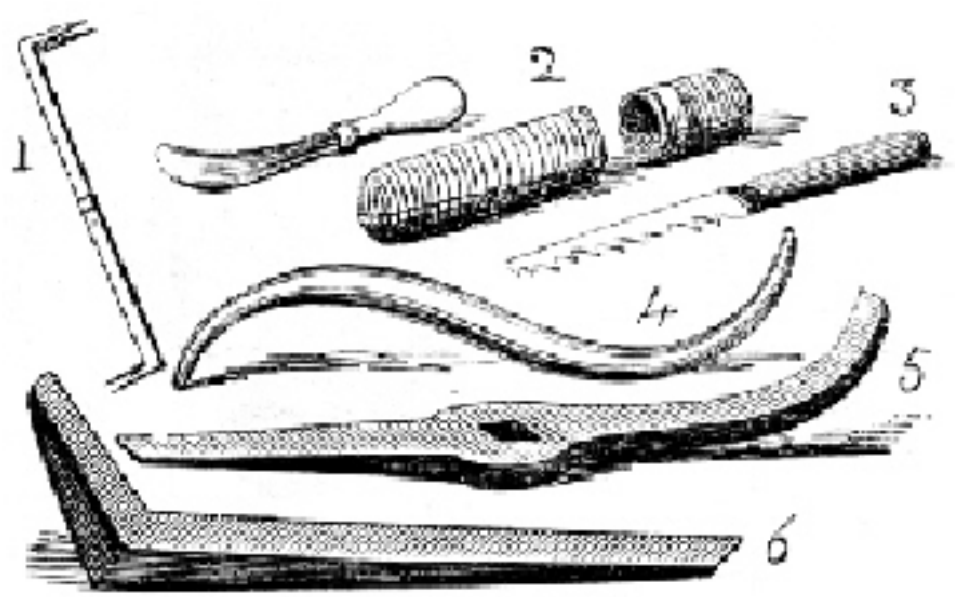
# HIGH SECURITY LOCK STANDARDS AND FORCED ENTRY: A PRIMER

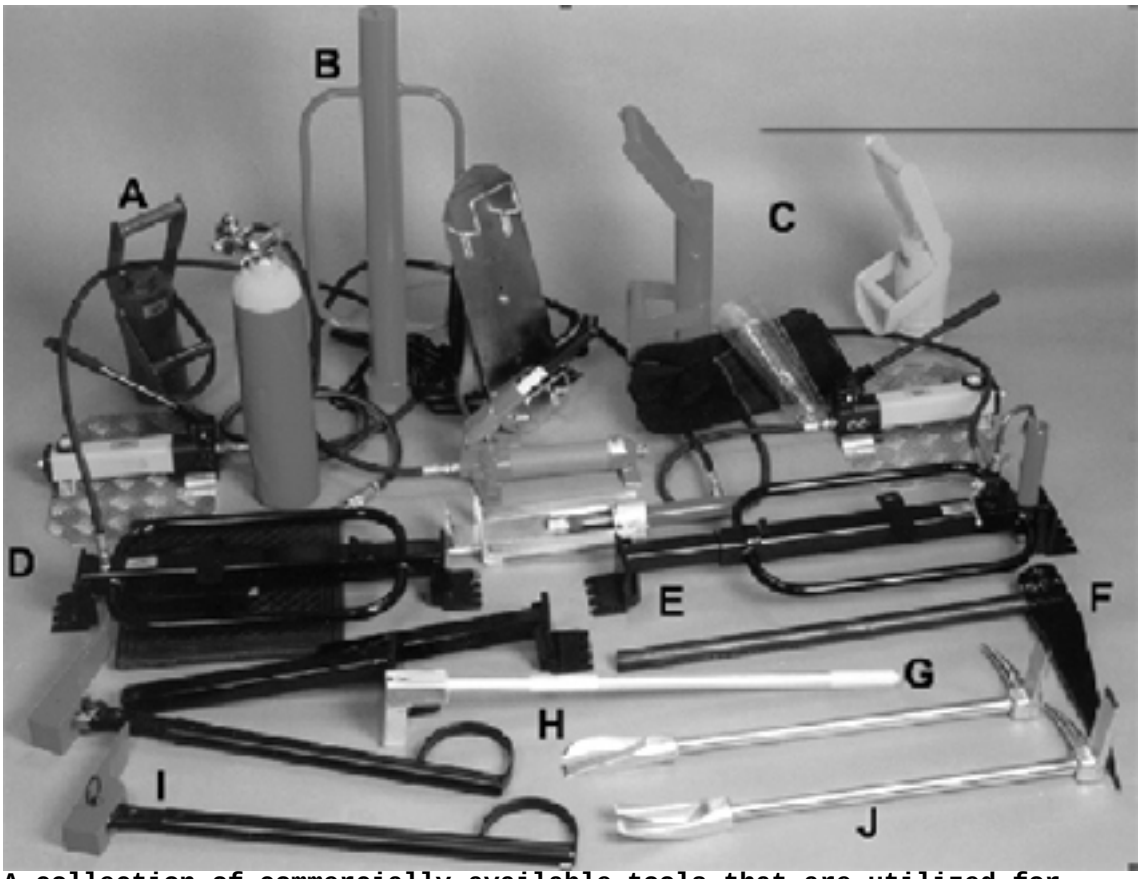


The subject of Forced Entry is covered in detail in ***Locks, Safes and Security*** and ***LSS+***. The graphics and video for this document can be found in chapters 29 and 32.




