Introduction

The type of locks that I will be covering in this will be Group 2 combination locks. These are the typical type of locks found on almost all safes. Some, such as the LaGard 3330, can give more trouble than the S&G 6700 series, which are simple and used as beginner locks and sadly, also the most common type of mechanical safe locks. If you are a beginner or don't even know anything whatsoever about this topic and you just want to learn this because it's cool or to impress a girl ;), then this book is definitely you. I know there are a couple other books/tutorials on this out there but I wanted to create my own. No matter how thorough the book, there will always be some missing piece of information and I'm hoping this fills in the gaps for others out there (and my girlfriend got interested in this so this book is dedicated to her <3). And I hope this will be able to address some of those questions and that this and all the different resources put together will be complete enough to get cracking! (Pun intended). If you have any information not in this that you would like to inform me of, feel free to contact me! I have an account on keypicking.com under the username of Daggers; just shoot me a message and I'll get back to you!

Group 2 mechanical combination locks are locks that are supposed to resist manipulation for 2 hours. That's the official rating. Yeah, right. Group 2M are slightly more manipulation resistant and feature things that make taking contact readings harder, false gates, etc. Group 1 is, again, supposed to resist manipulation for 20 hours. It's way better than group 2 and 2M but still not perfect. They feature things such as an extra step that needs to be done after you enter the combination to engage all the

parts to open it. And then there is the group 1R. Same thing as group 1 but has several more features that make it impervious to x-ray and ultrasound attacks. These locks can not be x-rayed to see the combination unlike the other groups. Group 1R features things like wheels made out of delrin (low density plastic that don't show up well on x-ray), spacers in between wheels with false gates, and other precautions that confuse the x-ray image.

I would also recommend you to spend the couple extra bucks to get a cutaway safe lock to view how it works as you manipulate. You don't need a cutaway safe lock but you do need a safe lock! I recommend starting with an s&g 6741. If it just says s&g 6700 then it's most likely a 6741. A 6730 is the same thing but requires more preciseness when dialing in the combination and so is slightly harder for a beginner, but is still just as good. Do NOT start with a LaGard 3330! It's in the same group of locks, but has some features that I will cover later which makes it harder to start with.

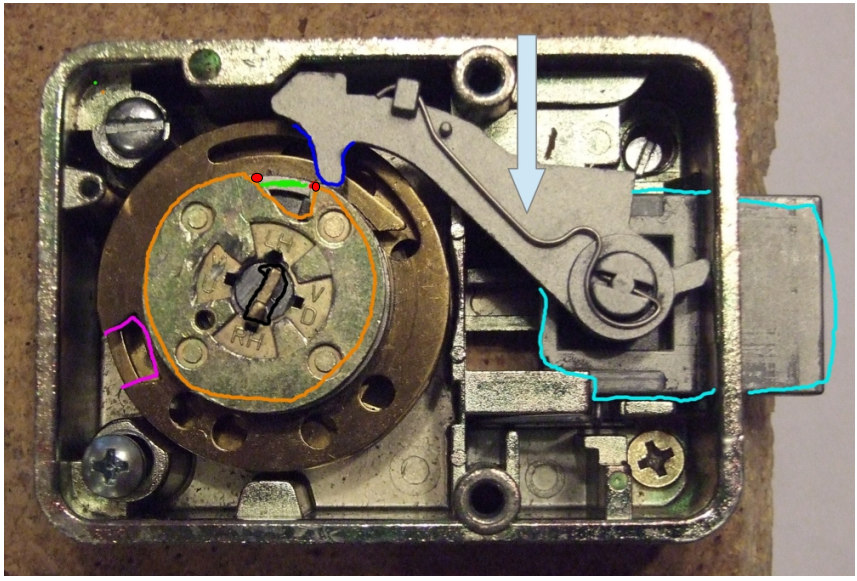
I just want to say that before you try to get too deep into this book, get a safe lock and mount it on a piece of wood. Just reading through without any physical lock to look and mess around with, it will be very difficult to understand all the different components. I'm not saying it's bad if you just read through this, but it greatly helps to be able to have the lock in your hands. This is a great hobby and I wish you the best of luck!

Some might argue that this knowledge should stay secret so that the criminals won't have access to it. But the criminals already know it. Knowledge on holes in security needs to be made well known so that all the good people know and fix it. Security through obscurity is no security.

Contents

Ch. 1: How safe locks work (or in other words, fail)

Ok, I have really bad photoshop skills so you'll just have to bear with me here. This is what the back of a LaGard 3330 (a typical group 2 safe lock) looks like with the back cover removed:



This is a LaGard3330. I highly recommend you have an s&g 6741/6730. It will for the most part, look the same. Ilco, Rench, Diebold, Mosler, these work too as long as you have a group 2 from them.

The part outlined in blue is called the nose. It rides along the drive cam which is circled in orange. There is a metal wire, at the end of the arrow, that you can see pushing the nose down onto the drive cam. This means it is a spring loaded fence type of lock. The thing the spring is on is called the lever or arm. Because the nose is being pushed down onto

the drive cam when the gap is under the nose that means it'll drop into the gap ever so slightly. That's where the two little red dots come into play. They are called the contact points. The nose hits those points every time it is coming out of the contact area which is the space between the two contact points as indicated by the green line. The part in the very middle of the drive can is called the spline key. It's outlined in black because it's such an easy color to see amid other dark colors..... nah, I just ran out of colors :P The shaft of the dial screws into the drive cam (you can see the silver shaft behind the spline key). It has a little notch for the spline key to fit into so that it will stay in place and not unscrew out.

Are you still following along? Okay good! Now, the brass circle behind the drive cam is one of the 3 wheels in the lock. The purple part cutout in the wheel is called a gate. These terms are very important for later so make sure you remember all these. Oh, and the part circled in teal is called the bolt. It locks the handle of the safe the lock is on. The lock doesn't actually lock the safe, it locks the handle which is turned to retract all the bolts along the door of the safe and allow it to be opened.

If you have a S&G 6700 series, you'll have this little brass arm thingy at the bottom below the bolt. Don't worry about that yet, I'll get to it. We will be learning more about what they all do later but for now, remember these parts and what they look like! Seriously, remember all these terms and commit it to your mind. Know them like you know apples are apples and bananas are bananas.

I'm going to take it all apart now and show how all the different components fit together to make this lock function! Study it carefully!

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

So I numbered them. #1 is a tension washer. It's slightly wavy so it acts like a spring and keeps all the wheels (#'s 2, 5, & 9) lightly pressed against each other so nothing wobbles and it all fits snugly together. #2 is wheel number 1. You can see the gate in the wheel. The position of the gate is what determines the combination. Wheel number 1 goes on first when being reassembled and will the be wheel closest to the dial. Wheel 3 is the wheel CLOSEST to the drive cam! This will be explained shortly. #3 is called a fly. Specifically, a movable fly. It fits directly on top of the first wheel as pictured and the fly has a slot on wheel 1 it fits into. #4 is a spacer. It spaces the wheels out from one another so they don't rub on each other.

