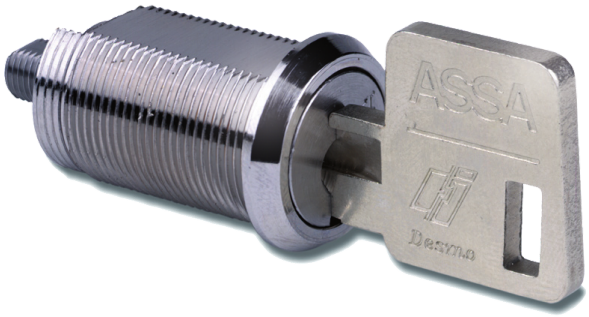
An Overview of the ASSA Desmo

By Mow

INTRODUCTION

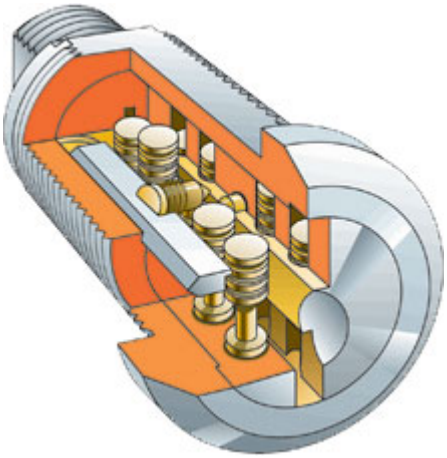
This article is intended to be a brief writeup detailing the features and operation of the ASSA Desmo. I found there to be very little information about this lock, official or otherwise. Included is everything I know about this lock and how it works.

The ASSA Desmo is a compact lock designed for high-traffic environments. In particular, it is marketed toward casinos for securing gaming machines or cash drawers as cam locks. They are commonly used in drawer and cabinet locks, high-security handcuffs, and payphone locks. They are also available as Scandinavian oval cylinders and padlocks. In the US, the Desmo is distributed by Abloy USA.



Promotional image of a standard Desmo cam lock

Making the Desmo unique is its operating principle of springless sliders interfacing with two sidebars. It is available in an 8-slider variant and a 6-slider variant, with 4 and 3 sliders on each side of the keyway respectively. The 6-slider variant is typically only used in small formats where the full 8-slider mechanism would not fit.



Cutaway promotional image showing all the main parts of an 8-slider Desmo cam lock

Selling points for the Desmo include a patent-protected design, a thick, strong key which is highly resistant to breakage, and a springless pin design which is resistant to dirt and wear. The key is supposedly so resilient that it is backed by a "Lifetime Functional Warranty" which provides free replacement keys in the event that one breaks as a result of normal use. The key is bitted with two tracks, one on each side of the key, which makes duplication difficult.

Also available is the Desmo RC (removable core), which allows the core to be hotswapped using a control key, similar to BEST SFIC locks or Bilock's QC mechanism.

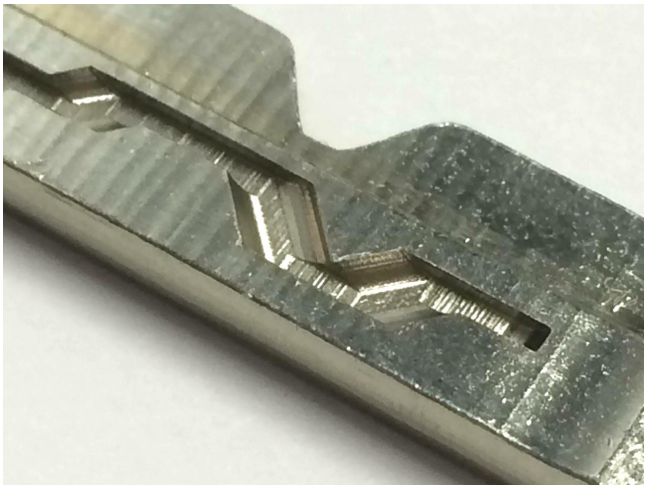
The Desmo has a successor, the Desmo+, which makes several improvements to the design. Namely, it has more cut heights and a larger MACS, which are accomplished by changing the shapes of the tips of the pins. However, I will not be discussing in detail the specifications of the Desmo+ in this article. It appears to be used far less commonly than the standard Desmo, and it is not backwards compatible, as, for instance, the Mul-T-Lock Interactive+ is. However, the basic functionality of the Desmo+ and Desmo is the same.

