REALTOR® Lockbox NXT Series

Security & Reliability by Design

December 29, 2009

SentriLock
Smart Lock. Smart Card. Smart Choice.™

Supported in the USA • Built by US and Canadian partnerships

Executive Summary

The REALTOR® Lockbox NXT Series, the SentriCard®, and its related system tools bring an entirely new level of security and reliability to the industry. From rugged materials to technology advances, every aspect was designed and thoroughly tested to ensure long life and robust security. This White Paper will give you a thorough understanding of the crucial elements to look for when choosing a lockbox, as well as the innovations and testing that went into the REALTOR® NXT series, highlighted in Table 1 below.

Table 1 – REALTOR® LOCKBOX NXT SERIES Exclusive Design Features

Property	Feature	Attributes
Case Material	Heat Treated Chromium Molybdenum Alloy Steel	Hard to drill with standard and cobalt drill bits. Impact, tensile and yield strength double that of other lockboxes.
Shackle Material	Enhanced Shackle - 8mm Diameter Heat Treated Specialty Alloy Steel	Over 200 lbs. of cutting force required which is twice the strength of other lockbox shackles and virtually impossible to cut with widely available 24 inch bolt cutters.
Physical Construction	Double layer heat treated alloy steel front, recessed interior vault door	When mounted on a door or railing, access to the contents using hand tools is prevented.
Latching System	Patent pending latch immobilizer system	Only lockbox where latches held securely in place, preventing exterior blows from causing undesired operation. Latch immobilizer also defeats attacks with high strength magnets.
Power System	Batteries can be replaced in the field by the lockbox owner. Remote power capability.	The only lockbox solution that doesn't require shipping the lockbox back to the factory to replace the batteries. Remote power paddle allows the lockbox to be powered externally so that even completely dead batteries can be replaced in the field. Special industrial formulation batteries provide reliable operation down to -35C.
Wireless	Short range wireless transceiver	Future friendly communications capability where the lockbox is no longer an island. Enhanced real-time notification of events, updating settings.
Access Device	Cryptographically secure smart card and one day codes.	Convenient size, no battery to worry about charging, and extensive security features make smart cards a simple and efficient access device.
Security Testing	UL 1037 and LPS 1175 Security Certification	The NXT lockbox is the only lockbox to have been tested and passed both North American and even more stringent European security standards.
Green Technology	RoHS Compliance	RoHS compliance ensures the NXT lockbox contains no environmentally hazardous substances such as lead, cadmium or mercury.
Assembled in the U.S.A.		Supports American high technology manufacturing jobs.

Abstract

With the passage of time, the reliability and security of lockbox products on the market has improved dramatically. These improvements are driven by competition, new security threats, greater availability of information (the YouTube effect) and an overall greater adoption of lockboxes as an access control system. In today's market, with more "For Sale" signs and fewer neighbors at home to notice, the potential for break-ins has increased. The need for security is greater than ever. The REALTOR® Lockbox NXT series of lockboxes is the culmination of 20,000 hours of research, development and testing. This White Paper examines and discusses the approach taken by SentriLock's group of 9 engineers in creating the most advanced and secure commercially available lockbox solution.

History

Lockboxes have been around for decades, beginning with simple mechanical key boxes and advancing to electronic solutions. While physical vulnerabilities and limitations were sometimes obvious in the early designs, the pressures to provide high security were rarely present. The primary reason agents migrated to lockboxes was convenience and not security. Instead of keeping all of the keys at the broker office, it made more sense to keep the key at the property, thus eliminating multiple lengthy trips back and forth between the listing and the broker office. Table 2 below summarizes the relative security, reliability and convenience of previous key management solutions and their limitations.

Table 2 – Evolution of Lockboxes

Method	Security	Reliability	Convenience	Weakness
Key at the Broker's Office	Low	High	Low	Often little was done to validate the identity of the person requesting the key.
Mechanical Combination Lockbox	Low	High	High	Combination boxes were usually shipped with the same factory default combination. Agents rarely changed from the factory default. Physical security is weak due to construction.
"Title Key" Lockbox	Low	Moderate	High	Title key box protection was limited by the fact that if a single key was lost or stolen, every lockbox in the system was vulnerable.
First Generation Electronic Lockbox	Moderate	Moderate	Low	Electronic lockboxes offer moderate security and recording of accesses. The need to retrieve codes for each listing prior to showing made convenience suboptimal.
Second Generation Electronic Lockbox	Moderate	High	Moderate	Electronic key based second-generation lockboxes improved convenience but physical security was less optimal due to materials and construction.
Third Generation Electronic Lockbox (REALTOR® NXT Series)	High	High	High	Improved design, materials selection, wireless alarming and electronic key renewal bring third generation lockboxes to the apex of the product curve.

