Physical Security

Breaking and Entering:

a Tutorial

What will be covered

- Common security measures
- How to defeat them
- How to improve them

What will **not** be covered

- Hacking into the mainframe

Focus

"Any problem on Earth can be solved with the careful application of high explosives."

- Three types:
  - Surreptitious
  - Covert
  - Forced

I do teach explosives:
Tonight at **6** in **26-204**

Something to Remember…

- Never lose sight of the big picture:
  - Your goal is not to pick the lock
  - Your goal is to gain access

Social Engineering

- People like to talk
- People make mistakes
- Catch Me If You Can

Methods of Influence

- Ethos
- Pathos
- ~~Logos~~

Ethos

- Ethos
  - Acting
  - Lying
  - Confidence

Example:
Pretending to be an employee

Pathos

- Pathos
  - Sympathy
  - Trust
  - Power

Example:
Asking a favor of the janitor

Social Engineering is Powerful

- Any security measure can be defeated by a sufficiently skilled social engineer
- It is the most general method I will cover

A Building

- Goal: Gain access
- Problem: The **structure** of the building physically blocks you
- Find **vulnerabilities** in that structure

Structure

- Ducts

Structure

- Ducts
- Drop ceiling

Structure

- Ducts
- Drop ceiling
- Windows

Structure

- Ducts
- Drop ceiling
- Windows
- Gaps, above and below

Structure

- Ducts
- Drop ceiling
- Windows
- Gaps, above and below
- Utility shafts

Structure

- Ducts
- Drop ceiling
- Windows
- Gaps, above and below
- Utility shafts
- Doors

Breaking In

Skills

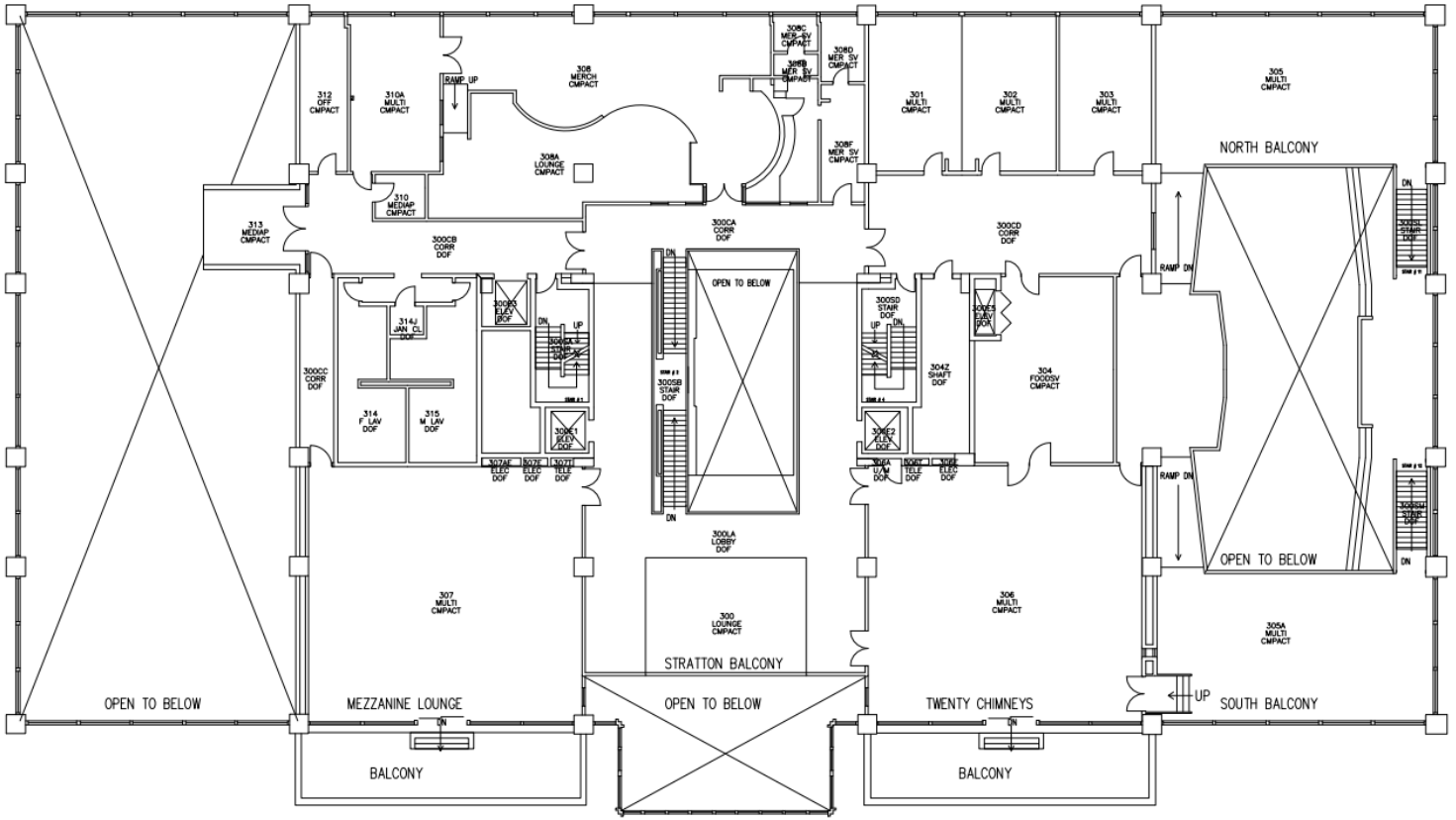
- Climbing
- Crawling
- Being a ninja

Tools

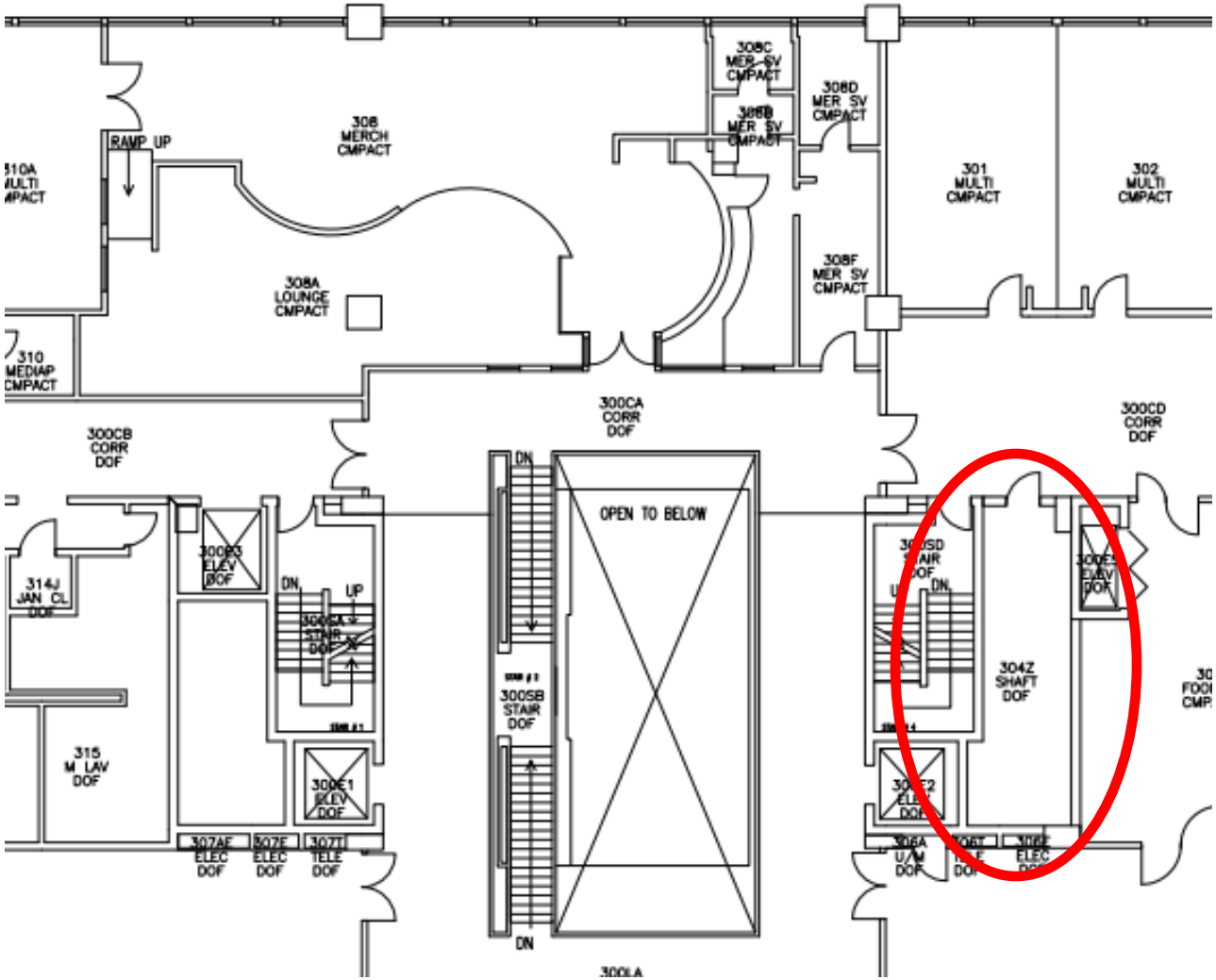
Screwdriver
Pliers
Knife
} Multitool
Headlamp

Breaking In

Floorplans



Breaking In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307TI
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DOF
306A
U/M
DOF

