

### **Motivation**

Back when I first decided that I was going to try the methods that I put forth in this article, I had a lot of difficulty gathering the information necessary to do the job. It seems that there is a shortage of information on this subject. It appeared to me that most locksmiths and safetechs either knew how to do it or they didn't. I guess they all learned the same way... trial, error. I was told "just practice with a lock in your hand" or "it's hard to explain how to do it" or "it's easy, just dive right in", and so forth.

Well, I did discover that it is as easy as everybody said, once you get the hang of it, but getting the hang of it was the hard part. So I decided to write this article to help others who were still having trouble "getting the hang of it" and hopefully, to fill the void on this subject.

I apologize if any of this information seems too basic for some of you, but it is my intention to offer the information as a basic primer, so that it can be useful to a wide audience with varying experience, knowledge and skill levels. If you are already thoroughly familiar with the material but come away with just one piece of useful information, great! If you (or any of your employees) are not, and it helps you a lot, better still!

### **Why bother?**

The traditional method of drilling through the door to defeat a safe lock is tried and true. There is a lot of information and technology out there (in the form of articles, photos, diagrams, illustrations, tools and templates etc.) that support and lend credence to this method of attack. Yes, it's direct, straight-forward and relatively uncomplicated, ya-da, ya-da, ya-da!

But consider this! We are all as smart as whips (otherwise we wouldn't be locksmiths or opening safes for a living). We are also logical, practical, creative, inventive, pragmatic, extremely adaptive and you know "natural born problem solvers", not to mention, honest, loyal, trustworthy, etc. That's why we get the big bucks, right? We are all getting the big bucks, aren't we? Let's have a show of hands. 1-2-3-4 OK, you can put your hands down now.

The elements of our personalities that were intentionally left out of the above stream of adjectives is another reason for writing this article. Those elements are: "hard working, tenacious, persevering and self-sacrificing".

At a recent A.L.O.A. convention, I was surprised to hear how much resistance there still was to side drilling and scoping change key holes. It's not exactly a new idea, but I've heard far too many comments like: "It's too complicated" or "It's too inaccurate" or "It takes too much time and preparation" or "I don't have or need a bore-scope", especially coming from still-active old timers, bent over from years of hardworking tenacity.

A few years back I said the same kinds of things about manipulation. "It's too hard to learn, it's an art, it's not a science. It requires too much patience and practice", but I did learn to do it, and I keep at it. Although today I am far from world class manipulator, I have had quite a few successes (and failures) but I do see and appreciate the value. I especially appreciate it at the end of the day when I am clean, dry, relaxed and relatively pain-free. I feel the same way about alternative drilling sites and the use of borescopes. It works! Prejudices aside, what ever works will eventually find it's way into my bag of tricks, period!

Frontal attacks have to be carefully planned too. They also require a good degree of research, preparation and accuracy to be successful and profitable. The problem is, that in some cases, they require far too much unnecessary strain and effort. We expend that effort whether we are laboring to freehand-drill an unexpectedly tough piece of hardplate or we're lugging heavy drilling equipment to and from the worksite.

Quite a few of us are advancing in age, wisdom, maturity and experience. We have spent far too many hours needlessly clobbering our bodies and our expensive tools, working out on tough barrier materials. This (as you might have noticed) does take it's toll. It is far from beneficial to our health (unless that's the only exercise you get) or to our financial status (drill bits, rigs, locks and obsolete repair parts are very expensive). So, without appearing to be a slouch, might I suggest taking an easier route, occasionally. You can start out slowly, test the water, see how you like it. It's clean, it's neat and it is much easier than it sounds!

### **Preparation: Plan your attack very carefully!**

The extra time you take researching the job (make/model of safe and the type and mounting of the lock etc.), will be more than compensated for by the ease of the opening (usually no barrier) and also the ease of the repair. So take your time! Measure twice and drill once!

Even aiming right through the edge of a chrome steel door bolt is still easier than penetrating a lot of the tougher barrier materials found in today's doors. A 1/4" or less difference in hole placement might even let you miss a bolt entirely (depending on hole diameter and depth) and still allow you to scope the change hole without too much difficulty.

