other Swedish products

In December 2010, Barry Wels and I visited the ASSA factory in Eskilstuna in Sweden. We were invited by Daniel Andersson, Chief of Development. During this visit we also met Bo Widén, the inventor of the famous high security ASSA Twin system.
For several hours we discussed with Bo, about his locks and talked about possible new inventions. In this article I will cover one of the new ASSA cylinders. It is the ASSA d12. This cylinder will replace the ASSA 700 (7-pin) which was launched in 1948. A little calculation says that the 700 series is already 63 years on the market, so maybe it is time for retirement.

We stayed in what the people there called the “ASSA Hotel”. This was an apartment with 5 floors where visiting Assa-Abloy employees or locksmiths who came from far away could stay. They need not to go to a hotel or find another place to stay and that saves money.

In this “hotel “ I saw different ASSA locks. A “new” lock that I noticed was the ASSA Twin Combi Electronic. A system that I had never heard of before. I will cover that in my next article, “Assa Twin systems part 2”. What I will also try to cover in the next article is the mysterious ASSA Twin 7-pin. I showed a possible key of it in Part 1. During the visit I saw that there are many unknown ASSA locks / systems and I realised that in these ASSA articles I have covered only 35% of what ASSA has developed.

Because the d12 has only been on the market for a short time, there are barely anecdotes or other stories to tell about this lock. This is the reason why I investigated this lock deeply and also looked at the dimensions and the workings of some of the elements in detail. Therefore, I divided the article into the key, pins, plug and similar systems in the market.

In this article, I call the pin closest to the bow the first pin, the bottom pin is the pin in the plug and the top pin is the pin in the housing. The top ends of the top pins are near the springs, and the bottom ends of the bottom pins contact the key.

Why is Eskilstuna in Sweden special for me?

The heaviest and most secure padlock combination from my collection comes from this little place in Sweden. Maybe that is a coincidence? Heavy (and secure) then is the Anchor Las 590-6 closed shackle padlock housing in my opinion. Secure is the half-Euro profile electro-mechanical ASSA Cliq Solo in this padlock.

This lock combination is also part of my collection with the most interesting technical features in it. It is also the only padlock that I have a special case for; the Pelican 1020, were this locks fits in perfectly.

Picture 1: Pelican case 1020 and Anchor Las 590-6 (CEN 6) padlock, with ASSA Cliq Solo cylinder

At the airport this lock is always a lot of “fun”, because I carry this lock in my hand luggage, because it is too precious to get lost. This costs me 5 minutes with each flight. The point is that at the security inspection I must open this heavy small blue Pelican case, total more than 2kg (4.4 lb), because on the screen they see a black square. Then they ask, "What is this?" I answer, "It’s a padlock" Then they tell me that I am not allowed to take it into the plane. Then I answer "you are kidding", and then they say "No, we are not, this solid piece of steel you can use like a hammer and you can throw it through the plane, meanwhile damaging all kind of things. It is definitely not allowed” Then I explain my work and the goal of the lock. In 50% of the cases the Supervisor comes and when he sees the other locks he says it is ok.

Why is this one of my best padlock combinations?

The padlock is a CEN 6 padlock, the highest European grade a padlock can have. The owner / director of Anchor Las, Bo Grunander, visited my office and brought this padlock personally. He explained me the many tests they did with his padlock. I will not go into detail, but one of the tests took 2 people. There was one man who kept the lock straight up, with the keyhole side-up. Another man hit the lock with a big hammer for 15 minutes on the steel plate which keeps the cylinder in place. He said it was awful to see. In the first test of the lock, the steel plate broke. They improved the plate and in this second test the plate stayed intact. In the next picture you can see the cover plate with the ASSA Cliq cylinder behind it. When I looked at the picture on the left I thought there was a white hair in the keyway which was spoiling my picture. After looking carefully I discovered that it was the mechanical contact point for the Cliq system (see green arrow).

Picture 2a,2b and 2c: Padlock with cover plate & without + Detail of the cam in the locked position

One of the nicest things about the padlock is that even when you succeed in breaking out the cover plate, the half Euro profile cylinder stays in place and you discover that you are only halfway in. The Euro-profile cylinder you see in picture 2b is really stuck; you cannot remove it, because it is stuck behind the cam (picture 2c). Only with the key you can rotate the cam away and properly remove it.

In the next picture you see the thickness of the cover plate, 11mm. You see the Assa user key and a Programmer Key of the ASSA Cliq-system. The Programmer key looks like a bump key. The sidebar track of this Programmer key is straight (see red arrow).

Picture 3: Detail of the cover plate with some ASSA Cliq keys

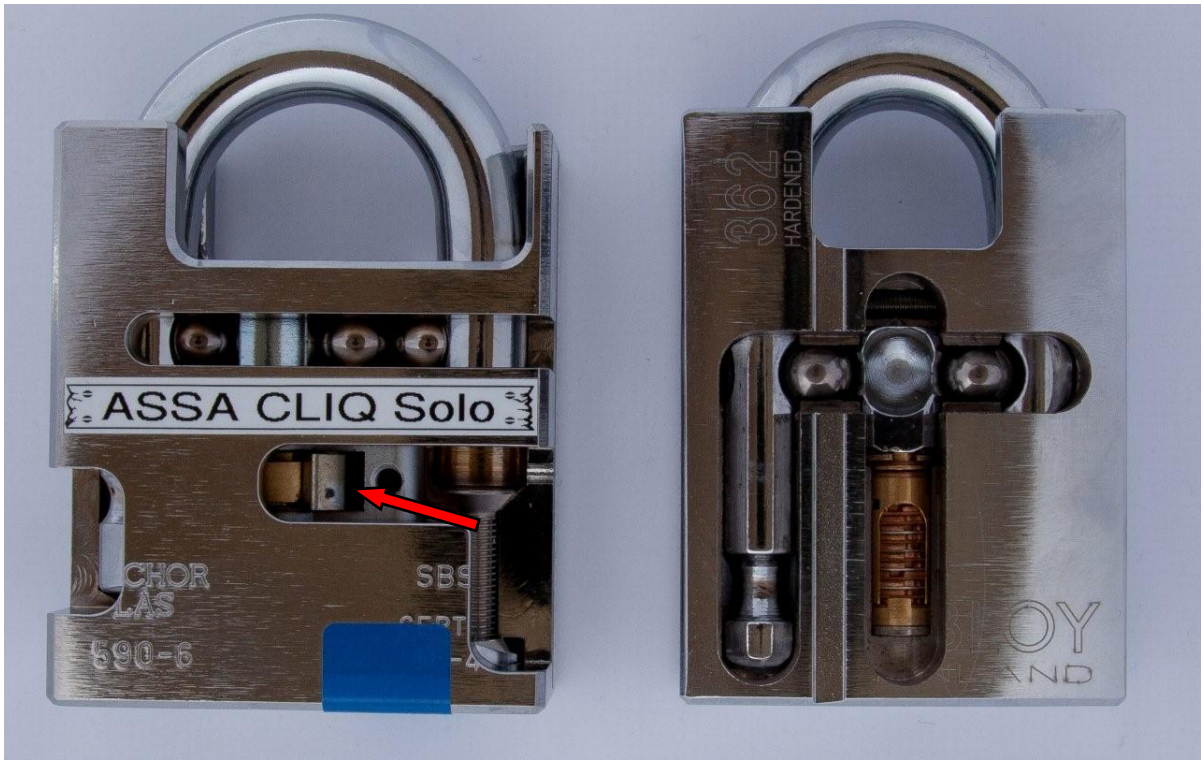
What also is clearly visible is the code number on the bow of the key. ASSA is capable to track this cylinder and find out the dealer who sold this lock. The dealer then possibly can track the owner.
I have seen several times examples of that.

Another security detail of this padlock is in the shackle and is in the “hole” for the ball-bearing. There are different grooves possible in the shackle to hold the shackle in place. This is the first shackle which I see that is protected against twisting this way. Some manufacturers like Abus use hexagonal shackles. The hexagonal shackle has also another advantage; it makes the shackle more difficult to cut with a bolt cutter. This manufacturer uses another technique. Anchor Las makes a round hole in the shackle were the ball-bearing fits in precisely. When you cut one side of the shackle and try to twist it, the shape of the hole in the shackle will prevent that. I called it Heel and Toe Plus, because the ball-bearing is caught in this hole and definitely will prevent the rotation of the shackle.

Note: During editing Julian Hardt was wondering why a hexagonal shackle was harder to cut with a bolt cutter. I asked Gerhard Meckbach from Abus to explain. At the end of the article on page 27, you will find his answer.

Picture 4a and 4b: Heel and Toe locking PLUS

In the next picture you can see the difference in size between an Anchor Las 590-6 padlock and an Abloy PL362. The shackle of both locks is 15mm.



Picture 5: Comparison in size from the Anchor Las 590-6 with the Abloy PL362
Note: The cam, which holds the cylinder in place after removing the cover plate.

The unique numbered blue seal prevents people that have temporarily access to the lock from tampering with the cylinder. I will save comments about the ASSA Cliq Solo for a future ASSA article, because this electro-mechanical lock has some very nice features.

The ASSA 700

I will not go deeply into the technique of the almost 65 year old ASSA 700. The ins and outs I have discussed already in another article. I just want to show this beautiful cutaway, which Julian Hardt specially made for me. It is a smoothly working cutaway and really all the working parts in the lock and all the pins are clearly visible.

Picture 6: ASSA 700 cutaway in locked position

In the next picture you see the cylinder with the proper key inserted. In my opinion this lock is still one of the best pin-tumbler locks I know. Personally I like very much to see clearly the variation of the pins used in this ASSA 700 lock. We got from ASSA several new parts from this system and when I compare these with the shape of the parts in the old cylinders, they look identical. So almost 64 years they hardly changed anything.