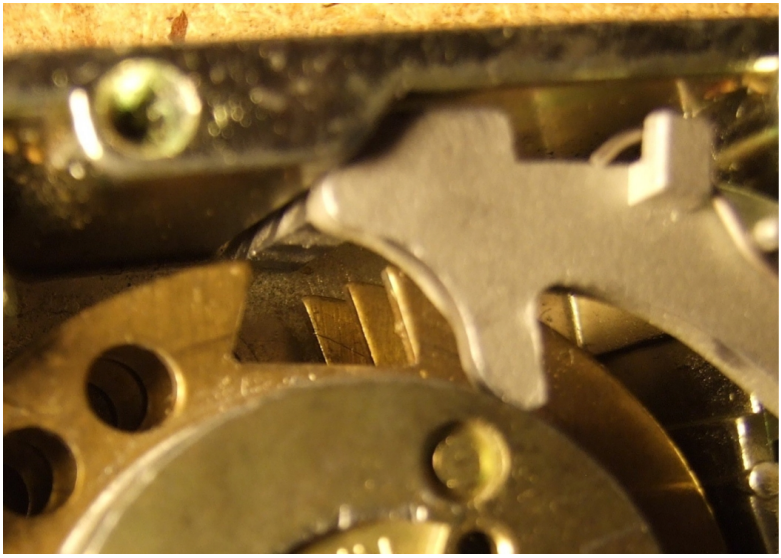
#5 is the second wheel. I have it laying upside down in the picture and for a purpose. #6 is pointing to a stub sticking out from the bottom of the second wheel called the drive pin. It fits into a groove on the top of wheel 1 and when spun, hit the fly that is laying on top of wheel one. This causes wheel one to turn with wheel two. Wheel 1 has no drive pin since there is no wheel under it that it needs to spin. #7 does the same thing as #3 and goes on the top of wheel 2 (the other side of wheel two than what's shown in the picture). #8 is the same thing as #4. #9 is the 3rd wheel. It is the same in appearance as wheel number 2 including a drive pin (since it has to move wheel 2) except that it has a larger fly (#10). The reason it's bigger will be explained later. #11 is another spacer but thicker than #'s 4 and 8. #12 is a retainer. After all the other parts are on the shaft, it snaps on to lock them into place. #13 is the drive cam with an upside down view. It goes on after the retainer. What holds it on is the spindle (the shaft of the dial) which screws into it as explained earlier.

#14 is the spline key and it holds the spindle to the drive cam. #15 is a metal bar above and behind the nose and is called the fence. When the nose is in the contact area on the drive cam, the fence lowers onto the wheels. Refer to the next picture to kinda visualize how that works. If the drive cam isn't holding up the nose, then the fence falls down onto the

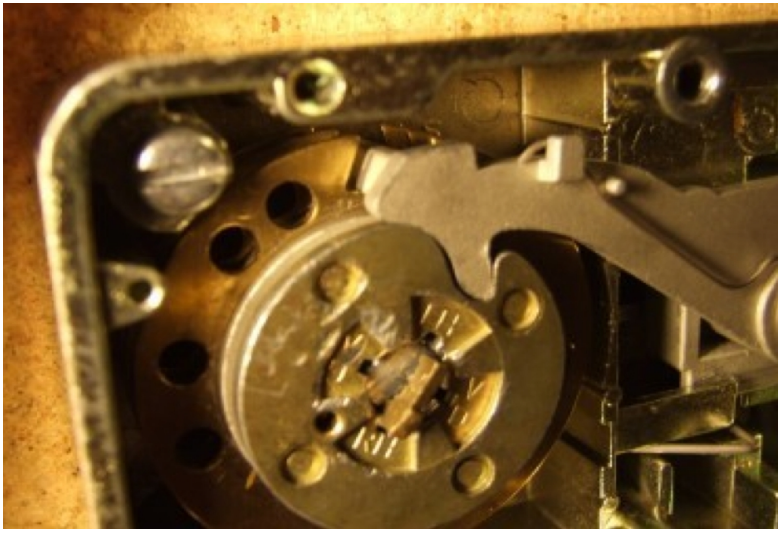
top of all the wheels. And I forgot to mark it but that plastic ring between and to the right of the 2nd and 3rd wheel is to keep the dial running smoothly and so there's no metal on metal interaction. It goes on the spindle.

So this is a pretty good picture on how the fence rests on the wheels:

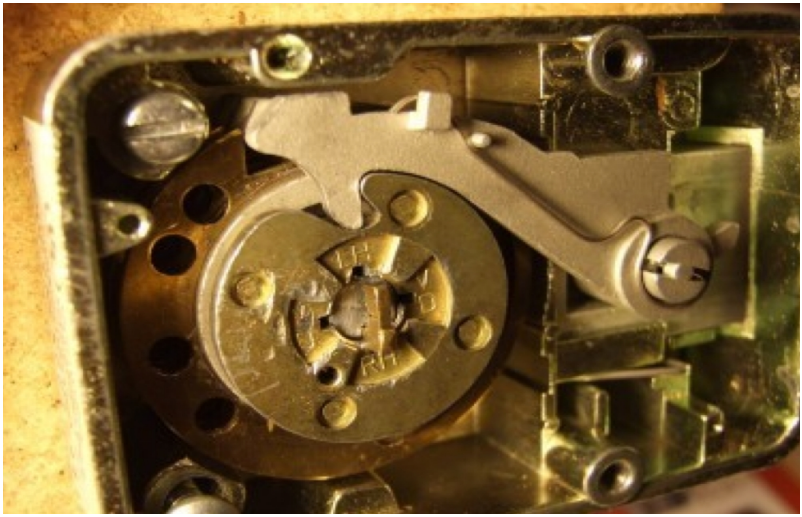
When the nose is on the drive cam, the fence is higher. Other wise, you would be able to feel the gates as you turn the dial and they scrape underneath the fence. Here's a picture:



Notice how high the fence is now? In this picture, the combination has been entered and all the gates are aligned. But even if they weren't, the fence still wouldn't be touching them because the nose is resting on the drive cam. Now, when we turn the dial to the contact area/drop in area in this next picture:



The whole lever arm falls in! Low enough that the metal protrusion at the top doesn't block it from moving sideways. Keep turning and it retracts the bolt:



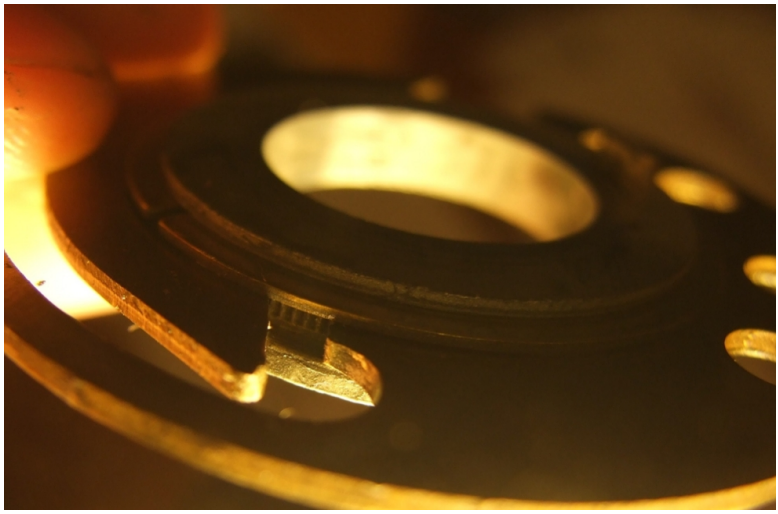
The lever arm moves under the metal protrusion from the top of the lock body. Now, You see the little metal spring below the bolt? It's called a re-locker. It has a little arm going under the bolt and the bolt has a cut in it for the arm. The arm goes up into the bolt so the bolt can't retract into the lock. The back cover pushes the arm down so the bolt is free to move. This is because instead of manipulation, some people drill the lock and punch off the back cover to see the combination. With the cover off, the bolt is blocked by the re-locker. S&G's have a little brass arm that goes down into a hole in the bolt instead of up from the bottom. The back cover pushes down one end of the arm and that raises the other end to allow free movement of the bolt.

Basically the most important paragraph here!!!