**These tools from the Chubb archives were utilized in burglaries in England more than two hundred years ago and will still be effective today against most locks. (1,4,5,6) are different pry bar designs, (2) is a slip-knife for shimming strikes.**

In previous articles and White Papers I described the threat to pin tumbler cylinders from the technique of "bumping" and how the vast majority of locks in America and indeed most parts of the world could be quickly and easily compromised with little skill or training. In this Primer I will continue to explore the difference between standard and "high security" locks and what the term "high security" really means. We will analyze the critical components of UL 437 (the Underwriters Laboratory standard for higher security cylinders) that everyone relies upon as one of the benchmarks for the security of mechanical locks. If you specify locks that are certified with UL 437 or BHMA/ANSI standards for your purchasing, risk management, architectural design decisions, or definition of security policies, this material may be particularly relevant because what you thought was locked and secure just might not be, even UL 437 or BHMA/ANSI 156.30 locks.




**A collection of commercially available tools that are utilized for breaking and entering by both law enforcement and criminal elements. (a) single-man ram, (b) two-man ram, (c) single-man ram, (d) two-man hydraulic ram, (e) standard hydraulic ram, (f) duckbill prying tool, (g) hinge puller, (h) "hooligan" pry bar for penetrating heavy metals and composites, (i) tapered-blade ripping tools, (j) pry bar for levering and puncturing.**

## Background

Resistance to certain forms of **forced entry** comprises one of the primary criteria for certification of UL 437 and ANSI 156.30 compliant locks. The UL standard has been around for many years and is one of the primary specifications to determine quality and security in a mechanical locking device. Manufacturers tout their compliance with the UL and ANSI standards and offer the certification as your guarantee that their locks can pass stringent tests that insure their fitness for applications requiring a high level of security. But what does the term "high security" really mean.

Most manufacturers make liberal use of the phrases "security" "high security", "ultimate security" and "maximum security" in their advertising and literature.

When I described the ability of an eleven year old girl to open a Kwikset cylinder in five seconds, such ability obviously does not connote any form of protection, much less "high security" unless, of course, the manufacturer intended that it means that a ten year old cannot open their locks but an eleven year old can!

Yet many lock makers continue to advertise their products in terms of vague, inflated, or outright bogus security claims that are designed to mislead the consumer into believing that these products offer real protection. Unfortunately, they rarely define or describe in detail just what they are protecting against. Kwikset, perhaps one of the most popular cylinders in America, sells more than twenty million locks a year by their own account, yet nine months after little Jenna Lynn demonstrated to the world how to open them, not much has changed. Although Kwikset has released a new programmable mechanical lock that cannot be bumped, this product has other design issues that impact on its security. This new lock will be the subject of a later security alert.

Some manufacturers either don't get it or don't care because they are still marketing locks that cost them less than two dollars to produce and yet they want you to believe they are secure. Remember the fundamental maxim in hardware security: you get what you pay for. If you want a two dollar lock (that you buy for about twenty dollars) to protect your family or your business, then by all means save money and purchase the cheap ones like Kwikset. Or you might want to keep reading to learn some of the risks in doing so.

So how do you as a consumer or security director or purchasing agent know the difference between hype by a manufacturer that make poor quality cylinders and those that produce quality locks? What is the difference between junk and those locks that actually meet certain stringent criteria for the assessment of quality and their ability to address the three critical security concerns for mechanical locks: forced entry, covert entry, and key control?

That, in essence, is what UL 437 and ANSI 156.30 is all about. But as you will learn their standards are only the beginning. As I document in ***LSS+***, notwithstanding certain manufacturers representations and press releases to the contrary, some high security cylinders can be bypassed by

bumping, picking, compromise of master key systems, and simulation of blanks that are supposed to be restricted and patent protected. For many products, security is simply an illusion.

**The 3T2R Rule: It's about time, tools and training**

**Links:** http://www.engadget.com

**Link:** http://www.engadget.com/search/?q=marc+tobias

**Link:** http://www.security.org/dial-90/alerts.htm

Underwriters Laboratory addresses the two most important performance criteria for mechanical locks: the primary ingredients that are supposed to insure that a significant amount of time, skill, or training is required to compromise the lock that protects the door (my 3T2R rule discussed in previous **Engadget.com** **and** **security.org** articles). The premise is simple: additional time means more opportunity to prevent or deter entry into a secured area or to increase the likelihood of detection. Time, in the world of covert or forced entry, is a function of many factors aimed at thwarting unauthorized entry.

For our present discussion, it may relate to how difficult a task is required to open the mechanism by force, using such techniques as drilling, punching, grinding or pulling. UL 437 and ANSI locks are specifically designed to resist certain types of attacks by force. This is perhaps the most prevalent method of compromise and makes up the vast number of burglaries. Locks are subjected to tests by UL and ANSI to determine their resistance to picking, impressioning, forcing, drilling, sawing, prying, pulling, driving, as well as endurance, and corrosion.

Time is also a critical factor in covert non-destructive entry. High security locks are generally more difficult to pick or impression than conventional cylinders. Many of them employ secondary locking systems such as sidebars that are activated and controlled by unique physical properties of the key, not found in less expensive locks. Some of these locks can be very difficult to bypass, even by an expert. Here is the caveat: even though certain locks are rated for high security use some can be compromised within a few minutes and often well under the ten minute criteria established by UL or the fifteen minute minimum set by ANSI. My discussion of covert entry and reality is left for the an analysis to be released later this summer.