Picture 7: ASSA 700 cutaway with correct key

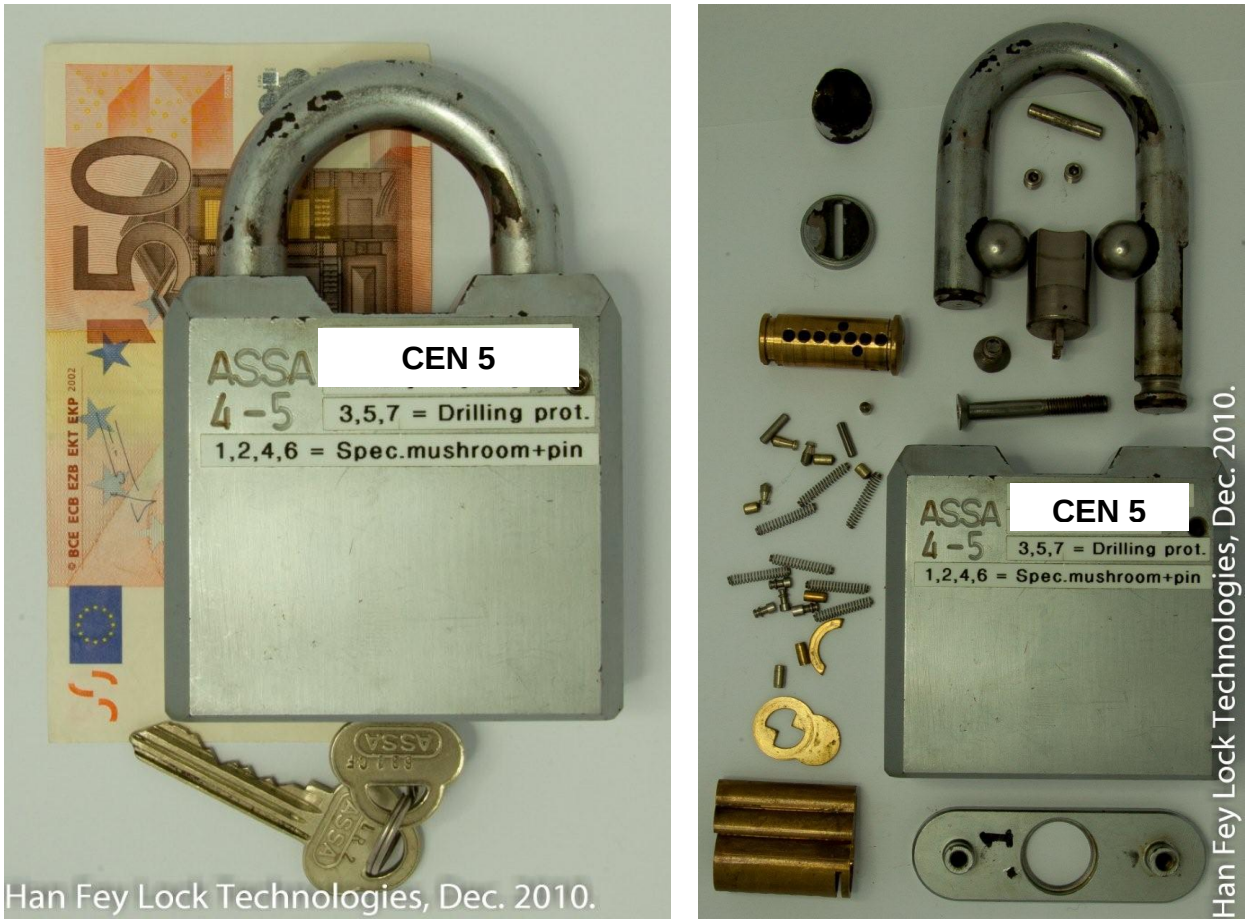
Note: In this cutaway you can see clearly how the bottom pins fit in the cuts in the key, really a marvellous cutaway.

A practical use of the old ASSA 700 lock

Bring this cylinder technique together in a solid housing and then you get this combination, the ASSA 4-5 padlock. I bought this padlock 10 years ago somewhere in Sweden. I assume it's from the 80's.

You can fully disassemble this padlock with a 2.5mm and a 3mm hex key (and the key for the lock of course). First you unscrew the Allen screw in front of the padlock. The shackle then comes loose. With a bigger hex key you unscrew the two Allen screws which are in the two holes were the shackle goes in. The cover plate will then come loose. Fully disassembled this lock consists of 40 parts. These parts are very easy to assemble again, because of several clever DFA tricks the ASSA engineers build into it. (DFA is Design For Assembly).

I really like this padlock, because of the techniques they used and the details. This made the lock in my opinion expensive to make. All these separate parts are high quality. When you look at the outside shape of the padlock, you can see that they angled all the sides of this padlock. These machined work steps cost money. In modern locks they don't do this anymore, or at least less.



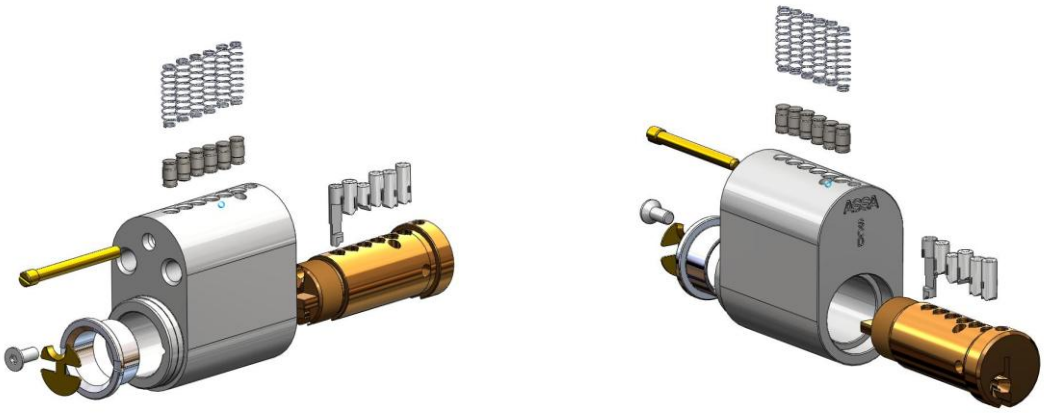
Picture 8a and 8b: Heavy ASSA 4-5 padlock with its 40 parts

Note: For my own information, I wrote on the lock the information about the pins, because they were new to me. You see I had the padlock earlier in my collection as the ASSA 700 Oval cylinder.
Note: With Adobe Photoshop I wanted to make some changes on the picture on the left. This was not possible because one or another way, the soft-ware recognized the 50 Euro bill.
I found it a strange experience that with your own software you could not make modifications to your own pictures.

This short introduction brings us to the successor of the ASSA 700 system, the ASSA d12.

ASSA d12

During our visit to ASSA we got some of these new d12 cylinders, the lock is a "medium security" product (from a Scandinavian perspective), just like the ASSA 700 and is not meant to compete with the ASSA Twin product-line, from security point of view. Before we could get / try these cylinders we had to assemble them ourselves in the production facility. After assembling them, I must say that this work was a good idea because the Swedish lady Camilla who helped us with the assembly also told us many hints and tips about the cylinder. The cylinder appears at first glance as a normal, pin-tumbler cylinder, which can be picked, impressioned or possibly bumped when you see the key. But I know that Assa engineers are clever so there should be more hidden techniques in the lock than you might think in the first moment. Further in this article I will try to describe some techniques I noticed in this lock.



Picture 9: Exploded view of the ASSA d12

It seems to be getting standard with more manufacturers to create their logos based on a stylish font or type face. We already saw some of this with the ASSA dp, and with the d12, they did the same. The “d” stands for the shape of the keyway, the 12 for the number of cuts in the key.

Picture 10: Logo of the ASSA d12, the “d” is supposed to be a stylised profile

In many other locks from the ASSA-Abloy group you also see the following logos on the bow. These are examples of the logos of Bo Widén and his companies. I know that more manufacturers use the Twin systems or other products of Bo Widén. Unfortunately I did not have keys or locks of this type in my collection.

Picture 11: Some newer and older logos of Bo Widén, I found in my collection

The logo left above I found on an ASSA Key, the logo left below on a Ruko and Schlage key and the 2 logos on the right I found on an IKON Sperwellen key. It seems that the logo right below is engraved.

The (design of the) key

The key is also special ASSA's idea was to replace a classic design key with a modern innovation, one that will soon be dangling from millions of key fobs the whole world over.

According to Stefan Lundin, Manager for New Lock Technology at ASSA, "For 63 years Sweden's most common house key has had the same appearance. Our new door locks use patented technology and security functions that were previously only available on professional products. In order to draw attention to this major change we have chosen to alter the appearance of the key itself". In connection with a major technology upgrade ASSA has chosen to change the design of the d12 key. For this the ASSA-Abloy group has Aesthetic Design Manager Perla Bovin, who worked on the design of the keybow. I did not know that ASSA-Abloy had these kind of people in their group.

The ASSA d12 has twelve profile points which, together with other new characteristics, add up to an entirely new level of security. According to Perla "it is very important that the new key communicates development and progress. There is more material in ASSA d12, the key has a soft, modern look with rounded edges and it displays the latest ASSA logo. The new key provides better grip and is easy to use." Perla also claims that because the key will be used so often by so many, user friendliness was a crucial aspect of the design. The increased amount of material also played a role here and made a trapezoid bow possible and was Perla's idea.

Picture 12: "*She designed the key to the future" picture of Perla Bovin*

When you look at the key you see that the key has double cuts in each chamber position. There are 6 chambers in this lock, so there are 12 cuts in the key. Because of the double cuts in the key, ASSA claims that there are 500.000 theoretical keys. The number of useable keys is 350.000. The standard for a high security lock is 100.000 keys. These cuts are straight across the blade and are not angled cuts. They are similar to a Medeco GMK (General Master Key) key with its angled cuts.

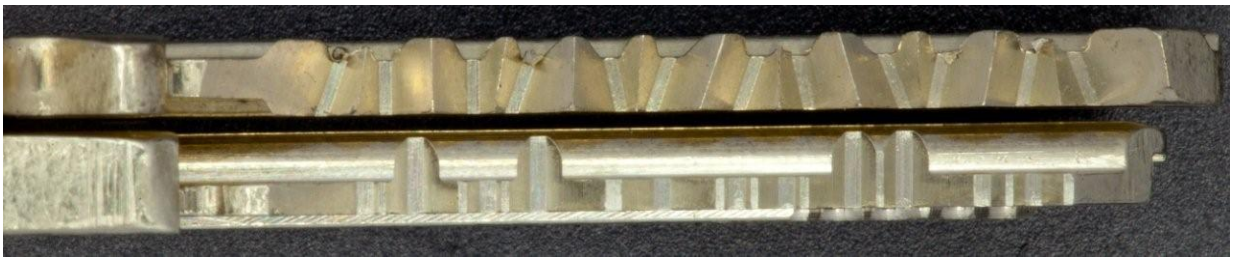
Picture 13: The new ASSA d12 key

Note:The specific d12 logo and the "Bo Widén" logo on the bow.

As I mentioned before, the d12 replaces the old and still excellent ASSA 700. As a possible nod to this old lock they have designed a combined bow. The old ASSA 700 plump apple-cheeked look bow, is still a little visible in the new d12 bow (see red arrow). These are the small details I like. The d12 in my opinion is full of these small details which protect the lock against all kinds of manipulation. This is one reason why I wrote this article.

