Simplex 5-button combination locks (*Hobbit*'s in-depth evaluation)

This deals with the Simplex or Unican 5-button all-mechanical combination locks. They are usually used in a variety of secure but high-traffic applications, and come in a number of flavors: dead bolt, slam latch, lock switches for alarms, buttons in a circle or a vertical line, etc. The internal locking works are the same across all of these. Herein will be described the mechanical workings and a method of defeating the lock that falls out by logical inference and observations from playing with it.

The internals

Caveat: If this seems unclear at first, it is because the absolutely best way to understand the inner mysteries is to take a Simplex lock apart and study it. It is highly recommended that the reader obtain and disassemble one of the units while studying this; otherwise the following may be confusing. The locking mechanism box is swaged together at each end, but it is trivial to open up without destroying it. To set a lock up for study, remove the back, leaving the front plate held on by its Jesus clip. Put a spare thumb turn down over the shaft so you have something to grab. Take care not to lose the button connecting pins; they drop out.

In the round configuration, the buttons talk via bent bars in the faceplate to the same vertical column as the straight ones. Thus all buttons henceforth shall be referred to as if they were in a straight vertical row, numbered 1 to 5 reading downward. The actual locking mechanism inside is a small metal box, about 3 inches high and .75 x .75 inch across the base. It contains five tumblers, one corresponding to each button, a common shift bar, and a couple of cams to handle reset and unlocking. The user dials the combination and turns the handle to the right to open the lock, or to the left to reset any dialed digits if he made a typo. If the proper combination has not been dialed yet, the shaft will not turn to the right. Setting a combination shall be described later. Some of the linear-style locks are actually made by Unican, but have the Simplex box inside. For these, a clockwise twist serves as both open and reset. There is a detent plate and a screwy lever system; if the lock is not open yet, the lever cannot turn to the *box*'s right. The detent slips, allows the levers to shift the other way, and the box arm is then turned to the left. If the detent does not slip, it's open, and the plate locks to the latch shaft and pulls it back.

Each of the five tumblers has six possible positions. Each button does nothing but push its corresponding tumbler from the 0 position to the 1 position. Therefore, each button can only be used once, since once the tumbler has moved, the button has no further effect. The trick comes when *subsequent* buttons are pushed. Each button press not only shoves its tumbler from 0 to 1, it also advances any "enabled" tumblers one more step. When a tumbler is enabled, its corresponding gear has engaged the common bar and pushed it around one position, so the next button press will do this again, thus taking previously enabled tumblers around one more notch. This way, the further-in tumbler positions can be reached. It can be seen that there are undialable combinations; for instance, only *one* tumbler can reach position 5 for a valid combination [Positions labeled 0 thru

5, totalling six]. If one sits down and figures out possible places for the tumblers to go, many combinations are eliminated right away, so the number of possibilities is *not* 6^5 as one might expect. Two-at-once pushes are also valid, and are *not* the same as pushing the given two in some other order. Pushing two [or three or ...] at once simply enables two tumblers at once and shoves them to position 1 at the same time. [This of course leaves less buttons unused to push them in farther!] The tumblers themselves are small round chunks of metal, with gear teeth around the top half and a notch cut into the bottom edge. When all these notches line up with the locking bar, the lock is open. The tumblers are mounted on a vertical shaft so they can spin, with the locking bar fingers resting against the bottom of each one. The locking bar is prevented from rising if any notch is turned away from it. Juxtaposed to the tumblers is another shaft containing idler gears, which in turn talk to the common bar in the back. The intermediate shaft slides up and down and makes combination changes possible. Note: The buttons actually talk to the idler gears and not the tumblers themselves. This is necessary since during a combo change, the tumblers cannot move because the locking bar teeth are sitting in the notches.

[Editor's note: Simplex locks are set at the factory with a default code of (2-4), 3. This is often not even changed.]

Combination change, other random facts

Once you know the current combination, you might want to change it. Instructions for doing this undoubtedly come with the lock; but it's real easy. There is a screw in the top with a hex hole; remove this from the lock body. Dial the proper combination, but don't move the handle. Press straight down through the hole with a small screwdriver, until you feel something go "thunk" downward. The lock is now in change mode. Reset the tumblers [leftward twist], enter your new combination, twist the handle as though opening the lock, and your change is now in effect. Re-insert the screw. This does the following: The thing you hit with the screwdriver pushes the tumblers down onto the locking bar [which is why the proper combination must be entered], and disengages them from their idler gears. Button presses turn the *idler* *gears* around, and then the opening action shoves the tumblers back up to mesh with these gears in their new positions. A subsequent reset mixes the tumblers up again to follow the new combination. This description is admittedly somewhat inadequate; the right thing to do is take one of the locks apart and see for one's self what exactly happens inside.