Before drilling: measure, compare and make sure your scope is long enough to reach from the entrance hole to the change key hole with a little bit to spare. You do have a good, long scope, don't you?

For the height, measure out from the face of the door, vertically in line with the widest part of the change key hole, as determined from dial center (\*see below). For the depth, figure in the thickness of door, air gaps, any barrier materials, mounting plate, lock case (which is 1 1/8" thick on most locks) and the back panel (sheet).

Allow enough depth to get behind the lock or behind the inside door panel. Sometimes there is an air gap of 1/4th of an inch, or so between the back of the lock case cover and the front of the inside panel (sheet). If not, a long screw driver or similar tool may be fashioned and used to bow out the back panel enough to get your scope in between, comfortably, without damaging the tip. Watch out for glass, screw heads, welds, sheet metal parts or cable relocker retainers! Ka-chunk, oops, Damn it!

\*Location of change key hole (relative to center of dial/spindle): S&G, Federal, Ilco, Lagard and similar key change lock footprints, from outside the door, dependent on lock handing.

Mounting:  
RH - 7/16" right and 1/2" below  
TLH - 7/16" left and 1/2" below (true LH lock)  
LH - 7/16" left and 1/2" above (RH lock reverse mounted)  
VU - 1/2" left and 7/16" below  
VD - 1/2" right and 7/16" above

### A "sticky problem"

Don't some of us just love to put those neat little stickers (customized with our company info of course) over the change key hole? They keep out dust and, hopefully, let us know when the end user has been tampering with the lock or trying to save money on D.I.Y. combination changes. Well, you might be able to use a long "L" shaped probe to poke a large enough hole through the sticker to see inside, but good luck. There's nothing like going to all this trouble just to be stymied by the advertising equivalent of a wad of gum. I stopped attaching those things the first time I saw one through a scope. Besides, I find that I get more business from putting a good quality stick-er or metal nameplate on the outside of the container.

### Sometimes you don't even have to drill a hole

On depository and floor safes that have not been installed yet or are in storage or on newly delivered safes, you can sometimes use existing mounting holes and other normally obscured openings in the container for viewing the back of the lock and the change key hole.

Drilling You'll probably be going in from the hinge side or the opening side, but don't rule out a top, backside or even a bottom attack. This may be your only option if there is a non-movable (or un-drillable) wall or obstruction beside the safe. Generally speaking, I've found that you are less likely to encounter obstructions that would inhibit the viewing of the change key hole, from the hinge side or the top.

I strongly recommend drilling a large enough hole to allow for a little up, down and side to side movement of the scope shaft and mirror tube. I like a 5/16" or larger hole. A larger hole is no harder to repair than a 1/4" hole, especially when it's on the side or rear of the safe. Clean out the hole real well, to eliminate any jagged burrs or slag that might damage your scope. Take a look through the hole with a straight view, at first, to get an idea of where any obstructions are and to get your bearings.

Lighting The light transmitted through the fiber bundle to illuminate the change key hole and the wheels is usually not adjustable except when using an expensive variable output light generator and light guide cable. I have found that using the Hawkeye Scope with the Mag light handle, I can vary the intensity of the light (in a very limited way) by screwing or unscrewing the head of the flashlight within a couple of turns. Generally, for scoping the change key hole, very little light is required and the standard Maglite or key-ring light (like those sold by NWS&V Services is more than adequate. I have also found that when using a video system (depending on the lux rating), often less light is required than when viewing directly through the scope eyepiece.

**Scope insertion** After timing and deburring an accurately placed hole of sufficient size, you are ready to insert your scope (initially without 90 degree mirror tube attached) and have a look around. Keep your eye on the eye-piece as you advance the scope into the hole. Once you get past any obstructions and come up on the lock case, mark the scope with a crayon or make a note of the depth and angles. Remove the scope and attach your 90 degree mirror tube or use an articulating scope (if you're lucky enough to have one).

Re-insert the scope and tube using your notes or marks as a guide. Knowing landmarks of the safe, boltwork and lock case will make this easier than it sounds. Remember, the flag opening (narrow side on S&G and Ilco) and the rounded portion (on the Lagard) of the CK hole face away from the bolt. Remember also that you will be seeing landmarks and wheel movements in reverse through the mirror tube. Compensate accordingly.