DESIGN OF THE KEY

The Desmo key has a very distinct appearance. The top edge of the key, where one would typically expect to find the bitting, has only a single cut approximately halfway down its length. This cut is actually to aid in key retention (more on this later); the bitting is encoded within two tracks milled into the lower portion of the key. ASSA calls these the "code grooves".

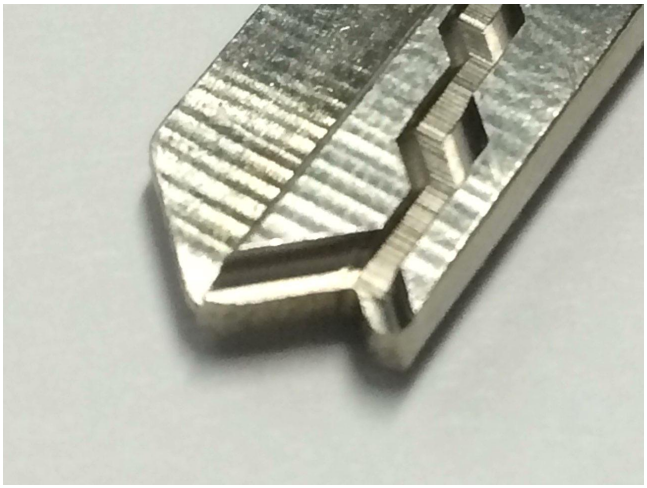
Desmo key

As the key is non-reversible, the tracks on either side are different. Each track encodes the heights of the 3 or 4 sliders on that side of the keyway. Note the shape of the diagonal cuts of this track. Unlike many other locks that utilize springless slider designs, the portion of the slider interacting with the key is not a round peg. Desmo sliders instead use a small flat disk at their base. This requires special cutting to accommodate changes in height.



Close up of the bitting track

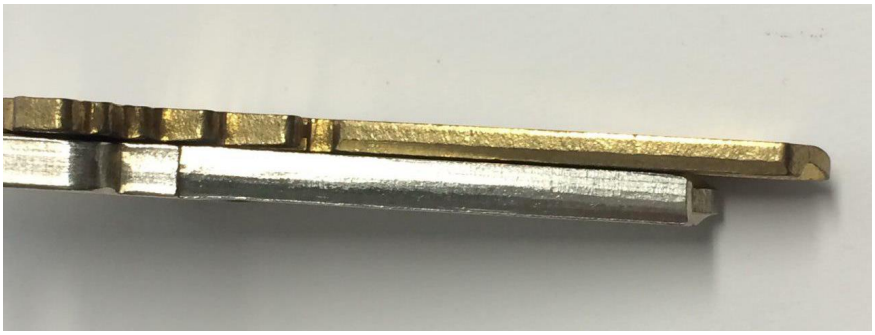
The very tip of the key has a wedge-shaped opening to guide sliders into the tracks. This is necessary as the sliders are springless and may be free-floating in any position before the key is inserted.



Close up of the key tip

Key blanks are not sold and key cutting is done only by ASSA. This makes unauthorized production of a duplicate key very difficult.

The key is designed to withstand heavy use without breaking. Advertisements claim it to be 30% thicker than most other high security keys (At its thickest, near the base, the key measures 0.118 inches or 3.00 millimeters). The absence of bitting on the edge prevents any deep cuts from weakening it. Keys are made from solid nickel silver instead of brass for extra strength.



Desmo key (bottom) compared to a common Schlage key

Below is an image of the keyway. You can see how wide open the bottom area is and appreciate the thickness of the cross-section of the key. I believe ASSA produces two variations of this keyway. Notice how the "shoulder" of the midsection is lower on the left side than on the right. Another version exists in which the right side is lower (a mirror image).