Material Strength

The choice of materials is one of the greatest influences in determining the security and reliability of the lockbox. The engineer's challenge is choosing the best fit of material to application. As with any choice there are trade-offs that have to be considered: performance, manufacturability, weight, material cost and other factors. Unfortunately, there is no one perfect material that can do it all. Engineers often jokingly refer to making everything out of mythical "unobtainium" -- a material that costs nothing, is easy to manufacture and has the perfect material properties for whatever function desired. The reality is no such material exists, so careful choices are made.

Lockboxes have diverse material needs depending on the application in the device, with strength being the most important. Strength measurement terms used for lockboxes fall into three main categories called tensile strength, yield strength and impact strength. Tensile strength indicates how much force is required to pull apart the material while yield strength measures the force required to bend a material. Both are important when designing to prevent prying. Impact strength tells how well a material can withstand the sudden application of force such as a hammer blow. As can be imagined, all of these properties are important in the selection of materials for lockboxes.

Lockboxes are constructed of die cast metal or sheet metal. Die casting allows complex metal shapes to be made at an affordable cost, but the materials are not as strong especially at very cold temperatures where the metal can become brittle. Sheet metal is low cost but requires more complex forming during manufacturing and is limited in the shapes that can be produced. The type of steel used also makes a huge difference. Table 3 shows a comparison of the materials used in various lockboxes.

Table 3 – Lockbox Materials

Lockbox	Case / Container Material	Attributes
Mechanical Combination Keyboxes	Die Cast Metal	Low to moderate impact strength but susceptible when cold. Easy to drill with standard drill bit.
Competitor Electronic Lockbox	Mild Steel Shell with Die Cast Key Container	Good case impact strength. Drillable with standard drill bit. Die cast key container easily drillable.
REALTOR® Lockbox NXT	Heat Treated Chromium Molybdenum Alloy Steel	Hard to drill with standard and cobalt drill bits. Impact, tensile and yield strength double that of mild steel.

The REALTOR® lockbox NXT's use of alloy steel for the construction of the vault provides strength and drill resistance not found in any other lockbox. Alloy steel differs from standard or "mild" steel used in other lockboxes in several important ways. Alloy steel mixes iron and small amounts of carbon,

chromium and molybdenum which allow it to be heat-treated. Heat-treating is a process where the steel is heated to high temperature and suddenly cooled. The result of heat treating alters the crystal structure of the steel causing a doubling in strength, plus it hardens the steel making it significantly more difficult to drill or damage with hammer blows. While the heat treating process and alloy steel add cost to the manufacturing of the lockbox, they provide substantial improvements in security.

Shackle Material Selection

Resistance to cutting is equally important. The shackle material should be able to withstand the force of 18 and 24-inch bolt cutters, regularly sold in hardware stores. Again, the NXT series of lockboxes provides the best protection available as shown below in Table 4.

Table 4 – Shackle Materials

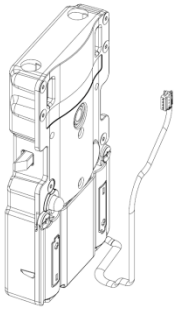
Lockbox	Shackle Material	Strength
Mechanical Combination Key Boxes	Stainless Steel or Mild Steel	70-100 lbs. of force required to cut with 24-inch bolt cutters.
Competitor Electronic Lockbox	8mm Diameter Mild Steel	100 lbs. of force required to cut with 24-inch bolt cutters.
REALTOR® Lockbox NXT	Standard Shackle - 8mm Diameter Heat Treated Chromium Molybdenum Alloy Steel	160 lbs. of force required to cut with 24-inch bolt cutters.
REALTOR® Lockbox NXT	Enhanced Shackle - 8mm Diameter Heat Treated Specialty Alloy Steel	200+ lbs. of force required to cut with 24-inch bolt cutters.