Picture 14: Bows of the ASSA d12 (left & right) and the ASSA 700 bow (middle)
Note: The classic shape has been replaced by a rounded trapezoid bow with the old design stamped into the key as decoration.
Note: The curved shape below the logo emphasizes the brand and a smile.

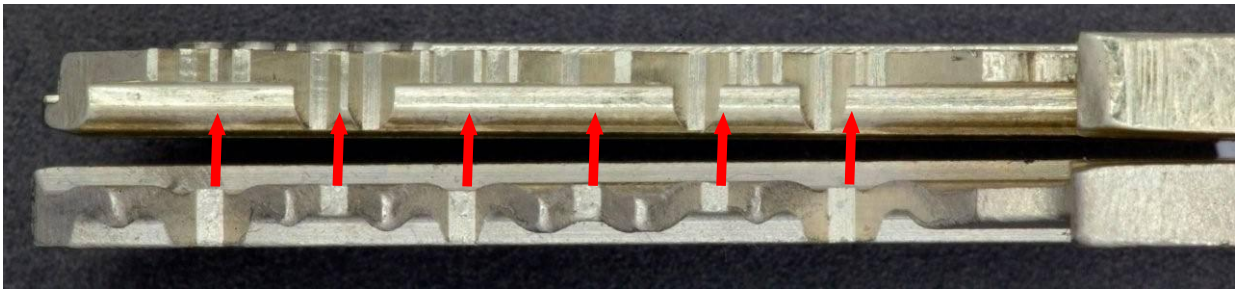
In the next picture you can see the ASSA d12 key compared with a Medeco GMK-key. The spacing is of course different from this 6-pin Medeco key. A 6-pin Medeco system can have 12 different cuts in the key. A 5-pin Medeco has a maximum of 10 different cuts in the key. I have some Medeco masterkeys and the height and angle can vary in one chamber position.



Picture 15: Top view of Medeco GMK key (top) and ASSA d12 (bottom)

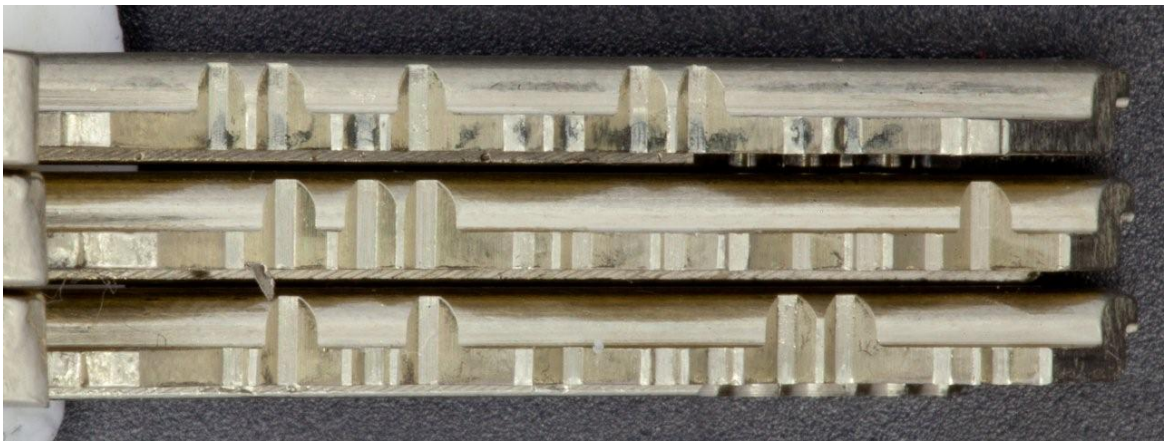
I noticed that the lock has 6 active pins. As a production engineer I was curious if they also changed the spacing from the chambers in comparison with the ASSA 600. The answer is no as you will see later. We noticed from former projects, for example DOM that when they came to the market with a new cylinder, the spacing of the pins was kept the same. This is logical, otherwise they would probably have to change the machines etc.

I noticed that with this new d12 it works the same. In the picture below you can see an ASSA 600 key, the ASSA 6-pin version, together with the new D12 key (top). You can see right away that the distances between the chambers are identical.



Picture 16: Keycuts distance between ASSA 600 (bottom) and ASSA d12 (top)
Note: I did not line up the keys exactly.

I received 3 pairs of d12 keys from ASSA. I played with the keys in the lock on the flight home and this is the reason why the track on one key is marked with black lubricant.



Picture 17: Top view of some ASSA d12 keys

Note: Here you can see clearly that all the 12 cuts are straight across the blade.

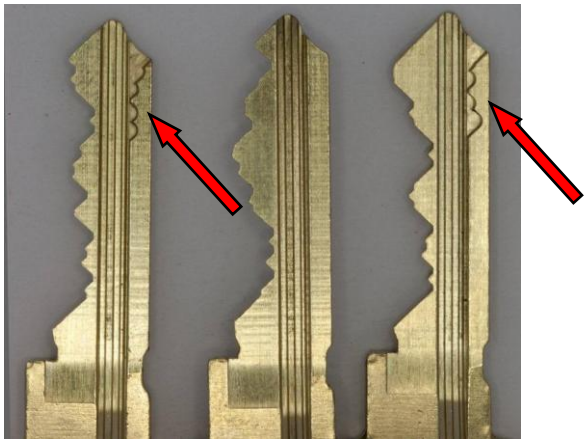
The 2 security levels

The d12 is available in 2 different security levels. In level 1 they only use the double cuts in the top of the key. In the higher level, level 2, there are also some extra cuts in the rib. In the picture below you can see the “3 “ possible keys you can get with the lock.

Picture 18: Level 1, level 2 keys and plastic ”keycard” to obtain level 2 keys

The key with the code “EPGYRE” is a lower level key. There are only pins in the lock, which have to be set by the upper profile cuts in the key. The code consists only of alpha characters.
The second key with the code “1249093” is the higher level key. If you look at the tip of the key you can see some extra grooves. These grooves are steering special longer pins we will discuss later. The blue plastic key comes with the d12, level 2 key. Only with these plastic blue keys you can get copies of the key. This code consists of only numbers.

In the next picture you can see some more details in the difference between the level 1 and the level 2 systems.



Picture 19: Level 1 (middle) and level 2 tips of the ASSA d12 keys (red arrows)

I tried to insert a level 1 key in a level 2 lock. It did not work, because the tip stops against the extended pin. This allows you to easily determine where the extended pin is located. The coding also identifies in which position it is. The “2” in the code “2AJJFDD” says that the extended pin is in the last position. The 2AJFDD code is an internal code and is the coding of the pins which are used.

Picture 20: The level 1 key does not go all the way into a level 2 cylinder

The bottom pins

First question I asked when I noticed the cuts on the key is if the pins rotate or if the pins are just not allowed to rotate. In a Medeco cylinder the pins must rotate a certain angle (20°) to get positioned properly and in a DOM IX-10 cylinder the pins are not allowed to rotate (see my DOM-IX article)
I noticed that the pins in this lock were not allowed to rotate for proper function. So what is the use of the many grooves in this key was my remaining thought.

When I disassembled the lock I saw how it worked. Each bottom or plug pin can have a variation at the end of the pin that contacts the key. The idea is that these pins should fall in the matching grooves or bittings on the upper edge of the key.

Picture 21: Some ASSA d12 bottom pins

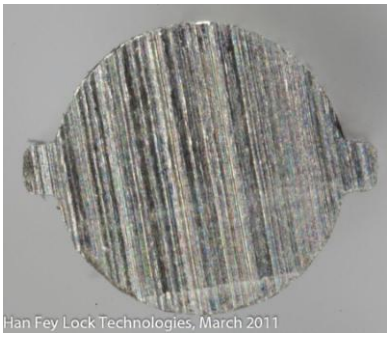
I noticed that there were 3 different “Contact Profiles”. The “CP” from the pin on the left is symmetrical. When you twist this pin, it stays the same. The pin in the middle has a longer edge on the left side. This pin will probably rest on the longer edge of the pin is my idea. Julian Hardt pointed me if that should be the case, then they wouldn’t need this design. I have the feeling one or another way he is right, but I did not have enough cylinders to check this actually.

When you twist this pin, you get a different pin. The pin on the right has a very long stretched out edge. When you twist this one, you have also another pin. This means in my opinion that there are 5 different “Contact Profiles” for the short bottom pins. I only had 2 locks, so I am not sure about this.

The two pins on the right have a “Fore” or “Aft” function, just like with Medeco. But they are not free to rotate in the cylinder. On the left pin the Fore and Aft is the same and this symmetrical pin you can compare with a Medeco center pin. When you take another close look at the pins, you see that they each have two wings at the side of the pin. These wings prevent the rotation of the pins. The length and the position of these wings are different in all the pins. Later I will discuss the reason for that. The German lock manufacturer Wilka used similar bottom pins with wings to prevent rotation in their high security locks 15 years ago. These pins had angled contact points with the key. These angled cuts in the key were for key copy protection.

How to produce these pins?

These wings are a technical challenge to produce, because how do you economically make billions of these pins with these wings and specific tips. The trick is that the raw material they use to fabricate these pins already has these wings along the side.



Picture 22: View on the raw material of the pins

The extended bottom pins

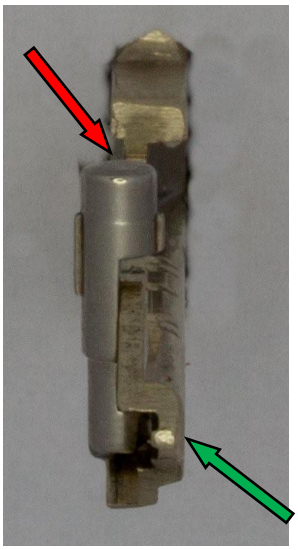
During the assembly I got a set of keys with the code number 2446987. Camilla typed in this code and she wrote on a paper “w1bLDA” she said these are the pins you must assemble in the lock. The lowercase “w” stands for the fact that you must assemble this pin with the longer tip of the pin to the front. If there is an uppercase “W” you must assemble the pins with the longer tip of the pin to the back. So these pins could be used in two different ways as I mentioned before. In the box there were the shorter pins A,B,D,E,F,H,J,L,N,R,U,T and W. So there are 13 different pins. Some of these pins you could twist 180° so you then maybe could create 18 different pins. The fact that characters are missing in this line, means that there are more different pins, which are possibly for government or other special applications.