"Left" Desmo keyway

DESIGN OF THE PINS

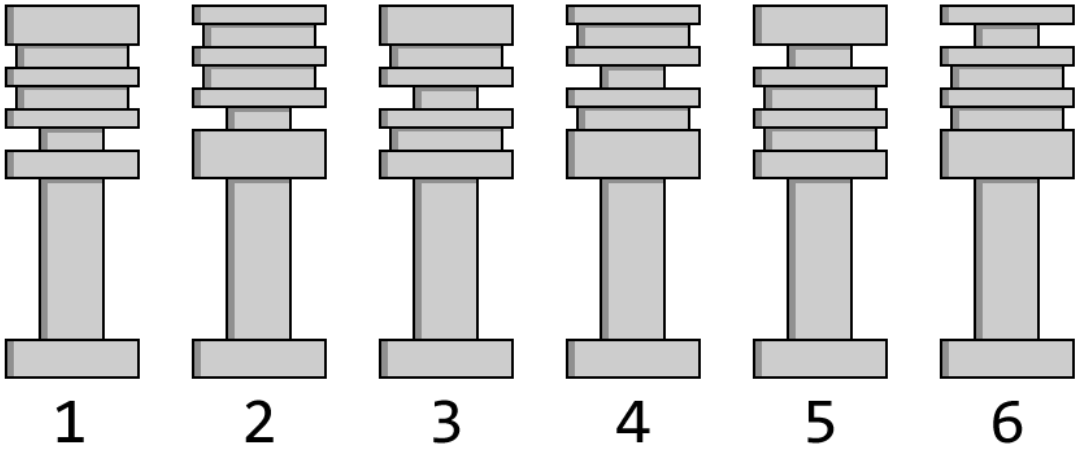
The pins in this lock are very unusual as well. They are very reminiscent of pin tumbler security pins, such as perhaps ASSA's old multi-stepped spools, or the side pins used in the Twin 6000.

Various Desmo pins

Desmo pin compared to other designs of ASSA security pin

In fact, they operate extremely similarly to Twin 6000 side pins. I have heard the Desmo described as a Twin 6000 with two rows of side pins instead of pin tumbler pins.

There exist 6 different cut heights on the pins. Each cut has two false gates accompanying it for manipulation resistance. The false gates are placed multiples of 2 positions away. For example the 3 cut has a false 1 cut and a false 5 cut, while a 2 cut would have a false 4 cut and false 6 cut. Master keying is available, which places multiple true gates on the pin. Unfortunately I do not own a Desmo with this feature and have never seen this done in person or picture so I do not know how this changes the placement of the false gates.



Scale drawing of all six cuts of pin

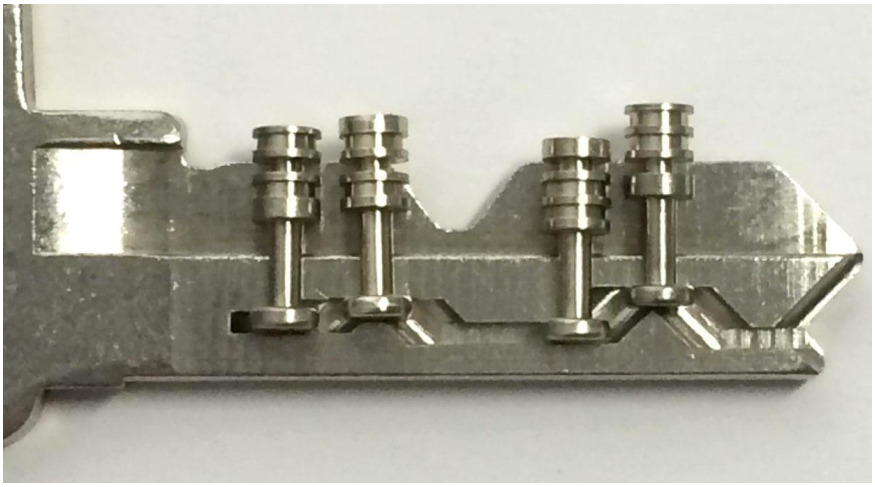
The very foot of the pin is what actually interfaces with the tracks of the key. It dangles down below the gates by an oddly long shaft. This is actually done for two reasons: first, it allows the pins to be laterally closer to the key. The gates can only move so far down before they contact the top of the key, and the shaft gives them extra room to do this. This also helps keep the design compact. Second, it helps prevent decoding. Shown below is the view down the keyway. As you can see, the area with the gates is separated up into the plug where decoding tools cannot reach, while the foot dangles down to the bottom of the keyway where the key can manipulate it.