Physical Construction

The physical construction of the lockbox has as much to do with security as material selection. The REALTOR® Lockbox NXT's vault uses a reinforced design to provide a high degree of difficulty in obtaining enough leverage to compromise security. A counter sunk vault door within the reinforced structure redirects prying force to dissipate it along large surface areas. By dissipating the force, the material springs back versus permanently deforming. Over the door seams is a second layer of steel which is welded in a breakaway configuration in key areas, thus slowing attack.

Latching Systems

The strength of the latching components is key to surviving pry attacks. In the NXT lockbox, careful attention to detail ensures the latches and the mating locking features in the lockbox have equivalent strength and do not distort or



yield under high stress. Electromechanical drive systems in the NXT lockbox are designed to prevent failure in high impact situations.

Security Standards

To fully validate the physical security of lockboxes, standardized testing is necessary. The difficulty of designing such tests is the variability of tools, methods and knowledge, as well as debate on what constitutes a true physical standard of security. Like bank vaults, safes and other security devices, history has shown nothing has been invented that is impervious to attack.

To date, there is no specifically designed physical security standard for lockboxes. Lockbox vendors are instead relying on other security standards under which to have their products tested. The two standards organizations that have security standards applicable to lockboxes, shown in Table 5, are North American Underwriters Laboratories (UL) and the United Kingdom's Loss Prevention Standard (LPS). The table below compares the two standards.

Table 5 – Accredited Testing Bodies

	Underwriters Laboratories (UL)	Loss Prevention Service (LPS)
Standard #	UL-1037	LPS 1175 Issue 6
Classification	Antitheft Alarms and Devices	Security Enclosures & Locksets
Rating System	Pass / Fail	8 Levels
Primary Focus of Standard	Device Safety & Reliability	Device Intrusion Security
Maximum Attack Time Tested	5 Minutes	60 Minutes
Attack Tool Categories	1	8
Standard Also Considers Non-physical Security Aspects	No	Yes
Novel Attack Modes Considered	No	No
Reliability / Environmental Test	Endurance, temperature, salt fog, moisture, rain and humidity, flammability, battery, dust, ultraviolet, aging, corrosion	No

The NXT series of lockboxes is the only electronic lockbox on the market that has passed both the North American and European security standards. Our lockbox is the most tested product on the market as shown below.

Impact Testing

Impact testing is one of the most inexact but important analyses that can be performed. Impacts typically take on two different forms: external impacts imparted in a single direction from blows with a hammer, and a second type where the lockbox itself is subject to impact with a hard surface such as concrete or asphalt.

First order impacts can defeat internal mechanisms in lockboxes because they impart the same motion in latches and other moving parts that normally occur during regular electromechanical operation. In effect, the shock of the blow causes a latch to move and unlock the device. Many lockboxes migrated to opposing latch designs with the thought that an impact on one axis would not defeat the system because the opposing latch would be driven into place by the impact. Many of these opposed designs did not anticipate the rebound energy the latch spring would have after the impact. Much like waves in a bathtub, the rebound energy can cause both latches to move toward each other on rebound and cause an undesirable release, especially when one latch is partially trapped by mechanical loading.

The NXT lockbox protects against these types of impacts through a patent pending latch immobilization system. Latches are physically trapped such that they cannot be moved once the mechanism is placed in the immobilized state. The NXT lockbox is the only lockbox currently on the market that is not subject to impact override of its latching mechanism.

The second order impact is much more difficult to model and design for because impact force often changes direction several times, and the magnitude of those impacts can be several thousand times the force of gravity. Take for example an internal latching part of the lockbox that weighs just 1 ounce. Under a 2,000 G impact, the same latch has the equivalent impact energy of an object weighing 125

pounds. This basically means that any part the latch touches must be able to withstand 125 pounds of force applied in a concentrated area.

The test methodology SentriLock employs on second order impacts is simple. Multiple lockboxes are taken to an area of concrete slab, and testers spend time hurling the lockboxes to the ground in an attempt to break into them. After a period of 10 minutes, the test is halted and the units are disassembled to evaluate the effects of impacts on the design.

Again, the NXT lockbox's material selection and latch immobilization make it extremely durable against this type of abuse.

