



MUSEUM SECURITY: THE ART OF ALARMS

BY STEVE KELLER, CPP

They say that art imitates life. That's not always so. Sometimes life is much more complex and its challenges much more ingenious. We've all seen the movies where the master criminal drops from the skylight through the laser beams that crisscross the museum's gallery. Or perhaps you've seen the one where the shapely female criminal slithers between the laser beams made visible by her special glasses. She just makes it to the priceless object before the guard arrives on his carefully timed patrol. In real life, guards don't patrol on schedule--and if they did, they'd probably be early or late. Infrared, the mainstay of museum motion detection, is passive, and is thus invisible even to special equipment. And most frightening of all,, low tech threats are much more of a concern than high tech threats. Thieves usually don't slither past detectors during museum heists. They pay their six bucks, walk in as members of the public, stay behind after closing by hiding behind the draperies or under a bench, and smash the window to get out. Guards respond and search the building for an intruder, assuming that windows are

only broken by those who break in and not by those who break out. Sometimes a thief just drives his car through the front window and drives out with the loot. Or he shows up at the door dressed as a police officer and is let in by guards who believe they are being helpful. More times than not, the thief just takes the object off the wall and walks out the door with it under his coat. Low tech thefts can be much easier and much more successful than trying to slither past an invisible beam!



As a security consultant specializing in museum and historic site alarm system design projects, I have to design against a variety of threats. I consider the high tech threat to be much more manageable than the low tech threat. Museum buildings are often works of art in and of themselves, and any security equipment is considered by some to be intrusive and in the way. Historic sites have what we call "historic fabric issues" meaning that the building's fabric and appearance must be undamaged or unchanged, even by alarm devices or the presence of exterior lighting. So what we are allowed to do in museums is often limited by the rules imposed on us by the nature of museums themselves. Even issues like where we place motion detectors is driven by the nature of the museum. I was once told by a museum director, "How can I

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hang pictures on walls when you put motion detectors there?" It may seem simple. Just use ceiling mounted motion detectors. Unfortunately, there are no UL listed ceiling mounted infrared motion detectors made for ceilings higher than eighteen feet, and I know of few museum exhibition halls with ceilings eighteen feet or lower. So alarm systems for museums are often far more complex to design than those used in other environments.

Unlike the commercial alarm system designer, the museum alarm system designer is much more limited. He or she is limited by aesthetic issues, building fabric issues, and even by the changing nature of the museum itself. Many very large exhibit areas lend themselves well to microwave detectors but they may be sub-divided in the near future when the current exhibit moves to its next venue and a new exhibit is displayed. The two dimensional pictures of this exhibit may be replaced by a massive, hanging kinetic sculpture next month—a veritable microwave reflector sure to cause false alarms. Nothing in a museum is permanent. Everything is subject to change.

Why not just glue sensors to the backs of works of art? Well, we don't even touch works of art without white gloves and a Ph.D., so affixing sensors to them or even to many of their frames is out of the question. And running wires to a picture that will surely be hanging two feet to the left when the exhibit changes, makes it real tough to predict exactly where that wires are to protrude from the wall and still be unseen.

The museum alarm system must be "over designed" to assure that changes that are made when exhibits change, do not block or neutralize some of the detection devices installed for the next exhibit. If this is not done, the alarm system soon becomes ineffective. I've seen many such problems over the years. And I've seen many design mistakes by alarm designers who don't really understand museum security. Probably the most common minor mistake is the use of magnetic door contacts on glass doors with no motion or glass break detection as a back-up.