Close up view down the keyway

The pins are made out of brass, which is actually a change from the Twin 6000 side pins which were made out of steel. I believe the reason for this is Twin 6000 side pins required a hole to be bored into the top to accept the spring, and this would weaken the pin too much to use brass, making it susceptible to brute force attacks where the pin could be crushed. However, as Desmo pins are springless, this is not an issue and therefore brass is a suitable material.

Top of Desmo pin compared to top of Twin 6000 side pin

Shown below is all of the pins of one side as they engage the key. You can see the true gates are all lined up when the correct key is inserted. Also note the spacing of the pins as they leave a gap in the middle. This gap is for the sidebar spring and key retention mechanism.



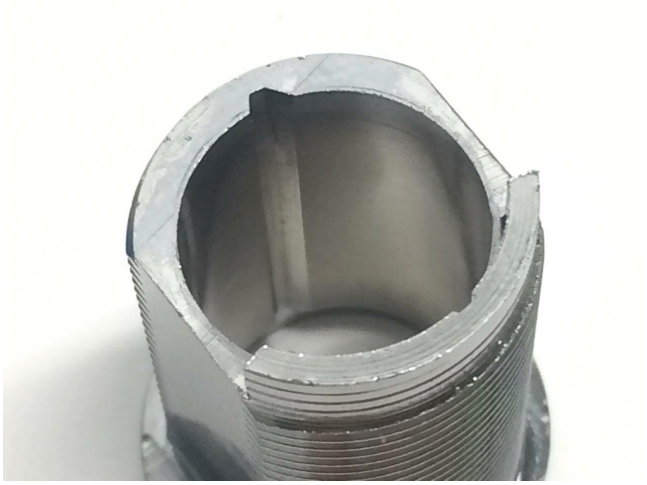
Pins engaged with the key track

Due to the springless design of the pins, there is very little resistance when inserting the key into the lock. As the pins are completely round, they are allowed to "roll" along the key, further reducing friction against the tracks and distributing wear on the pin over a wider surface. This allows the key and pins to endure heavy use.

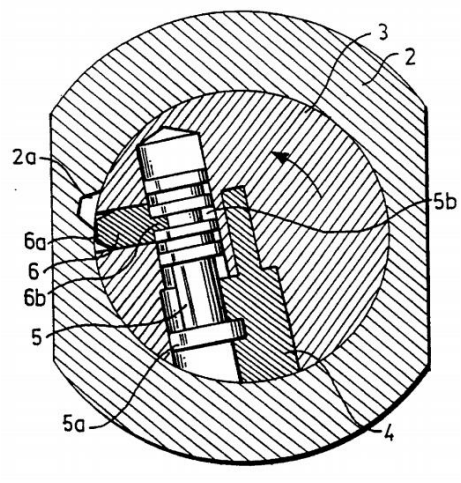
SIDEBAR OPERATION

The sidebar mechanism is rather typical for a sidebar lock. It is similar to Bilock's dual sidebar design. Two grooves in the housing allow the sidebars to protrude from the plug under spring bias while in the locked state, and force them into the plug when it is turned. If all of the pins are raised to the correct height, the gates will all be in alignment and allow the sidebar fence to drop into them.

One thing that is unusual about the sidebars is that they are not located perfectly at 3 o'clock and 9 o'clock, as many other sidebar locks tend to place them. They are elevated slightly, closer to 2 o'clock and 10 o'clock.