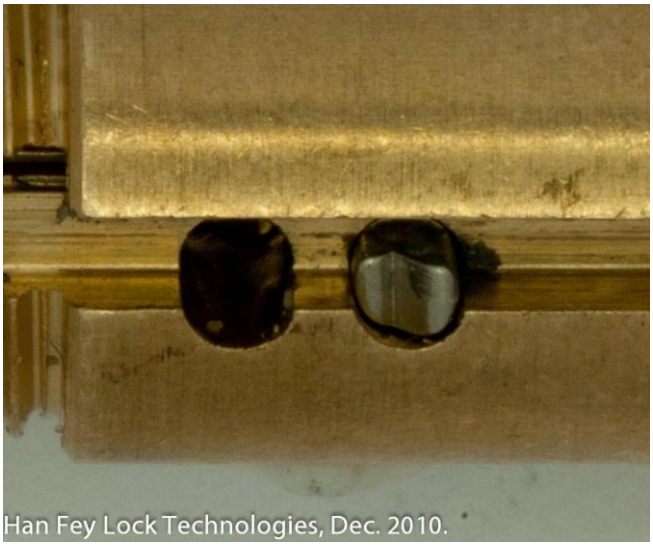
In the pinning kit we also saw pins with the number 1, 2, 3 and 4. It seems that these pins were the pins which interact with the cuts in the ribs of the key. These pins could not be flipped around, because the cuts in the rib were only on one side. The fact that the number “1” is located in the second position of the code means that this longer pin is in the 5th chamber (2nd chamber in ASSA nomenclature).

In the other code I had “2AJFDD” here the number is located in the first position. This means that the longer pin is in the 6th position (1st chamber position in ASSA nomenclature). The cuts in position 5 or 6 on the upper edge of the key are disguising / fake with this key. They have no function in a level 2 lock, but in more complex systems a level 2 key can operate a level 1 lock.

Picture 23: The longer bottom pins, with coding 1, 2, 3 or 4

Note: These longer pins are only used in the 5th and 6th position in the lock (1st or 2nd in the ASSA nomenclature).

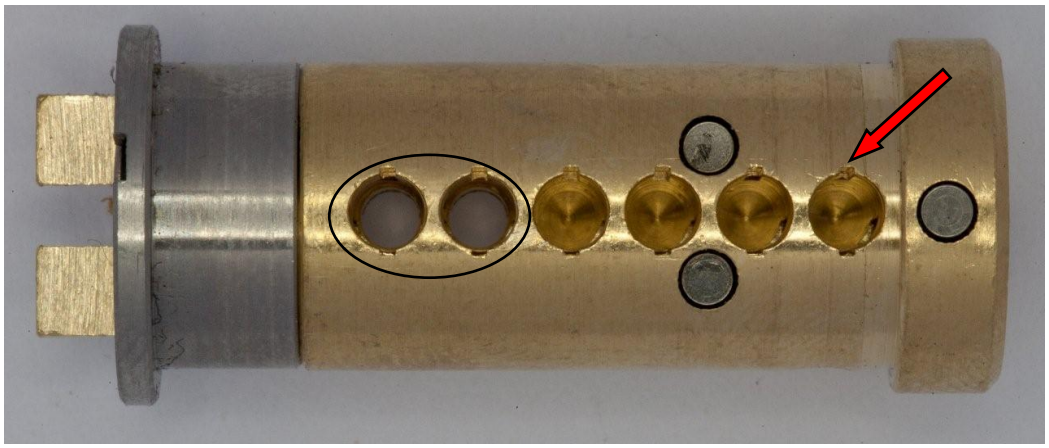




Picture 24a and 24b: The longer bottom pins with the key.

Note: On the left picture you can see the tip of the key (green arrow), with the longer bottom pin (red arrow)

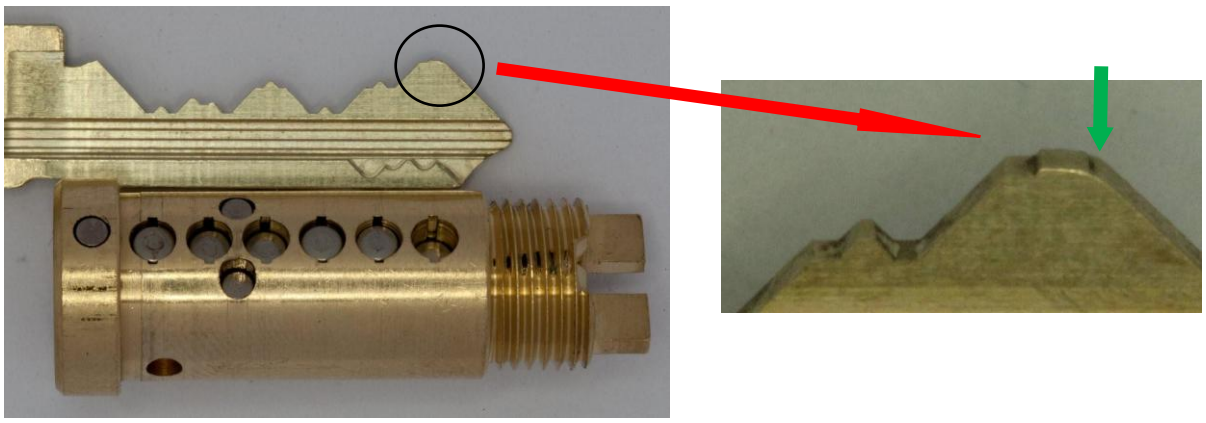
After removing the plug I noticed the next things. The holes in position 5 and 6 were fully drilled through (see oval) as expected. The positions 1 through 4 looked normal. If you look closely at the chambers, you see the grooves for the wings of the bottom pins. It is also nice to see the drilling protection.



Picture 25: The plug without pins

The chambers in the plug in combination with the bottom pins

This key matches with the pins in the lock. What I noticed is that the depth of the pins in the plug with the key removed does not correspond with the cuts in the key. Reason for that is that the bottom pins rest on the bottom of the wings.



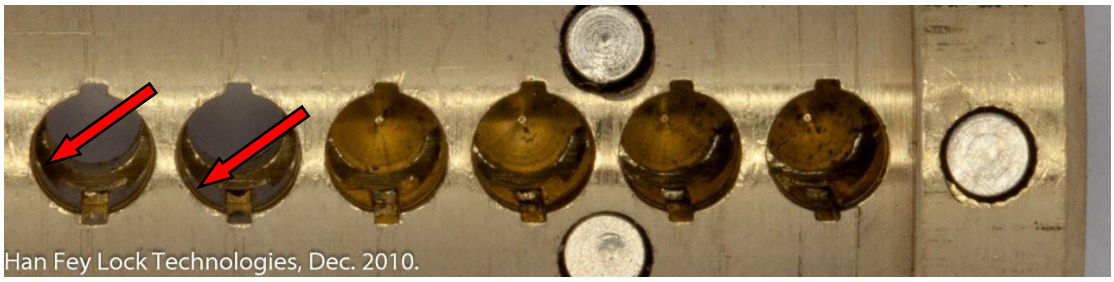
Picture 26a and 26b: Pins in the plug in the locking position and detail of the tip
Note: The pins do not rest on the bottom of the chamber. Reason to look further.

I tried to measure the length and the depth of the cuts in the key, to make an estimation of the bottom pins used in combination with the contact points. Suddenly I saw the next small detail.
The big variations in heights in one chamber I could easily see with my bare eyes, when I started measuring with a caliper I noticed the next thing. In the last chamber position you can see how minimal the variation in key cuts can be (see the black circle). When you see this key with the naked eye it just looks like one big top, when you look closer you can see that this position exists of 2 different heights. When I assembled the lock with the pin in the wrong rotation position, it fell a little deeper in the plug in comparison with the pin in the good rotation position. Still the plug rotated. Julian Hardt helped me on this and I had to look further into this situation. It seems that the contact point of the pin in the other twisted position rests on the slope of the tip of the key (see green arrow). They made the last cut on the key shallower, otherwise it would interfere with the slope in the pin.

These are the details, which show me that the designers of this lock have spent a lot of time in designing this lock.

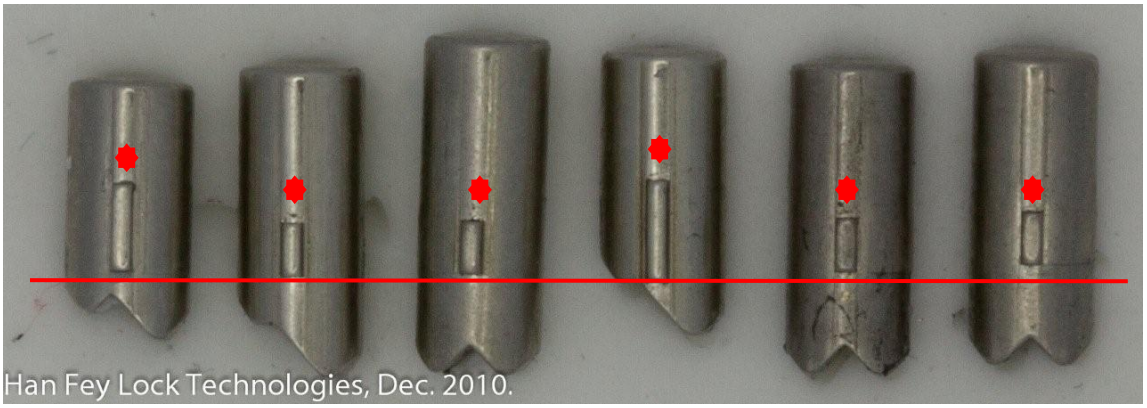
The Plug

The developers wanted to close the keyway / chambers as much as possible for manipulation tools. Therefore they did not mill the grooves for the wings all the way through. When you look properly in the holes of the chamber in picture 27 and picture 29, you can see the serration on top of the chamber (Pol und Gegenpol, Heinz Pickhaus)



Picture 27: The top of the plug

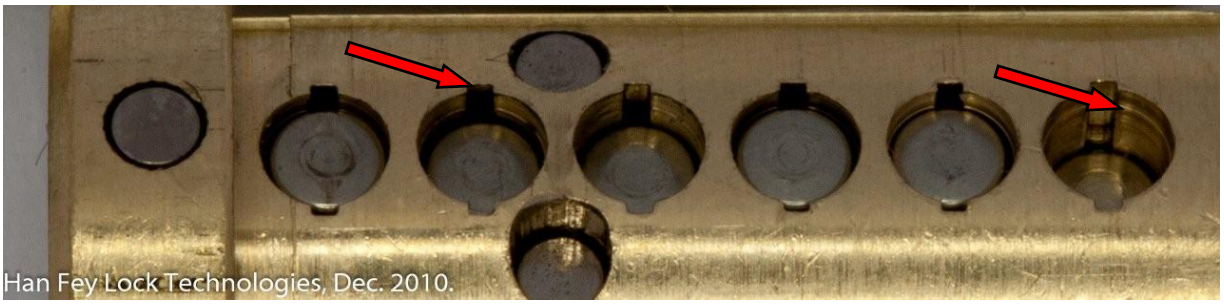
Not totally cutting through the grooves has also another advantage, it creates a jumping bottom line on the bottom of the bottom pins as you can see. This is a good protection against bumping and pick guns. In the next picture you can see this. The German manufacturer CES is doing the same in their VA and VB series. The red mark ✸ marks the highest position the pin can move upwards, otherwise the top of the wing comes out of the plug. This is a protection against over lifting.