Some designers are overly impressed by specialty products. I often see curtain motion detectors, those that provide a four inch curtain of detection, used for no good reason, when a standard-pattern motion detector would provide better coverage. In a museum, the more volumetric space you can fill with motion detection, the better off you will be. One museum used curtain detectors across all of its doors. True, this would detect a burglar when he broke in and passed through the doorway. But a standard motion detector would provide more extensive coverage and detect movement in the entire lobby, not just the few inches inside the doors. And then there are the glass break detectors used to detect the breaking of glass on exhibit cases in the gallery. It's too bad that the designer didn't know that museums rarely use real glass on cases, in favor of polycarbon which does not break at the frequency detected by an acoustic glass break detector. Another typical mistake is the use of glass break detection as



"primary" detection without motion detectors as back-up. In a museum's changing environment, a window may be unobstructed today and covered by light filtering blinds tomorrow. Unfortunately, these blinds also block out the sound of breaking glass and conventional motion detectors are necessary as primary detection in most instances.

The museum security system designer should know how museum thefts really occur rather than how Hollywood portrays them as occurring. The perimeter must be secure, with all doors, windows, skylights and other penetrations electronically protected. It is desirable, but not always possible, to protect every air vent in the building, and it is also desirable to detect movement at night in all parts of every collection bearing area. So many designers, faced with a realistic budget, often saturate galleries with motion detection rather than alarm every air intake vent in the room. While the intruder might not be immediately detected, he would eventually be detected upon arrival in the collection bearing area. Saturation motion detection is desirable over perfect perimeter protection since museum thefts could more easily occur by staying behind than by breaking in.

Burglaries through skylights are a real possibility, so skylights must be protected. Simply projecting a curtain of infrared across a skylight is not adequate in my opinion, nor is the use of glass break detection alone. I feel strongly that every motion detector

must be capable of being walk tested from the floor. I feel that every security system should be walk tested each and every day at closing time as part of the routine closing procedure. If the curtain detector projecting across the skylight can't be walk tested from the floor, how is the guard to know that it has not been blocked by a paper bag placed by the museum's painter or electrician? Low tech defeats high tech all too often.

Museums must be protected to at least Underwriters' Laboratories Extent of Protection Level 4 according to "The Suggested Guidelines for Museum Security", the de facto standard prepared by the Museum, Library and Cultural Property Committee of ASIS and available on the ASIS internet site. This vague UL standard requires a sound electronic perimeter, with other interior detection appropriate for the collection and the risk. So the designer of a museum system must understand how museum thefts occur in order to be able to design against them.

Would I as a museum security expert break into a museum to commit a theft if I were the crook? Absolutely not. The risk of being caught breaking in is too great. What I would do is stay behind until all but the minimal guard crew is present. Every museum has a critical period of activity between public closing and the activation of the alarms where there is activity in the galleries and alarms must necessarily be off. Staff continue to work in the galleries after the public has departed.



Cleaning occurs and lecturers prepare their scholarly materials. Designers measure for the next show. This activity often occurs until well after 6 PM, and all during this time the motion detection is off in all but the most high security areas like the vaults. If a museum does not have a sound perimeter based on technology other than motion detection--door contacts and glass break detectors, for example--it is impossible to secure the building during this period when the alarms are generally turned off but guards are not present in the gallery.

What this means is that museums have three primary operating modes: Open to the public with all but the perimeter and individual object and exhibit case alarms turned off, closed to everyone with all alarms turned on and the building essentially vacant except for essential security and engineering staff, and "in between", the "gray area", when guards are not present and most motion detectors are off, but much activity is occurring. The alarm system must be capable of providing adequate protection in all three operating modes.

If museums simply used door contacts and motion detectors for protection, once staff began to arrive for work and alarms were turned off, someone might be able to break a window, climb in, and remove an object without being detected. An employee, like an engineer or custodian, could carry something out undetected. So most museum security system designers over design the system so that all modes of operation are covered.

In designing a security system for a museum, there are several things I must consider. Will the building be occupied by a guard 24 hours per day, seven days per week. It may seem obvious that a guard is necessary and important, but believe it or not, there is a difference of opinion between many security practitioners and insurance company security experts on this issue. Insurers consider the ideal situation to be having a 24 hour guard in an adjacent building, not in the museum itself. Having him close by is important for quick response in a fire or emergency, but having him outside the building assures that he is not inside going through the Roman gold coin collection when he is supposed to be working. They would not give him access to the building or to the alarm system. He would be in a secure building where he monitors the alarms and cameras, and enters the building only with a police escort and only after getting a key from a locked and alarmed rapid entry key box. Entry into this box to obtain the building key would alert the central monitoring station who would call the police. Insurance people don't seem to trust security guards in museums.