Doors

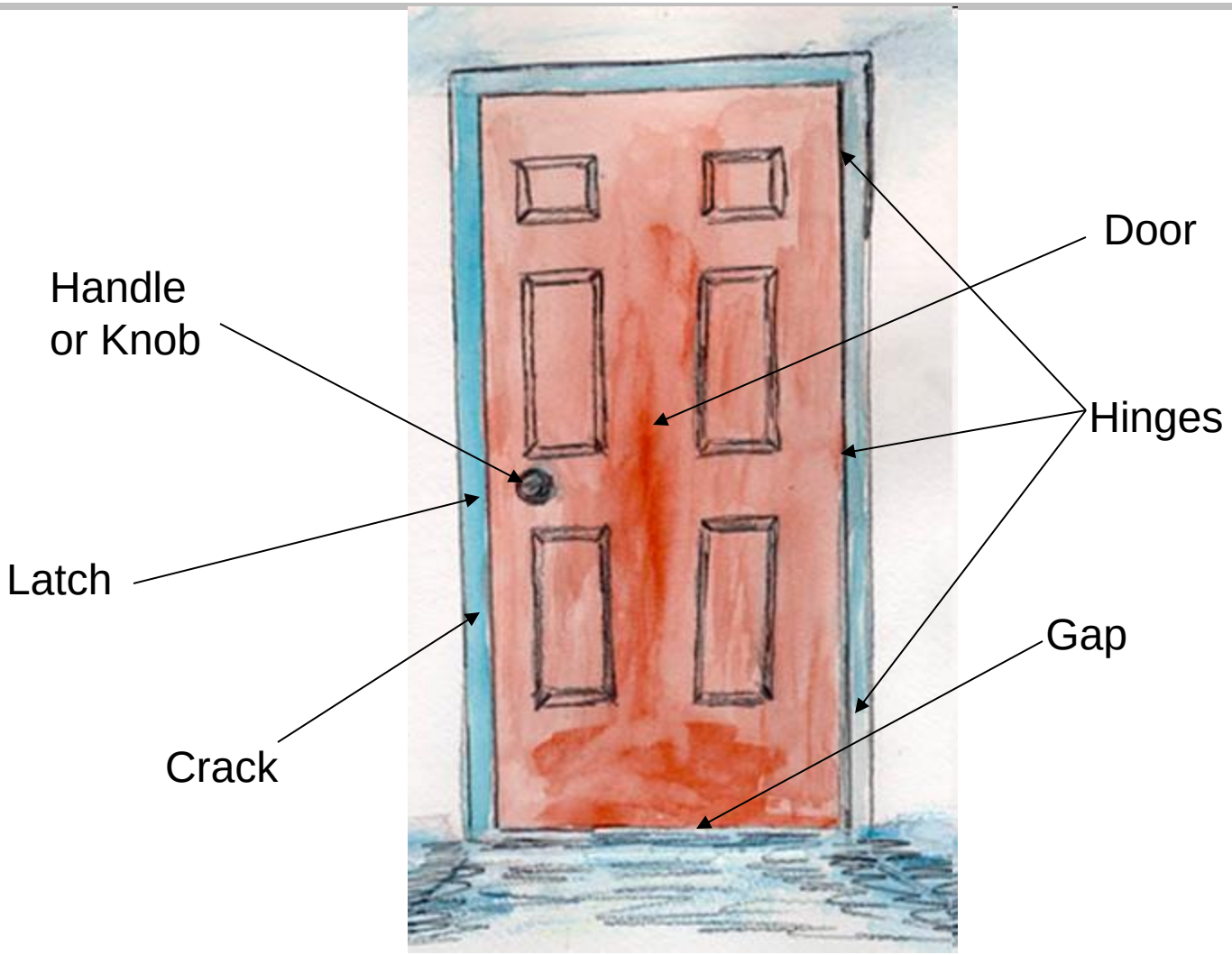
- Goal: Get through a door
- Problem: **Latch** prevents door from opening
- Find **vulnerabilities**

Compromising Doors

Q: What is the easiest way to get through a door to a secure area?

A: Walking through it

Doors



Breaking In

1. Walk through an open door
2. Get somebody else to open it
   - Knocking
   - Door surfing
3. Pull on it
4. Turn the handle

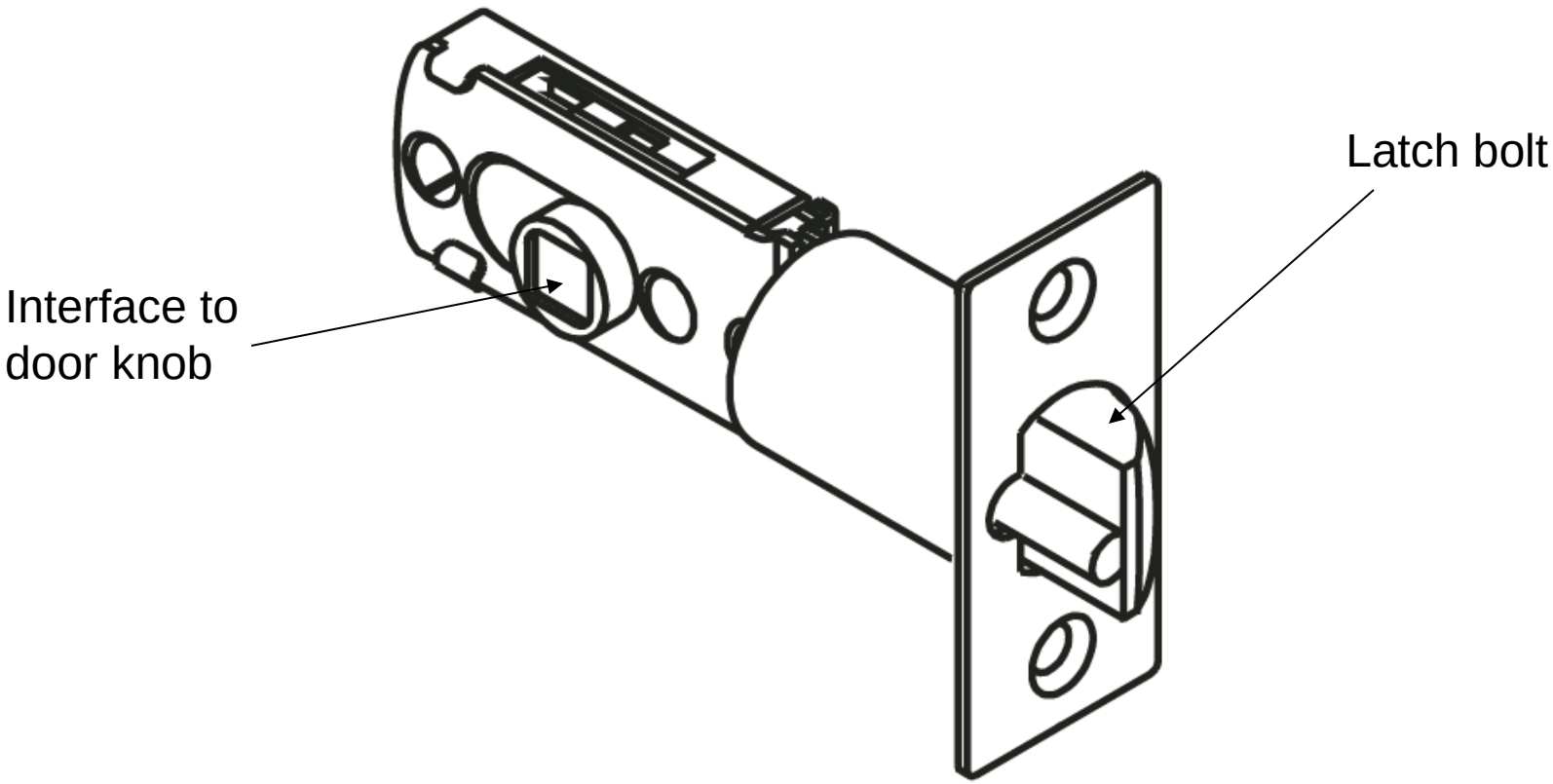
Okay, I've tried all of those
→ Exploit poor installation

- **Crack**: Prying it wider
- **Latch**: Carding and Sliding
- **Gap underneath**: Reach through and open from the inside
- **Hinges**: Removing the pins
- **Other features**: Exposed screws, vents

Card and Slide

- Exploits friendliness of latch

Latch



Spring latch

- Apply pressure to the end of the bolt
  - Or the angled face
- The bolt will retract
  - As if the door were closing
- The door can be pulled open

Dead bolt

- Does not have an angled face
- Is not susceptible to end pressure
  - Will not retract if you push on it

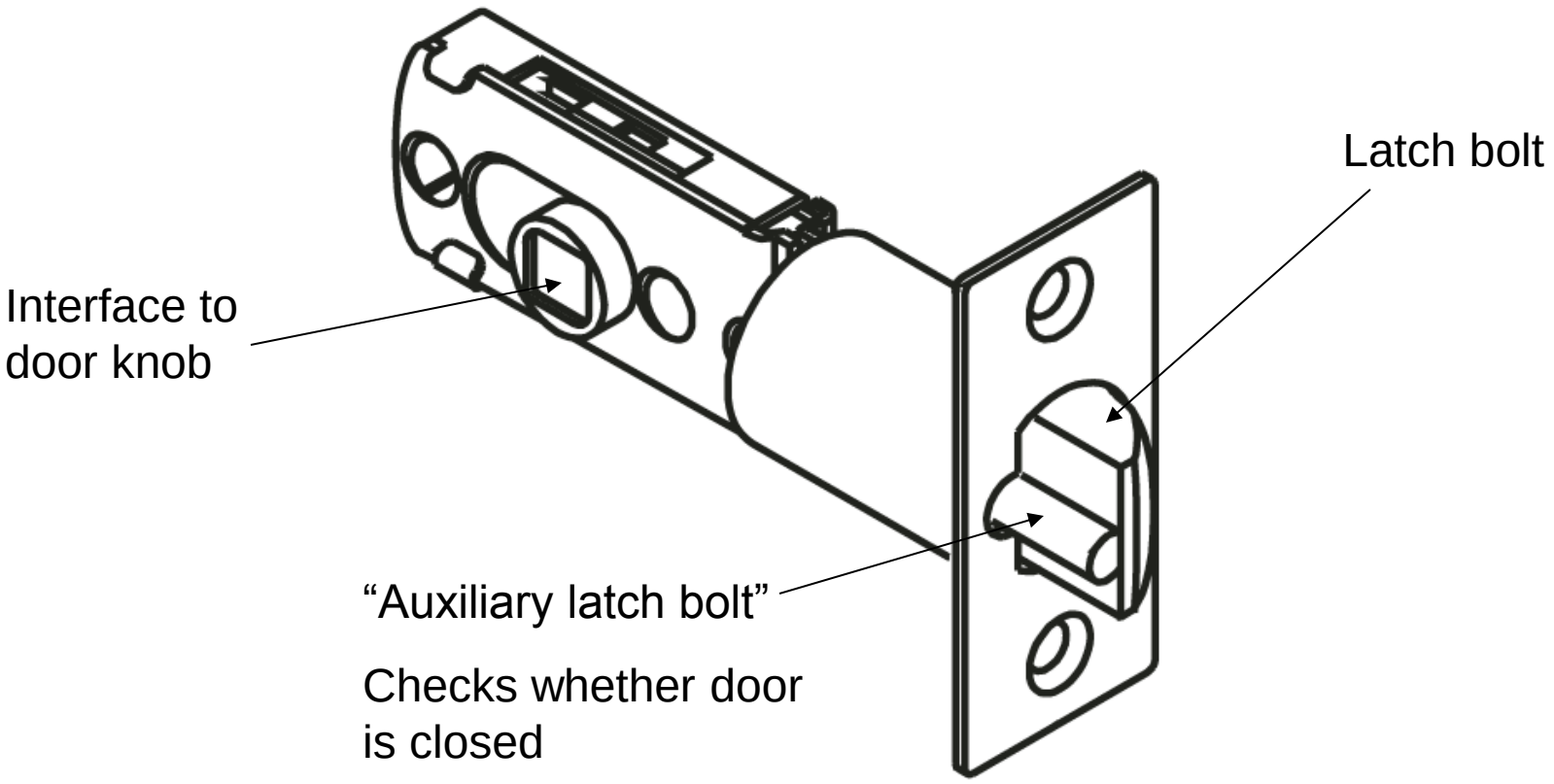
- Not susceptible to carding or sliding

Dead latch

- Combines both ideas
- Will retract freely when the door is open
- Will not retract when the door is closed
  - Except by the handle

- Not susceptible to carding or sliding
  - Unless it is broken or installed incorrectly!