Ok, now it's time for you to learn how the wheels move. The dial is directly connected to the drive cam so amount that the dial moves, the same movement is done by the drive cam. If you spin the dial at least one whole rotation to the right, it will take one full left rotation of the drive cam (and dial) to start the 3rd wheel moving left. Keep going and it will take another full rotation left to move the second wheel and again for the 1st. The reason the first wheel to get picked up is called the 3rd is because it's the 3rd # in the combination. Think about it; spinning the dial 4 times left sets the first wheel and 1st # in the combo. Now, you reverse direction 2 whole rotations to the right to pick up the 2nd wheel and then keep going until you get to the second number in the combination. Reverse direction again to the left one rotation to pick up the 3rd wheel and then stop at the 3rd number. You can't set the 3rd wheel first because then, how are you going to set the 1st and 2nd wheel without messing up the 3rd? Combinations are usually dialed by spinning the dial left 4 times to 1st #, right 3 times to 2nd #, left 2 times to 3rd #, then you spin the dial to the right to the drop in area and retract the bolt. When I say left 4 times to the 1st #, that's saying pass the 1st # 3 times and stop on the fourth. When I say right 3 times, pass the 2nd # 2 times and stop on the 3rd. Because of how they work, it takes 2 rotation (two passes of the second number) to pick up the second wheel. To PICK it up, not set it on where it's supposed to be. Then you have to move the dial to the 2nd number for the third time and leave it there. That's why you stop the 3rd time.

How combination changing works

In the next photo you can see there are small serrations in the wheel.



The brass bit from the wheel locks into those. You can see a circular-ish shape hole by this. When the combo is change, all these holes line up and a special metal rod called a change key slips into there. On the back of the lock casing there is a hole in the bottom left for this. The change key is turned and the brass arm going into the serrations is lifted off and then a new combo is dialed. The brass (which includes the gate of the wheel) is in a different relative spot to the silver center of the wheel (which has the drive pin and fly) and the combo is now different. Not all wheels will look like this but if they use a change key, they will work on the same principle, the change key moves the arm off the wheel, and then back on to the new combo.

Ch. 2: Exploiting these failure points

You made it through learning how these locks work! Or maybe you didn't..... just go back and re-read, you'll get it soon enough. No one gets it on their first go anyways! You're probably wondering what failure points did I go over? Well, learning how something works is the same thing as learning all the ways that it can be defeated. You just have to recognize what it is and that's why you're still reading! Locks to practice on: In this I will be using the example of an s&g 6741. I recommend either the 6741 or 6730. The only difference is the 6741 has a dialing tolerance of +/- 1.25 and 6730 has +/- . 5. This means with the 6741 if a number in the combination is 10, you can dial 8.75 or 11.25 and with the 6730 only 9.5 or 10.5 and the lock will still open.

Why and how it's possible

These locks seem pretty secure right? The only thing you can use to move or do anything with is the dial. It's not like a key lock where you can stick some lockpicks in and pop it open, what you see is what you get! Safe cracking works through the measurement of where the contact points are located. On my lock, it's 96 for the left contact point and 6 for the right. You can feel these points on your lock. They will always be in the same general area. They will move, but only to a maximum of an increment and a half or so.

Now, remember how when the contact area is under the nose the fence rests on the wheel pack? This is the key. Look at the drop in area on the drive cam; it's sloped. The further down the nose is, the less wiggle room

there is for it until it's all the way in there and fits snugly. The contact point on the sloped side is the right contact point and the other side is the left one. Imagine it as if you are staring at the front of the lock (not the back) and you can see through it to the contact points. Left and right. You have to turn the dial left to touch the right contact point. If you turn it right, the nose drops down but you can't feel exactly where the contact point is. So you feel the right contact point only by hitting it from the left side of it. Opposite for the left contact point. And when I say hit, I mean to just lightly feel it. If you put too much force, the nose will ride up on it and go past.

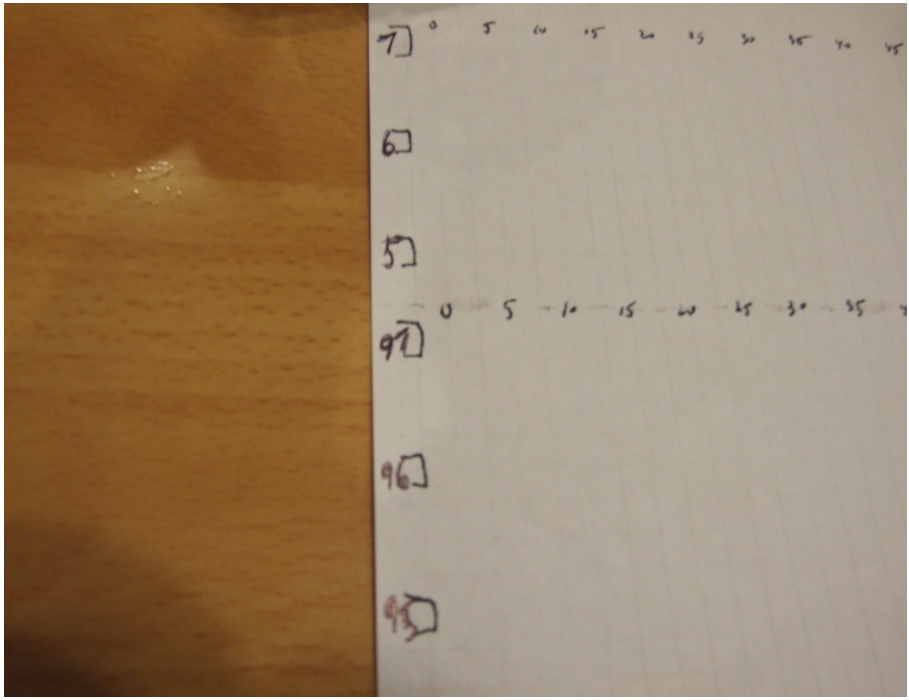
Now you know how to find the contact points! Next thing to do is to know what this information can do for you. When the nose is deeper in the drop in area, there's less side to side play. This means the contact points will be closer together. But how does the nose go deeper in without all the gates being lined up?? Look at this next picture very closely; you've seen it before:

If you look at where the fence is on the wheels, you can just barely make out that it's only touching ONE wheel. The second one. The third one is slightly below and the first one is even more so lower than the 3rd. Now, imagine if the gate on wheel two was there under the fence. The fence would drop ever so slightly onto the next largest wheel, the 3rd one and the nose would drop further into the drop in area. That means there's less wiggle room. The contact points will be closer together by about a quarter of an increment. That's not a lot, but that's what we measure when we do manipulation. We pick up all the wheels, generally with a left rotation, and put them at 0. Then we spin the dial with right rotation to the contact area and measure the contact points while making sure not to pass 0 or else the wheel positions will be disturbed. We then turn left until we reach 0 again put all the wheels at 2.5 and measure the contact points again. Wash, rinse, and repeat at 5, 7.5, 10, and so on until you get to 97.5. That's 40 positions around the dial. We go 2.5 increments because these locks don't open on just that one combination, there is some error so 2.5 increments is sufficient. So basically since one wheel is bigger than the rest, we are graphing just the biggest wheel, not all of them. This flaw is unavoidable. The imperfections of machines make this happen. The third wheel usually is the wheel that the fence rests on. This is not just because of wheel size, but because the spring pushing the lever down is only pushing on the lever, on the side closest to the thirds wheel. It unbalances it and the side of the fence where the nose is, is pushed down further than the back of it. ONTO THE GRAPHING! Here's a graph paper you can use. I would recommend just recreating it and then scanning it and printing out copies. You want it to be full 8.5x11 page size.

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95

Graph #1

So the first thing to do is to label your graph. Write Graph #1 AWL and then your lock model at the top. AWL means all wheels left. That's how we're going to be starting. This is important so that you can come back and know where you left off. Safe cracking doesn't have to be all at once, you can stop any time and come back later. In the 2nd to the top boxes on the left side of the paper you put the right contact point. You want the closest whole number. Let's say you have a contact point of 6 1 4 or 5 3 4, then put 6. If it’s 6 1 2 you can put 6 or 7, doesn’t matter. Then in the box above it, put 7. The box below, 5. Do the same with the left contact point and the bottom 3 boxes. It should look like this:



Now, pick up all the wheels with left rotation (spin left at least 3 or 4 times.You can feel the wheels being picked up) and park all wheels on 0. That means stop on 0, or put all the wheels there. Parking is the same thing as leaving a wheel on that number. When you dial a combination to open a safe lock, you are parking the 1st wheel on the 1st # and the 2nd wheel on the 2nd #.