I, on the other hand, feel that there are too many things that can happen in a museum unless a guard is present, like water leaks or fires, which can be detected early by an alert guard, thus averting disaster. I'd prefer to see a guard in a secure control room monitoring excellent electronics, while a second guard patrols. I'd like alarms to be transmitted to an off-site central



station. And I'm currently designing all control rooms equipped with CCTV cameras that can be viewed by anyone with a password from anywhere in the world over the internet. The security manager can dial in and see his guards playing cards or "resting their eyes" when they should be working.

If the building is not staffed by a guard 24 hours per day, then the operation of the alarm system becomes much more complex. If the guard does not operate the alarm system for employees, who will? The early arriving custodian? Someone has to be trained in the use of the alarm system who can be trusted. I'd prefer that this be a guard. As an alarm system designer, I have to make certain assumptions about the quality of the security people who will operate the system. And I have to provide supervision to keep them honest. This is a management issue, not an alarm issue.

If the building is not staffed 24 hours per day, I don't feel comfortable using a more powerful and versatile PC-based access control and alarm monitoring system. I don't feel that non-security staff should be expected to turn alarms on and off using a PC keyboard. We have enough false alarms without the involvement of half the employees trying to operate the security system, never mind the vulnerability of giving non-security staff access to the system via the keyboard. And the issue of false alarms is an important one for museums. Few environments use more motion detectors than museums do. A typical average sized museum may have 400 motion detectors. If

each one experiences just one false or accidental alarm per year between the hours of midnight and six in the morning, the museum will have more than one false alarm per night. Since alarms in a museum are taken very seriously, this is too many false alarms. So the museum security system must be highly stable and resistant to false or accidental alarms.

So whether the building is staffed at night is a primary factor in deciding whether the alarm system will be a simple alarm panel or several alarm panels operating as one system, or a PC based alarm and access control system which can be activated or shunted point by point.

My next consideration is the perimeter of the building. The "Suggested Guidelines for Museum Security" requires that every door in a museum be controlled, either by a guard or electronically. It should not be possible for someone to enter or leave without passing a guard or activating an alarm. I protect the perimeter with redundant technologies. A door will have both a contact and a glass break detector or motion detector--probably all three. Windows will be alarmed if they can be opened, to prevent someone from opening a window without being detected, and passing an object out to someone. Doors, such as fire exits, should be equipped with locally annunciated audible alarms but should also send an alarm to the alarm panel. I want violators to know that they have caused an alarm. Doors should be equipped with delay locking hardware when fire and life safety



codes permit. The alarm should begin sounding locally at the door, and on the alarm system panel or computer, as soon as the violator presses the panic bar. A different alarm should occur when the door actually opens after the delay period has passed.

Like a castle with concentric circles of protection from the outer walls inward to the "keep" where the food, water and ammunition were stored, museum security consists of concentric circles of protection inward to the high security store rooms, vaults and exhibit cases. The next level of security is the interior motion detection. As a minimum, museums must have motion detection that detects movement at strategic locations within the building. Stairwells, outside elevators, inside gallery doors and windows, and at major pedestrian crossroads are just a few strategic locations that should be protected. Traps of motion detection limit where the intruder or stay behind can go and theoretically limit the potential losses. Even magnetic door contacts can help guards conclude the direction of travel by an intruder. I am often asked why I place door contacts on several doors within a close proximity of one another. The reason is that I can detect direction of travel of an intruder even if motion detectors are turned off.

Minimal security is not good enough for most museums. Most museums attempt to achieve saturation motion detection throughout collection bearing areas. I'd prefer for an intruder

to be limited to no more than a few steps anywhere in the building before he is detected by the alarm system. In reality, the budget usually results in the actual level of detection to be somewhere between perfect and minimal.