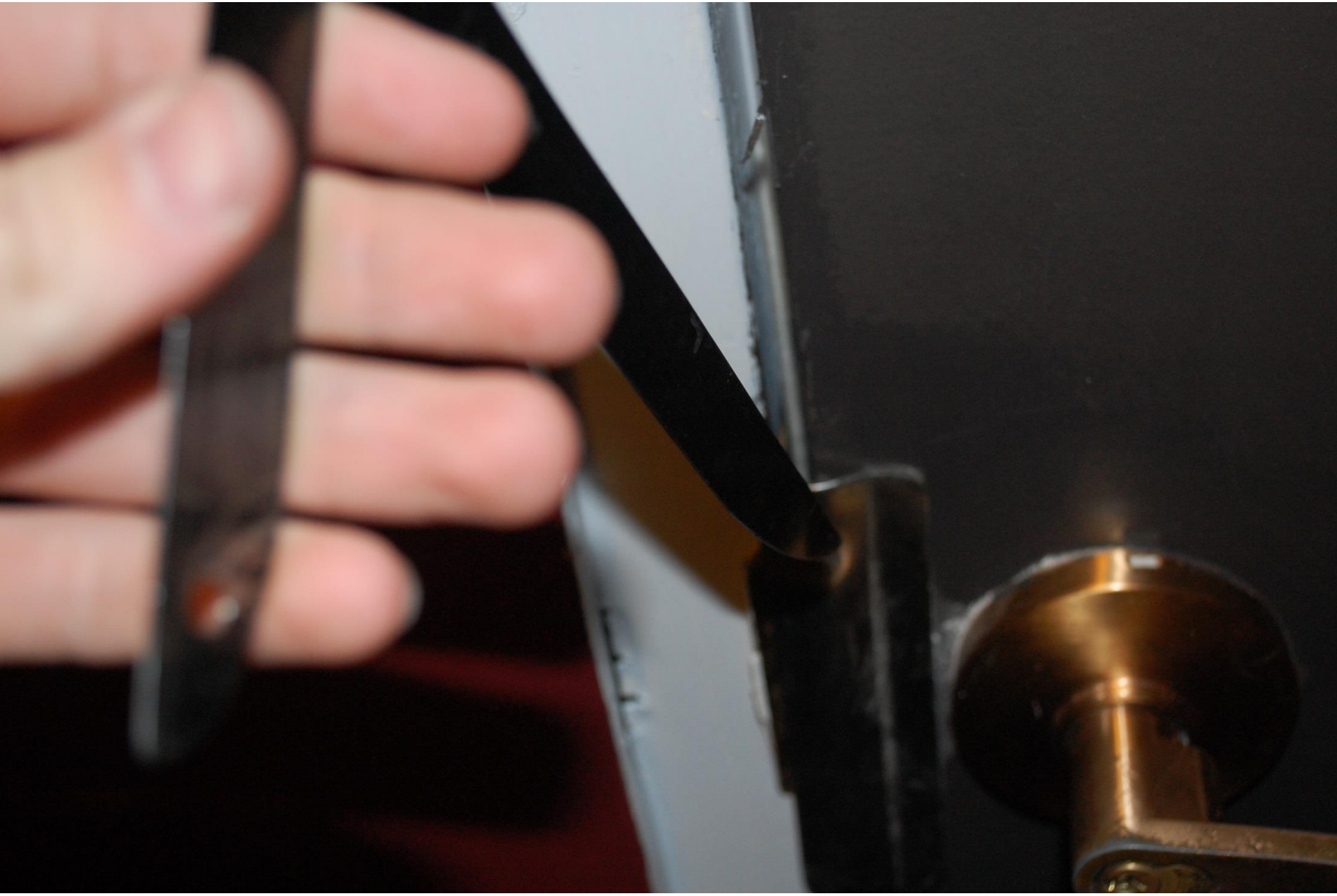
Latch

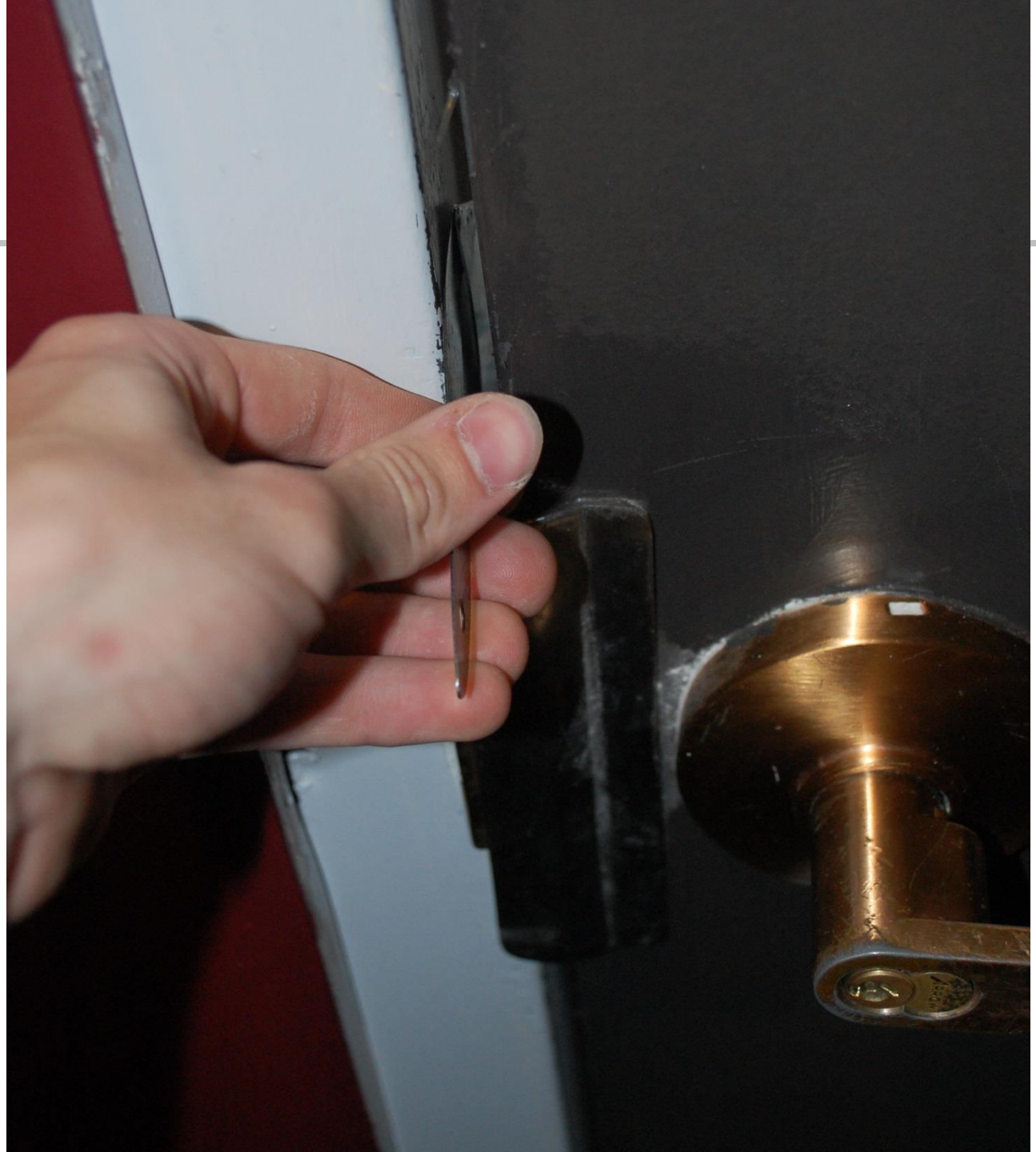

Latch bolt
Interface to door knob
“Auxiliary latch bolt”
Checks whether door is closed

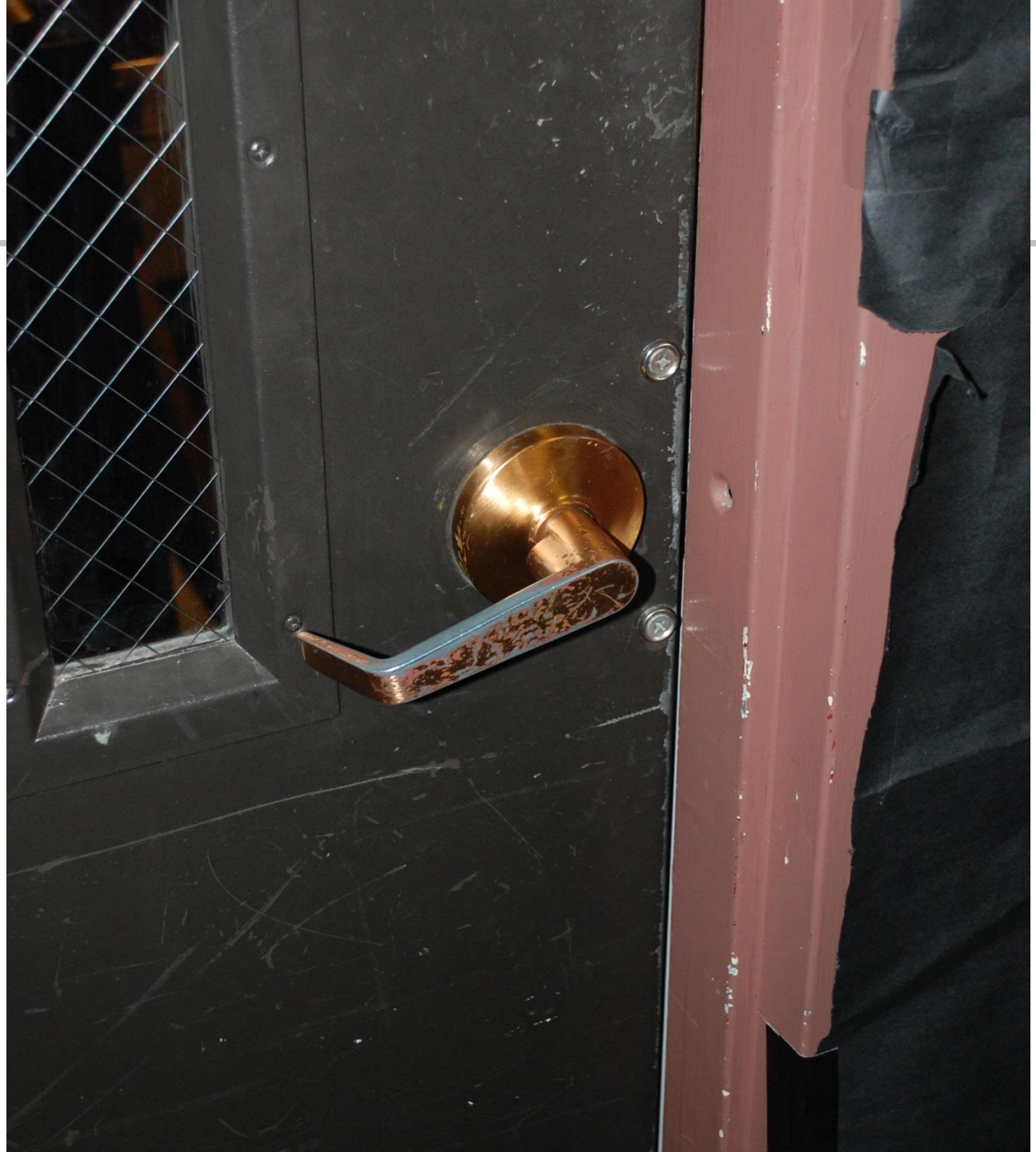
Sliding

- Insert slide into crack, behind latch
- (Optionally) Apply slight tension to the door
- Pull slide down and towards you
  - Depress latch
- Door opens