Picture 28: The bottom pins aligned on height of the wing

Note: The red line marks the position were the wings rest in the plug.

This creates the variation in heights on top of the bottoms pins in the locked position. The pins have to be pushed up less, in comparison with the pins in an ordinary cylinder, to make the correct shearline. This is different than other locks, but I am not yet sure if this is good or bad.



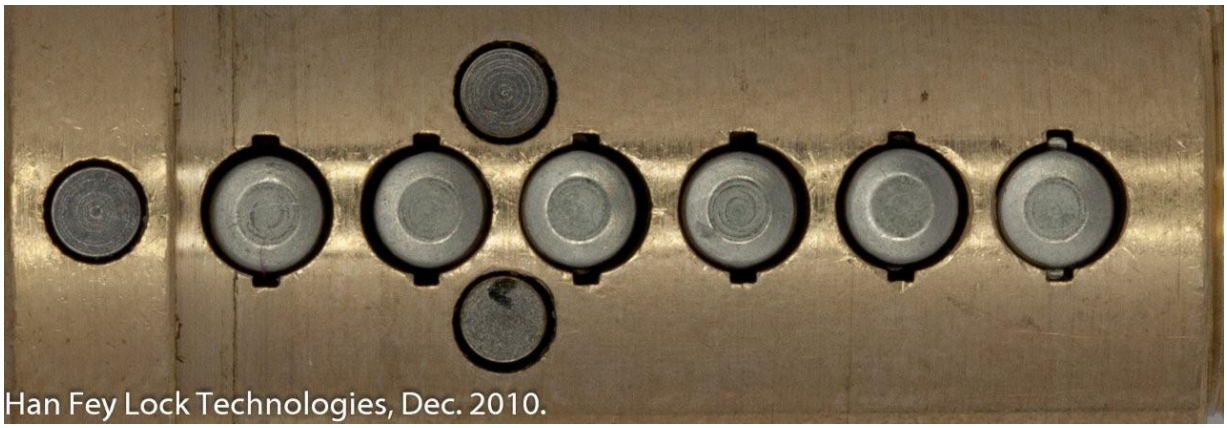
Picture 29: The shearline in the locked position

Note: The bottom pins are not falling in deeply. You can see clearly the tracks in the chambers for the wings in picture 29. You can imagine that if the drilling hole in the housing is only round and does not have these extra grooves (see arrows), you cannot push the bottom pin out of the plug. These wings have also another advantage. When you mill a hole with a Milwaukee (a portable milling machine) just like locksmiths do in Europe under the plug, the bottom pins probably will get stuck.

The pins in combination with the different diameters of the chambers

With a simple caliper I measured the diameters of the pins and the chambers. I noticed that the pins were around 2.85mm. The holes in the plug were 3.0mm and the holes in the housing were 3.1mm. I assumed that they used this variation to increase the resistance against bumping. The pins and especially the top pin with the grooves on the bottom and top will move from the left to the right in the chamber and that way loose impulse energy.

On the next picture you can see the pins, lifted to the shearline. You can now see clearly the space between the wall of the chambers and the pins. This is the second European manufacturer where I notice that they “copy” the cheap Chinese tolerances as a protection against bumping and picking. The fact that there is play of the pins in the chambers does not mean that these parts are produced with wider tolerances. This play just offers extra protection against certain manipulation methods.



Picture 30: Top of the plug with correct key

Note: the play around the pins in the chamber.

You easily can check this play, by inserting the key with the tip in the lock and then notice the play of the plug CW and CCW.

Another funny element is that it also offers resistance against lock picking. The idea is that if you try to insert the key and put little tension on it, it will get stuck, because the angled, serrated top pin will hook in the chamber. In normal pin-tumblers the way of the pin is straight. In this ASSA d12 lock the plug can be rotated a little and therefore the movement of the pin is not straight anymore, because the chambers of the housing and plug are not evenly aligned anymore. It’s a technique I have never seen before, but it reminds me of the Lips / Ikon cylinder from 2003.

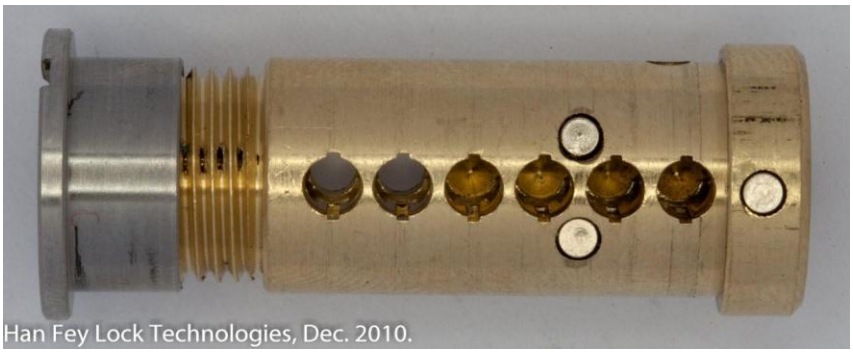
The Lips / Ikon cylinder is actually the start of Barry Wels and me in the lock manufacturer world. In 2002 we discovered a trick to open this lock. We contacted the manufacturer Lips and demonstrated this flaw. They repaired it right away and the lock is now secure.

We also got a golden tour through their factory and I got some interesting locks to add to my collection.

Picture 31a and 31b: Lips / Ikon 8062 cylinder from 2003

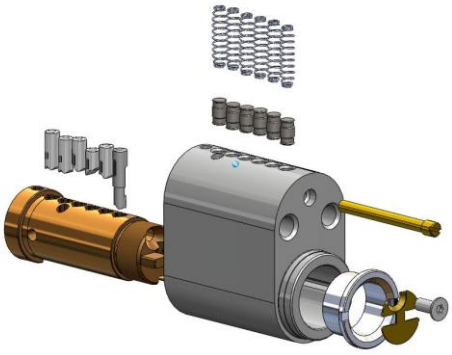
The core pull-protection.

When I first got the d12 plug in my hand, I noticed the steel clip on the end. In fact it is not a clip, but it was a nut. They screw the “nut“ on the tip of the plug and then the nut will hold the plug in place in the Scandinavian Oval cylinder. The nut is fixed with an axial screw. This nut is a new kind of core pull protection. In my opinion, it looks very effective. I did not see Euro profile cylinders in the factory yet. Curious if they also will have this protection.



Picture 32: The plug with the nut as an efficient Core pull-protection

In the next picture you see how they prevent rotation of the steel nut with a Torx screw.



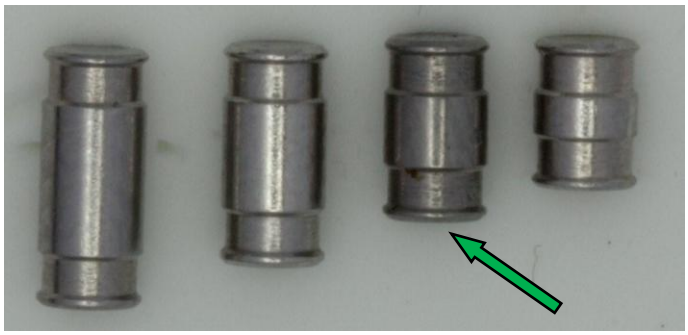
Picture 33: The plug with the nut as an efficient Core pull-protection

The one size top pins

When we were almost finished assembling the lock in the factory we had to put in the top pins. Camilla said we were only going to use the pin #B (5mm) length top pins. We first thought this is not good. With the straight keyway, you could easily push in the pins in the chamber of the housing and measure the length. This distance of pushing in the pin could give an idea then of the length of the bottom pin. This way the lock could be easily decoded. Fact is, that if you could measure the length of the pin, you also have to determine if it has the chisel shape, Fore or Aft or if it is a symmetrical pin. All these questions make it, in my opinion, very hard to make a matching key. Maybe it is an idea to make a key with the flat surface cuts, like EVVA is doing? I personally think you will eventually get problems with the MAC.

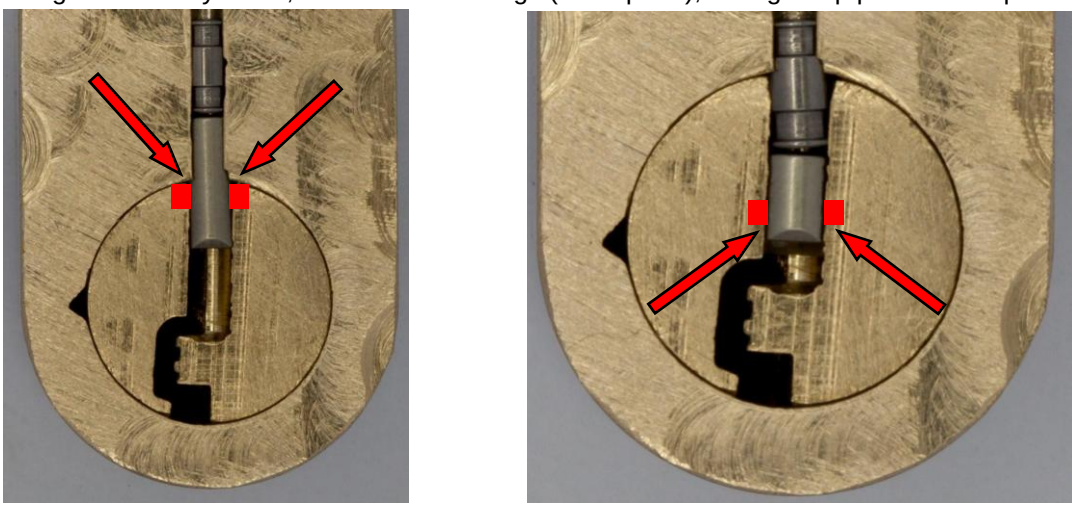
In the picture below, you can see the different top pins that ASSA uses in their various Twin systems. The lengths of these pins are 7mm (pin #D), 6mm (pin #C), 5mm (pin #B) and 4 mm (pin #A). In the d12 locks they only use the pin #B.