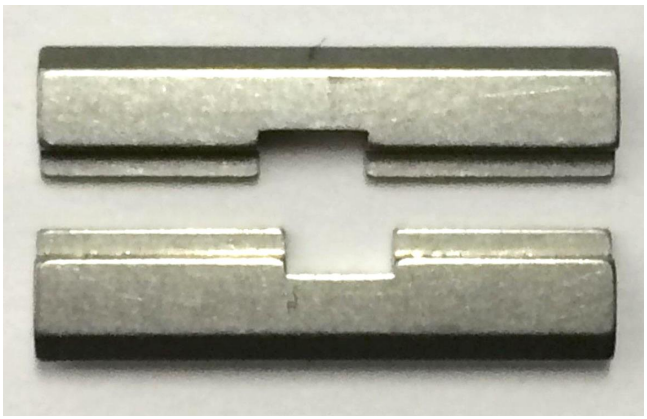


Sidebar grooves inside the housing



Sidebar cam action from the Desmo patent (US5517840A). Note the sidebar (6) and slot (2a).

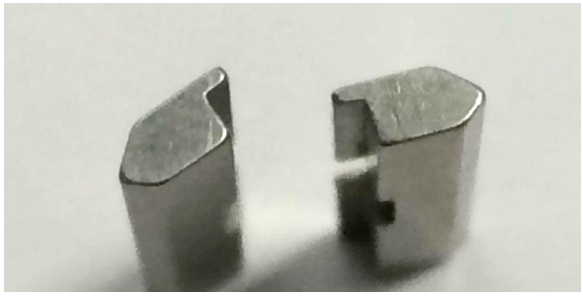
Note that the sidebars, while they are the same, are asymmetrical. When the sidebars are installed, the cutouts for the sidebar springs are positioned with one in front and one in the rear. This is required by the key retention mechanism.



Desmo sidebars

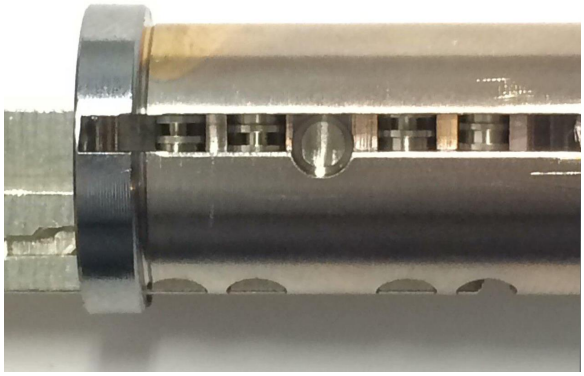
The sidebar uses only a single spring in its center, rather than the typical spring at each far end. This is to conserve space.

The sidebar uses a reduced fence design, shown below. This is also typical for many slider-sidebar lock designs. It allows for more cut positions on the slider and greater effectiveness of false gates.

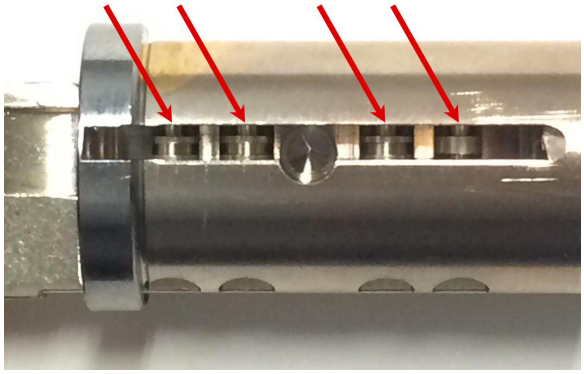


Reduced area fence

Below you can see the view into the pin chambers through the sidebar slot in the plug. Note the spacing of pins, with two in front of the sidebar spring and two behind it. In a 6-slider Desmo there is only one pin behind the sidebar spring.



View down the sidebar slot. Side pins misaligned.



Same view, side pins correctly aligned. Note how the gates align at the very top of the slot to match the sidebar fence.