OH GOD YES
Our Milkshake Brings All the Boys to the Party
Saturday, 10pm
1E
Our Milkshake Brings All the Boys to the Party
Saturday, 10pm
1E





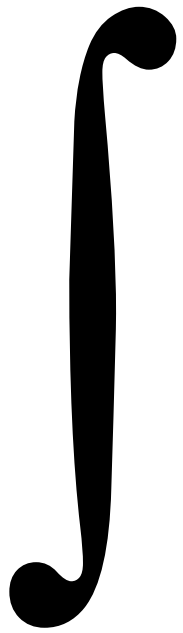


Carding

- Insert card into crack
- Work card around the shape of the jamb
- (Optionally) Apply slight tension to the door
- Push card into latch
  - Depress latch
- Door opens

Integral

- Opens door from inside
  - Turning handle

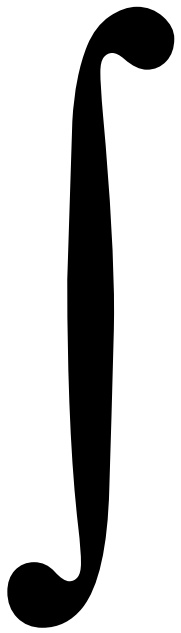


Integral

- Insert integral through gap below door
- Swing up onto door handle
- (Optionally) Apply slight tension to the door
- Pull down
- Door opens

Integral

- Opens door from inside
  - Turning handle or knob



Breaking In

1. Walk through an open door
2. Get somebody else to open it
3. Pull on it
4. Turn the handle
5. Crack / Card / Slide / Integral
6. Hinges / Screws / Vents
7. Lock Cylinder

The 80-20 rule

- You can now probably get into about 80% of “secure” places
  - And we haven’t even talked about anything too complicated yet

Locks

- Mechanical

Locks

- Mechanical
- Optical

Locks

- Mechanical
- Optical
- Radio-Frequency

Locks

- Mechanical
- Optical
- Radio-Frequency
- Magnetic

Locks

- Mechanical
- Optical
- Radio-Frequency
- Magnetic
- Tactile

Locks

- Mechanical
- Optical
- Radio-Frequency
- Magnetic
- Tactile
- Biological

Attacks

- Theft of the physical key
- Listening for the code during a transaction
  - “Sniffing”
- Reading the code from the key
  - “Snooping”