High security areas need special protection. Storage rooms and vaults, the photography studio where art is often left overnight while being photographed, the conservation lab, art packing and shipping rooms, and similar areas are provided with saturation detection. Similarly, these rooms are given other forms of protection as well including CCTV and card access.

While more museums are robbed by low tech rather than high tech means, it is important that steps be taken to make the alarm system highly resistant to tampering or system failure of any cause. Museums usually have 24 hours of battery back up on their alarm system, even if the building has a generator. The phone lines which carry the alarm signal to the off site, UL certified central monitoring station are fully supervised as are all circuits within the building. Any attempt to cut or disrupt the alarm signal as it leaves the building is immediately detected. Signals are always backed up by multiple technologies. While cellular can be defeated, it is commonly used as one of several back-up means, since it is more likely to remain in operation in certain disasters, at least for the initial period of time following the disaster, than are land lines.



The alarm system is only as good as the people who operate, monitor, and respond to it. Cash handling areas are always provided with panic alarms as is the security control room which is hardened to withstand, as a minimum, a high powered small arms attack. This gives the guard enough time to hit the panic button then hit the floor and wait for help to arrive.

I'm often asked about CCTV systems with on-screen motion detection. I don't use it. I do interface a conventional alarm detector with a camera so that areas in alarm can be viewed on the monitor, but I prefer to always have the benefit of two separate systems, not one fully integrated system. And while I do allow the guard to see the area in alarm, I do so reluctantly. The "Suggested Guidelines" require that whenever there is an alarm, there must be a response to the alarm. It is not acceptable for a guard to make a decision from the control room to not respond to the gallery to check out an alarm because the image on the CCTV appears to be clear. The "Guidelines" say that "Whenever there is an alarm, there must be a response to the alarm." The ability to view the area in alarm is merely a tool, not a means of making a decision about response. Guards are human and all too often will make a response decision based on what is easiest, not what is best.

The final level of alarm protection is on the objects themselves. Museums often use wireless transmitters to carry the alarm signal from the free standing

exhibit case in the middle of the marble floor, to the separate alarm system dedicated to object protection. Wireless is also ideally suited for protecting pictures since it is not practical to run wires to each one, given the fact that the pictures will move regularly. Running wires is the most desirable method of alarming individual objects, of course, because hard wired detectors can be better supervised against tampering than can wireless detectors.

Wireless transmitters must be small enough to fit behind a painting without actually touching the back of the picture. They should be able to accommodate any type of switch or contact. The ideal system will be able to sense a momentary closure of the contact as would occur if a shock sensor were placed on the frame to detect a light touch of the canvas, but this is truly difficult. Many pictures are mounted in the frame with a spring loaded stretcher that allows the canvas to expand and contract with changes in the temperature and humidity, and this sometimes makes the sensing of a momentary touch difficult. As a minimum, removal of the picture from the wall must be detected and a signal sent to an independent system in the museum's control room or off site central station. Exhibit cases are also often protected by wireless systems, although hardwire is, again, the best choice. The system designer must conceal the transmitter in the base of the case so that the unit can be serviced without removal of the art or artifact being protected. The access panel to the transmitter must be



protected by a contact as well. Exhibit case alarms usually detect any attempt to gain access to the case via any access panel or door, including any overhead lighting access panel, the removal of screws, or breaking of glass. Most have vibration sensors that detect cutting of the case itself. Cases with electricity often have smoke detectors or even temperature threshold sensors in them, and larger cases have motion detection or CCTV inside. It is usually necessary to conceal all of the devices from view. It is not at all unusual for exhibit cases to be alarmed so that once the case is closed and the alarm resets itself, no one, even the curator or security director, can open the case without generating an alarm.