The third parameter for high security cylinders is key control. Essentially this means that the keys cannot be easily duplicated because the production and distribution of key blanks is controlled by the manufacturer. This ability to control duplication is usually tied to patent protection so that there are severe sanctions for the commercial sale or exploitation of protected blanks, keyways, and interactive elements between locking mechanism and keys. The Medeco M3 and Schlage Primus are perfect examples. Both of these manufacturers have protected components within the lock that are acted upon by physical portions embedded within the keys, thus providing protection against the more common methods of key duplication. However, as will be explained in a later article, virtually any mechanical key can be replicated so the concept of key control must be closely examined for what it actually protects against. It is really a question of how difficult it is to replicate the key, not **whether** replication is possible. With the exception of magnetic-based keys such as the Evva Magnetic Code System (MCS), very few keys are totally immune from copying, regardless of their patent protection and mechanical design. The simulation of patented key blanks will be addressed in our detailed analysis to be released in August 2007.

**THE FIRST PRONG OF THE THREE PART TEST FDOR HIGH SECURITY LOCKS: FORCED ENTRY**

**Is your lock secure against forced attacks?**

Force can be applied in a variety of ways to compromise locks, locking hardware, bolts (the projection that keeps the door locked), strikes (the receptacle for the bolt within the door frame itself), door frames (most often made of wood for residences and metal for commercial and government facilities), and doors themselves (solid or hollow wood, wood chip, or metal). There are many forms of attack with just about any hand or power tool, from screwdrivers to pry bars to electric grinders. The cheaper locks, as we shall demonstrate, often can be destroyed or compromised in seconds while the high security rated cylinders may be virtually impervious to an attack unless it is prolonged and advanced.

Underwriters Labs and ANSI test locks in terms of certain tools and how long the lock can resist an attack. Generally, cylinders must not be compromised for **five**

**minutes** for forced entry and ten or fifteen minutes for covert entry (picking and Impressioning). The tools include common hand tools, hand or portable electric tools, drills, saw blades, puller mechanisms, and pry bars. Common hand tools are defined as chisels, screwdrivers no longer than 15", hammers having three pound head weight, jaw gripping wrenches and pliers. Pulling devices can be a slam-hammer with a maximum head weight of three pounds or a screw type as shown later in this article. A slam hammer is a common tool that is also utilized in the automotive body shop for pulling dents and by locksmiths to pull ignition and safe deposit locks.

Burglars have been exploiting weaknesses in locks and related hardware for hundreds of years. Such attacks can be delayed or thwarted through proper design and the employment of advanced metallurgy that produce extremely tough materials. But of course there are limits to what such hardware can withstand, especially given the sophistication of some commonly available power tools. Criminals can easily purchase tungsten carbide and diamond tipped drills, grinders, mills coupled to battery operated electric motors, and other implements. Most burglaries are effected by simple tools such as chain wrenches, pry bars, wedges, chisels, hammers, battering rams and duck bills. Some of these common attacks are described in this document.

UL 437 and ANSI certified locks contain hardened steel inserts in the plug and shell to protect against drilling. They also utilize armor shields to further protect the cylinder body from many forms of attack. Additionally, most locks have stainless steel or nickel silver internal components for added protection.

**Security is Not Just the Lock**

Physical security against attack must not rely on just the lock. One of the misconceptions that I am most often asked about is the deadbolt. Many assume that if they have a deadbolt lock, then all is secure. I explain that a deadbolt is only one component of the locking hardware and does not guarantee security; far from it. First, a deadbolt has nothing to do with the actual cylinder lock. In the case of Kwikset and other low quality locks, for example, their deadbolt means nothing if the pin tumbler mechanism can be compromised as was shown by the eleven year old. The

pin tumbler lock simply **controls** the deadbolt and that is all.

If the door, door frame, and strike are not equally secure then the "system" will fail when force is applied. It is clearly a case of the weakest link in the security chain, and nothing could be truer in the security environment. Everything must work together to protect you. And don't forget about the windows, either, especially in the residential environment. They are often a simple target, either for compromise of the often poorly designed locking system or they may not even be locked at all. And if there is a glass panel in your door or next to it, then your security may be minimal to nonexistent. If you have deadbolt mortised cylinders on both sides of the door, that may help but then a hazard is created in the case of fire.

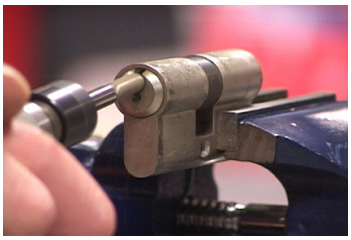
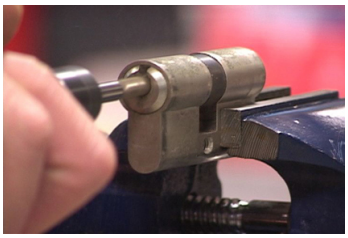
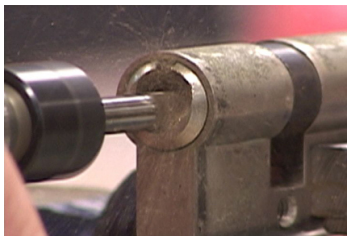
Shatter-resistant glass may be employed in commercial buildings but that is no guarantee of protection either, especially if polymers are installed that can be cut with a small handheld torch. And those thin metal doors that you see on many store fronts and commercial office buildings? Even though high security drill resistant cylinders with long deadbolts are employed, often the **locking hardware** can be easily compromised by drilling one small hole **next** to the lock and then inserting a stiff wire to manipulate the bolt. Remember, the key does not unlock the door directly, it only allows control of a cam or other movable piece that **actually** withdraws the bolt. Mechanical bypass is detailed in Chapter 29.