Common Mechanical Locks

- Pin tumbler

Common Mechanical Locks

- Pin tumbler
- Wafer tumbler

Common Mechanical Locks

- Pin tumbler
- Wafer tumbler
- Warded

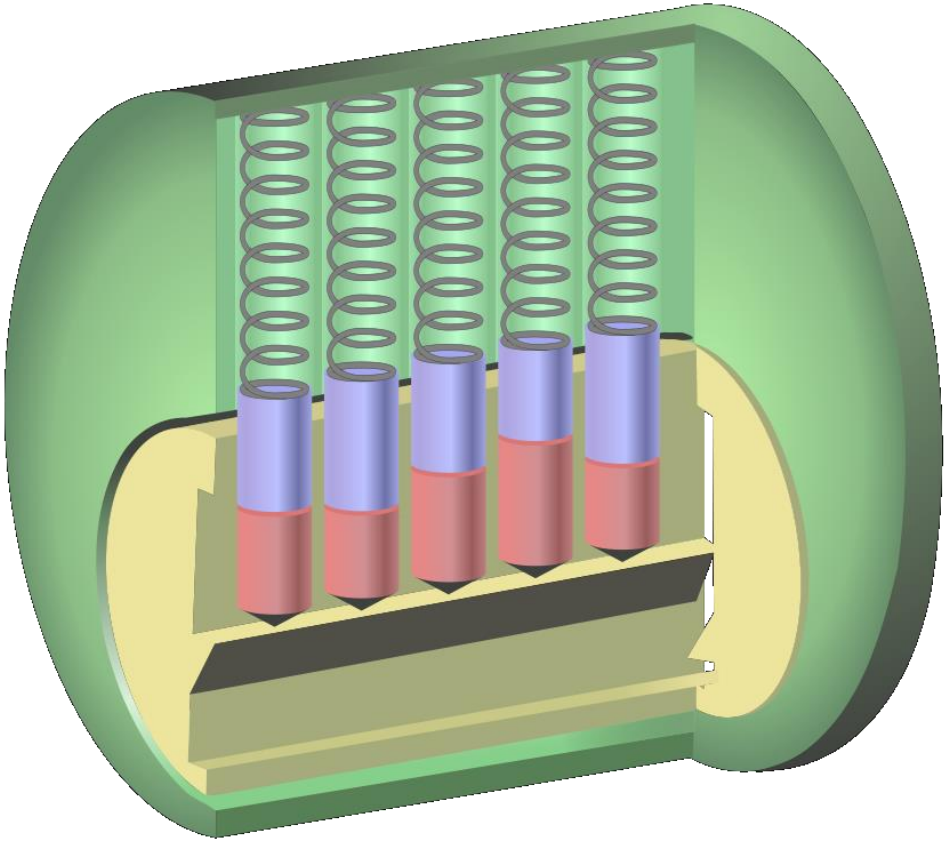
Common Mechanical Locks

- Pin tumbler
- Wafer tumbler
- Warded
- Tubular

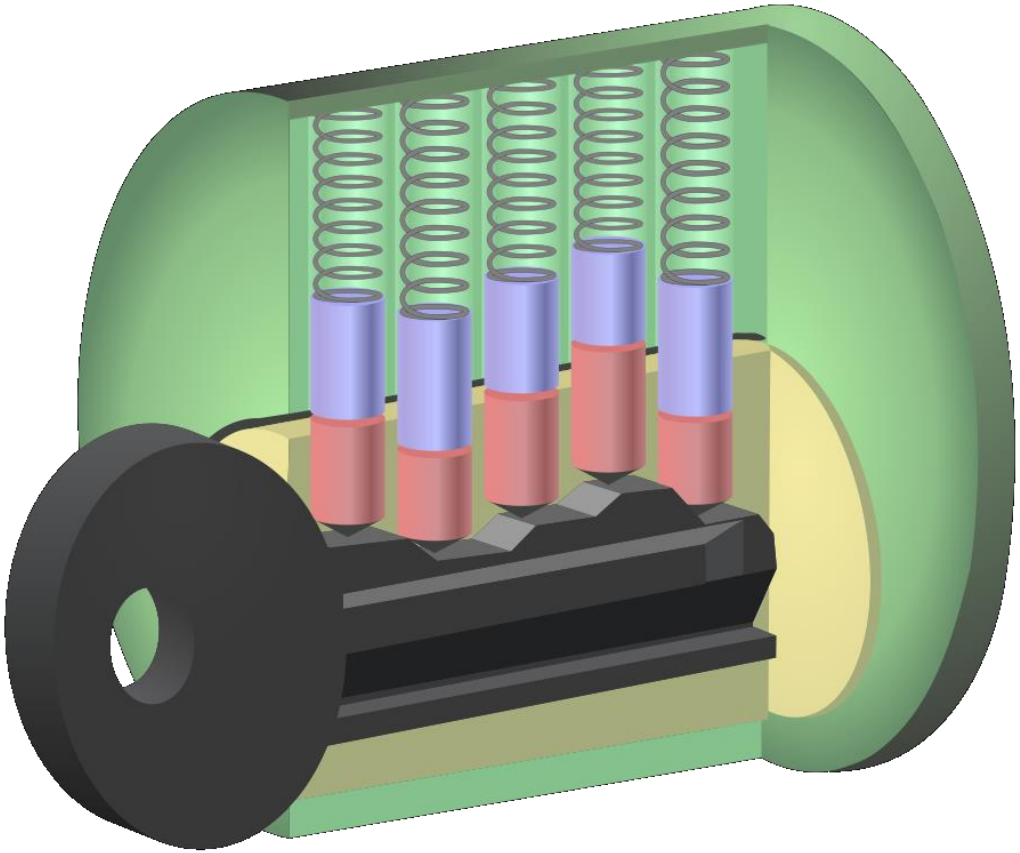
Common Mechanical Locks

- Pin tumbler
- Wafer tumbler
- Warded
- Tubular
- Disc detainer

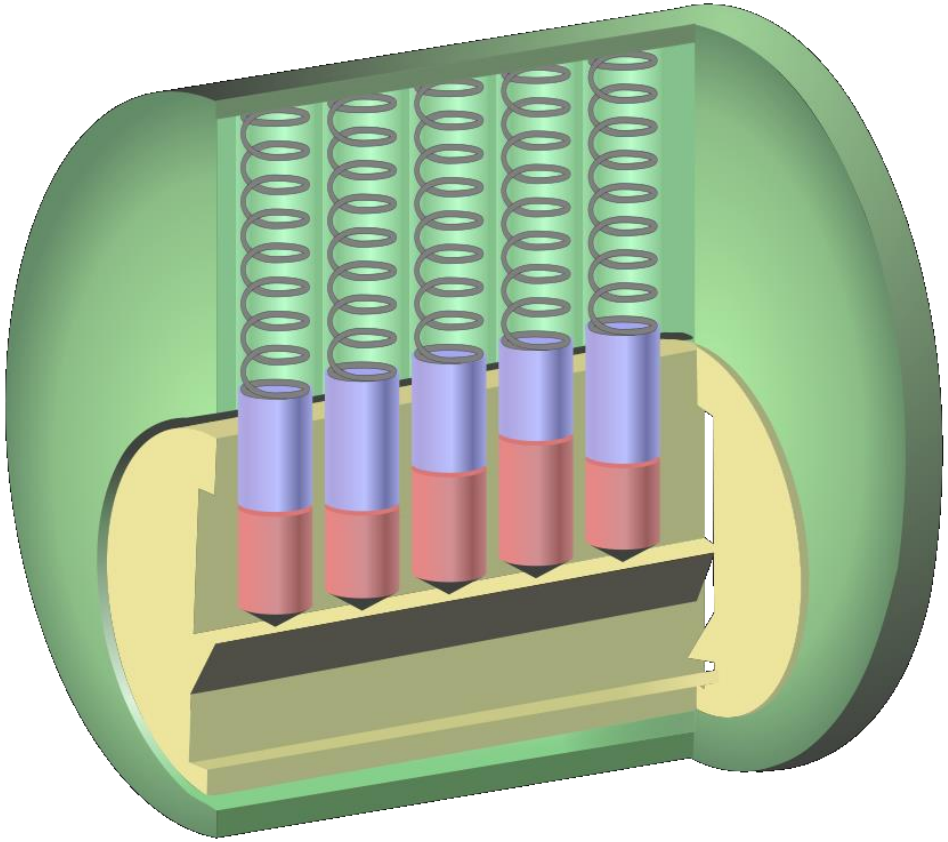
Pin tumbler



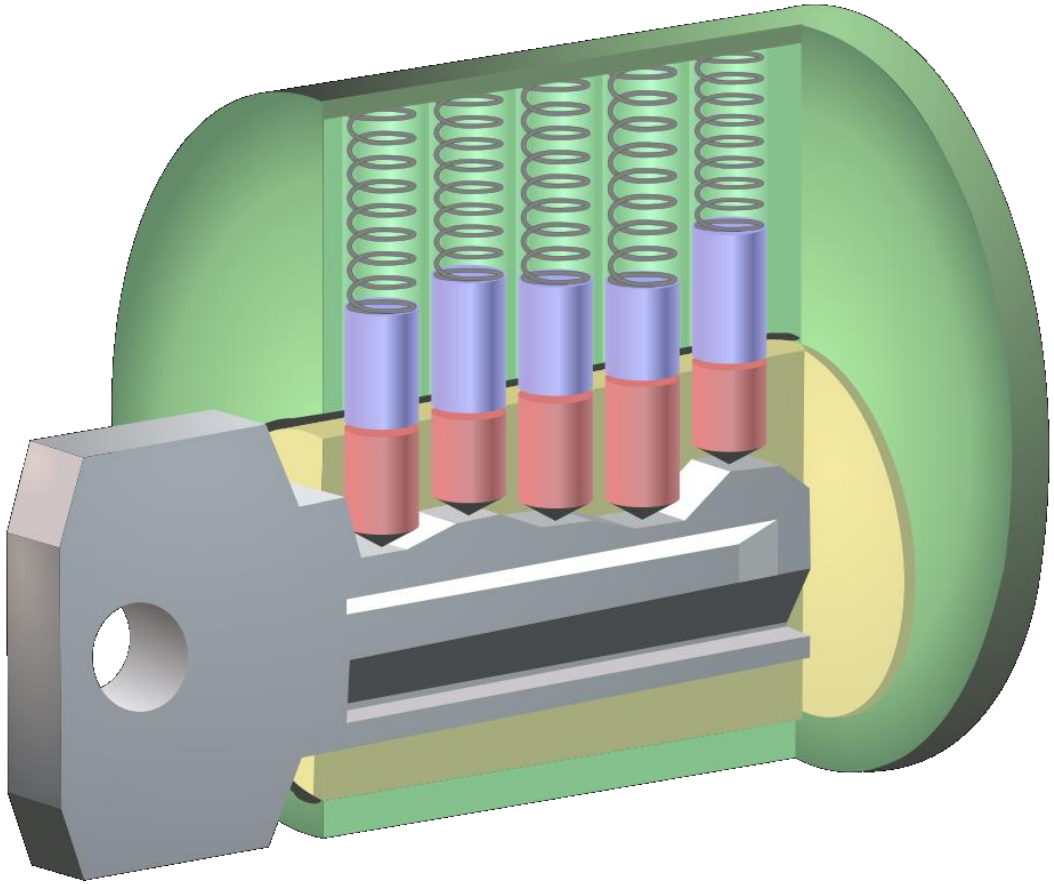
Pin tumbler



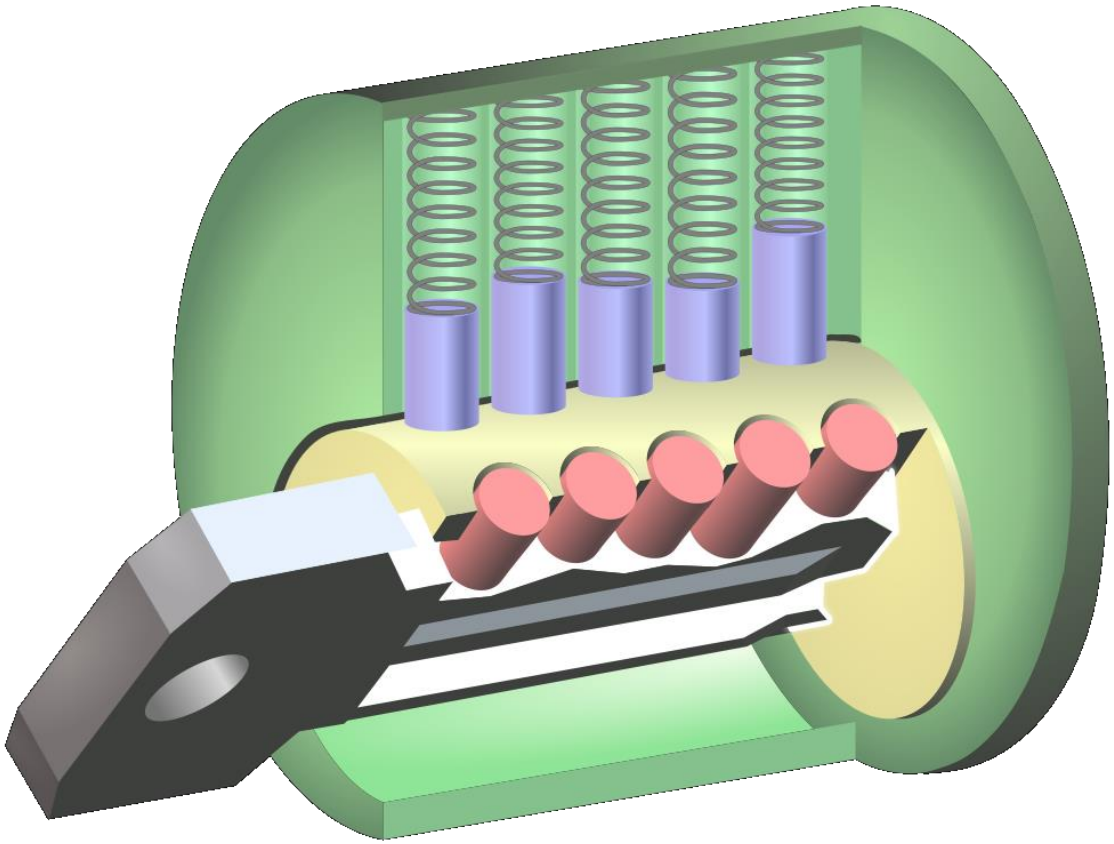
Pin tumbler



Pin tumbler

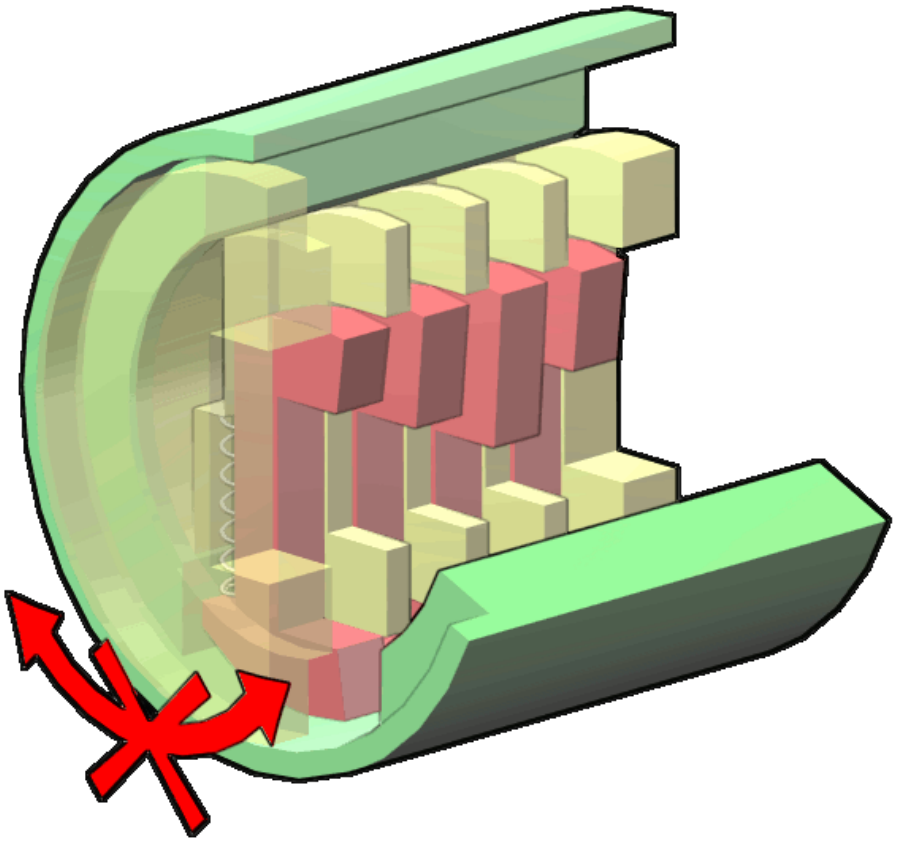


Pin tumbler

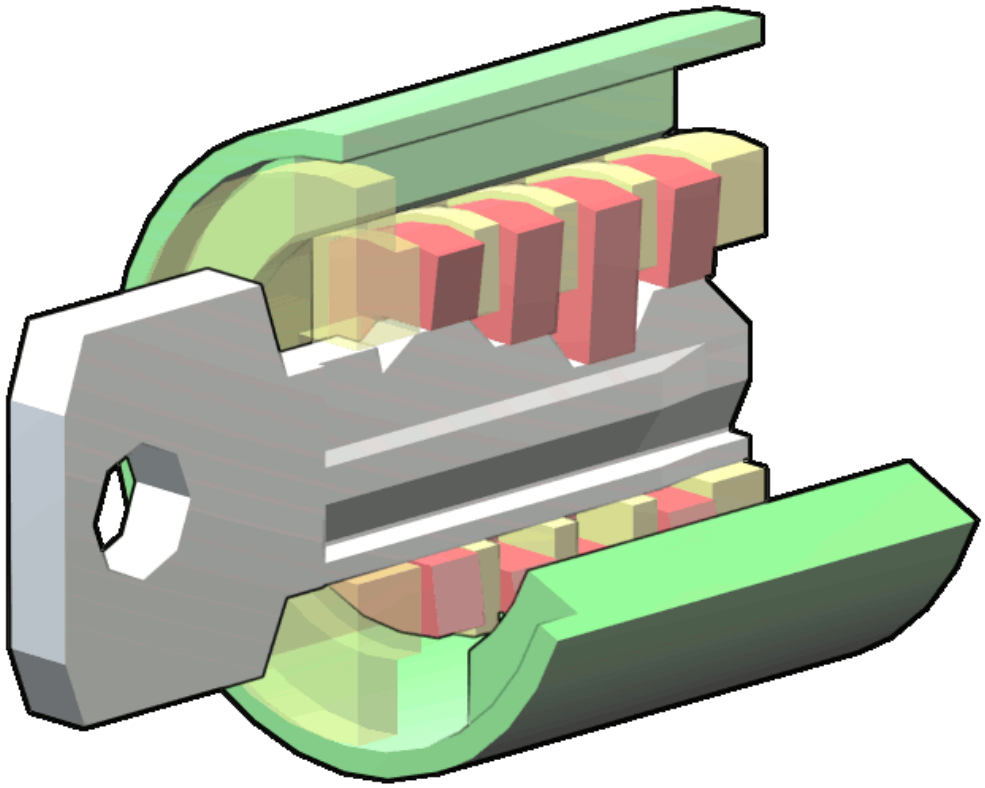


Pin tumbler

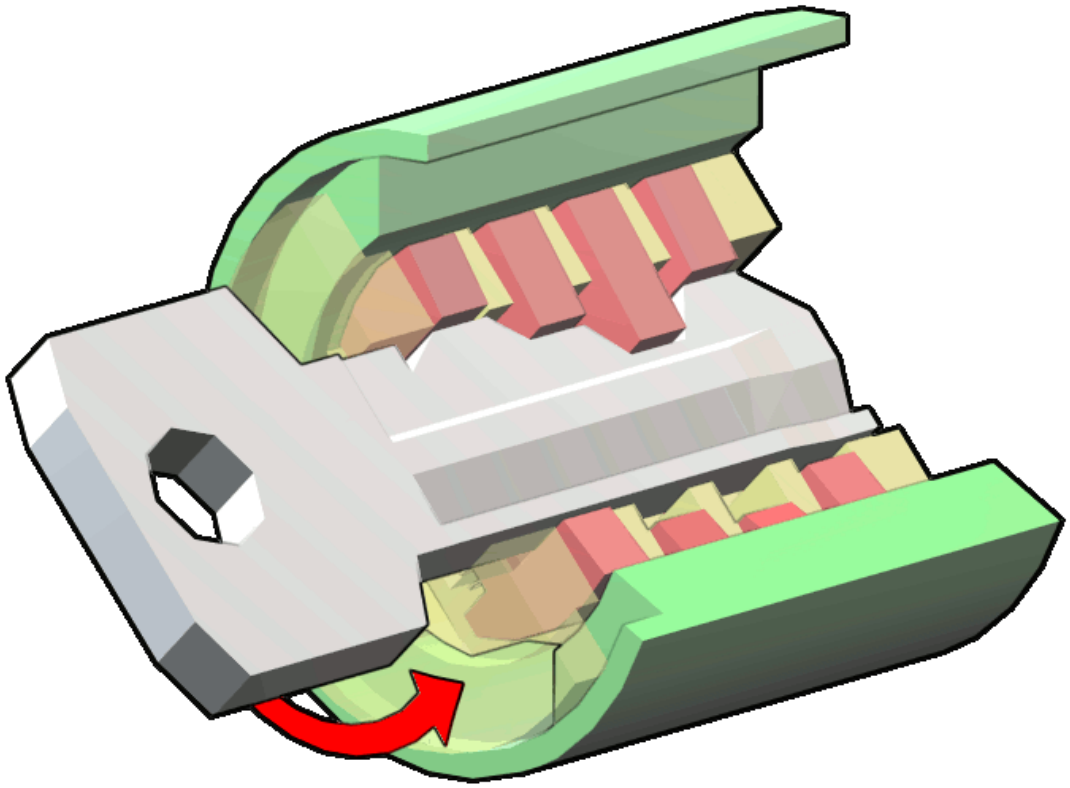
Wafer tumbler



Wafer tumbler



Wafer tumbler



Vulnerabilities

- Careful Manipulation
  - Move the pins or tumblers slowly until they are all at the shear line
- Chaotic Motion
  - Apply enough energy to the pins or wafers that they bounce around chaotically and at some point form a gap at the shear line

Careful Manipulation

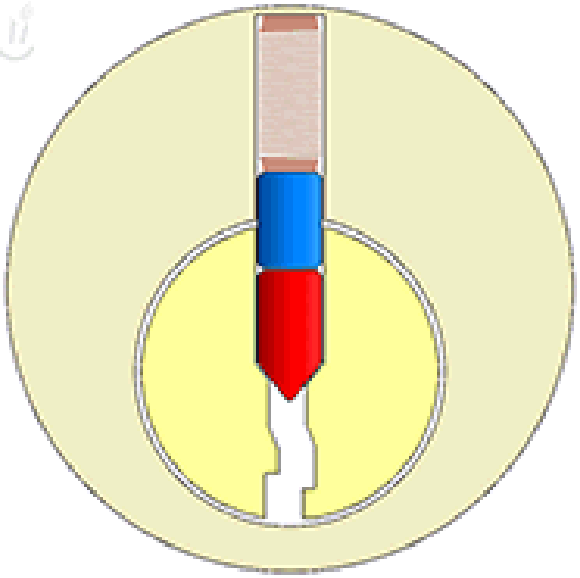
- Picking
  - Exploit mechanical defects to isolate each pin
  - More on this soon
- Impressioning
  - Use binding action at the shear line to mark a key
  - Click

Chaotic Motion

- Pick gun
  - Vibrate the pin stacks until they all split at the shear line
  - Click
- Bumping
  - Apply energy to the pins using a specially cut key and a hammer, causing them to bounce and eventually split at the shear line
  - Click

Lockpicking

- Imagine a one pin / one wafer lock



Lockpicking

- Imagine a one pin / one wafer lock
- Add more pins
  - Apply tension
  - Due to mechanical defects, one pin stack will bind
  - “Set” the pin stack