Prying

Prying is probably the most common attack expected given the minimal tools required and the low amount of noise generated. To thwart this type of intrusion attempt, material selection and design of the lockbox are equally important. Materials can provide resistance to bending or breaking, but the weight penalty is severe if material selection alone is considered. Careful design prevents tools with larger surface areas or diameters from being used, and recessing key features eliminates gaining leverage in critical areas.

The NXT series lockbox tests consist of a worst case scenario. The lockbox is mounted in a vise where maximum transfer of leverage force is imparted into the lockbox. The NXT lockbox incorporates double heat-treated and interleaved walls around the opening perimeter. Specialty welds are used to provide strength as well as key breakaway areas. The breakaways allow flexing of the steel shell to dissipate bending force applied to the outside of the lockbox.

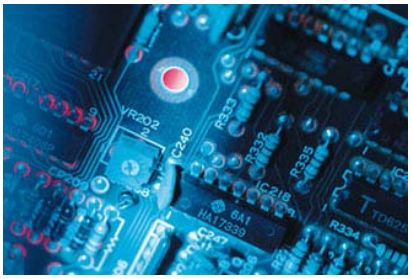
High Strength Magnets

With the discovery of rare earth magnets and the advent of the global Internet marketplace, careful attention must be paid to attacks utilizing high strength magnets. Specifically, readily available Neodymium Iron Boron magnets made today have static field strengths exceeding 1.4 Teslas. Such magnets can exert a pulling force of over 300 lbs. yet are small enough to fit in an individual's pocket. The Tesla Unit measures the concentration of a magnetic field, essentially measuring a magnet's strength.

Many lockbox-latching systems can be defeated with such magnets. The attack leaves no evidence of intrusion so it may be some time before discovery of the situation occurs. The field strength of these magnets is so strong that it can penetrate steel enclosures and essentially magnetize every component in the lockbox. If the lockbox relies upon latches that move or are retained by a magnetic field during operation, such as those utilizing solenoid actuators, the lockbox can be opened when the magnet is attached to the outside case, leaving no evidence of intrusion.

The NXT series lockbox prevents any undesired motion of the latching components by utilizing a patent pending latch immobilization system. When the lockbox is closed, the internal mechanism in the lockbox is moved to a position where the door and shackle latches are locked into place. The parts that provide the immobilization are non-magnetic so they themselves are not subject to being defeated by magnetic fields.

Electronic Safeguards



Much attention is paid to the obvious physical security of the lockbox, but electronic security is equally important. Computers and, more importantly, information about attack methods is easily obtained via the Internet so it is always best to seek out the companies producing the best electronic security technology. Smart cards have been widely used and tested for decades in all types of security environments.

Smart cards are such a compelling choice for security because of their size, reliability and low cost. What makes a smart card smart is an electronic chip that is embedded in the plastic card. There are many different types of smart card chips on the market today with different features and capabilities--all the way from simple memory to sophisticated microprocessor based cards. As shown in Table 6, SentriLock identified 5 key areas of chip security features necessary for system security. All are present on the SentriCard®.

Table 6 – Necessary Chip Security Features

Chip Security Feature	Attack Prevented
Anti Wiretapping	Data communicated between the chip on the card and the host computer system is encrypted so that a "man in the middle attack" (where an attacker places themselves in the middle of the communications link) cannot alter the data passing through without detection.
Tamper Detection	Computer chips are sensitive to voltage fluctuations and improper signals. The chip has special circuits to detect abnormal signals and voltages and shuts down to prevent errant operation.
Dynamic Authentication	Each time the host computer and the chip start a communication session, the challenge and response between both devices changes unpredictably so communications can't be recorded and played back by an attacker to gain access.
End to End Security	At no time are communications decrypted at any point other than SentriLock's servers or the chip itself. Data in transit is fully encrypted.
Self Destruct / Self Deactivation	While not as exciting as Mission Impossible type self destruct, self destruct is an important safeguard against brute force attacks attempting to guess a valid access sequence. In the case of the SentriCard®, after a small number of invalid authentication attempts, the chip disables itself permanently.

Each chip is protected with a challenge response system utilizing a 109 bit cryptographic engine to gain access to the physical storage of the card. Sensitive data on the card is further encrypted to provide maximum security. These features coupled with tightly controlled distribution of un-programmed chips makes the SentriCard® a reliable and robust security device.