**FORCED ENTRY: WHAT EVERY BURGLAR KNOWS ABOUT LOCKS, DOORS, STRIKES, BOLTS AND DOOR FRAMES**

**Locks: Drilling and Pulling**

Conventional cylinders can be easily drilled to create another shear line (to allow the plug to turn freely without a key) or to totally remove the plug and all internal components. Either technique can often be accomplished quickly. As demonstrated in the video that I made recently in Amsterdam with Paul Crouwel, (a master locksmith and associate), a conventional lock can be simple to compromise, while a high security lock can be extremely difficult to drill. In this case, we selected a Buva standard lock and an Evva 3KS for our test. These are popular cylinders in Europe; the 3KS has an equivalent high

security rating. The Buva non-high security cylinder was easy to bypass. This definitely was not the case with the Evva cylinder; its hardened steel anti-drill pins stopped the mill from entering the plug. After several minutes of continued attack, we failed to affect the operation of the mechanism in any way.

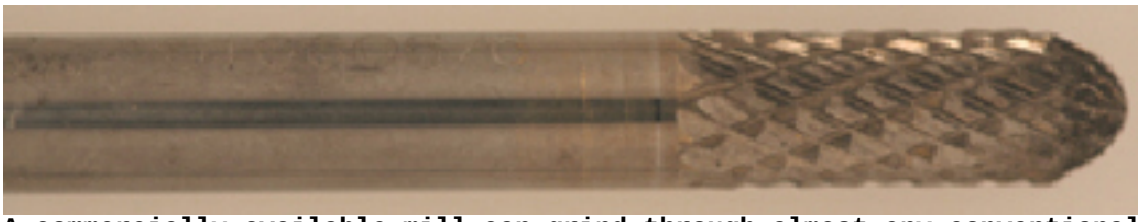




**This is an attack on a standard cylinder with an mill. Note how easy it is to destroy the plug.**
**Link:** http://video.security.org/forced_entry/drilling_plug_200.wmv

First, a normal profile cylinder is drilled for the plug. This means that a mill or drill bit is inserted into the keyway to obliterate all of the internal components.

The video shows an attack on the plug, removing all internal components. A screwdriver can then be used to rotate the bolt control. A mill is inserted at the shear line (top photos), and directly into the plug (bottom) to remove all internal components.

**This demonstration shows how a normal cylinder is drilled at the shear line.**
**Link:** http://video.security.org/forced_entry/drill_shearline_normal_200.wmv

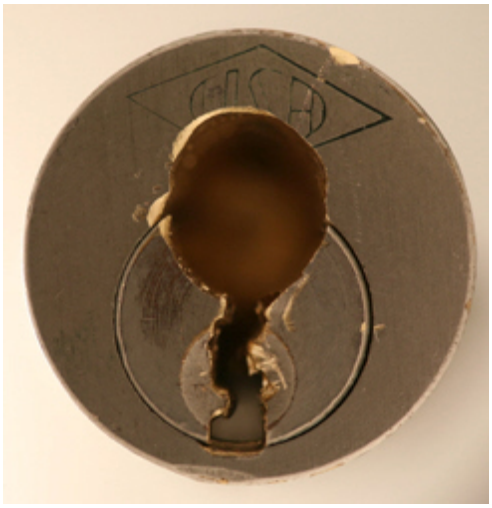


**A commercially available mill can grind through almost any conventional cylinder. This tool is made of extremely tough tungsten carbide and is used with a battery operated motor.**

Another popular attack involves the use of a drill bit or mill to create another shear line as shown in the video demonstration.

**This sequence shows how a mill can be used to create another shear line.**

**The standard locks were drilled to create another shear line. A screwdriver can be used to turn the plug.**



High security locks can be extremely difficult to drill, as shown in the photographs below. They employ hardened steel pins at critical positions in the plug and shell to protect against this form of attack. In the video demonstrations, we utilized a mill to attempt to penetrate an Evva 3KS at the shear line and plug. The lock body resisted all attempts to enter the plug and the hardened pins prevented the mill from gaining any foothold, and only allowed penetration to the depth of the hardened pin (right). Contrast this with the ease in destroying the Buva lock.

**The mill could only penetrate the body of the lock until it encountered the hardened pin, either in a plug or shear line attack.**

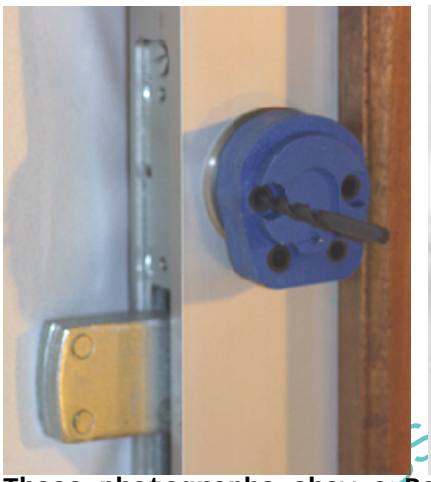
We wore out the mill during the attack. Note how the embedded pins prevent the mill from gaining entry. Construction of the lock prevented the attack with only minor damage done to the keyway.