    - Pinch-off effect at the shear line
  - Another pin stack will bind
  - Set every pin stack
- Isolate each pin stack so that picking a 4-pin lock becomes picking 4 one-pin locks

Lockpicking Wafer Locks

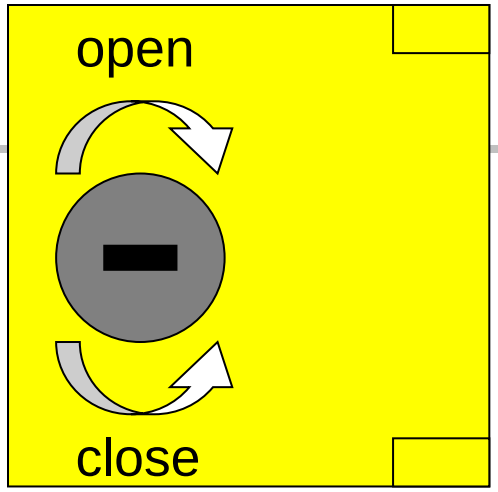
- After a wafer sets, the plug will rotate a very small amount
  - Pinch-off effect at the shear line
  - The wafer will become fixed in place
- As long as you don’t over-lift the wafers or over-torque the plug, a haphazard lifting motion with the pick will open the lock very quickly
  - If this does not work, try to feel each wafer and see if one is not set

Lockpicking

- Get a box
- Get a pick (hook or snake)
- Get a tension wrench

→ Open the box

Lockpicking



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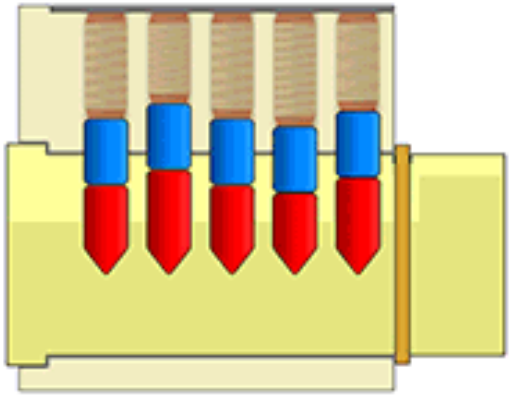


Intrusion Detection

Q: What's worse than walking through a door and hearing an alarm go off?

A: Walking through a door and not hearing an alarm go off

Sensors

- Reed switch

Sensors

- Reed switch
- PIR

Sensors

- Reed switch
- PIR
- Ultrasound

Friendly Sensors

- Turn on lights
- Open doors
- Prevent alarms from sounding
  - On “inside” of door combined with handle / crash bar sensor
  - Checks that a person is exiting
  - Would not be tripped by a slide / integral

Angry Sensors

- Trigger alarms
  - Silent
  - Audible

Reed Switches

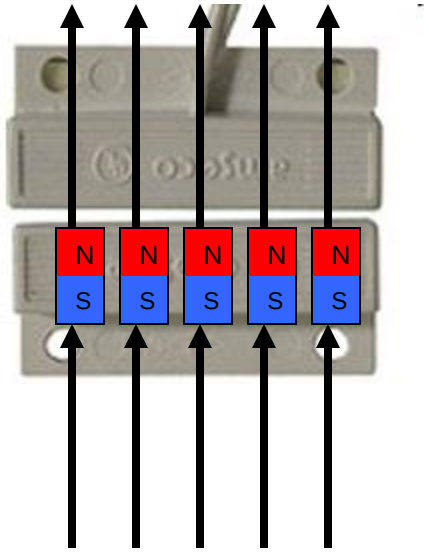
- Magnetically controlled switch
  - If there is a magnet field present, the alarm will not go off
- Usually on “inside” side of door
- Door opens

  → Magnet moves away

  → Alarm sounds

Defeating Reed Switches

- Make sure the magnetic field never goes away



Defeating Reed Switches

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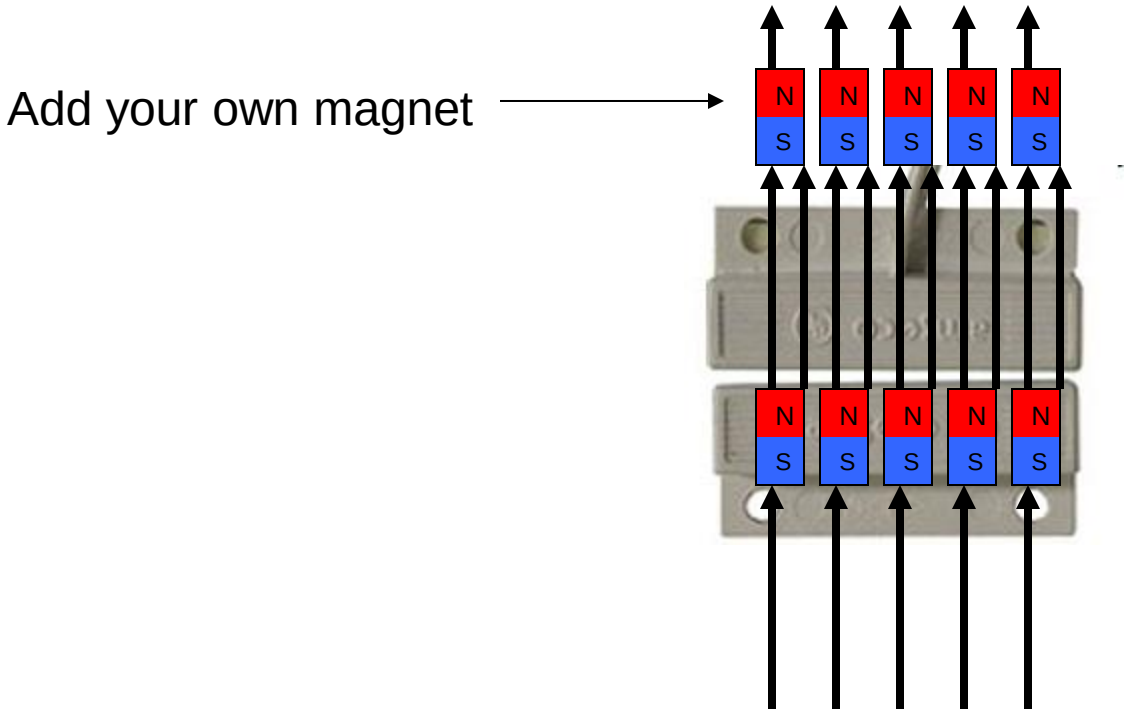