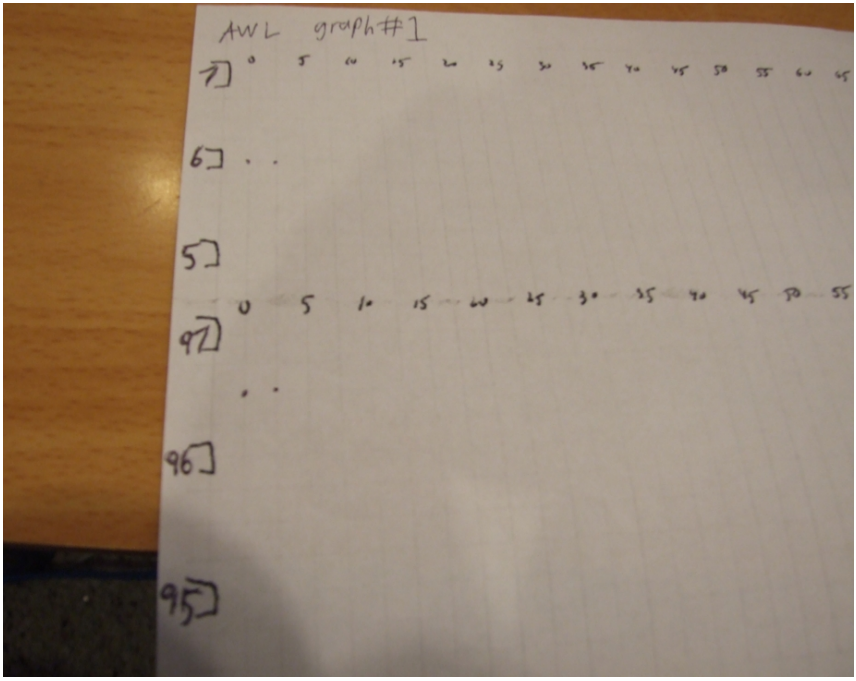
The way you graph the number where the contact point is, is simple. The way the graph is divided, the horizontal lines stand for 1 4 of an increment. You want to be able to consistently read the dial and see if it's on 6 1 4, 6 3/8, 6 1 2, 6 5/8, etc. Going by 8th's is the best. An eighth is in between each horizontal line. So if the right contact point is 6 1 4 for all wheels on 0, you would go down from 0 (on top of the paper) to one line above the 6. Put a dot there. Same procedure for the left contact point.

Remember when I said that the contact points have to be felt from the inside out? If 0 is in between the two contact points for you, turn right to feel the left contact point (this is for all wheels left. Because if you have all wheels right, turning right even more would mess them up). Lightly move the dial until you encounter resistance. You should be moving the dial with enough force to move it, but light enough that the contact point stops the dial and your hand keeps moving on the surface of the dial but doesn't move the dial itself. It takes practice. Being able to take accurate contact readings is KEY TO EVERYTING! Graph the number it stopped on. To read the right contact point, spin right rotation to the other side of 0 (because going the short way and spinning left will mess up the wheels on 0) and go slightly past the right contact point. Lightly turn left and read the right point. Then graph it.

If 0 is to the left of both contact points, just spin right and read both

contact points that way, making sure not to pass 0 and mess up the wheel positions. If 0 is to the right of both contact points, spin left and do the same thing.

After you've graphed the two contact points for 0, spin the dial left and pick up all the wheels again at 0. Turn to 2.5 and repeat the same procedure. It should look something like this:



This has two points on 6 and two points on 96.5. You want to repeat this process all the way around at every 2.5 increments. If you have a contact point on 5 1 4 or somewhere close to a number you're testing, you have to be careful not to disturb it when you take contact reading. Let's say you have 5 1 4 and 14 3 4 and your contact points. AWL to 5, right rotation just BARELY pass 5 1 4, try not to go completely

to 5. It's not too bad if you do though, just don't go past it! Spinning right, the wheels will pick up not quite where you left them with left rotation. The wheels will pick up a bit under 5 so you have some extra room to move between where the wheels are and the contact point.

Now, lightly feel the right contact point. You can spin the dial back and re-feel as many times as you want, just be careful not to disturb the wheels at 5. You can feel where the wheels are and where they pick up so you can get a sense of how far you can go before you disturb them. Now, when you test 15, put all wheels left rotation to 15 and turn the dial a couple increments right, past 14 3 4. When taking the contact point reading here, just make sure to do so lightly and not have the nose ride up on the drive cam. Turn too far and the wheels at 15 will be messed up. So graph the whole wheel pack and you'll get something like:

This!

This graph is how you find the gates. So you'd understand how it's kind of important. Taking the correct contact point readings means an accurate graph! So make sure when you take contact point readings, it always consistent! It's best to use a light touch and make sure that the point you take is right where the nose touches the drive cam. But if you use the SAME EXACT amount of force each time (even if the nose does ride up on the drive cam a little) then you should still be fine. Not everyone will have the exact same points because everyone feels with differing amounts of force, but relatively, the graphs should show the same thing.

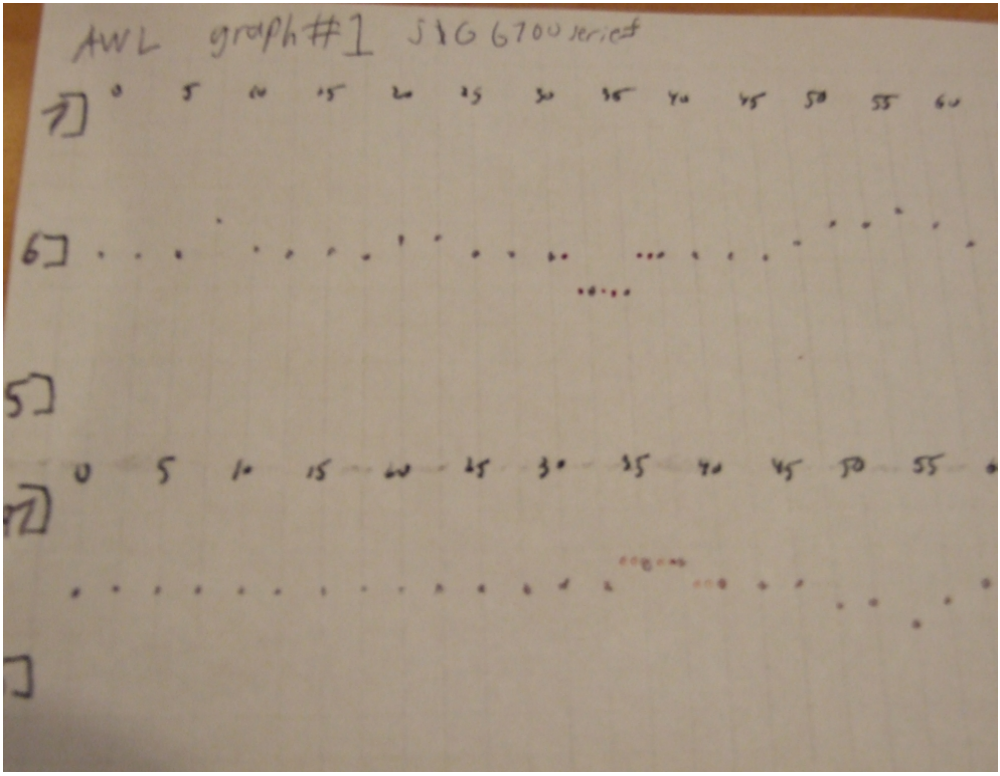
Now for you to know what a gate will look like on your graph. When the fence is resting on the wheel pack and the gate of the largest wheel is under it, it will be lower right? Yup. And then when it's moved off, it will be higher right? Yup again! The gate on the wheels are shaped like a U so the points on the paper should resemble that. It will drop and them go back up. Now think hard and you'll remember the right side of the drop in area is sloped. This will give a greater change in contact point that the other side. The left contact point reading will be less dramatic but will help confirm a gate on that number. So a typical gate will look like a drop for a couple numbers and then back up again on the right contact point and then up for a couple numbers and then back down again for the left contact point.