Close up of sidebar engaging with true gate on a 4-cut pin

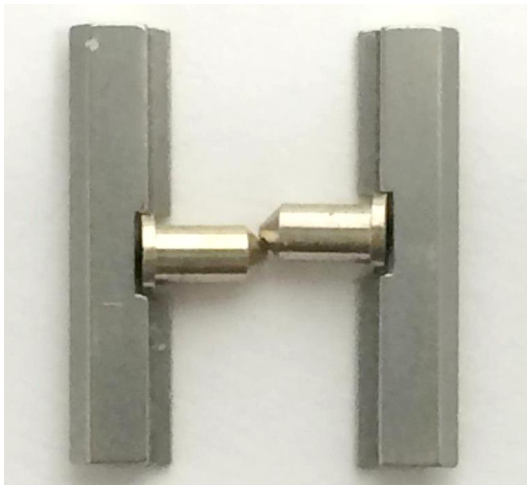
KEY RETENTION

One particular design difficulty for slider locks is key retention. What users tend to do with any lock is pull on the key while rotating it back to the locked position, and the key will slide out as soon as it is able to. This is a trained behavior from years of using pin tumbler locks. In a pin tumbler lock, pulling on the key will lift the key pins up the bitting slopes, pressing them up against the walls of the housing. When the plug aligns back to the locked position, the key pins can immediately rise into the top pin chambers, allowing the key to be withdrawn and securing the lock.

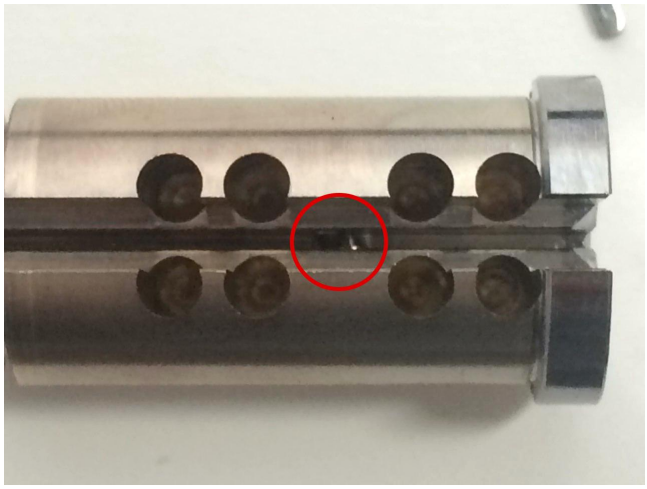
For slider locks, however, pulling on the key in this fashion will cause the sliders to begin to misalign. This causes the true gates to pinch down on the sidebar from both sides, creating friction that blocks the sidebar from returning to the locked position, and entirely preventing the key from being withdrawn from the cylinder. This is not only annoying for the user, but causes wear on the sidebars and slider gates.

This is the reason for the single cut in the blade of the key. Each sidebar spring has a pin down the center of it, and when the sidebars depress, the tips of these pins press into this cut. When the key is pulled, the key cut will contact the angled tips of the pins and apply outward forces to the sidebars. The sidebars press against the housing and stop the key from being withdrawn any further, thus

avoiding the slider misalignment problem. When the plug rotates back to the locked position, the sidebars are immediately forced outward into their grooves and then the key can be withdrawn smoothly.



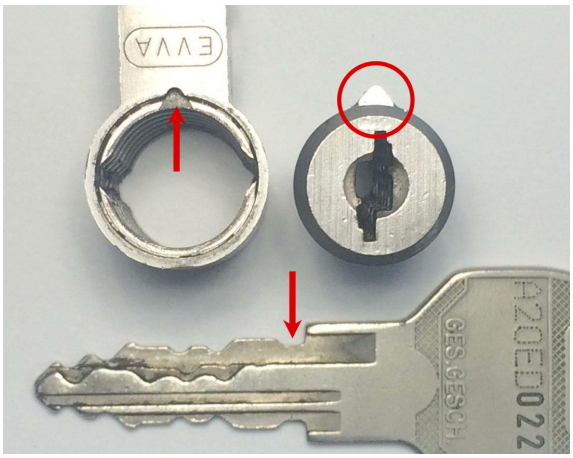
Key retention pins as they engage with the sidebar. Note how the spacing with one in front of the other allows them to touch.