When you get to the lock case, look for the change key hole. Center it so that you are getting the best possible, straight on view of the hole and fasten your scope in place. With a little practice this becomes second nature. A good way (besides using gaffer's or duct tape) to keep your scope on the mark is to use a pre-made machinists magnetic tool holder and a clamp. Some techs like to use a photographer's light stand or tripod. My first attempt at a holding fixture was made from a goose neck clamp with a plastic coating on the scope clamping end. Later I made a better one out of a flexible arm magnetic base, a 1/4 x 20 screw, a rubber band and a hose clamp. It allows easy repositioning but is extremely rigid. I'm still experimenting!

**GOT VIDEO?** Although not an absolute necessity, a video camera attached to the eyepiece of your scope turns an otherwise awkward job into a real pleasure. It's a whole different ballgame when you are sitting comfortably in front of the dial and looking at the wheels (on a monitor or TV) at the same time. You can go with black and white or color. I like color because differentiating between various viewed objects is a lot easier when you can see them in color. Brass looks like brass, nylon like nylon and zamac like zamac and so on. Try to get a camera with good lux rating. The lower the number the better. The average rating for a good consumer camcorder is less than 1.0 lux (too bad they don't have C or CS couplers). Professional surveillance and scientific equipment will have ratings below 0.05 for B&W and below 1.0 for color cameras.

You can buy a good monochrome camera and monitor for about \$300. Surveillance equipment works well if you don't use the lens. You may have to experiment with different types of mount adapters. The expensive part of this set-up is the camera adapter for the scope (basically a machined, hollow metal flange with a C or CS threaded adapter on the camera end and some sort of clamping arrangement to attach to the borescope eyepiece) which can run in excess of \$200 alone. It is possible to jury-rig or make your own adapter. The distance from the camera chip to the lens of the borescope eyepiece is critical. If you have a focusable borescope, this distance is of only minimal concern.

The photos in this article were taken using my 17 inch Hawkeye, a color video camera (with adapter) and a 150 watt, quartz-halogen light source. They were viewed on a standard TV and recorded to VHS tape on a standard, home VCR. They were captured using a Raster Ops video capture device at 640 X 480 pixels and 72dpi. The photos were printed at 300 dpi using a Textronix dye-sublimation printer, yielding high resolution photos of approximately 11/2" X 2 1/8". As you can see, this kind of setup can render excellent views of the interior of any lock or container but can also be used for training purposes.

### **Terms and abbreviations used in the following instructions**

**Gate (G)** The gate is the opening in the combination wheels that the fence drops into. It's the biggest opening in the wheels, spanning approximately 5 numbers. It's real obvious. It is (on most wheels) exactly 50 numbers away from the changing cam. The most obvious exception is Diebold. Diebold's gate is 40 or 60 numbers away from the changing cam (depending on direction of wheel rotation). The gate is most useful as a window to see the landmarks of the wheel directly behind it. See photos 5 & 11.

**Lever (L)** The mechanism that allows retraction of the bolt when all combination wheel gates are aligned with the fence and the driver gate or notch is aligned with the lever nose. The lever is attached to the lockbolt by the lever screw and is usually spring loaded so that it will drop smoothly and positively when the lock is mounted in any position. If it does not have a spring it is known as a gravity lever.

**Lever nose (LN)** The rounded hooked end of the lever that drops into the driver gate and allows retraction of the lockbolt.

**Fence** (we don't need no stinking abbreviation) The perpendicular part of the lever that drops into the aligned wheel gates. Although it is very important in frontal attacks at the drop, there is not much to say as regards it's role in scoping the change key hole. For the purpose of this subject material, it's OK to ignore it.

**Contact area (CA)** The numbered area of the dial where contact with the left and right areas of the driver gate is felt by the lever nose as you gently turn the dial back and forth (usually around 5-15 on most locks).