Reliability Testing

SentriLock performs a significant number of reliability tests during the design process. The goal of reliability testing is to subject a number of production grade lockboxes to conditions that exceed those expected during normal use. During testing, units undergo many checks and examinations. Many of these tests are conducted internally by SentriLock on custom designed test fixtures while others are sent out to a certified testing laboratory. Outside labs are used when specialized test equipment is required; however, SentriLock engineers still design and oversee the conditions, parameters and analysis of the test results. When an outside lab is used, their credentials must include A2LA certification or accreditation. The American Association for Laboratory Accreditation (A2LA) is a nonprofit, non-governmental, public service, membership society. The mission of A2LA is to provide comprehensive services in laboratory accreditation and laboratory-related training. Laboratory accreditation is based on internationally accepted criteria for competence (ISO/IEC 17025:2005).

Low Temperatures

Most people are surprised to learn that low temperatures are much more challenging to deal with in electronic lockboxes than high temperatures. Unless the lockbox is going to Mars, high temperature conditions will fall within the range guaranteed by the manufacturers of the electronic components. All of the electronic parts in the NXT lockbox are rated for what is termed in the electronics industry as “industrial temperature range” or -40C to +125C.

The challenge faced with very low temperatures relates to the batteries that power the lockbox. People who drive cars in extreme northern winter temperatures know how cold affects batteries. They just don’t work well. The reason is well known. All batteries use a chemical reaction to create electricity and, in the cold, the chemical reaction slows down. The slower the chemical reaction, the less power that is available. The NXT lockbox uses the only type of battery available that can provide power down to -40C – the lithium camera battery. Thankfully these batteries are inexpensive and widely available.

SentriLock lockboxes are also the only lockboxes which allow the customer to replace the battery. In very cold climates where the ambient temperature routinely is below -30C, the customer can use this

advantage to replace the lockbox battery more frequently to provide greater reliability to those accessing the lockbox.

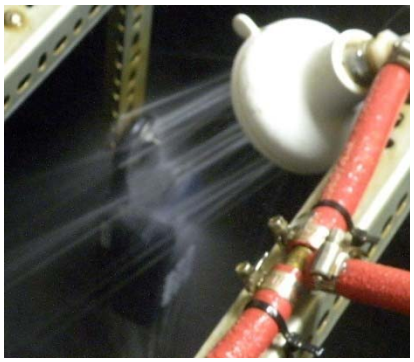
The NXT lockbox design was tested for cold performance by placing lockboxes in an industrial temperature chamber and cooling them to -30C first for a period of 24 hours. Each lockbox was tested to ensure it functioned properly. The second phase of testing lowers the temperature to -39C for another 24 hours, which is the limit the battery is rated to. Again lockboxes were tested to ensure proper operation. Lastly, the temperature was lowered again to -45C for an out of range test. The NXT lockboxes even operated at this temperature.

High Temperatures

High temperature testing consists of heating the units under test to a temperature of +85C and maintaining it for an extended period of time. In the six years SentriLock has been designing, testing and producing lockboxes, heat related failures have never been observed with the exception of a couple of lockboxes that had been incinerated in house fires.

Humidity and Rain

Humidity, rain and moisture are number one on the list of difficult to design for environmental conditions. Water comes in many forms, and its ability to permeate through the tiniest openings requires great skill in engineering solutions. SentriLock lockboxes handle water in several ways. First, every electronic circuit board is covered in a silicone based conformal coating. Similar to silicone bathtub caulk used by homeowners, the silicone is applied to the circuit board creating a waterproof protective layer over every component and exposed electrical connection. The second defense is a series of seals, similar to what are used in automobiles, which create barriers to the entry of water. SentriLock always uses two layers of protection – to keep water out and ensure there is a second level of protection just in case.

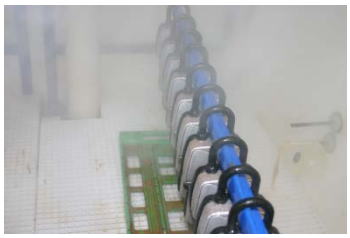


The test apparatus used by SentriLock for water intrusion testing consists of a sealed enclosure with spray nozzles powered by a re-circulating water pump system. The enclosed environment amplifies the effects of manmade downpour by creating a large volume of water vapor. The water vapor has the ability to infiltrate spaces that the spray cannot reach. Lockboxes are placed in the test chamber and subjected to varying levels of spray intensity, duration and angle. After a session in the chamber, the lockboxes are completely disassembled to evaluate the protective measures.