While some designers integrate the wireless with the hard wired building security system, I prefer to keep them independent. I even like to see them report to the off-site central station independently, on separate dialers and separate phone lines. Some museums even purchase their building system and wireless system from different companies and maintain separate service agreements for each. I have several clients with more than one independent alarm systems covering the same spaces. The building's PC based alarm monitoring and access control system is backed up by a conventional alarm panel with less expansive but partially redundant coverage. Even a rogue alarm system technician for the one system has no access to or knowledge of the second back up system. The individual object detection system constitutes the third independent system protecting the same spaces and collections.

Some works of art and artifacts in museums are protected by what we generally refer to as anti-touch alarms. These may or may not be connected to the control room, or they may just annunciate locally alerting the guard. They may or may not call up CCTV cameras when tripped. A typical anti-touch alarm is a curtain of infrared projected past a row of pictures on the wall. This may seem easy to do, but it is not. People want, and often need, to get real close to pictures in order to study the detail in the brush strokes. After all, our mission is education and those who really study the art must be able to approach it to see it. (For that same reason we rarely use protective glass on the pictures, as glass causes glare and diminishes the visual experience.)

When infrared is used in front of a picture there must be some way of keeping the public from walking into the field of protection and causing an alarm. The ideal museum would have a low railing in front of the row of pictures. The railing would project out about 32 inches and the four inch wide field of infrared would be as tight to the picture as possible allowing visitors to point or lean over for a better view without setting off the alarm. Anyone reaching too far into the infrared field would cause an audible alarm to sound until their hand is removed, at which time the detector would reset and the alarm would silence automatically. But few museums allow a railing in front of pictures and this complicates things.

Another technical problem with using infrared anti-touch alarms is that unless



the protected wall is very long--longer than the range of the detector--the detector's field of coverage will project into traffic paths or areas where detection is not intended. For example, if the protected row of pictures is along a wall with a doorway to another gallery, there may be no way of stopping the infrared from passing the row of pictures and crossing the doorway, causing false alarms. While there are solutions to this problem, like using two opposing detectors and wiring the devices so they both must trip before an alarm is generated, or terminating the detector into the wall before it reaches the door, the use of curtains of detection is limited.

Motion detectors can also be used on free standing objects like furniture and statues to keep people from touching but these need constant service attention and adjustment. Nevertheless, anti-touch devices are very important. Touching is common in a museum, and over the years, objects can be touched out of existence. Vandalism is also a common threat and anti-touch devices, while not preventing vandalism by someone who is intent upon causing major damage, can alert the guard when vandalism begins, so that it can be stopped before the object is totally destroyed. And anti-touch devices can prevent a special type of theft that museums often experience. Furniture, for example, can be the target of attempted thefts of the brass hardware or knobs by those needing an original fixture to replace one that is missing on the similar object that they own.

And souvenir hunters often want a piece of an historic artifact.

No matter how good the alarm system is, it will be useless if the guard who operates it is not somewhat protected in the secure control room and does not have a secure means to call for help such as a panic button. It will be useless if the guard fails to take action on the slightest hint of a problem. One museum was notified by the central station of a problem with their dedicated alarm phone line, then made an assumption that the problem resulted from a car hitting the pole down the street. The problem was, in fact, a burglar who cut the line and the accident was staged. The line to the central station must be as secure as is possible, even if the leased line or special monitoring service is more expensive than standard Grade "C" digital dialer service which is commonly provided.

The security system must be over designed so that if a "hanging wall" is installed, cutting the room in half and blocking the detector's view of a window or door, a second detector provides the missing coverage. And every device in the alarm system must be tested daily before closing, in a walk-test, to make sure that no device has been tampered with or masked in any way.

Finally, someone must make immediate corrections when problems are found. If a detector is found to be obstructed or not working, something must be done immediately to fix the problem. This may mean paying a premium to get



the detector working before everyone goes home, or it may mean leaving a guard to stand watch because the system's effectiveness is diminished. Hopefully, if the system was designed with redundancy, a malfunction of any one detector will not cause a major hole in the protection of the building. When I design a system, I never group detectors so that they annunciate as zones. Every detector must annunciate point by point so that I know exactly which detector is in alarm. And if one detector continuously false alarms, the whole zone doesn't have to be turned off until it is fixed. And of course, in the changing environment of the museum, it is very important that someone from security make corresponding changes in the alarm system when necessary. The constantly changing environment can wreak havoc with alarm detection.