**Change key hole (CKH)** The square, arrow or half moon shaped hole in the case cover, through which you are able to insert the change key, when all wheels are correctly aligned for combination changing. (Photo #1)

**Change key tip hole** (I'll only use this term once so no abbreviation is needed) this is a small circular shaped hole on the inside front (closest to the dial) surface of the lock case, opposite the CKH. It's where the tip of the change key goes when it is properly inserted into the change key hole and through the changing cams of all the wheels. It is there to provide a fixed parallel plane with the change key hole and to allow proper horizontal alignment of the change key. This is probably more than you need to know about this. It's mostly important to us as a visual reference to dead center when we have all the changing cams aligned at the CKH. (Photo # 1 & 2)

**Changing cam (CC)** The opening in the wheels that accepts the change key when aligned at the change key hole, which when turned, separates the outer and inner portion of the wheel to allow resetting of the wheel to a new number. These come in an interesting variety of shapes, colors and sizes, especially as viewed through the change key hole. The CC is usually located 50 numbers away from the gate. Diebold's "zero change" changing cam is located 40 or 60 numbers (depending wheel rotation) away from the gate. (Photo #1)

On Lagard wheels, the changing mechanism is an opening in the wheels that accepts the change key and allows wheel separation. I have a lot of difficulty calling it a changing cam, so for lack of a better term let's call it the change key opening. (Photos #2 &12)

The change key opening is a diagonally placed, semi-circular cut-out, with a long (spanning 25 numbers inclusively) horizontally shaped tail. This cleverly designed, tail shaped, cut-out in the flat wheel surface is actually a spring that expands and allows wheel separation when the change key is turned. One end of the tail forms the "change key opening". The opposite is a dead end. (see the lagard wheel map illustration) When you first see the dead end of the changing mechanism, the working end of it will be centered in the CKH in roughly 25 numbers of dial rotation. It's the Lagard substitute for the "lonely rivet". (see below)

These can be very hard to identify for the beginner. The third wheel in many Lagard locks are stainless steel (painted black). This makes them very hard to see. Luckily the black wheel is closest to the CKH. Over all, Lagard wheels have no distinguishing landmarks, other than the gate, balance wheels and changing mechanism. What there is to see will point you in the direction of the changing mechanism once you get used to it.

On S&G, Mosler, Diebold and Ilco style wheels the changing cam is a square hub made of white or yellow metal within a circular cut-out in the flat wheel surface. This circular cut-out is smaller in diameter than the balance holes described below. It is much more easily identifiable than the Lagard type. This type is often referred to as a "change hub". See Photos # 1, 6 &7

**Balance holes (BH)** These are holes formed into the wheels to balance them so they will not vibrate to the open position. They can be used as landmarks and also as windows to see through to the next wheel. Lagard balance holes are significant because there are four of them, all in a row. That gives you lots of opportunities to see through them. Also, if you've gone past four in a row, either the gate (within a span of 8 numbers) or the changing mechanism (within a span of 17 numbers), depending on direction of wheel rotation, is up next (see Lagard wheel map and photo #9). Mosler, Diebold and most other early combination wheels, from various manufacturers, do not have any balance holes at all.

On S&G and Ilco wheels you will only find balance holes on either side of the rivets that are on either side of the changing cam. If you are looking for a changing cam, pay close attention to the balance hole that is immediately followed by a rivet. In about three more numbers you'll see the changing cam come into view.

**Rivets (R)** "let me introduce you to my little friends" Rivets hold the layers of the wheels together. They are usually uniformly placed, made of brass and are easily seen and centered in the CKH. In my opinion, they are the best landmarks to accurately predict what you will be seeing next, as you progress the wheel.

On Mosler, S&G and Ilco wheels you will usually find six rivets on each wheel. There are two on either side of, and in close proximity to both the the gate and the changing cam. There are two more, one each, centered between the gate and changing cam on both hemispheres of the wheel. (See illustration). Diebold wheels also have six rivets but they are positioned somewhat haphazardly, due to differences in wheel construction and the unusual (zero change) changing cam placement. Unfortunately, you will find that rivets are conspicuously absent on Lagard wheels.

Basically on S&G, Ilco and Mosler, if you see a rivet that is all by itself, for more than a few increments without seeing anything else, then the place that you first saw that rivet centered in the CKH is exactly 25 numbers away from either a gate or a changing cam. Pay close attention to where those lonely rivets are! They can shave quite a few minutes off your time. They are "my little friends" and they are there to help you too. (Photo #8)

**Change index (CI)** The index on the dial ring that you dial the first three (or more for a 4 wheel lock) opening numbers to, when you want to align all the changing cams with the CKH for the purpose of changing the working combination. No CI? I wonder why?