Later I realised they did not have to be afraid of over lifting attacks and pin measuring attacks, because of the wings in the bottom pins. The chambers in the housing do not have these extra grooves. So you can lift the pins up only until the top of the wing contacts the shell, and then you cannot push the pins further out of the plug.



Picture 34: Some used Top pins in ASSA locks

In the next picture, on the left you can see how I tried to push a bottom pin fully up. This is the perspective I learned from Peter Field. Of course it is not yet as good as Peter is doing it, but I wanted to try it.
The wings in the bottom pins prevented me from pushing this pin any further (red square). This also works the other way around. I took the shortest pin with the standard top pin. Because the bottom pin does not go all the way down, because of its wings (red square), a longer top pin is not required.

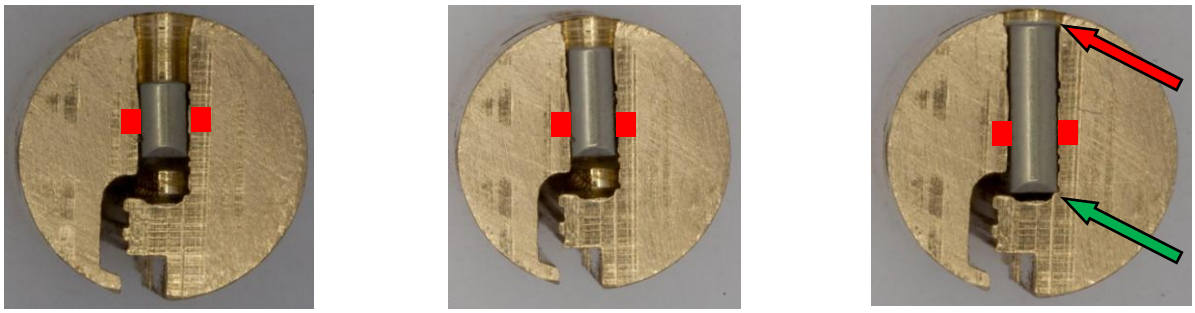


Picture 35a and 35b: A high lifted pin and a short pin.

Note: The red squares are the right and the left wing on the bottom pin
Note: The red arrows mark the positions were the bottom pin rests on the wings.
Note: The rotation of the plug is slightly turned, because of the play in the diameters

A special front view at the rib in the plug and the wings in the pins.

In the next picture you can see some different length bottom pins in the plug again, but now in another perspective.



Picture 36a, 36b and 36c: Different "shielding" positions of the bottom pins

Note: The red squares are the right and the left wing on the bottom pin
Note: The height and position of these wings can vary

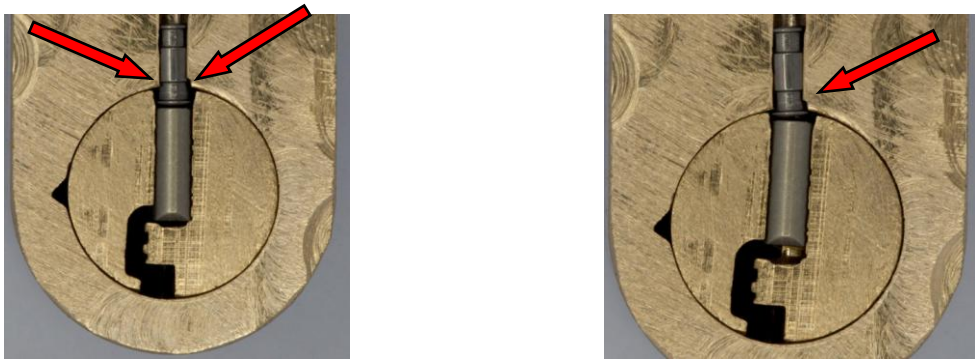
The pin on the left is the shortest bottom pin they use. The pin on the right is the longest pin. The pins will not fall all the way down, because of the wings on the side of the pins. The pin simply rests on the bottom of the wing. This picture shows also why a pin #B is sufficient for locking the plug.
The strangest thing I saw in this picture is that the longest pin does not totally "close" the keyway. You can lift up the longest pin in the right picture a little (red arrow) and then you create some space for pick tools. I did not test it, but it is just an idea. I think however that it will be hard to lift the pin on the left (short pin), when the pin on the right (longest) is in front of it. The 90°angled shape of the keyway, because of the strategically placed overlapping rib, makes it also very hard to push in the pins from the side. Time will tell.

The function / working of the tilting top pins

With the diameter play in this lock, I discovered that these pins have a whole new working dimension. In the next pictures I will try to explain that. On the left picture you see the lock in the locked position with a long pin. I especially used a long pin; because I know out of experience that most anti-manipulation features in locks do not always work if there is a long bottom pin in the chamber.
The plug has a big play when putting tension on it, like a lock picker would do. If the pin is lifted now, most people would expect that it should get stuck in the serration of the plug (see red arrow), just like I did. Strange enough, but this doesn't happen. Maybe in the older types of ASSA Twin, but not in this type I noticed. When I take a top pin and move it in the chamber of the plug, I do not feel resistance, but when I try to insert a key and I put tension on it, I feel resistance.

Where does this resistance come from ....

I cut the front away from an Oval cylinder and looked at what happens in the cylinder.
Because of the variation of the diameters of the chambers, we already noticed that we then get a play on the plug. The top pin tilts in the chamber as you can see in the right picture. The right lower side of this pin now gets stuck at the position of the red arrow when you push the bottom pin up. You simply cannot push the bottom pin any further up. This way the lock pick security in this lock works in my opinion.

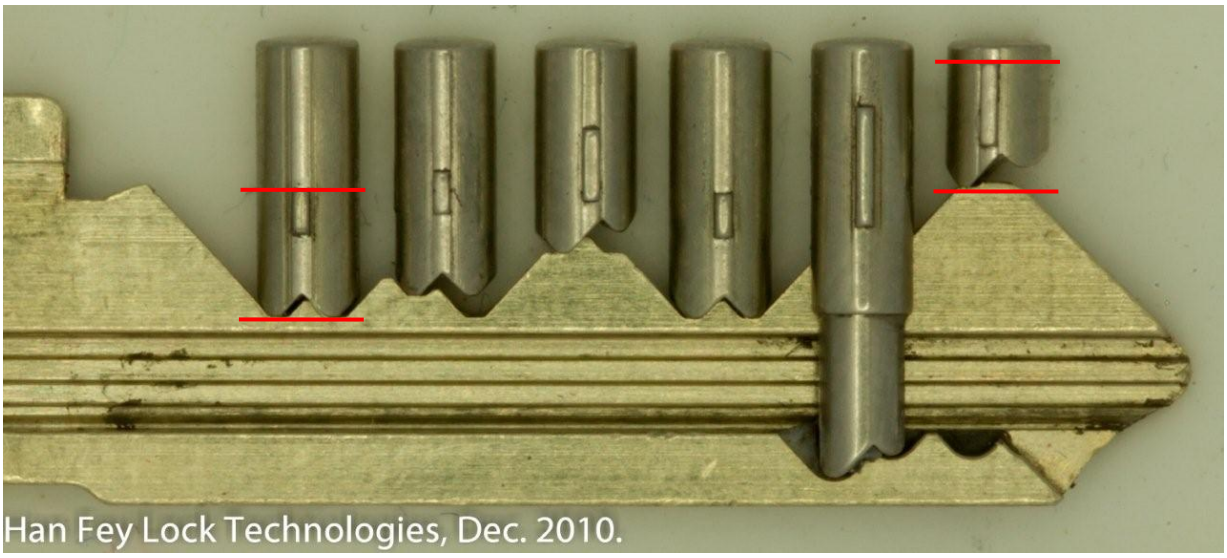


Picture 37a and 37b: Plug in locked position and tilting top pin in the housing

Of course I asked myself, am I right concerning this, and therefore I tried the next small trick. You come with a blank or a key with a high top on the tip. You insert this tip in the keyway and give it a little tension CW or CCW. Then you push the key in. The key will get stuck now and you cannot push the key further (Red arrow situation). You release a little bit tension and push again, now you can push in the key a little further in the keyway and you feel resistance. This means that you slide the small part from the bottom of the top pin over the start of the chamber in the housing. That is the resistance. The click means that the pin has slipped over the barrier from the chamber in the housing. You have set this first pin now. I assume lock pickers also know this feeling ;-)

The essence of the bottom pins with the key

The total essence of this lock you can see in the next picture. You can see that the wings are positioned on different heights. This way you cannot lift the pin into the housing. The plug has these extra grooves; the housing does not have these extra grooves.



Picture 38: The essence of the bottom pins

Daniel told me a nice detail that the distance between the top of the wing, to the longest tip is always the same (red lines). This means when you try to over lift the pins you always push in the pins the same height.

Making masterkeys from the system?

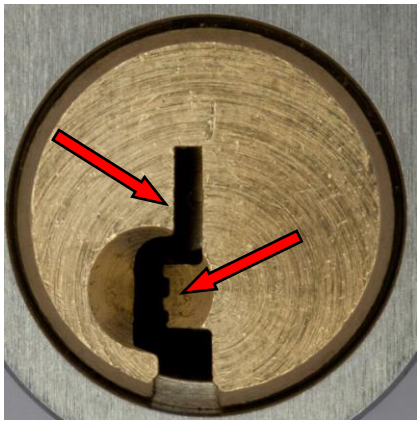
In the past we learned some tricks to make a master key, when you fully disassemble some locks from the system. With this attack you can make some keys and then you may be able to determine the Master key. If a lock for example has 5 pins and 3 master pins in certain positions you know that there are 8 (2^3) possible keys which will open the lock. One of these keys will then be the master key.

I did not see a Master key system of this system yet, but If you should disassemble this ASSA d12 lock and find 3 master pins in it, you know that there are also possibly 7 different sub-keys, but now you do not know which contact points on the pins are used. This way this type of lock is possibly protected against this attack. Theoretical this might be right, practically I do not know yet. The future will tell.

The keyway

As far as I know there is now available only one keyway profile from this ASSA d12 type. I assume that they can vary the small ribs later in the keyway or add extra ribs in the vertical part of the keyway, just like they do in the Twin Exclusive keyways. This way they can create more keyways for the d12 system. Maybe they later will totally mirror it so that you get the b-profile. Abus and Cisa are doing this as we will see later.

What you see is that the keyway is paracentric and straight. In comparison to EVVA they do not make that many ribs in the keyway. Therefore the keyway looks in first instance like a Viro keyway, a popular lock chosen by sport lock pickers because in the straight keyway you easily can insert pick tools.