**This is an attack on an Evva 3KS at the shear line.**
**Link:** http://video.security.org/forced_entry/evva_3ks_200.wmv

**Attack on an Evva 3KS with a mill to destroy the plug.**
**Link:** http://video.security.org/forced_entry/drill_evva_3ks_200.wmv

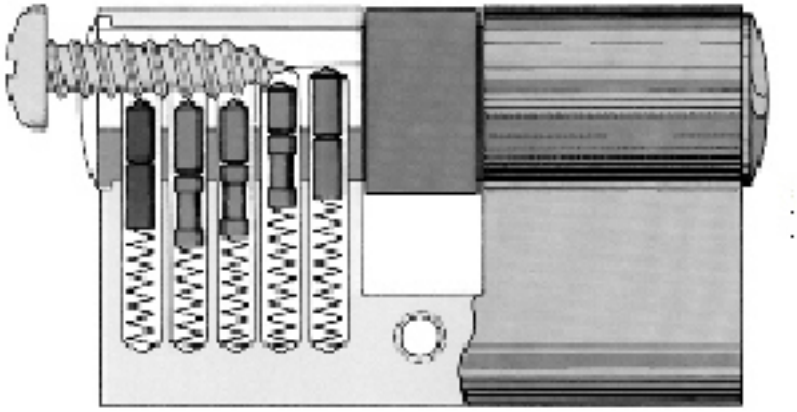
## Attack of the Set Screws

Most mortise locks in commercial facilities are held in place by a side mounted set screw that mates with an indented portion of the cylinder. The set screw is tightened against the cylinder so that the lock cannot be unscrewed and removed. Common methods of attack involve the destruction by drilling of the set screw or applying sufficient torque to the cylinder to shear the screw, which will allow the lock to be unscrewed from its housing and removed. Another method is to drill out the two retaining screws, as shown in the cylinder.




**These photographs show a Peterson Mfg. drill jig for destroying set screws.**

## Pulling and Breaking Locks

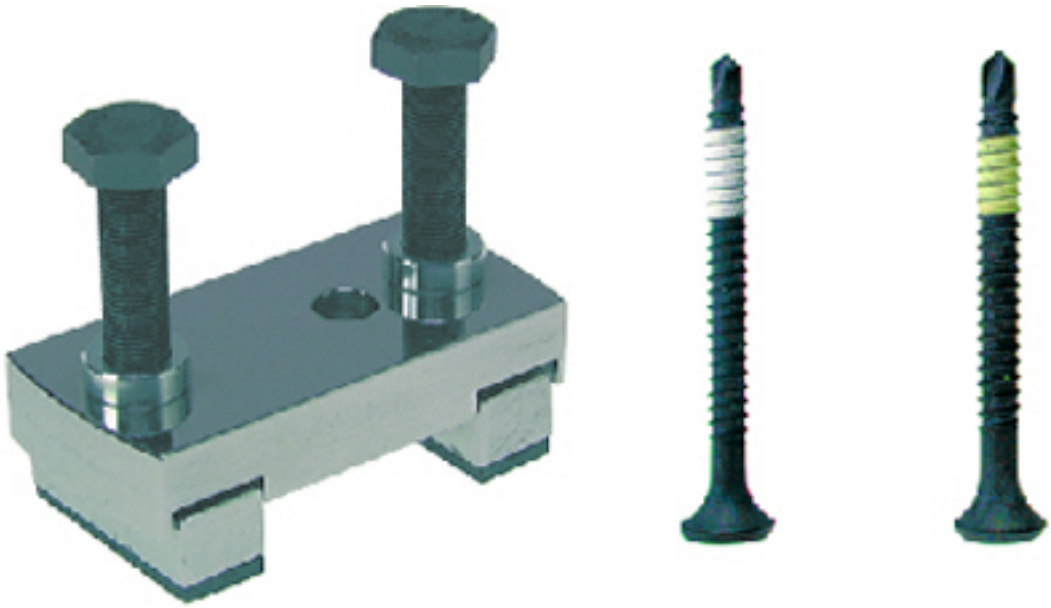


Cylinders can often be pulled from their housing. In the video demonstration we easily removed a Mul-T-Lock profile cylinder by inserting a special hardened screw into the keyway, then applying extreme pull with a tool that is designed to exert reverse pressure against the door. The operating principle is extremely simple and the author has found many variations of pulling devices that were used by criminals in burglaries. Commercial sets are also available.