**Opening index (OI)** The index on the dial ring that you dial the opening numbers (working combination) to, when you want to open the lock.

**Driver (D)** The driver or drive cam is the part of the combination lock that connects directly and absolutely with the dial and spindle and transmits rotation to the wheel pack. The lever nose drops into a cut-out (or gate) in the driver (when all wheel gates are aligned under the fence) to allow and facilitate retraction of the lock bolt.

**Wheel # 1 (W#1)** The combination wheel that is furthest from the driver. Usually (in a rear drive lock) this wheel is closest to the dial. Normally, It's read last.

**Wheel # 2 (W#2)** The combination wheel between W#1 and W#3. In a rear drive lock, it is read second after wheel # 3.

**Wheel # 3 (W#3)** The wheel closest to the driver. It is viewed through the CKH directly (in a rear drive lock), without moving any other wheels other than the driver. It is read first.

If the lock is a front drive type, the process of reading the wheels through the CKH is simplified, as you are reading them in the same order you would dial them to open the lock.

**Reading:** Accurately reading the landmarks will help you to find the gate or changing cam faster. Take your time. It's certainly no harder than reading the depths of a wafer lock or the impression marks left on a properly prepared keyblank. Studying the wheelmaps and photos in this article will prepare you to identify and use what you will soon be seeing through your scope or on the monitor screen.

Accurately aligning the change key cams with the CKH, once you've found them, is the next step to a quick opening. With a gate or change cam at the CKH, take readings from the CI. A gate (in most cases) is 50 numbers away from the CC, so if you're reading a CC, the true number appears at the CI. If you're reading a gate, the number at the CI is 50 numbers off from the true opening number. Example: seeing a wheel gate at the CKH and 46 at the CI means that that wheel is set to 96. Dialing that wheel to 96 at the CI will allow you to see a changing cam at the CKH.

Trying to read a gate is a lot harder because they are wider than the changing cam and harder to center. It is rare that you will get an accurate opening number from a gate. Use the gate as an approximation and then dial that wheel 50 (or for Diebold 40 or 60) numbers off, to bring the changing cam into view and then center it to determine a more accurate opening number.

### **Dialing and reading procedures simplified:**

#### **Step 1.**

Start by reading the 3rd (closest to the driver) wheel first. This is obviously the easiest because you are viewing it directly and not having to move any other wheels to do it. Record the true opening number (taken from the change index when the changing cam is aligned perfectly with the CKH. You now have the opening number for wheel # 3. Next add or deduct 50 from this number. This will be the number that you dial wheel #3 to each time, after your incremental progression of wheel #2.

This aligns the gate of wheel #3 with the CKH so as to make viewing W #2 easier. It also allows you to progress the wheel in larger increments because you can see more of the wheel through the gate than you can through the changing cam. Just slow down (move the wheel in smaller increments) when you see something that indicates that you might be approaching either a CC or a gate.

#### **Step 2.**

Next, park wheel #1 at a random number by dialing 4 times left to 20 or whatever. Next dial wheel #2 (two times right to the same random number that wheel #1 is set on. Next, in increments of 2 numbers move wheel #2 around right and then dial the third wheel one turn back left to align the gate with the change key hole (50 numbers off from the true opening number as determined above). Continue this cycle of wheel rotations until you have the changing cam for the second wheel perfectly aligned with the CKH. Determine the opening number for wheel #2 at the change index. Add 50 to this number. This number will be used to position wheel #2's gate at the CKH to read W #2.

#### **Step 3.**

Dial wheel #1 4 times left to your random number as above. Next dial the known numbers of wheels 1 and 2 the appropriate number of turns (50 numbers off) so that the gates of wheels 1 and 2 appear at the CKH) and observe wheel #1 through them. Continue this cycle in 2 number increments (or larger if you are comfortable with it) until you have the

Changing cam of wheel #1 aligned at the CKH at the same time as the gates of wheels 2 and 3. This is wheel #1's true opening number.