The Unican model has a disk-locked screw on the rear side. Removing this reveals a round piece with a flat side. Twist this clockwise to enable change mode as in the above. This lock, of course, would be a little more secure against random people changing the combination for fun since you ostensibly need a key to get at it. Keep in mind that "reset" on these is done by turning the knob all the way *clockwise* instead. There is a linkage that ensures that the shaft inside goes counterclockwise for the time that change mode is enabled.

It is amusing to hear local locksmiths call the Simplex internals a "computer". It would seem that none of them have taken one apart to see what is really inside; the box is painted black as far as they are concerned and non-openable. Obtaining one is the unquestionably best way to learn what's in there. Unfortunately they cost on the order of $120, a price which clearly takes advantage of the public's ignorance. These locks are *not* pick-proof after all, and anyone who maintains that they are is defrauding the customer. There are a variety of ways to increase the picking difficulty, to be discussed elsewhere. Your best bet is to borrow one from somewhere for an evening and spend the time learning its innards.

Determining an unknown combination

Contrary to what the marketing reps would have you believe, the locks can be opened fairly quickly without knowing the set combination and without damaging the lock. Through a blend of a soft touch, a little hard logic, and an implicit understanding of how the locking mechanism works, they generally yield within five minutes or so. [There are *always* exceptions...]

This method requires that one does not think in terms of a sequence of button presses. One must think in terms of tumbler positions, and simply use the buttons to place tumblers where desired. For practical description purposes, it will be assumed that the buttons connect right to the tumblers, rather than the idler gears that they really do. The idler gears are a necessary part only during combination changes. Unless you are doing a change, considering it this way is pretty close to the facts. Remember that a 0 position means the button was never pushed, and 5 is enabled and shifted as far as possible.

Turning the thumb handle to the right [clockwise] raises the locking bar against the tumblers. Since the lock is never machined perfectly, one or more tumblers will have more pressure on it than other ones, and this shows up as friction against it when it is turned via the button. This friction is felt in the short distance between fully-extended and the detent on the button [the first 2 or 3 mm of travel]. Some will travel easily to the detent, and others will resist efforts to push them in. Suppose you are twisting the handle, and tumbler 1 has lots of pressure on it [you can feel this when you try to push button 1 in]. When you back off the tension on the handle a little bit, the button can be pushed in against the resistance. The fact that the button has resistance at position 0 tells you that tumbler 1's proper position is *not* 0, or there would be no pressure if the notch was there! Upon pushing button 1 in, you find that no pressure has appeared at any other button. This eliminates position 1 for tumbler 1, also. Now, how do you get tumbler 1 to different positions so you can test for pressure against other ones? Push subsequent buttons. Push any other button, and tumbler 1 advances to position 2.
Ignore what the other tumblers are doing for the moment. Now, perhaps another button has some resistance now. This means that tumbler 1 is either at the right position, or getting close. Basically you are using other tumblers to find out things about the one in question. [Keep in mind that the first one with friction won't *always* be tumbler 1! Any tumbler[s] could have the first pressure on them.] Continuing, push another "don't care" button. A "don't care" button is one that is not the one you're trying to evaluate, and not the one that recently showed some friction. What you want to do is advance

tumbler 1 again without disturbing anything else. Did the pressure against your test tumbler get stronger, or disappear? If it got stronger, that points to an even higher probability that tumbler 1 is supposed to be at 3, rather than 2. If the pressure vanished or became less, 1 has gone too far, and you were safer with it at position 2.
Let's assume that the pressure against your test tumbler increased slightly when tumbler 1 was at 2, increased even more when tumbler 1 was at 3 and vanished when you pushed it onward to 4. Reset the lock. You now know the proper position of tumbler 1 [that is, whatever tumbler first had pressure on it]. You've already drastically reduced the number of possible combinations, but you aren't finished yet.

You can now eliminate positions for the next one or two tumblers the same way -- but to set things up so you can feel the pressure against these, you must ensure that your newly-known tumbler [1 in this case] is in its proper position. It is useful to make a little chart of the tumbler positions, and indicate the probabilities of correct positions.