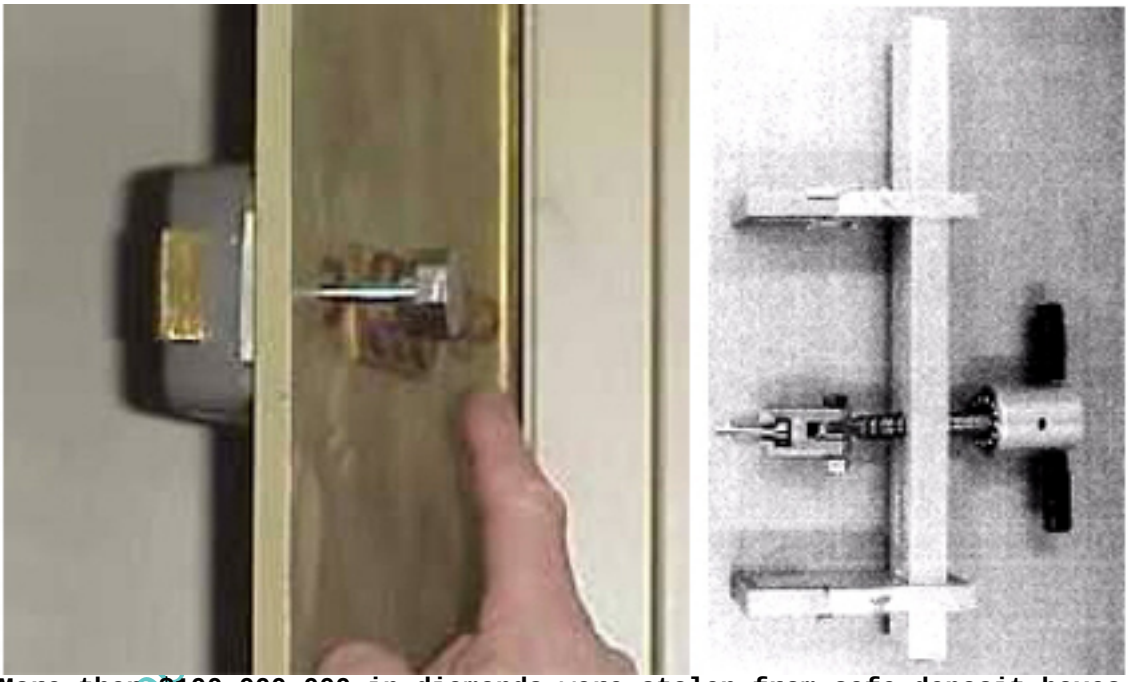
**A Mul-T-Lock profile cylinder is pulled from its housing with little difficulty.**
Link: http://video.security.org/forced_entry/mul-t-lock_pull_200.wmv

Then we attempted to remove the Evva 3KS. We tried for several minutes without success.

**An EVVA 3KS could not be pulled from its housing.**
Link: http://video.security.org/forced_entry/3ks_pull_200.wmv



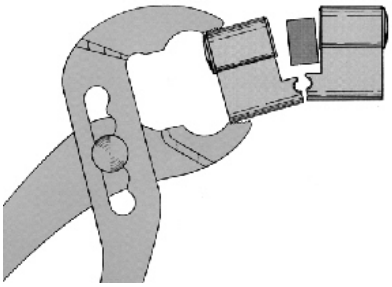
This same technique was employed in a spectacular burglary in 2003 in Antwerp, Belgium. The author reviewed the crime scene where thieves stole $100,000,000 in diamonds from 129 safe deposit boxes inside of a vault during a six hour period. They created a steel key that they inserted into each lock, applied a pulling force, and warped the brass bolt to open each door to expose its contents.



**More than $100,000,000 in diamonds were stolen from safe deposit boxes in the basement of the Diamond Center in Antwerp using a modified pulling technique to apply extreme reverse pressure on the vault doors in order to warp the brass bolt. The thieves were caught but the diamonds were never recovered. The lock at the right shows the simple**

**mechanism. These photographs are of the actual locks from the vault in the Diamond Center.**

Profile locks can also be removed with wrenches or simple tools to rip them loose from their housing, breaking the retaining screw.



**Vice grips or breaker tools can be used to defeat profile cylinders.**

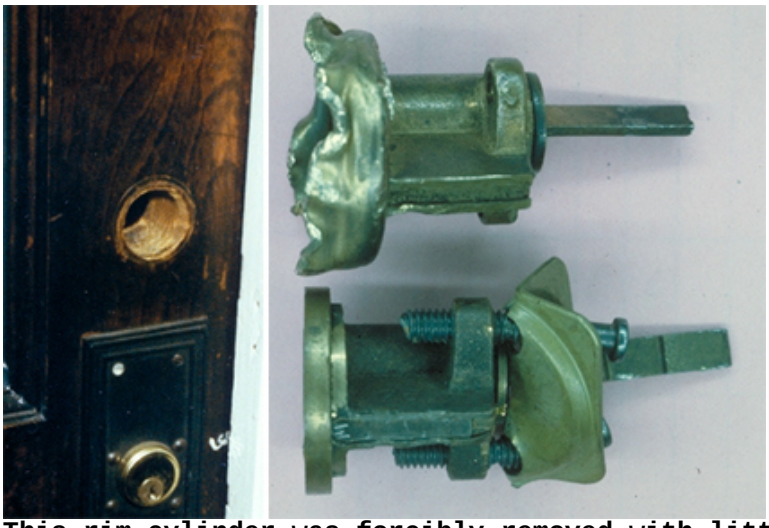
## Attack by pounding to create a fracture of mounting hardware

Cylinders can be pounded with steel picks or chisels to fracture their housings. They can then be easily removed.

**In this burglary the lockset housing was fractured. It was then an easy matter to remove the cylinder.**

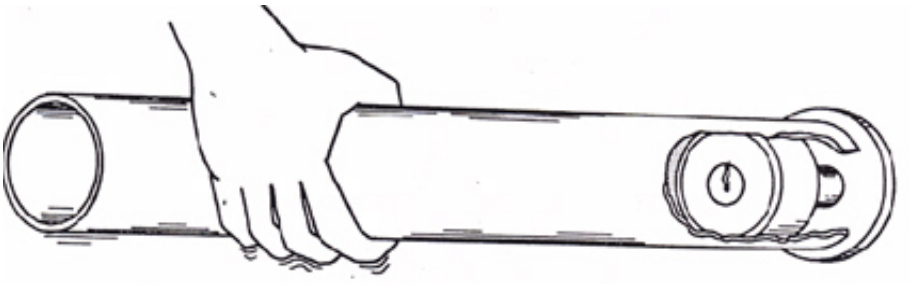
## Attack by prying or twisting

Cylinders can also be pried loose if not mounted properly The photograph shows a rim lock that has been ripped from the door.