#### **Step 4.**

Convert the numbers for wheels 2 and 3 back to the true opening numbers by adding 50 to them. Once you have all three true opening numbers, dial them to the change index to align all the change cams at the change key hole and check for proper alignment. Adjust the numbers as necessary. This step will eliminate a lot of over and under dialing, later on. You should be able to see the change key tip hole in the back of the case, centered through all three changing cams. It's a good idea to leave your scope lined up with the change key-hole until the lock bolt retracts.

Once you are satisfied that you have correctly determined the true opening numbers, dial them to the opening index. Barring any other unforeseen problems, you will be rewarded with the satisfaction of the lock bolt retracting and the handle turning, often on the first try. **\*Don't get carried away and forget to remove your scope before opening the door.** CRUNCH!!! \$1200....ka-ching! Thank you for your new borescope order.

Wasn't that easy? If it hasn't opened, try rapping the door near the lock or oscillating the dial at the contact area to align any slightly misaligned gates under the fence. If that doesn't do the trick, you will have to go back and look at your alignment again and compensate by under or over-dialing each wheel.

After thoroughly familiarizing yourself with the construction of the different brands of combination wheels, the landmarks will become easily recognizable, allowing you to predict when the changing cam or gate is getting close to the CKH during your progressions. This familiarization makes the job go a lot faster. In the beginning or for unfamiliar locks, it will help you to have the same brand and model lock (with wheels exposed by a cut away or with the back cover removed) at hand, to refer to. Refer to my "wheel map illustrations" to help you determine the landmarks.

It takes practice to learn to dial the wheels backwards, forwards and independently and also to align the changing cams precisely enough to get exact opening numbers, especially through a scope that may not be positioned opt-ically or when viewing through a mirror tube. After practicing on a couple of locks it will become second nature. You will wonder what all the fuss was about.

#### **Variations on a theme:**

Zero change locks: These locks align the changing cam at the CKH when the opening number is at the opening index. On these locks you will not see a change index, unless a dial ring from another lock has been modified and used in place of the original, for some reason. If you are sure of your alignment and the safe doesn't open when dialing you numbers to the opening index, dial them to the "change index" and then turn back to the contact area to see if the lever drops. If it does, you have a zero change lock with a false change index. You must now redial each number to the false change index and note the numbers that appear at the opening index to determine the true opening numbers. Remember Diebold changing cams are located 40 numbers clockwise away from the gate. In other words, if you see a gate lined up with the CKH at 60 the changing cam will show up at 20 instead of 10. (See wheel maps).

Not seeing a change index doesn't necessarily mean that you have a "zero change lock". Mosler dial rings do not have a change index because it is required that you set the combination 10 numbers higher at the opening index. Sometimes you will find a home made change index filed or otherwise marked on the Mosler dial rings. "25 + 10 = 45, doesn't it, George?" "Duh.... I don't know, Lenny."

Front drive locks: Some lock manufacturers have the driver in front of the wheel pack (towards the dial), instead of at the rear, as discussed above. This makes the process of reading the wheels even easier. Having the driver in front means that you are determining each wheel directly, in order of it's normal dialing sequence and direction of rotation. You will be seeing the changing cams of wheel #1 lining up closest to the change key hole, then wheel #2 and then wheel #3.

Some locks that have this arrangement are: key changeable versions of the Mosler 302 and CD120. Another is the Diebold 180-55 rotary, found on lug door chests. "Through the CKH" observation of which wheels move when, will tell you whether it's a front or rear drive lock.

Watching a dialing cycle through the CKH can provide a wealth of information, whether you're simply changing a known combination on an open door or you're opening the lock by scoping the CKH. Pay close attention!

#### **Way Cool Bonuses of using alternative drilling sites:**

Bonus #1

Alternative drilling sites and scope reading can also be used to scope the actual wheel windows, as found on hand change locks on some insulated files and metal cabinets (Cole Steel Equipment etc.) and some of the older Sentry boxes with small case locks, that are harder to manipulate than the direct entry type. It's sometimes even easier than scoping change key holes because some of these are front drive locks and you are aligning the wheel gates, in order, directly at the drop in, through the window, as you dial.