Picture 39: ASSA d12 keyway (d-shaped)

It is strange that they call the system d12, of course I understand, because of the d-shape keyway. In European style it could also be the p12 or q12, because the pins are down. In America you could call this "new" keyway also b12, because here the pins are up.

Picture 40a, 40b and 40c: Some other possible "future" ASSA keyways, b (American style) , p and q?

The keyway is designed by Bo Widén and Daniel Andersson (the main developers of this system). I assume they designed this keyway so that it should be hard to insert pick tools in it. The keyway has therefore a shielding rib. The idea is that if the first pin in the lock is for example a long pin it is then hard to touch the pins behind this pin with a lock pick. This long pin acts as a shield in the keyway protecting against picks and other manipulation tools.

Some funny wires and another clever detail of the keyway.

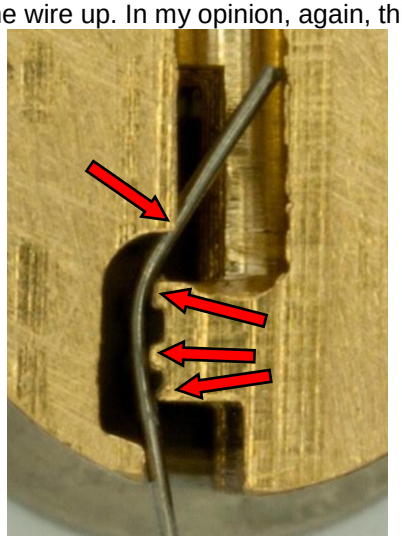
My daughter Anne,13 years old, goes to the orthodontist because she has braces. Sometimes I go with her to see what these people are doing for their money. After visiting this institute for several times I noticed that they sometimes replaced the steel wires from the braces with another thickness of this steel wire. I asked “Ploontje” an assistant-orthodontist for some used wires. Most funny about this material was that it has different thicknesses from 0.35mm till 0.60mm. So much thinner than a paperclip of 0.9mm and also more flexible. It was a kind of memory metal. When you bend it, it comes back in the original shape. I asked “Ploontje” if she could collect some of these used wires for me, and she did. Next time I visited the orthodontist I got a box full of wires in alcohol. Especially the fact that she gave them in alcohol I liked.

I was really happy with these wires and she could not understand why I could be that happy with it. I explained what I did and I must say that I already opened some locks with these wires.

Picture 41: The memory wires from the braces in alcohol

Note: When you look properly you can see that most of them are horse-shoe angled

I also looked if I could use some of the wires in the d12 lock and I discovered another security feature in the lock and then especially in the keyway. I tried to push up the bottom pins with one of these wires. What I noticed was a big resistance when I tried to push the wire higher in the chamber of the lock. I saw also the reason for that. It was the 3 ribs in combination with the 90° angle which cause a lot of friction when you try to push the wire up. In my opinion, again, this is no coincidence.



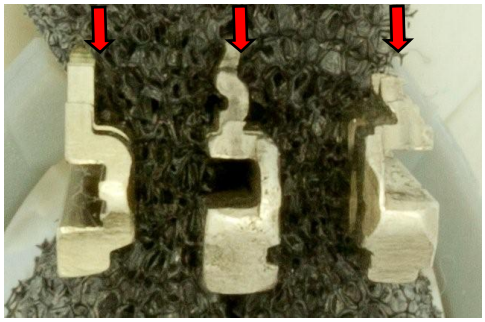
Picture 42: Detail of the keyway with the ”anti-slip” ribs and the 0.45mm wire.

The ribs (red arrows) are there in my opinion to make the keyway more narrow and to give more friction when you insert a wire or something similar. It looks a like an anti-slip rib.

Look-alike keyways => The Vachette

Where have I seen this type of special keyway before? What other manufacturer tries to shield of the pins deeper in the lock, with standard bottom pins which are located in the front of the lock?
Then I thought of Vachette, the V10 and the V.I.P. The keyway is practically the same, only Vachette uses several different keyways and they have a lot of different dimple holes in the side of the key.

In the front view of the keys, you can see that the d12 profile is much more off the center, than the 2 different Vachette tips. This is possible due to the use of the chisel tip pins. The red arrows in the next picture mark the positions of the bottom pins in the plug.

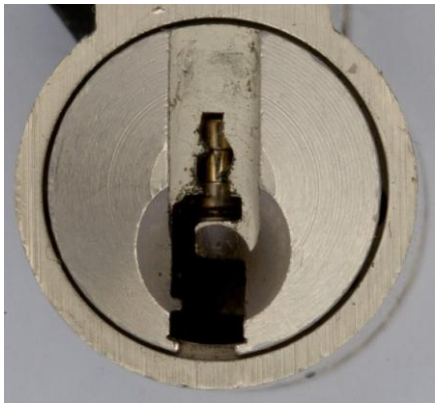


Picture 48a (left): Bow of the older V10 and the new V.I.P
Picture 48b (right): Front view key d12, V10 / V.I.P and another V.I.P profile

Picture 49: Older Vachette V10 key

Note: The same V10 key is also used in my Assa Twin article part 1.

In picture 50 you can see the front of the V.I.P keyway. When you look in the keyway you see that the first pin is strange serrated. I did not investigate this yet.



Picture 50a and 50b: Detail of Vachette V.I.P keyway

I found another V.I.P key in my collection. It seems that this keyway was identical to the Vachette V10 key in the middle in picture 48b. The many dimple holes in the side of the two different keys also were in the same positions.

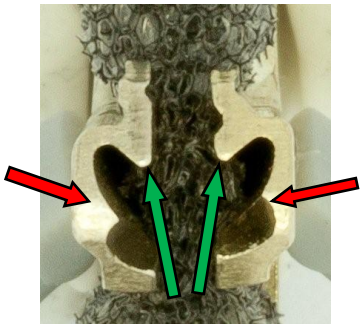
When you look closely into the keyway, you see a nasty first pin. I did not investigate this pin yet, but I know the French sometimes have good ideas. When you look closely in the keyway of this Vachette, you see also some of the side pins.

Look-alike keyways => The ABUS TS5000 and the Cisa TSP

In the Abus TS5000 (TS stands for Top Security) and the CISA TSP (Top Security Profile), Abus and Cisa use similar tricks to close their keyway against pick tools. The TS5000 has 6 active pins and several in-active and active side pins which are controlled by the dimple holes in the side of the key. The XP1 has 6 active pins and is an ordinary pin-tumbler. With the TS5000, Abus claims that they can make more than 7.000.000 key variations. I once visited an Cisa dealer in Belgium who had several different key profiles he said. With this he meant that he had keys with different dimple holes configurations on both sides of the key.

Picture 51a and 51b: Keyway Abus TS5000/XP1, Cisa TSP / ABUS GMK-profile

In the next picture you can see the ABUS TS5000 key and the CISA TSP key from the front. You see clearly the undercut in the keys. This undercut weakens the key, when a bottom pin is too long. The cut in the key goes all the way through the rib, picture 53b(red arrow). When you have the combination deep cut and dimple hole on the side of the key on the same height, you get a very weak key. The part with the red arrow, picture 52 is also partially cut away if there is a dimple hole on that position. The first types of Abus had these deep cuts in combination with the dimple holes. This resulted in many broken keys, because you got a weak key. This is the reason why Abus skipped the deepest cut, to get a sturdier key.



Picture 52: Front view of Abus TS5000 key and Cisa TSP / ABUS GMK

Note: GMK stand for Grand Master Key system

In the next picture you see the deepest cut in the 4th position (red arrow). This cut is so deep that it fully shields the 5th and the 6th pin in the lock. The cut in the first generation Abus TS5000 locks is so deep that it cuts through the rib, so that you get a hole in the key (red arrow). With the extra dimple hole on the side in the key (green arrow) you get a very weak key. So Abus skipped the deepest cuts in their second generation locks, I do not know if they jeopardised the patent protection with this move.

Picture 53a and 53b: Abus TS5000 key with deep cut

Note: I bought this first generation Abus cylinder right away after introduction therefore I have one with a hole in the rib, in my collection ;-)

A theoretical and practical approach on picking the Assa versus the Cisa / Abus

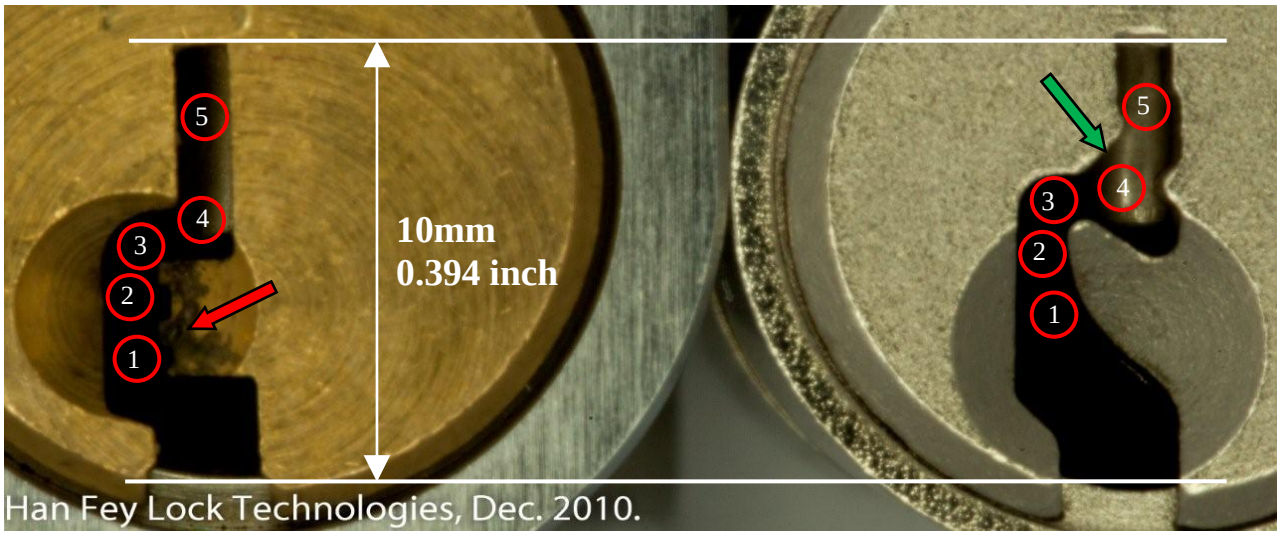
The first person who picked the Abus XP1 was the dentist and World lock pick champion Manfred Bölker in the year 1992. He used this lock in the German competition were other people also had to pick this lock. The Abus XP1 is having the same keyway as the Abus TS5000, but has no active elements on both sides. It was a two-stage rocket, because a few years later I saw Julian Hardt picking the Abus TS5000. Julian is one of the lock pickers, just like Manfred, who first use their brains, before they start picking. I sometimes use my brain, but then I do not start picking. The first time I saw this keyway I was impressed and thought that it could not be picked. The before mentioned two "lock pick champions" from the SSDeV succeeded.