But this isn't the only way a gate looks like. A gate can drop but not go back up in a number or two. Let's say it makes a drop that is 4 increments wide. The whole thing would be too wide to be a gate so the gate would be right after the drop. Another way a gate can indicate is not by a drop at all, but by a small rise on either side. i.e ..^..^..

It's very important for you to know that when gate indicates, the indications will be at least ¼ of an increment on the right contact point. On better manufactured locks, it can indicate only 1/8 of an increment

but on any lock you'll be starting with, you want to look for ¼ of an increment difference.

So it dips down for a couple numbers and then back up (with the right contact point. With the left, it'll go up and then back down. Think about it, when the two contact points get closer, the left one increases in number). Where in this graph do you see a dip in the contact point and a corroboratory rise in the left contact point? Si! It drops at around 35 for the RCP (right contact point) and up at 37.5 for the LCP. It can sometimes be in the same spot but it can also be a little off like it is here. Remember, the gate will only drop for about 2 increments. Now you want to do something called amplification. Remember how we went every 2.5 increments? Go every 1 increment from 31-39 and graph that in a different color. You'll get something like this:



This is to find the center of the gate. Going every 2.5 increments isn't precise but it lets us find the gate. Now we need to know the exact number it's on. So for the RCP's it's 32-35. Find the middle of that. It's 33.5. Now do the same for the LCP's. It's 35.25. Then find the middle of these two numbers; it's 34.375. Congratulations!!! That's one of the numbers! You don't really have to dial in 34.375, you can dial 34.5 or 34 1 4. Never go off by more than 1 4 increment! Now to find out which number in the combination it is :P Is this seeming like a long process yet? It should, but with practice you can get your time to 5-10min!

High low testing

The way you can determine which wheel the number belongs to is something called high low testing. Recall that the nose drops lower when the gate is under the fence. The contact area will be narrower. Now, when the wrong number is entered, the contact area will be wider. So we want to put the number we found on two of the wheels and throw the other wheel off. And do this with each wheel. So that in two of the tests, the gate will be under the fence and in the other it won't. So in one of those tests, we should have a contact area that I significantly wider since the gate will not be under the fence for one of the tests. We start with the first wheel being thrown off by 10 increments under. This is a low test. It doesn't have to be 10, it should be at least 10 though. This is just so it has more isolation.

For example: We find 34.375 (we'll make it easy and say 34.5)

Low testing:
R24.5 L34.5 L34.5 (Right 4 times to 24.5 and left 3 times to 34.5)
L34.5 R24.5 L34.5 (This puts only the 2nd wheel on 24.5)
L34.5 L34.5 R24.5 (Left 4 times to 34.5 and right twice to 24.5)

Each of these times you want to measure both contact points and write them down. Then find the space in between them. That's the size of the contact area. Now, this is where a thorough understanding of how safes work come into play. So let's say these 3 test show this:

LCP: 97	RCP: 6	Contact area 9
LCP: 97	RCP: 6 1/4	Contact area 9 1/8
LCP: 96 3/4	RCP: 6 1/4	Contact area 9 2/4

The most likely wheel to have 34.5 as a the combination is wheel 3. But we need to do High testing as well (it's not required if the indications from low testing is good enough. It just helps support it):

High test:
R44.5 L34.5 L34.5 (Right 4 times to 44.5 and left 3 times o 34.5)
L34.5 R44.5 L34.5 (This is putting only 2nd wheel on 44.5)
L34.5 L34.5 R44.5 (Left 4 times to 34.5 and right 2 times to 44.5)
and say we get:

LCP: 97	RCP: 6	Contact area 9
LCP: 97	RCP: 6	Contact area 9
LCP: 96 7/8	RCP: 6 1/8	Contact area 9 ¼

Now both test show wheel 3 to indicate. So we know so far the combination is ?-?-34.5. This is why an understanding of how wheel pick up is needed. You need to know how to put each wheel at a specific number and know which wheel is at what number. IT IS CRUCIAL!!!

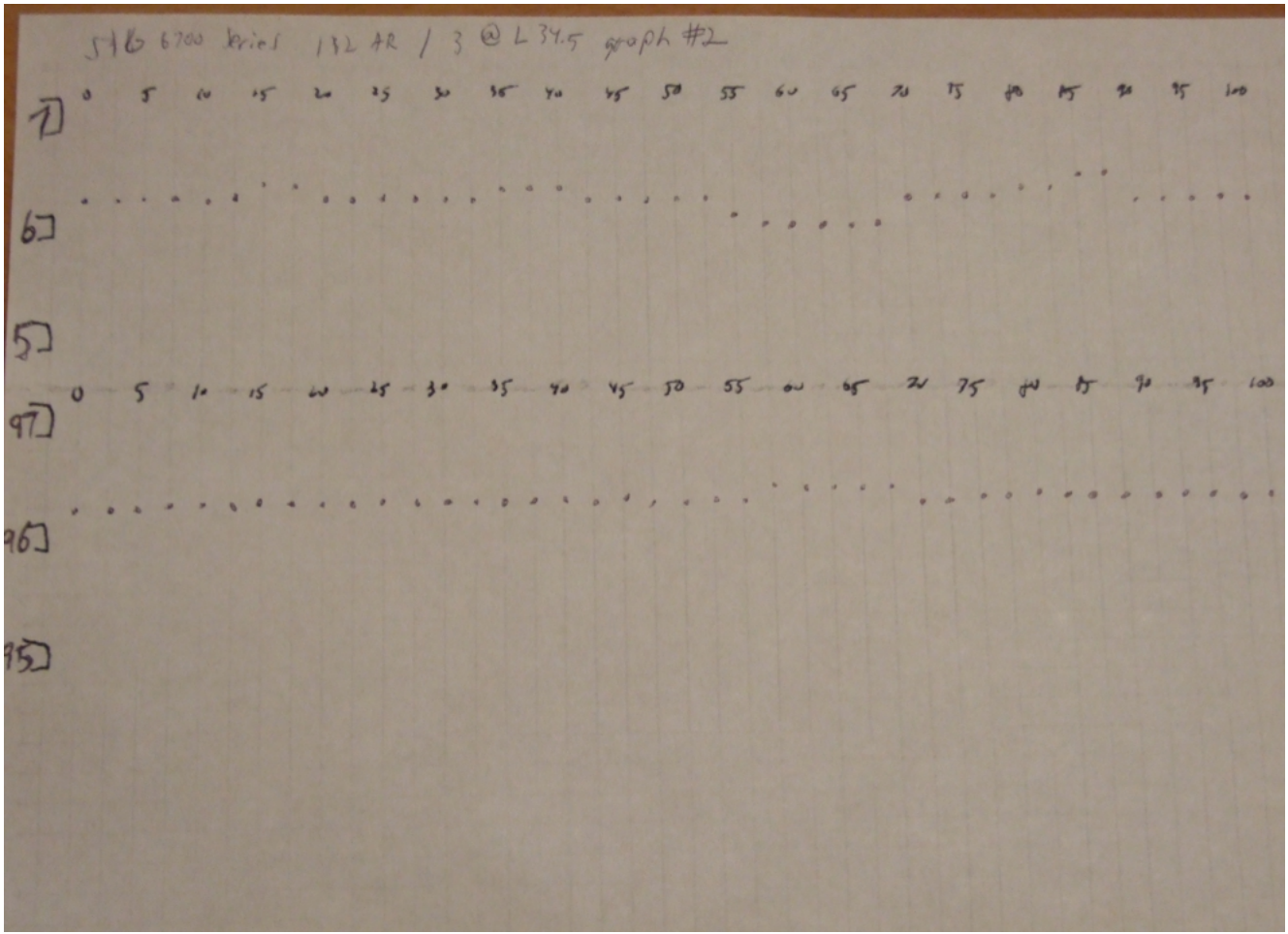
I included a little chart that helps you with this in the very back of the book for you to use. Even though you may not ever use high low testing since I describe a better alternative (in my opinion!) to it later, it's there if you want it :)

VERY IMPORTANT NOTE! Notice how we found 34.5 with AWL rotation. In all the high low tests every time we put a wheel on 34.5 is is with LEFT rotation. This is important. Parking with right rotation will put the wheel slightly off. The width of the fly and drive pin on each wheel makes it so that when you approach each wheel from the opposite direction, it will pick up in a slightly different spot than how you left it. Compensating for this will be covered later under “Rotational Conversion”.