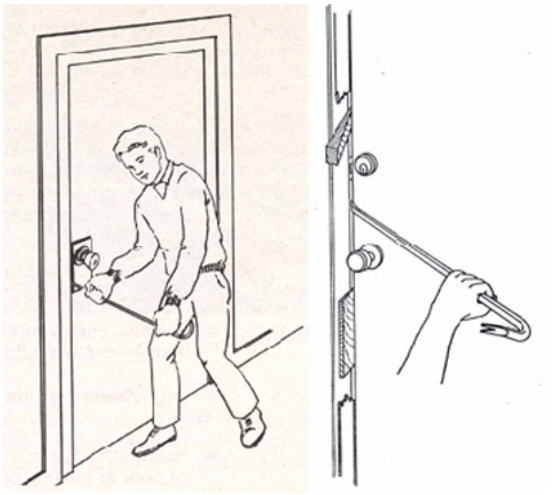
**This rim cylinder was forcibly removed with little difficulty.**

A pipe wrench or similar tool can also be utilized to bend and break a door knob or other protrusion.

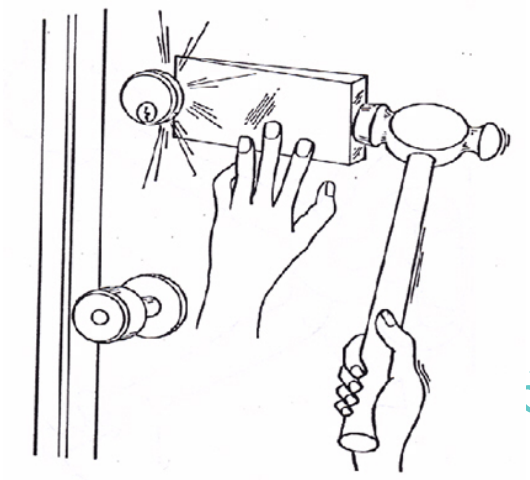


**Attack by prying and wedging**

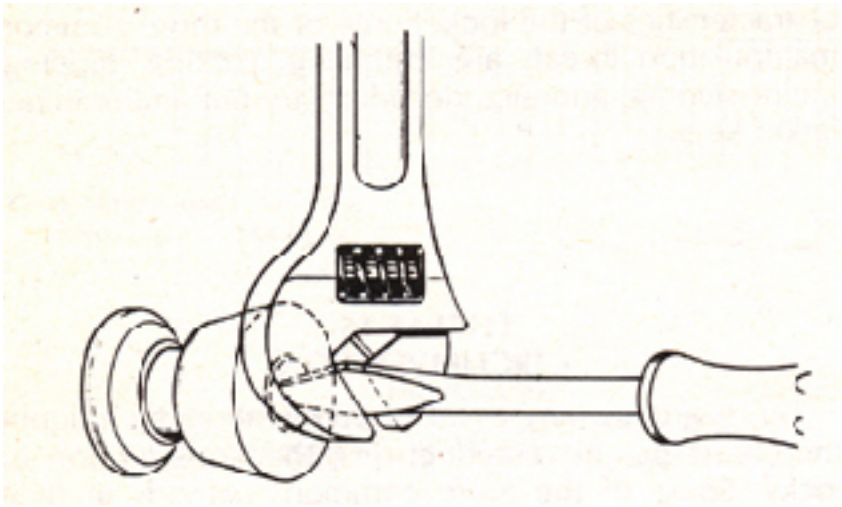
A 180 pound man using his body weight on a 36” pry bar can generate a 6,000 inch-pound moment, producing a 3,000 pound force. This force can be used to jimmy a door by prying and wedging.



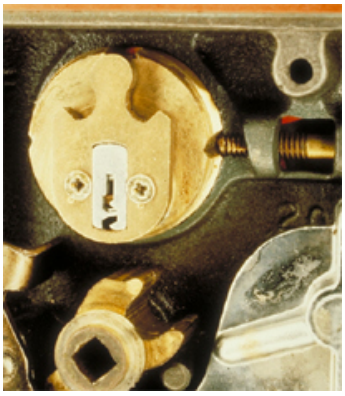
A wedge or chisel and hammer can be utilized on a protruding lock cylinder or housing. The maximum compressive wedging force which can be created in the attack is 300 pounds.



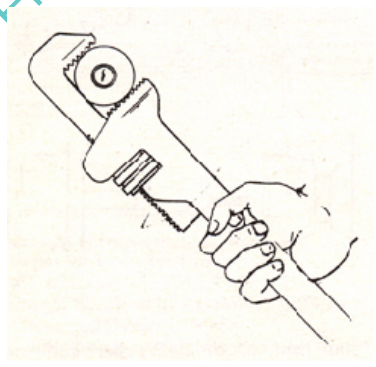
**Torsion or Twisting Attacks**



Torsion and twisting forces can be applied as shown in the diagram. With a screwdriver inserted into the keyway, a torque as great as 600 inch-pounds can be applied by using an adjustable wrench. Depending upon the physical design of the lock, locking mechanism or housing, torsion or twisting force can be used to break it.