It's a lot less messy than going in through the front, for a direct look at the drop in. It also beats the hell out of angle drilling or transferring. The repair job is a lot easier as well, especially if it's an obsolete lock or has difficult to replace, decorative trim on the door. Filler and a small dab of JB Weld and paint will take care of a side hole on a Sentry or import. A pop rivet or hardened sticker is all you'll need on the "Cole" style cabinets.

#### Bonus #2

Reading the manufacturer's reset code number on digital-electronic safe locks that have them, such as on S&G 6120 series and the older style Lagard 3600 with the flat, 8 conductor keypad cable and RJ-45 connector.

#### Bonus #3

Assuming no malfunctions, you can also open a lock without knowing the handing, by marking (outside the dial ring) 1. the opening index. 2. A hole location number (it can be any number you like (say 25) and 3. A new change index mark that is exactly 180 degrees (50 numbers) opposite the hole location number (75). Pull the dial and remove the dial ring. Draw a thin, straight line that intersects the center of the spindle hole, your new change key hole location number and your new change index mark.

Next, drill a 1/4th inch hole through the door, 5/8ths of an inch out from the center of the spindle, at the new CK hole location you chose (11/16" X 25), and stop at the lock case. Then switch to a nice, sharp, flat-end 1/4" bit to penetrate the lock case slowly and with almost no pressure, so as to minimize burring. Be sure to stop before even touching a wheel. Next, align all the changing cams with the "new change key hole" you drilled by turning the spindle. This is much easier, from the front, as the wheels line up in order. Unlock all three wheels using a modified change key or a piece of 1/8th inch half round (for LaGard) or square stock (for S&G/Ilco) and very carefully reset all the wheels using the spindle spline (aligned with your new change index) as the number, to 4 X left. Then relock the wheels.

Assuming a dial which is splined at 50, all your wheels will now all be set to "50". Next, dial the spline 4 times left to your opening index mark, then turn the spindle right to stop. Even if you were a little bit off on your alignment, it's still a much simpler matter to dial all three wheels together, high or low, until the bolt retracts.

\*\*\*\*\* END \*\*\*\*\*

### **List of photos and illustrations for this article:**

#### Photos:

1. Ilco/S&G CKH (all CC's lined up)
2. Lagard CKH ( all CKO's lined up - close)
3. Diebold CKH
4. Mosler CKH
5. Lagard gate and BH through CKH
6. Diebold CKH (close-up)
7. Mosler CKH (close-up)
8. Ilco/S&G (the lonely rivet)
9. Lagard CKH (BH and Gate, close-up)
10. Ilco/S&G (rivet between BH and CC)
11. Ilco/S&G CKH (rivet and gate)
12. Lagard CKH (showing all CKO's lined up and tip hole)
13. Lagard back cover and CKH (also showing CKO's aligned)

#### Wheel map illustrations:

- A. S&G/Ilco type Wheel map
- B. Lagard Wheel map
- C. Diebold Wheel map
- D. Mosler Wheel map

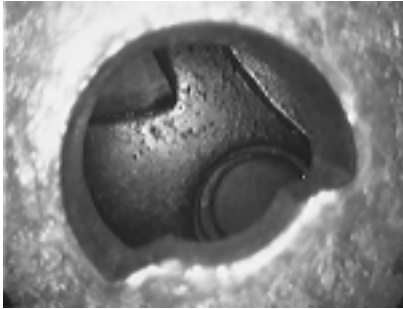
# Photos of change key holes and important landmarks

For "Alternative Drilling Sites and  
Scoping The Change Key Hole"