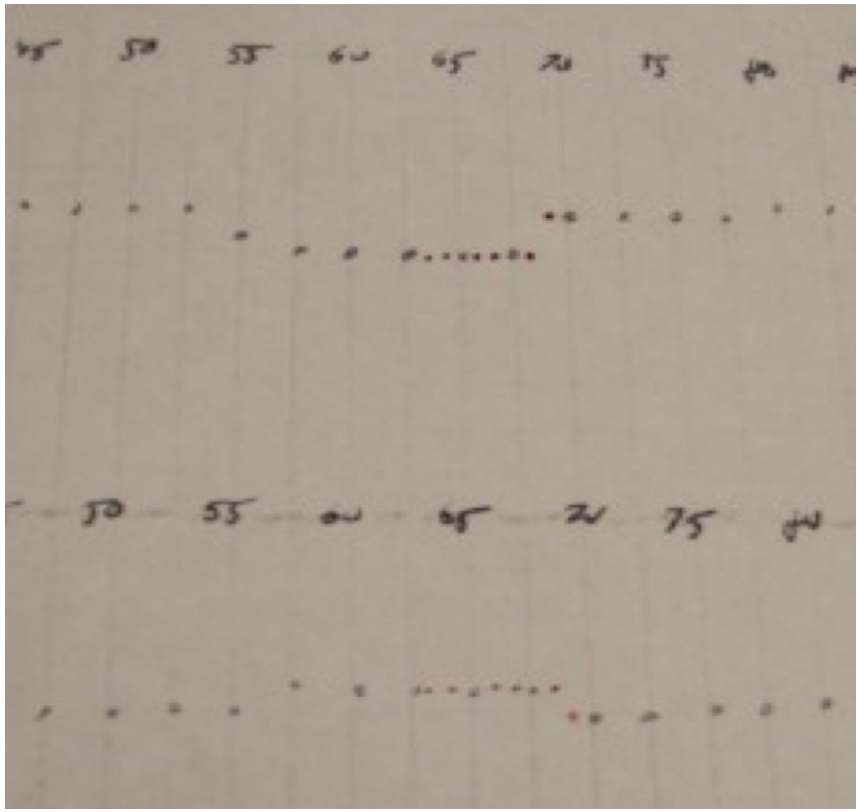
Graph #2

So start graph number two like you did number one with all the titles and all. But since you have wheel 3 going left you will have the other two wheels going right. It would be titled with LOCK TYPE Graph #2 1&2 AR / 3 @ L34.5. This means you are graphing wheels 1&2 with right rotation and wheel 3 is parked at 34.5 with left rotation when you take contact readings. AR means around right.

To graph this you pick up all wheels with right rotation and stop at 0. Then you turn left and pick up wheel 3 from 0 and stop at 34.5. Then you graph your contact points. Next turn right and pick up the wheel from 34.5 and the other 2 wheels at 0 and turn to 97.5. The 1st and second wheel will pick up at the same time so no need to to an extra rotation. You'll get better at is as you go. Then repeat the whole process, turning left to pick up wheel 3, park it at 34.5 and read contact points. Just be careful when you pass by 34.5 and you try to read 32.5. You're going to mess up the wheels so you'll have to reset the first wheel. You can just start at 32.5 instead of 0 to avoid this problem. That is what I recommend. So the whole thing should look like:


STB 6700 trial 132 AR / 3 @ L 34.5 graph #2
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Now, there's not an indication like there was in the last graph. There could be, but here there's not because I'm illustrating a principle to you. Things don't always work as perfectly as they did in the first graph I showed you. Since you are graphing the wheels with RIGHT rotation, you read the graph from right to left. The first graph was AWL so you read it left to right. Gate signatures can vary and can also be directional, as in only read as a gate from one direction. A down and up signature is the most common type you'll get. The next one is where it drops and doesn't rise back up within a reading or two. It can rise back up, but not immediately after. That's the case in this graph. We see after 70, it drops and takes a while to come back up. That is a gate signature. The whole thing is way to wide to be a gate so the gate is going to be right under 70. Amplify your findings and you should have this:



Since gates are usually about 3 increments wide I would choose 67.5 as the gate center not 68. Now do high low test again and find which wheel is indicating. Since we already know 34.5 is the 3rd wheel we only need to do high low tests for 2 wheels not all 3.

Pay attention to the rotation direction. It's different than the first high-low tests we did because this number was found with right rotation. So every time we go to 67.5, it needs to be right rotation.

Low test:
L57.5 R67.5 R67.5 RCP: 6 LCP: 96.5 Contact area: 9 ½
R67.5 L57.5 R67.5 RCP: 6 ¼ LCP: 96.5 Contact area: 9 ¾

L57.5 R67.5 R67.5 RCP: 6 ¼ LCP: 96 ¾ Contact area: 9 ½
R67.5 L57.5 R67.5 RCP: 6 ½ LCP: 96 ½ Contact area: 9 ½

Let's say wheel two indicates like in the example, so now you know the combo is ?-67.5-34.5. Now, just dial in 0-67.5-34.5, 2.5-67.5-34.5, 5-67.5-34.5 and so on until it opens. You can graph this until it opens just in case the lock does not open you have something extra to refer to but usually it's not needed to graph on the final run. If you read Oldfast's chronicles on keypicking.com you know he goes by every 2 increments. This is because it is possible to miss a number every 2.5 increments if it's a lucky s&g 6730. Personally I graph with 2.5 because I know my 6730, even though it has +/- .5 dialing tolerance, it's not that precise and will work with 2.5. With experience, you'll be able to get your own way of doing it.

Let's say in your first graph, the 2nd wheel indicated first and not the 3rd. You would graph the second graph by going all wheels LEFT to 0, right 3 times to 34.5 (actually, not 34.5 but that will be explained later in Rotational Conversion), left twice to 0. Repeat with 97.5 instead of 0.

Basically, you're dialing in a combination each time because the first wheel has to be set, the second wheel has to be set in a different place than the 1st, and then the 3rd wheel has to be set different than the 2nd. If the 3rd wheel reads first, the first two wheels are parked in the same place together so there's no extra dialing for the second wheel.

If the 1st wheel reads first, then it's easy! The 2nd and 3rd wheel can be graphed without disturbing the 3rd wheel at all! If you start at 32.5, you won't pass 34.5 and mess up the first wheel there. This doesn't happen often though. The third wheel is the wheel that indicates most of the time.

Rotational Conversion

Now if you graph with AWR and the 1st or 3rd wheel indicates or you graph AWL and the second wheel indicates first, then you need to make sure you dial to the right number. If the combo is 30-90-60, it's going to be dialed L-R-L traditionally. If you dial it in R-L-R, and then left to drop in area and right to retract bolt, it won't even drop in. The gates will be just barely off from underneath the fence. That's because with each wheel, the width of the fly and drive pins add up and push each wheel off more. The 3rd wheel will be the least affected because there's only the drive pin of the drive cam. The 1st wheel has to deal with the drive cam, fly on the 2nd and 3rd wheel, and the drive pins on those wheels as well.