As I said before, I am not a lock picker, but try to analyze a lock and out of the used techniques that I see, I try to find a theoretical attack. Initially I thought the lock was impossible / difficult to pick but also lock pick champion Arthur Meister demonstrated that is was in fact not hard to pick. Nevertheless, I see it as a learning curve and it improves my way of looking more practically at locks.

I spoke with Manfred about the practical approach about picking the Abus XP1 lock and he told me in detail how he picked the lock. First he wanted to open the lock with a pick-gun. Therefore he modified the needle of the gun till a thickness of 1.5mm. This did not work because this was still too thick and if there was a pin 6 (longest bottom pin) in the lock, this pin was already lifted out of the plug. So he started to concentrate on picking.

For this he modified an HPC2000 normal hook / finger. He filed down some parts of the shaft and the tip so that it could go properly into the keyway all the way. He specially pointed out to me that it should be a used HPC2000 tool, because after use the tool could resist more torsion. With a new tool and another brand of tool it did not work he told me. These Germans are very thorough in testing things and they are a source of very good ideas.

He discovered that in the first chamber positions of the lock, there mostly was not a long pin, because the key was then to fragile. The chamber positions 1, 2 or 3 he picked the ordinary way. The pins deeper in the lock were the challenge he said. For this he used the before mentioned modified "hook / finger". He inserted the pick tool at circle position 1, 2 in the picture, with the tip upwards. Then he went with this tool in the deep to the 4,5 or 6th chamber position, so deep in the lock. Then he moved the tool upwards till circle position 3 and he rotated the tool and maneuvered the tip of the tool between the rib and the bottom of the bottom pin.
Circle position 3 was the turning point of his tool. This way he tried to set that specific pin. And so he went on to the next pin etc. Working this way requires a tool that twist a little bit, therefore the used HPC2000 pick. He also told some tricks to by-pass the mushrooms in the lock.



Picture 54: Detailed picture of ASSA d12 keyway and Abus TS5000 keyway

Note: The circles all have the same diameter, this to show the possible space in the keyway.
Note: Some dirt / oil get in the ribs of the key. When you insert the key then in the lock, the ribs in the keyway will clean the key. You can see the dirt on the ribs (red arrow).

I also asked Manfred what to do if there is a long pin and after that comes right away a short pin. He said, that you use the before mentioned technique with going in with your pick at circle position 1 or 2 and then manoeuvre the tool to the right chamber position. He said, it takes some time but in the end it will work. If there is a long pin in a certain position and you have probed it, do not touch it was also his advice. This all looks simple, but we must not forget that Manfred spends multiple hours a day, investigating locks, picking locks etc. In between he is also working as a dentist it looks like. The developed manual skills and the drive he has you cannot compare with ordinary lock pickers. Don't be surprised if Manfred says he used more than 500 blanks training, the weeks before the “Impressioning championships” in Germany and the Netherlands (Lockcon).
It may seem strange to an outsider, because when you look at the amount of money he spends and the time it cost. But ok, this is Manfred who wants to be the best and actually is the best. In Germany they call him “Master of the Universe” do not mix this up with “Miss Universe”

I also discussed with Manfred, the tightness of the keyway of the d12 in comparison with the Abus TS5000. It looks like the Abus keyway is designed to use point 3 as a turning point and the positions 4 and 5 as a lifting point. Therefore that space in the rib, with the 45° (see arrow). As far as I know, these Abus locks are not produced anymore, this is the reason why I went more into detail on this keyway. The ASSA d12, with the double 90° angles, makes it very hard to lift up the pins to the correct height was also the idea of Manfred. Time will tell.

Manfred’s goal of this part of the article is not to teach how to pick locks, but give an idea how lock pickers think. When you go to a TOOOL-meeting or SSDeV meeting or other lock pick meeting all over the world, you will learn the used techniques quickly.

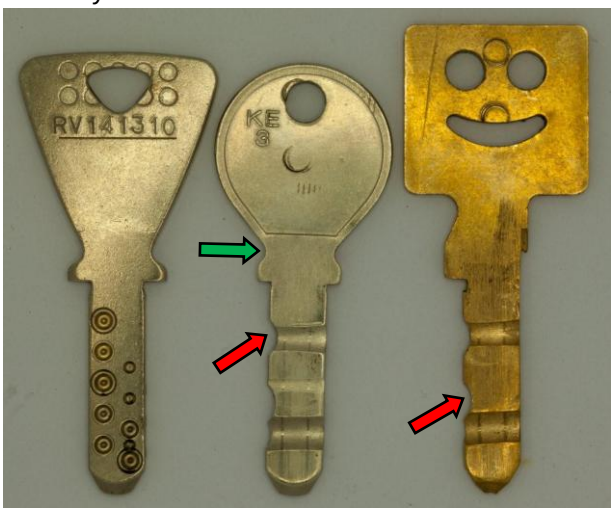
Another small project of Manfred Bölker

As a collector I visit a lot of places and lock shops etc. A few years ago I visited a hardware store and I saw the next Lips Keso dimple padlock. I was interested in this lock, because the keyway was a little bit extended and comes out of the lock body. You can see the bulb on the keyway (red arrow). This way you can create more different keys, by only extending the keyway. People who know me, know that I like these small details and that my collection is full with these small detail things. I saw this trick with the extended keyway with more lock manufacturers. Anyway I asked the man, can I buy this lock? He said no, because there are no keys with the lock. In a lunch break there was a group of boys in his shop and they stole the keys (not the padlock) so he said he could not sell the lock. I insisted on the fact that I wanted to have that lock, so the man said 1 Euro. Of course I bought the lock and put the lock without keys in my collection.

Picture 55: Lips Keso padlock

Years later we got more used with the impressioning technique. I thought of the lock and gave it to Manfred. Within 30 minutes he made a key out of a Silca blank. A few months later I did the same with an Easy-Entrie key. I assume most people know that the 25 on the Easy-Entrie key stands for the thickness of the key, 2.5mm.

When I show people these keys, I get mostly 2 different remarks. There are people who say WOW and look with respect at the key with its smooth operation in the lock and there are people who say, I can insert the key only one way. If I insert the key the other way it does not work. If you look properly you can see that the key is not reversible. The red arrows in picture 56a and 56b mark the side of the keys where we filed down the key for the vertical pins in the cylinder.



Picture 56a and 56b: Left and right side of the impressioned Lips Keso keys

Note: The green arrow marks the "bottom" of the key. In the picture of the padlock you can see the red mark on the side of the key. People who do impressioning do know why.
Note: The original Lips Octro key is not the key from the padlock. It is just a random key out of my collection.
Note: It seems that the new Keso 4000S is protected against the impressioning attack. I did not test this yet.

Concerning the hexagonal chain and the bolt cutter

Here the explanation of Gerhard Meckbach (Product and Purchasing Director) from Abus, Germany.

When you imagine the "mouth" of a bolt cutter, it opens v-shaped. In case of a round diameter which should be cut, 2 points of the "V" hit the round diameter of the loop of the chain. You get a maximum pressure force on these two small surface points and because of the high pressure, the cutting part of the bolt-cutter might penetrate. The deeper the cut might go, the softer the material will be.

At the same time a further effect applies. The more the arms of the cutter can be closed the more force can be achieved in a manual attack (imagine the dynamic of the gear of a bolt cutter).

Now let`s imagine, the section is hexagonal and in this case one blade of the v-shape mouth bites on a flat surface and cannot penetrate easily, because the cutting pressure force of the cutting blade of the bolt cutter is divided on a greater surface, the flat surface of the chain.

The other side hits then a corner of the hexagon. So, at least one side of the hexagon resists better than a round face.

Bolt cutters need to penetrate on both sides of a shackle or loop of a chain, because after a while the attacked object shatters / bursts. If one side allows no penetration the shatter-point is only reached later.

Further, if a round and hexagon rod have the same section (equal weight) the "diameter" of the hexagon is larger than the round one. Larger diameter means wider opening of the cutter means less power applied etc.

Weight plays a role for two-wheelers and therefore counting all reasons, hexagon or square sections are more effective to resist bolt cutters than round ones.

Closing comments

The goal of this article is to explain the techniques used in this new ASSA d12 lock. To bring a little variation in the article I introduced some other items of which I thought that people could find interesting.

I tried to show the parts in the lock in detail and with measuring and giving dimensions of the ASSA d12 lock I tried to explain more of the movements and the working of the parts together. Normally the key is the part which activates all these parts in the lock. In these modern times we have lock pickers who try to do the same with all kind of impressive pick tools or techniques. I do not know if modern locks should have to resist all these attacks. The range of valid practical attacks / techniques lock pickers are using is also extending and still growing. We have for example, lock picking, bumping, key duplication, etc. By improving your lock for one certain attack, you possibly make it weaker for another attack.

The manufacturer has to balance between these different attacks. You get then a kind of Spider-web diagram. It is my idea that out of this web, manufacturers will then create their locks. Maybe I am wrong with some assumptions I made about the used techniques in this lock, maybe not.
Fact is that I (only) had 2 complete Oval cylinders and one keyset level 1. Out of this hardware I extracted this article. What was new in the lock for me were:

- The second level of cuts in the key, arranged by the rib.
- Play of the pins in the chambers which should withstand the lock manipulation techniques
- Overlapping keyway with 90° and anti-slip ribs.
- Multiple contact points on pins and keys, in combination with wings in the pins.

What I like about ASSA is that they have the guts to show people like me and Barry Wels the inside of their factory and that they cooperate in writing an article about their lock. There are still manufacturers who are afraid of this and believe in “security by obscurity”. I think in this modern time with Internet that is almost impossible.

I want to thank Peter Field, Manfred Boelker, Julian Hardt and Michael Huebler for some good input they had on the article. My friend Mitch Capper I also want to thank for the pictures. He spent some days in my house and installed all kind of software on my computer, like “Live View”. Therefore I could take these new standard of nice pictures.

I personally think that ASSA did a good job with the d12. Do not forget the d12 is a "medium security" product (from a Scandinavian perspective). They succeeded in introducing several new techniques in the lock and I think the lock is ASSA worthy.

I hope you have enjoyed this article,

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