Defeating Reed Switches

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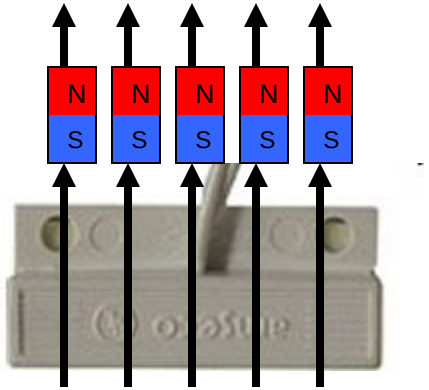

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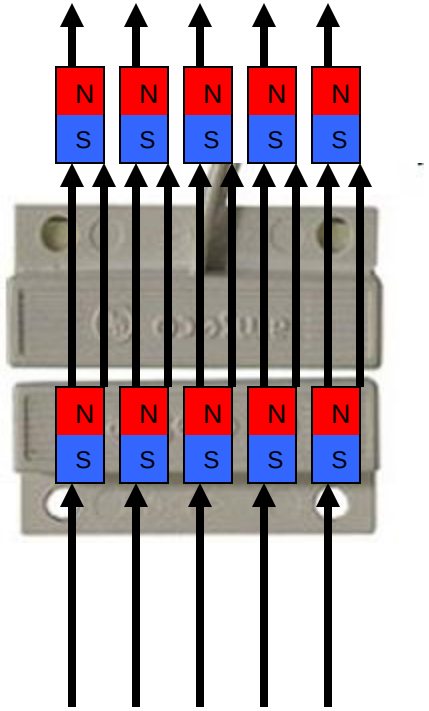

Defeating Reed Switches

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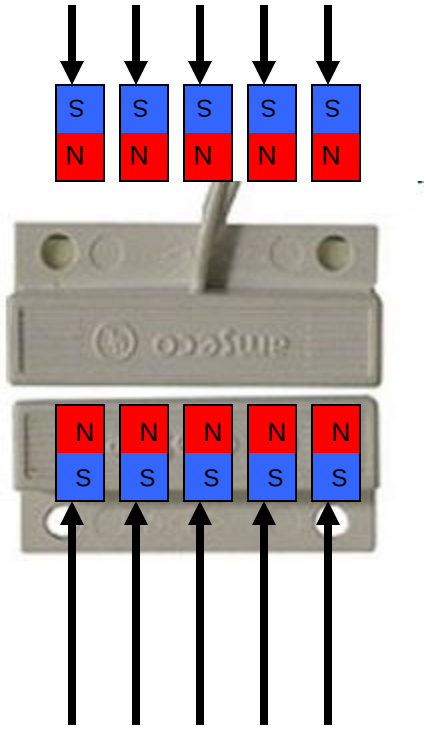


If polarity is incorrect,

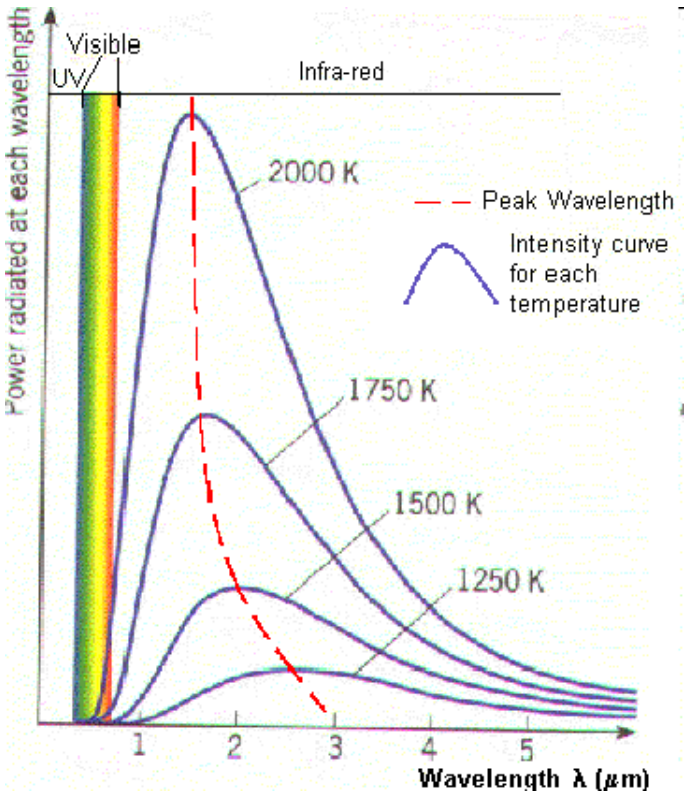
Alarm goes off while door is still closed!

Defeating Reed Switches

- Reed switches are on the inside of doors
- You can’t attack a reed switch from the outside
  - However, if you ever have access to the inside, you can disable the reed switch for later use
- Often, you will have to find another way around the door

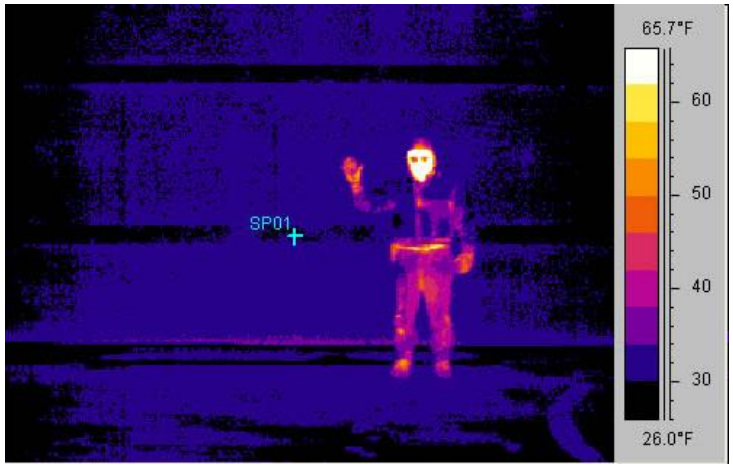
Passive Infrared (PIR) Sensor

- Radiated heat is a form of light
  - Long-wave IR
  - Too long to see
  - Behaves like light



Passive Infrared (PIR) Sensor

- Radiated heat is a form of light
  - Long-wave IR
  - Too long to see
  - Behaves like light
- To the sensor, your body appears to be glowing



Defeating PIR

→ Block or reflect your body's heat

– Some materials are opaque to long-wave IR

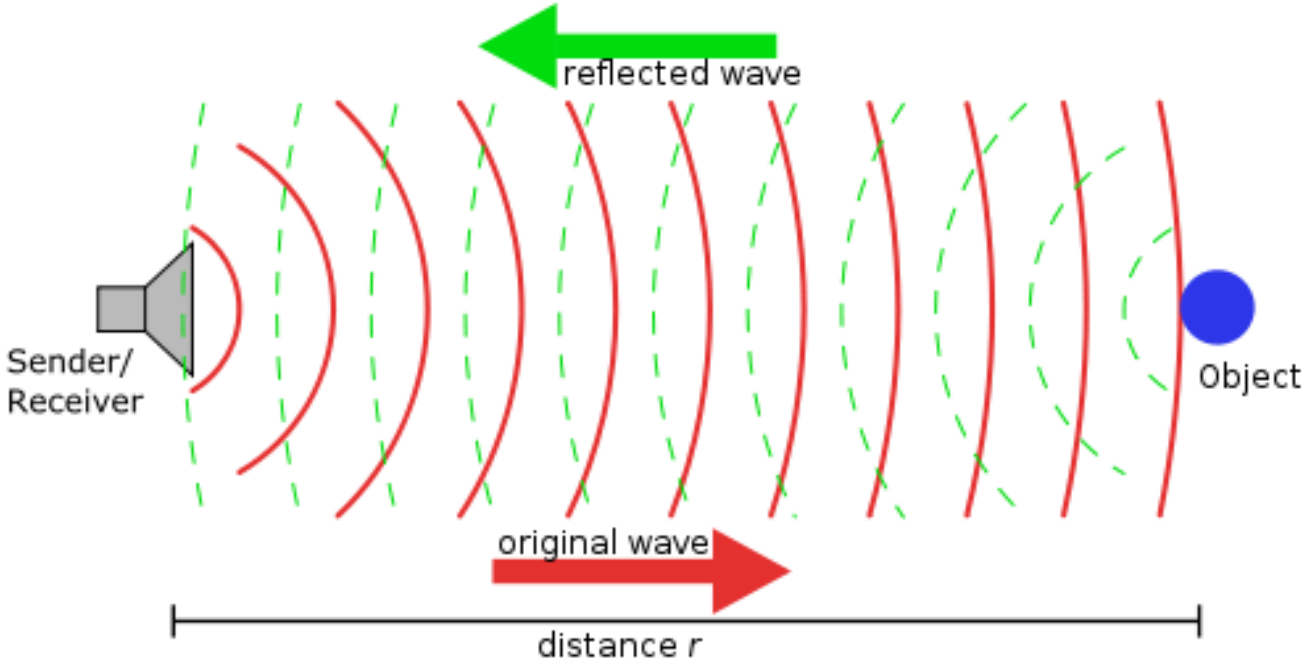
- Glass
- Thin film of oil
- Walk incredibly slowly

– Sensors detect a rapid change in IR

Supplementary Reading:
Mythbusters, Diamond Heist

Ultrasonic Sensors

- Speaker emits high-frequency “Ping”
- Microphone hears echo
- Travel time tells you distance to nearest object



Defeating Ultrasonic Sensors

- Cause no reflections
  - Absorb sound
- Bed sheet

Supplementary Reading:
Mythbusters

Setting off Alarms

- Monitoring system
  - Logs the event, no response
  - Unlikely to be noticed
- Silent alarms
  - Triggers response
- Audible alarms
  - Designed to scare away intruder
  - Often no response

Listening for Response

- A simple HAM radio can listen to the police
- As per FCC regulations, all allocated frequencies are published
  - Even private security

http://www.radioreference.com/apps/db

Setting off Alarms

- Response is often slow
- Rapidly exit
- Casually walk away
  - Social Engineering

Where to go from here?