Key retention pins in place within the plug

EVVA slider locks implement a feature like this as well. The EVVA 3KS, which is extremely similar in function to the Desmo, uses special tips on the sidebar that grab the key and are forced out when the key is pulled. The EVVA Dual has a small key retention bar located at the front of the plug which blocks key removal unless it is aligned with a small slot in the housing.

EVVA 3KS key retention tip and matching cutout on key



EVVA Dual key retention bar. Arrows show where it releases into the housing and grips the key.

KEY DIFFERS

The calculation of key differs for this lock is surprisingly complicated. There are 6 cut heights allowed on the key, with a MACS of 4. The MACS only applies between two adjacent pins. Each side of the key is completely independent, and the key retention pins create a break between the banks of slider pins. Therefore, the 8-pin key can be thought of as four 2-pin keys together, and the 6-pin key can be thought of as two 2-pin keys and two 1-pin keys.

The final number of keys differs is then 1,336,336 for the 8-slider variant and 41,616 for the 6-slider variant.

DISASSEMBLY

The Desmo is very easy to disassemble. Depending on form factor, the plugs may be retained with either a screw-on tailpiece or a C-clip.

Rear end of Desmo cam lock with a C-clip

Because the Desmo is completely a sidebar lock, the correct key is not needed for disassembly. Sidebars only block rotation of the plug; it can still be slid straight out once the plug retainer is removed.

Once the plug is free, the sidebars and key retention mechanism may be removed and the pins may be slid out the bottom. Some formats will have a small spacer ring just behind the face of the plug which will need to be slid out of the way before the pins may be removed.

In the Desmo RC, pins are loaded in from the top rather than the bottom. A sliding retaining plate keeps them inside the plug during core swaps.

Desmo RC cores. Note the plate for pin retention and colored insert to tell them apart.

Here is the Desmo fully disassembled with all of its parts laid out:

ATTACK RESISTANCE

Optionally, the Desmo may include hardened steel rods to protect the slider banks from drilling attacks.

Anti-drill inserts (thanks to LockPickingLawyer for the image)

Due to the slider-sidebar construction, the Desmo is immune to key bumping attacks.

As mentioned earlier each slider has two false gates to resist manipulation attempts. These are quite well done false gates that snag the sidebar and require careful probing to distinguish from true gates and manual counterrotation to escape from.

By observing where the sliders snap into gates under tension, it is possible to tell only if each slider is an "odd" cut (1,3,5) or an "even" cut (2,4,6). This does not accelerate manipulation or aid in decoding very much. I believe a decoding attack would be infeasibly difficult.

MANIPULATION STRATEGY

The ASSA Desmo is not an easy lock to pick open. The false gates and lack of spring force on the pins can make it difficult to feel binding pins. Depending on the orientation of the lock, gravity may unset some of the sliders.

Many people (myself included) find it easier to pick the Desmo visually, by looking into the keyway to see if a pin is binding. This can be accomplished via a backlight behind the cylinder, or a front light shining into the keyway. Some people use lengths of fiber optic cable inserted into the keyway to illuminate the entire inside of the lock.

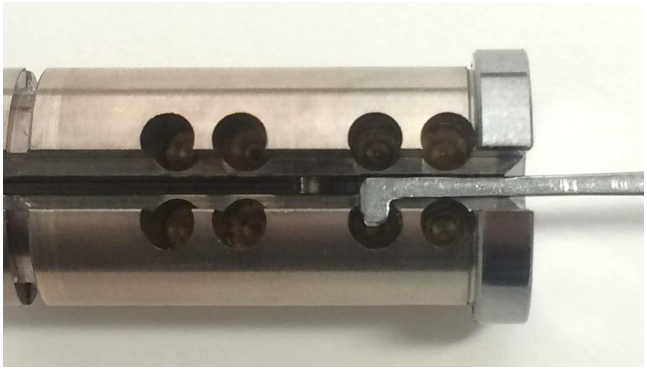
View down keyway with the aid of a light

However, a light is not strictly necessary. The Desmo can be picked open by feel alone if need be.