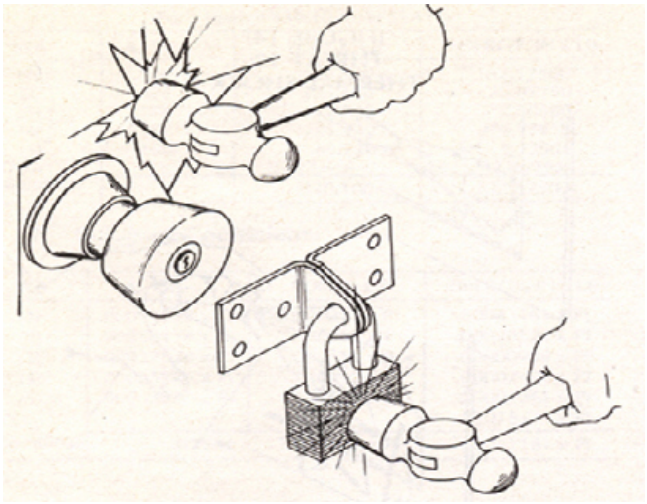
**Mortise cylinders can be twisted with a pipe wrench to shear the set screw that is really the only thing retaining the cylinder within its**

**housing. In this burglary the single screw that held the cylinder in place was sheared. The cylinder could then be easily removed and the bolt withdrawn.**

## Impact Force

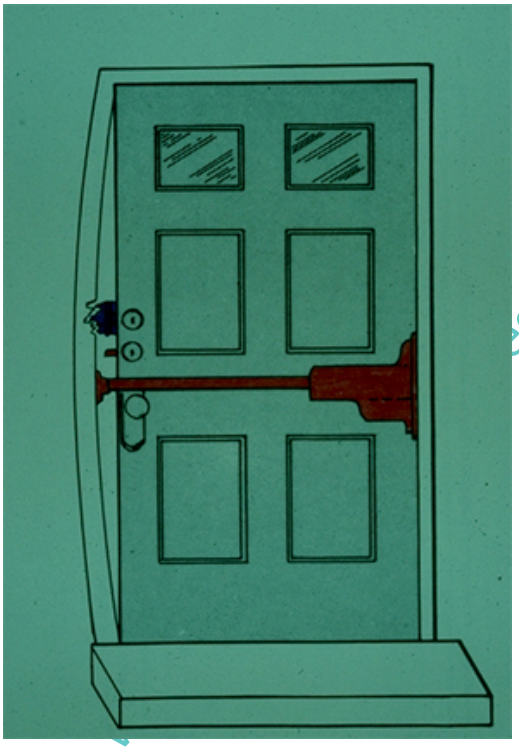
The maximum energy input to the door has been measured at 1800 inch-pounds, based upon a 180 pound man impacting at 88 inches per second. Maximum equivalent shoulder impact was measured to be no greater than 1500 pounds for all types of doors that were tested. The maximum energy input using a kick was measured to be 775 inch-pounds. The application of lateral force that is applied to the door latch or bolt from shoulder impact of 1800 inch-pounds can result in a maximum load to the lock of 2250 pounds. Many doors and locks will not survive even this simple form of attack.

A man swinging a one pound hammer was measured to be able to apply a maximum energy input of 170 inch-pounds impact per blow to a glazing system or to a lock in a door or padlock. This is sufficient to cause failure from this most rudimentary form of attack.

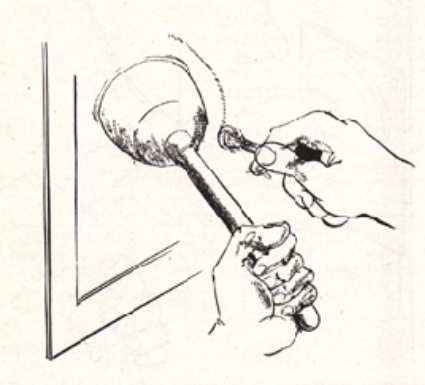


**Spreading Door Jambs and Frames**

Jamb spreading is one of the simplest forms of attack. There are many tools that can be placed on opposite sides of the door frame to cause the frame to flex far enough to clear the protruding latch or bolt, unless high security hardware is employed. Some of these tools develop in excess of 10,000 pounds of force.



**Jamb spreading is a common technique to bypass latches and bolts.**



Glass cutters are a very simple way to enter a residence or building. In this diagram, a suction cup is utilized in combination with a diamond cutter to easily remove a piece of glass without any noise.

**Summary**

I have only shown a few of the many methods of forced entry. Imagination is the only real barrier to the criminal because of the prevalence of simple to sophisticated tools. Suffice it to say, if you install cheap locks, you may surely suffer the consequences. If you are concerned with the security provided by your current locks you should consult with a locksmith that sells higher quality hardware. He can assess whether your overall security is sufficient to guard you and your assets.

To assure at least a minimum of protection against physical attack, be certain to specify UL 437 **and** ANSI 156.30-2002 high security cylinders, or as a less expensive alternative, ANSI 156.5, 2001 Operational and Security grade cylinders. Make sure that every component that offers a barrier against entry is secure. That means locks, locking hardware, doors, strikes and frames. And make sure that a simple loid attack (using a thin piece of plastic to bypass the bolt or latch) is not possible.

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All photographs shown in this document appear in Chapter 29, Picking, and Chapter 32, Forced Entry, Locks, Safes, and Security, and LSS+, the Multimedia Edition.