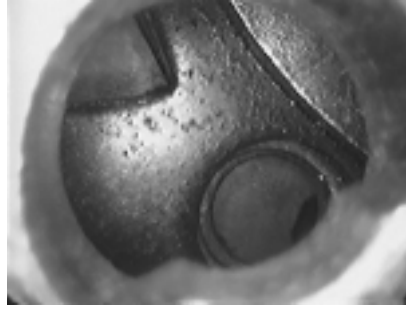
© 1999 by Ken Doyle All rights reserved



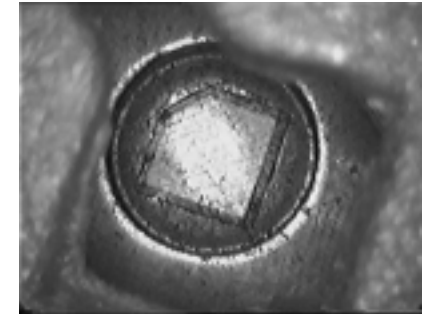
**Diebold CKH**



**LaGard Gate & BH**



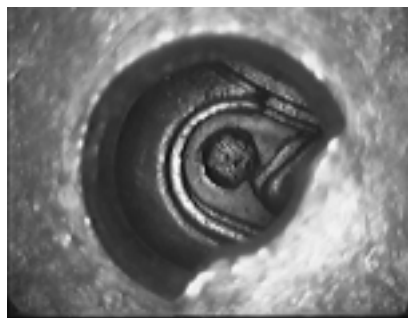
**LaGard gate & BH-close**



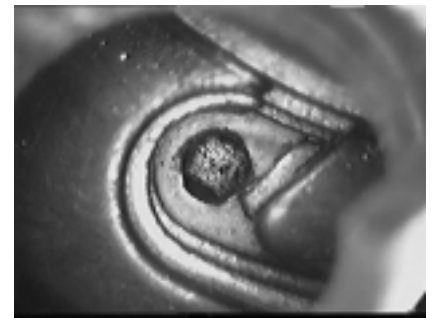
**Diebold-close**



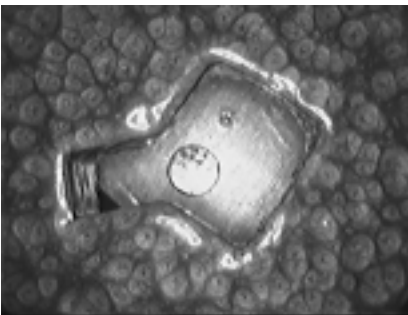
**Lagard CKO's**



**Lagard CKO's & tip hole**



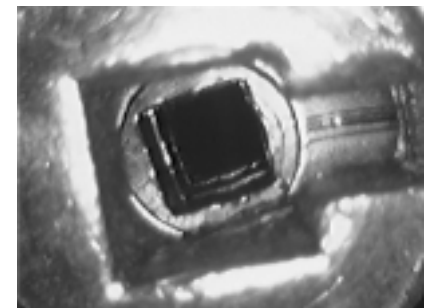
**LaGard-close**



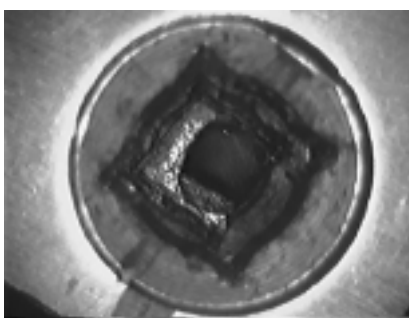
**Ilco/S&G Lonely rivet**



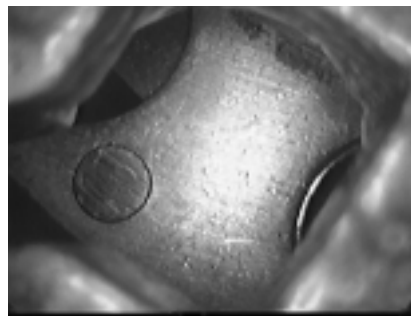
**Mosler CKH**



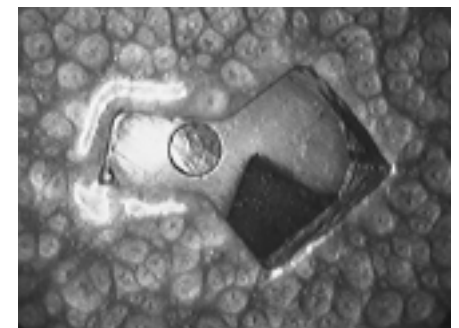
**Mosler CKH-close**



**Ilco/S&G-aligned**



**Ilco Rivet between BH and CK hub**



**Ilco/S&G Rivet & Gate**