Quite a few tools can be used to manipulate the sliders. Dimple flags, half diamonds, or even short hooks will likely be effective. If not picking visually, a custom tool capable of gripping the slider foot tightly to test if it is binding may also be useful.

Custom tool to manipulate the slider feet (thanks to huxleypig69 for the image)

Pick placement is very easy in this lock due to the chambers being offset away from the bottom of the keyway. Starting from the front, it is easy to slide a pick to the rear and count the chambers it falls into to know exactly which slider your pick is located under.



Pick placement guided by pin chambers

The top of the keyway provides plenty of room for tension tools, provided they do not interfere with the key retention pins. Wiper insert or prybar type tension tools are both effective.

Under tension from the tension tool, the first task is to set each of the sliders into a gate, be it false or true. Any of the sliders may be binding at this early stage, but quite often one side isolates and its sliders bind before the other side. Depending on gravity, it may be wise to start with all sliders as far in the direction of gravity as they will go, and working them progressively in the opposite direction. Give each slider a nudge upward, and if it is binding, continue until it clicks. If it is not binding, push it back down and leave it alone.

When all the sliders are in a gate, the plug will turn partially into a false set. Depending on isolation, the other side may be binding as well. It is entirely possible to have two binding sliders, one on each side, due to tolerances in the plug fit into the housing. Once everything is presumed to be in a false gate, and nothing more can be accomplished under constant tension, it is time to look for sliders in false gates.

If using a light, the typical test for binding sliders is to position your pick under it and attempt to lift it, then position your pick over it and attempt to push it down. Binding sliders will have absolutely no movement, while non-binding sliders will have a small degree of freedom to jiggle. If not using a light, this step is difficult without a custom tool to grip the slider foot.

Once a binding slider is identified, repeatedly and lightly poke the slider in the direction you have been working them. At the same time, very gradually release tension. The repeated poking is important; constant pressure applied to the slider will cause the false gate to pinch the sidebar fence and create friction.

As soon as the binding slider is free, nudge it up just slightly past the point where it was bound and then reapply tension. Continue to push the slider up until there is an audible click and movement of the plug as the sidebar fence snaps into the next gate.

Afterwards, test if that same slider is continuing to bind. If it is, it will need to be nudged up another gate. Otherwise, probe the other sliders in the lock and move them up a gate accordingly.

If your particular Desmo isolates sides, then at some point one of the sides will be picked entirely. This is usually accompanied by a louder than usual click and deeper than usual false set. At this point, the other side will begin to bind and will need to be picked in the same manner.

On some occasions, all sliders have been picked to the correct gate but the lock is not opening. You may need to make a pass around all of the sliders, on both sides, giving them a light poke up and down to center the true gate under the sidebar fence. When everything is exactly lined up, the lock will open.

FINAL THOUGHTS

Overall the Desmo is one of my favorite lock designs from ASSA. It is clearly very well-thought-out and able to accomplish all of its goals quite well:

- It is compact
- The design resists wear and dirt
- It operates very smoothly
- The key appears very strong
- Keys are tightly controlled and require special skills and machinery to duplicate
- It is very resistant to picking

One thing that disappoints me about this product is it is very difficult for an end user to obtain. Sites that sell ASSA products typically will not carry the Desmo. Many sites that do carry it are casino supply sites.

I had actually contacted my ASSA dealer to inquire about ordering Desmos, and he told me they are completely unavailable through ASSA to the US.

I think there is much more that could be done with the Desmo than what ASSA is restricting it to. It is one of the most secure cam locks available, rivaled by the likes of the Medeco Duracam, Abloy cams, MCS cams, and Bilock cams. It is also one of ASSA's most weather-resistant mechanisms.

However it remains only available in a limited range of formats, is quite a rare lock to see, and is difficult to buy as an end user.

For the time being, the Desmo is limited to casino security or being a cool collector's item. I think it's a neat lock anyway.