To fix this, first pick up all wheels and take them to any number. I like 50 because it's far from the contact points and I won't confuse the wheels picking up from the contact points. You can go right or left. In this example I picked up all wheels right. Now start turning left and right before you get to 50, slow down and feel for where the 3rd wheel will pick up. It might be 50 or it might be a bit off. Act like you're feeling for a contact point, be light and gentle. Let's say it picked up at 50.5. So the

first wheel is .5 off. Now go around again and feel for the second wheel being picked up. Let's say that's 51.5. So the 2nd wheel is 1.5 off. Now do the same for the 3rd and let's say It picks up at 52.5. So the 3rd wheel is 2.5 off. I like to write them down like this: .5-1.5-2.5 just so I know which wheel is off by what amount. So for the combination of 30-90-60 L-R-L converting to R-L-R, we start by dialing 30 with right rotation. But we go PAST by .5 to 29.5. This puts the gate centered under the fence. For 90, we go left to 90 and PAST by 1.5 to 91.5. Same thing with the 3rd wheel. Go right rotation PAST 60 by 2.5 to 57.5. Then left until you feel the nose drop in to the drive cam and the turn right to retract the bolt!

Ch. 3: Alternatives

There are different ways to graph and different ways to tell which wheel is indicating rather than using the hi-low method.

Wheel isolation

Hi/low tests are annoying and complicated but the good news is that you don't have to do them! Since wheel 3 indicates most of the time, you can just park wheels 1&2 in the “forbidden zone” (the contact area. It's called that because you're not supposed to set the 3rd number to a number inside it) and then just move wheel 3 through the area you think there's a gate in. If the contact points indicate a gate, then you know it's wheel 3 because nothing else is moving! If nothing indicates, you can do the same for wheels 1&2 separately.

Alternative if 2nd wheel reads 1st

If the second wheel reads first, basically what you are doing is entering a new combination every time you test a number for the 2nd graph. 0-34.5-0, 2.5-34.5-0, etc. The first wheel has to be moved so you end up taking so much time! An easier way is to just put the 1st and 2nd wheel on the gate for the 2nd wheel and just move wheel 3 around. In the first place, wheel 3 usually reads first, if not, the wheel 3 is most likely going to read 2nd. This is way faster and has a high chance of you finding the second gate so I highly recommend you do this. This is what I do when the 2nd wheel reads first in a lock.

Alternative to AWL

The first obvious answer would be AWR, all wheels right. Yup, you can do that too if the lock isn't indicating any gates with AWL. It's just that 2 numbers in the combo are set with left rotation and the 3rd wheel usually indicates first; and the 3rd wheel is set with left rotation. When you set a wheel at let's say, 50, with left rotation, it will be in a different spot that if you set it at 50 with right rotation. I'll explain how to compensate for this later. You can also graph just one wheel such as the 3rd wheel so that you don't have to do hi-low or isolate wheels to find which wheel is indicating because it's the only wheel moving. But again, this is only faster if the 3rd wheel indicates first.

Make it all go faster

If you want to get fast at manipulation, you have to take some shortcuts. Don't graph. It takes WAY to much time! And only take right contact points, the right ones are enough of an indication by themselves because of the slope of the drive cam. Just go AWL and look for a suitable drop, amplify, replace your hi/low tests with wheel isolation (this will be covered later), then move on to the next wheel. Keep going like this. Or if you're ok with some risk, just run the 3rd wheel around with the first two wheels right in the middle of the contact area until you find a gate and then amplify. That way, you don't have to do hi/low testing; you know it's on wheel 3! Repeat for wheel 2. You can get 5-10min manipulations this way!

Ch. 4: Tips and tricks

So the main purpose I wrote all this was to help people with no knowledge of safe cracking. When I started out I had many problems I had that I wasn't sure about and this section is to address those issues for others that might have those problems. If the lock doesn't open:

- High-Low tests: Make sure you are getting the high/low tests right. Put the right wheels on the right numbers and in the correct rotation. Remember: Wheel 1 is the first number in the combination so it is the wheel that's closest to the dial and gets picked up last. Wheel 3 is the last number and gets picked up first. Don't forget that or to use correct rotation.

- Dial accurately: Dial within 1/8 of an increment of where you are trying to park a wheel. It's best if you get EXACTLY on that number. If your contact point feels really faint, here's a technique a guy that goes by the name Datagram taught me. Get close to the contact point and then turn the dial by lightly running your thumb along the dial with just enough friction to turn the dial. When it hits the contact point, it should stop exactly on it. Make sure you DO NOT increase the force otherwise the nose will ride up on the drive cam and you'll get a false reading. This takes practice. Try having the back of the lock open as you do this and look at it/have someone else look for you/or record it so you know just how much force to put on the dial with your thumb. If you have too light of force, you'll randomly stop and think the contact point is there.

- Read correctly: Make sure you are consistent with your readings. This is a big thing. If the increments on the dial are really wide and it's hard to pinpoint exactly where the dial is, tape a needle to the index mark you dial to and a piece of tape tapered to a point on each contact point. This helps greatly with readings since you need to be consistent down to the

1/8 increment. What you see to be 3/8 could be what I see to be 2/4 or vice versa. That doesn't matter as long as you are consistent with all your readings. Another problem is you have to make sure that you are viewing the dial from the same angle! Looking at it from different angles can give you varied readings. You can also tape paper on. This little setup was done in 30 sec and it works well enough to tell that in the picture it's on 8 3/8 not 8 1/2 or 8 1/4.

- Feel consistently: Like I said before: It’s best to use a light touch and make sure that the point you take is right where the nose touches the drive cam. As long you use the SAME EXACT amount of force each time though (even if the nose does ride up on the drive cam a little) then you should still be fine. Not everyone will have the exact same points on their graphs because everyone feels with differing amounts of force, but relatively, the graphs should show the same thing. Graph the first graph with the same combination several times without looking at previous

graphs until you get the same graph every time! That way, you'll improve on your touch. It'll take time but it's worth it!

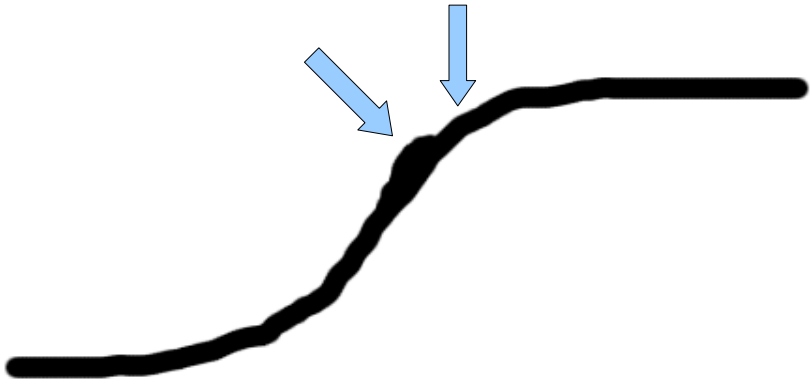
- Taking contact points exercise: If you're having trouble feeling accurately for contact points, there are exercises you can do to improve your touch. If you take the back cover off and put the dial where you think the contact point is, you can look and see if you're riding up on the drive cam or not. A smart phone or a mirror helps with this. Another way would be to have someone else look and see when you touch the contact point and when you think you do. Sometimes if you use too light of a touch, you'll stop before you even hit the drive cam.

- Dial efficiently: In order to save time when manipulating, you have to know how to dial in test combinations without extra rotations. Let's say the contact area is 85-95 and you found the second number in the combination to be 30 and the third to be 50. You dial 0-30-50. For the next test at 2.5-30-50, you rotate left to pick up 0, then when you pass 30, it picks up. When you pass 50, that picks up. So you only have to do one rotation to pick up all the wheels. But if the combination was ?-50-30 then after the fist test of 0-50-30, you turn left from the contact area to 0 and pick up the first wheel, then continue to 50 and pick up the second wheel, and now you have to make a second rotation to make it to 30. So it takes a little more than 2 rotations. Carefully study how the wheels pick up with the back cover off and you'll understand pretty quickly. Also, try to make rotations without having to change your grip as much. Try to do it all in one movement. That saves more time than you would think!