- Security Audit / Penetration testing
- Locksport
- Urban Exploration
  - Exploration of abandoned buildings
- Infiltration
  - Exploration of off-limits areas of active buildings
  - “Hacking”

High Security Locks

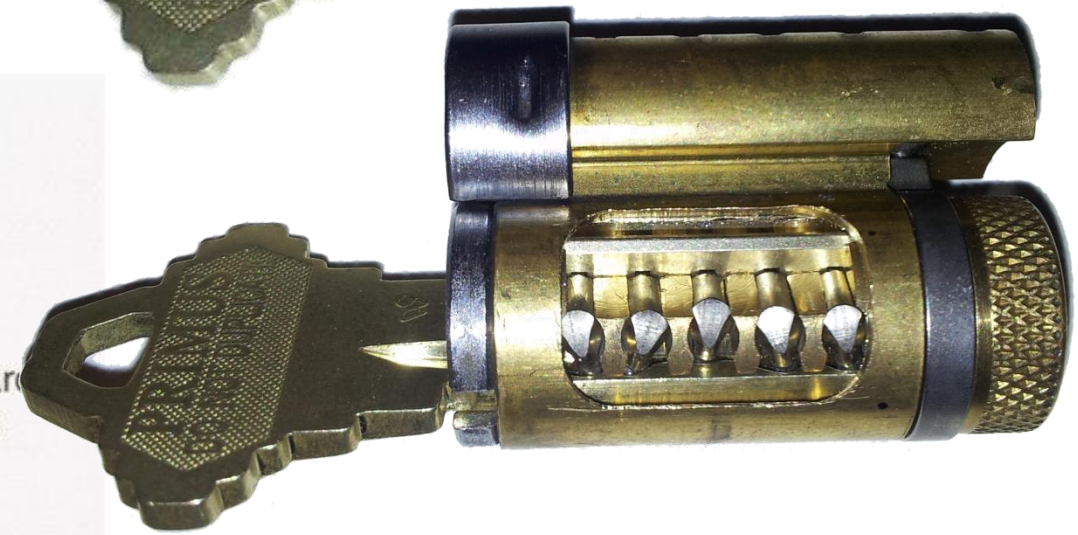
- Medeco m3 and Biaxial
  - Pin tumbler
  - Security pins
  - Pin rotation matters
- Schlage Primus
  - Pin tumbler
  - Side “finger” pins
    - Height matters
    - Rotation matters

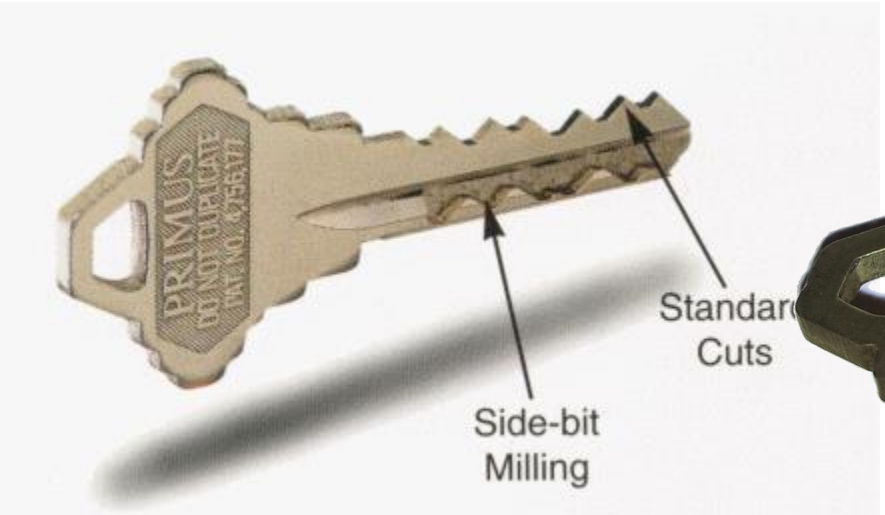
Schlage Everest

- Single finger pin in the back
- Must be raised to the right place to open the lock
  - However, this height is a known constant
  - And happens to be the exact thickness of a thick paperclip
- Attack
  - Insert paperclip
  - Lock is reduced to simple pin tumbler design

Schlage Everest

Schlage Primus





Schlage Primus

- With high tension, sidebar binds after pins
- With lateral tension, sidebar does not bind
- Isolates security features
  - Pins can be picked
  - Sidebar can be picked as well, but it is HARD

Schlage Primus

- Sidebar codes are sold to locksmiths by Schlage
  - Will be the identical within a facility
  - Very easy to acquire a sidebar
- Split-key attack
  - Grind down a key until it is just the sidebar
  - Any Primus on that sidebar has been reduced to a simple pin-tumbler lock

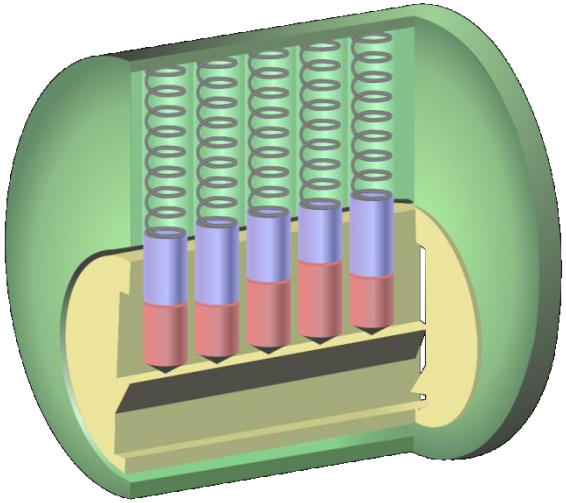
Example: Grind down a spare room key and gain access to any part of the building through a split-key attack

Schlage Primus Everest

- Patent extension of Schlage Primus
- Adds the “Everest” additional finger pin
- Still susceptible to split-keying

Get a Key

- Steal one, or…
- Get the information to make one
  - Photograph
  - Disassemble a lock



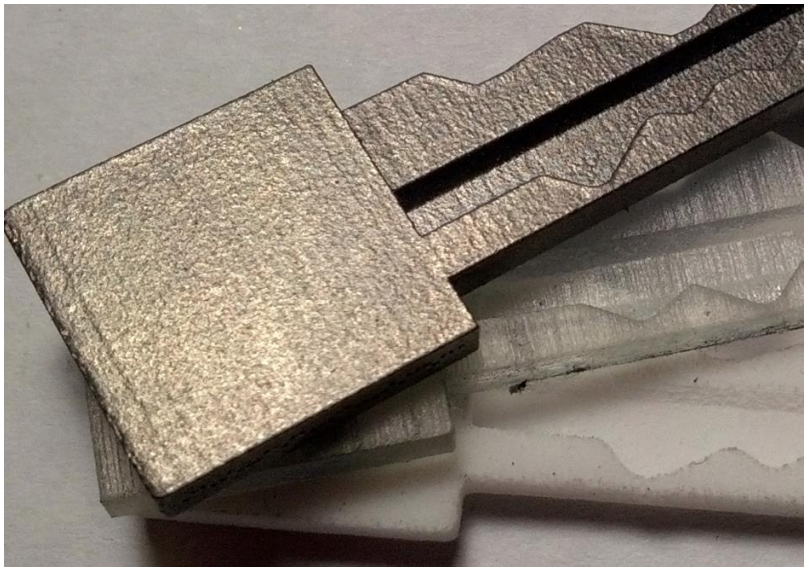
Supplementary Reading:
“Contextual Physical Security”

Make a key

- Can you copy a key?
  - Hardware store
- Can you make a key from a picture?
  - Hand-filing

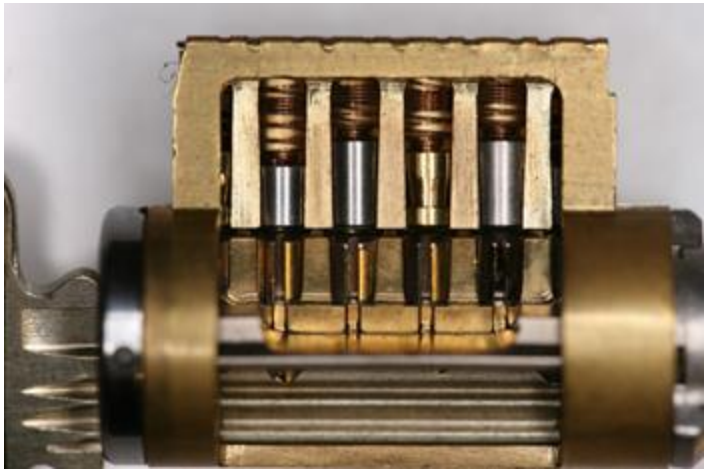
Make a key

- Can you make a high security key?
  - 3D Printing



Supplementary Reading:
My *DEF CON 21* talk

Medeco Biaxial



$$$

Medeco Biaxial

- Picking
  - Hard due to pin rotation
  - Unlike Primus, there are true and false gates
- Many vulnerabilities
  - Picking
  - Code setting keys
    - Vulnerability in issued sidebar codes
  - Split key does not work

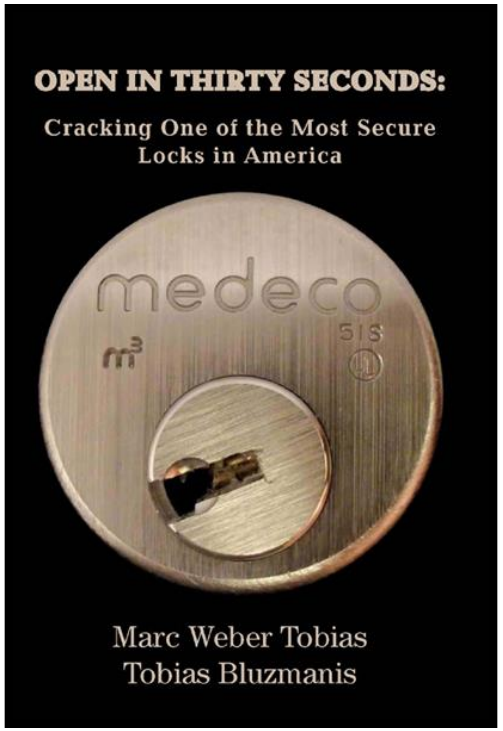
Medeco m3

- Patent extension of Medeco Biaxial
- Added “slider”
  - Analogous to the Everest finger pin
  - Always depressed to a constant depth
  - Can be defeated with a paperclip in the same way as Everest
- Made the keyway wider, facilitating picking
- Arguably *less secure* than Biaxial

Medeco

- Marc Weber Tobias
- UL-437 high-security standard:
  - Resistant to picking or bumping for a minimum of 10 minutes
- Wired test: 6 locks
  - Longest: 9 minutes
  - Shortest: 7 seconds

Are there any “high-security” locks?



Kaba E-Plex

- FIPS 201 Government Certified as High-Security
  - Only lock to achieve such certification
- Used in pentagon, White House, etc.

Fails:

- Shorting Electronics
- "Rapping"

Johnny Long

- Click [5:30]

Thanks

- Slides will be emailed to the class list

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