Museum alarm systems should be nearly invisible to the museum visitor. The honest visitor should not be bothered by the appearance of the detectors or cameras, while the criminal should be able to look for them and see that they exist. The impression should always be given that there is more to the alarm system than meets the eye. As an alarm system designer, I'm not trying to cure the ills of the world. I'm not trying to prevent crime or reform criminals. All I'm trying to do is encourage the criminal to slither on over to the museum next door because the ones I protect are too risky to bother with.

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Side bar #1

Walk Testing Your Alarm System

Steve Keller recommends the following walk test policy and procedure:

1. Conduct a walk test every night before closing your building and setting the alarm.
2. Check every detector in the system that is accessible. Visually inspect to see if there are obvious problems. Glass break detectors can be defeated by placing gum or sound dampening material in the listening hole. Motion detectors can sometimes be defeated by masking the lens or blocking the lens with something like Vaseline. A dishonest employee can place something in front of the detector or between a detector and a door or window.
3. If possible, set off every device to be sure that the signal is received at the control room. Do audible alarms work properly?
4. Keep walk test lights on motion detectors "on". Know what the lights means. Many security practitioners see a walk test light wink at them and assume that this means that a signal has been sent to the panel. Dual technology detectors often have three lights, one for each technology and one indicating that the signal was sent to the panel. A winking light may simply mean that one technology has tripped but not both as is required for the signal to be sent.



5. Walk test each motion detector by seeing if you can get past them. This often requires that you crawl on the floor or climb over or under furniture. Try several times to see if you can defeat the detector.
 6. Check to see if wires have been tampered with.
 7. Check to see if detectors have been misaimed. A dishonest person could have aimed them so they are not as effective.
 8. Test the signal to the off-site central station to see if the signal is received there and the central station reacts properly..
 9. While you are at it, make a visual check of smoke detectors to see if they are covered or rendered less effective. Construction areas are among the places that most need detection but are most likely to have detectors that have been tampered with or obstructed.
- Side bar #2
- The following basic considerations must be made when designing a museum security alarm system:
1. Be sure door contacts are placed on all exterior, stairwell, and all storage room doors as well as doors to other areas needing security. Be sure contacts are mounted in the door frame when possible and not surface mounted. Be sure they are on the protected side of the door if they must be surface mounted. Use the correct specialty contact for the application: tamper contacts, overhead door contacts, etc.
 2. Place motion detection inside doors, windows, skylights, and other perimeter penetrations. Mount them out of reach. Use dual technology when practical. Use quality commercial quality detectors. Use the correct detection pattern.
 3. Acoustic glass break detectors are secondary detectors to motion detectors in most operating modes. Place them out of reach. If you use impact sensing glass break detectors,, use the correct device for the glass you are protecting.
 4. Provide as much volumetric detection as you can afford. Meet UL Extent of Protection Level 4 as a minimum. I try for Extent of Protection Level 2 in Collection Storage areas or other high security areas.
 5. All equipment must be UL listed for the use made of it.
 6. The alarm line to the central station must be the highest grade available and must always be "protected", formerly called UL Grade "AA", i.e., highly resistant to tampering by high tech means. Provide a back-up system at the highest grade available.
 7. Provide a panic button for the guard in the control room. The panic button must report to the central station with a unique signal so the central station knows that the guard is under duress or attack and can react accordingly.
 8. Over design the system so that changes to the gallery configuration will not result in diminished detection.
 9. Design in redundancy so that an intruder or stay behind is detected by two means in most instances.
 10. Provide detection against stay behinds.
 11. The individual object alarm system should be independent of the main building alarm system.