For humidity testing, a laboratory-based condensation test chamber is used. The environment is 100% humidity at +35C. Again the high level of water vapor in the air causes moisture to reach every unsealed space in the lockbox.

Salt Fog

To provide meaningful security, lockboxes utilize metals in their construction. With very few exceptions, metals are subject to corrosion. This is due to their atomic makeup in that metal atoms don't have 8 electrons in their outer shell. This imbalance makes metals react with other compounds and also explains why almost all metals mined on Earth are not extracted in their pure metallic form but rather ores that must be chemically separated. Even so called "stainless" metals such as stainless steel have a nearly invisible coating at the surface where the oxygen in the air has reacted with the metal. In the case of "stainless" metals, the reacted surface creates a protective layer that prevents further corrosion.



Coastal areas are subject to onshore winds that carry ocean spray inland, bringing dissolved salts from the sea. The combination of salts with moisture provides the ideal conditions for unprotected metals to react with oxygen in the air or the salts themselves to create corrosion. Corrosion can quickly damage or destroy parts.

In the NXT lockbox, alloy steel is used for large parts such as the case and shackle. Unprotected steel is very reactive and will begin corroding in salt fog within minutes! To protect these parts, SentriLock again looked to automotive-based solutions since no industry has had more experience dealing with corrosion caused by salt. The alloy steel in the lockbox is protected with either e-coat or nickel plating. Both processes fully immerse the part in the protective material versus painting that could leave unprotected areas.

To simulate and accelerate the conditions that might be experienced in a coastal area, a salt fog test is performed on fully assembled NXT lockboxes. The test chamber is set up according to either ASTM B117 or ISO 9227 standards which specify 5% salt solution and +35C water temperature. The lockboxes are placed in the chamber and removed at various intervals to check for unacceptable corrosion. Years of intense coastal exposure can be simulated in a few hundred hours of salt fog exposure.

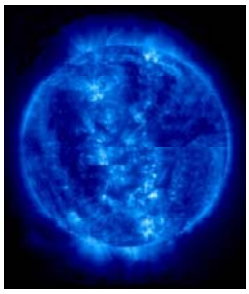
Cycle Testing

Cycle testing consists of operating the electromechanical systems of the lockbox repeatedly to simulate years of use. During design cycle testing, units are cycled thousands of times, disassembled, examined for wear, reassembled with the same parts and run for thousands of additional cycles. The NXT lockbox design was tested to 10,000 operational cycles with nominal wear observed on the mechanical parts. With normal usage patterns based on statistics collected from millions of lockbox operations in the field, this equates to dozens of years of normal use.

Altitude

The NXT lockbox was subjected to the equivalent altitude of 10,000 meters at a temperature of -40C to verify there were no abnormal operations or battery leakage in these conditions. While these conditions are extremely unlikely in normal use, they could exist during air shipment if the cargo area were to be depressurized in flight.

Ultra Violet Exposure



SentriLock tests all materials for exposure to ultraviolet light (UV). UV is present in all sunlight and can cause degradation of plastics, rubber and painted surfaces. To test UV exposure, the lockbox is placed in a laboratory grade carbon arc lamp chamber. An electric arc between two carbon electrodes creates intense light with a high level of ultraviolet light. During the test, the lockboxes move on a carousel to ensure even exposure of all surfaces. Years of sunlight exposure can be simulated in hours of exposure in the test chamber.

SentriLock: Smart Lock. Smart Card. Smart Choice.™

While threats become more sophisticated, new technologies emerge and customer needs change, SentriLock responds by constantly innovating and providing our customers with the newest and best lockbox available. With sophisticated software built into every box, future upgrades will be simple, fast and seamless!

For an interactive Flash demonstration of the SentriLock REALTOR® NXT Lockbox system, please refer to www.sentrilock.com/lblive/lblive.html. This demo includes a 360 degree view of the lockbox and movies for several key attributes.