Troubleshooting

-If you can't find any gates: There may be times when you graph but can't find any indications of a gate at all. A reason might be because the lock you are working on has a dialing tolerance of +/- .5 such as the S&G 6730. With these locks, a gate could appear as normal with a 2 increment drop, only a 1 increment drop, or with no indication at all. Now, in the latter two cases, you want to re-graph with 2 increment readings instead of 2.5. This will cause the gate to appear as normal.

-Two contact points on one contact point: Sometimes when taking contact readings, you might come across a situation where the contact point will feel really soft and then you turn a bit more and it's more solid. Sort of like two contact point on one. This can be really confusing but what going on here is that there is a bump on the drive cam. Here's a picture to illustrate what is going on:



The first picture shows a normal right contact point. The second picture is one with a bump. What you're feeling is the bump and then the slope again. The arrows point to the two different parts that you can feel. When this happens you can take either point but you need to make sure you take the same one every time. Some problems might arise if you take the second but much more noticeable one. When a gate is present under the fence, the bump won't matter because the nose will be low enough it won't be scraping by it. Because of this, I take the first reading every time. It just saves on some uncertainty.

-High/low testing isn't working: If your high/low tests are inconclusive and don’t show enough change to accurately indicate which wheel is indicating, make sure you’re doing it right; that all rotations are correct. If you found a gate with left rotation, it ALWAYS has to be set with left rotation. If that’s not the problem, then I would recommend switching to wheel isolation. I would recommend that anyways as it is less complicated and generally faster. Once you find the gate center, park wheels 1 and 2 in the middle of the contact area and move wheel 3 to a couple increments before the gate and then to the center. If there is a

significant drop, then the gate belongs to wheel 3! If not, do the same for wheels 2 and 1. Only 1 wheel should be changing positions, the other two should always be in the same spot in the contact area so the gate can only belong to the wheel that is moving. If none indicate this way, you probably don’t have a gate. Look for another indication or try graphing with AWR or AWL depending on what you started with.

-If all else fails: You want to make sure you aren't following these instruction blindly. You want to think and adapt it. Make sure you always know which wheel is moving and where it is. You have to be able to put the right wheel, with the right rotation, to the number that you want to put it on. One of the biggest mistakes is wrong rotation, or picking up the wrong wheel. That is why knowing how the wheels interact with each other and move is the most important thing. You have to accurately visualize the wheel pack in your mind.

Chapter 5: LaGard 3330, Mosler, and Diebold

As explained, the LaGard has a masking effect or wheel shadowing, whatever you want to call it. This means the graphs will look like it has multiple hills/a giant hill or mountain in it. The reason behind this anomaly is that the wheels are more oval in shape. If you go back and take a look at the LaGard wheel shape, you'll see that little arm on it. The one used to change the combination. It puts pressure on the silver wheel center in one direction only. So that pressure transfers to the other side of the wheel and slightly deforms the wheel into an oval shape. An S&G wheel has two arms and thus cancels each other out quite well.

The first thing to do is to just try to manipulate your 3330 normally. If that doesn't work then move onto these techniques. Because of how the wheels are oval, it makes predicting the general location of where the gate will be easier. The location of the gate and the location of the combo changing arm will always be in the same place in respect to each other. And with the way that the arm deforms the wheel, the gate appears ~90 degrees away from the top of the oval. That's ¼ turn or 25 increments. So, make a graph first with AWL or AWR and find the highest point. The gate for that wheel will be about 25 increments away, either direction. Of course, you still have to find out which wheel that would be. I credit this method to Altashot from keypicking.com. Thanks Altashot!

These next tips help you with finding out which wheel is causing a hill on your graph.

If you couldn't get your LaGard open with the above method, try one of the ones below that matches your situation. Or if you want to learn how

to know which wheel is causing a hill on your graph.

For graphs with one big major hill in it:

First thing, make a first graph and find the lowest point on the graph. I'm assuming you did AWL or
AWR. This means that low point, is a low point for ALL wheels. No wheel has a high point there or else it would not be low. Do something similar to a high-low test now. Put two wheels on that low point and one at the highest point. Do it for each wheel and find contact area. The widest contact area will belong to the wheel that has the big hill. Now put that wheel on the lowest area and graph the other two wheels. Keep doing this to find the highs and lows of each wheel and try to “unmask” the other wheels.

For graphs with multiple, distinct, hills:

Do the same thing as previous but for each hill. Tag each hill to a wheel so you know which wheels to park in which spot to reveal the gates on the other wheels. Put wheels 1&2 on their lowest point and isolate wheel 3 and graph just that wheel. If that doesn't work, try with just wheel 1 or just wheel 2. I prefer to try wheel 3, then 2, then 1. 1 is last because it takes longest to graph that one when isolating it.

Another way!

Take readings every 10 increments and then amplify the lowest point starting from the previously graphed point. Find out which wheel is indicating there with the above methods. Let's say wheel 3 had that point. Graph a second graph with the same 10 increment method while wheel 3 on its low spot. Find another low spot on the graph and the wheel it belongs to. Basically, you're acting like that low point is a number in the combination even though it might not be. Do a third graph with the other two wheels on their low spots. If it doesn't open, put the final wheel on its low spot. You should now have low spots for all the

wheels. Put wheels 1&2 on their low points and graph just wheel 3. They should allow wheel 3 to be graphed. Do this for wheels 1&2 if wheel 3 doesn't show up. Just keep finding lower and lower points and eventually one of them will be an actual gate.

Mosler and Diebold

If you happen to have a group 2 Mosler or Diebold, things will have to be done a bit differently. For Moslers, the drive cam is closest to the dial so the wheels pick up from front to back instead of back to front as in a normal scenario. Just make sure you can account for this and that you always know which wheel is moving and where it is.

Some Diebolds, such as the 177's, have a differently shaped drive cam and nose. The nose is U shaped and so is the drop in area on the drive cam. Some might actually be slightly tilted so that the left contact point is the one that will indicate more of a change. So either take both contact points or be careful that you're taking the correct contact point. When taking only the left contact point, everything else is the same, just make sure to look for a rise on the left contact point instead of a drop on the right.

Acknowledgements

Thanks to everyone at keypicking.com! Especially Oldfast for large portions of information as well as getting me started in this hobby! And to my girlfriend Dayana for the motivation to write this :)

The way I first got started into this hobby was when I was browsing through keypicking.com and I saw a thread labeled “Oldfast safe chronicles” . I was intrigued and took a look. I always imagined safe cracking to need tools or such a crazy amount of skill. Oldfast lays things out in such a simple yet alluring way that I couldn't help but be captivated. Whenever I would hit a roadblock reading other writings on manipulation, either his chronicles or he himself would usually be the way I was able to keep going.

The very first method described on defeating the LaGard 3330 is a method from Altashot. This is not my method. I want to credit him with this and thank him for it as it has greatly helped me and I hope it will greatly help you as well!

I also want to give a shout out and dedicate this book to my girlfriend. She has been such an encouragement that I don't think I would've finished this book without her. People say the best way to learn is to teach and I've found that to be true. Just by teaching her how to manipulate, has opened my eyes to the variety of problems different people might have when learning. Not everyone struggles with the same things and so I have to try and be as thorough as possible to help everyone. So if you find yourself struggling, try to teach a friend or family member how to do this and you'll realize you know more than you think! Thanks for reading this and good luck!

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Number being tested:_____ Rotation: R L

High test:

Wheel tested	Test combinations		
1	_____		
2		_____	
3			_____

Wheel 1- LCP: RCP: Contact area:
Wheel 2- LCP: RCP: Contact area:
Wheel 3- LCP: RCP: Contact area:

Low test:

Wheel tested	Test combinations		
1	_____		
2		_____	
3			_____

Wheel 1- LCP: RCP: Contact area:
Wheel 2- LCP: RCP: Contact area:
Wheel 3- LCP: RCP: Contact area:

Combination so far: _____-_____-_____