Exhibit Case Construction and Alarming Design

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December 3, 2004
(Edited March 29, 2006)

Introduction

This information is presented to guide museum staff, exhibit case designers and fabricators in the construction and alarming of exhibit cases. It may be advantageous from a manpower point of view to install alarm devices and locks in exhibit cases at time of fabrication. These guidelines provide guidance for these situations, as well as those where SI or OPS staff may be installing alarm equipment.

The decision on the physical construction of the cases, and the need to alarm them should be a joint decision between the museum and OPS. The need to provide alarms depends of the nature of the objects to be displayed. OPS security standards require that firearms and items of precious metals such as gold and silver require a higher level of physical construction with electronic alarms, suitable locking devices and assessment CCTV. Any alarmed case requires CCTV.

Levels of Risk

Typically, objects in cases and displayed on platforms can be expected to fall into one of four risk categories, where the risk level can be expected to be established by the museum's staff. Objects on loan may carry conditions that require a level of protection above that which the museum would normally establish, if the item were in their collections.

Low Risk

Items are not considered to be of sufficient value such that the impact of their unauthorized removal, theft or damage would be detrimental to the image or reputation of the Smithsonian Institution. Other items might fill their void.

Security is provided in terms of physical construction and locks, or railings and barriers to keep the public from approaching too close.

Medium Risk

Items are considered to be of sufficient value that the impact of their unauthorized removal, theft or damage would be significantly detrimental to the image or reputation of the Smithsonian Institution.

Alarm contacts are added to detect case opening or Vitrine top removal. Light attics are alarmed if they provide access into the area where objects are displayed. CCTV alarm assessment is provided. Platform displayed objects are designed to permit use of motion detectors. (Local audible sounders can be added as a deterrent, in addition to reporting to the security control center.) CCTV image recording would occur if equipment was in place at the facility.

High Risk

Items are considered to be of sufficient value such that the impact of their unauthorized removal, theft or damage would be highly detrimental to the image or reputation of the Smithsonian Institution and could impact the mission of SI.

In addition to the above electronic protection, shock sensors are provided to detect attempts of forcible entry. A higher level of case construction and locking would be sought. Locks would be rekeyed to ensure key accountability. CCTV alarm assessment is provided. CCTV image recording would be in place. Wired alarms are utilized.

Extreme High Value

Display is a newsworthy event and every practical means should be employed to protect the object on a 24-hour basis. Items are considered to be of sufficient value such that the impact of their unauthorized removal, theft or damage would be extremely detrimental to the image or reputation of the Smithsonian Institution such that the ability of the SI to receive borrowed collections or gifts may be impacted.

Typically, H*igh Risk* protection is supplemented by the presence of security force personnel during public hours, and either electronic space/area supplemental electronic measures after hours, or 24-hour security officer coverage. CCTV recording is in operation continuously.

Construction materials for cases

1. Where Acrylic is utilized, designers are encouraged to utilize material in excess of 10mm when the surface expanse is large enough that a sharp blow from a hard object is likely to fracture the material.

2. 13mm laminated glass is recommended for cases containing firearms, gold or silver items, where the object is designated as irreplaceable, or where the loss would be an embarrassment to the Institution. Acrylic is not considered a good alternative for cases containing high value items.

3. The joining of Vitrine tops to bases should be secured in a manner whereby the retaining screws are not visible and subject to removal. The preferred method is to secure the vitrine top from within the base, where an access door provides access to the screws. Alternately, the vitrine top can be surrounded with molding to hide the screws. The preferred method of securing the molding is with recessed screws that are puttied over and painted. With the methods described above, there is no need for security screws.

4. Should security screws be used, the preferred product are Torx screws (Torx model TR preferred), which require a removal tool not commonly found in hardware stores. (Cases constructed under contract should include two Torx screwdrivers.)

5. A vitrine-type case receiving alarm devices requires an access door that is large enough to allow an SI alarm technician to service and test wire connections at a terminal strip, and to service/adjust shock sensors, should they be installed. The preferred access door mounting method is to use concealed hinges and a lock with captive key (i.e. the key cannot be removed unless the lock is "locked") If access is through a light attic, other alarm requirements apply.

6. A case with light attic on top that is receiving alarm devices or will be the area where alarm terminal strips will be located, requires the light attic door(s) to be of substantial construction, for which metal is preferred over wood. If wood is used, it should be a minimum of ½-inch with ¾-inch support framing on the protected side to aid in reinforcement and to deter prying up of the door with hand tools. If longer than 900mm two locks are to be provided. Exposed hinges should have non-removable pins. (Should light attic doors not be hinged yet alarmed, more alarm contacts will be required than if they were hinged.) The location for the alarm wiring terminal strip is to be at one end of the light attic, near the case front or side, where a technician can service it. Should electronic shock sensors be included, it may be desirable for them to be serviced also from the light attic.

7. Cases with light attics with light diffuser panels need to have the diffuser panels secured in place with continuous metal angle brackets fastened from above with security screws. For cases containing high value objects the diffuser panels should be provided with a 10mm laminated glass barrier between it and the objects below.

8. Light weight alarmed cases should be provided with sandbags in the base to provide stability and to deter carrying the case to another location. The extra weight helps to minimize nuisance alarms. A toe-kick setback is helpful in minimizing alarms when the cases are equipped with shock sensors.

9. Case bodies considered to be high security type (i.e.: containing alarm devices) should not be constructed of material less than 19mm in thickness.

10. Where many high value objects are displayed in wood cases, it is recommended that 9-guage expanded metal be sandwiched between two sheets of 19mm case material to provide additional physical security.

Alarming of Vitrine exhibit cases

Vitrine tops should receive plunger-type alarm switches on two opposite sides (which will be wired together as one alarm zone.) It is difficult to predict which type of alarm contact would best fit a particular application before a design is at hand.

1. Vitrine tops extending more than 24-inches in any one direction should receive four alarm switches---one on each of the four sides to protect against forcing a corner up and achieving the ability to fish an object from the case. OPS or a security consultant can offer guidance as needed.

2. A practical switch is the Sentrol Pin Plunger type 3015, because of the adjustable 6-32 screw that provides fine adjustment between the base and the Plexiglas top. The provided 6-32 screw can be replaced with a longer screw if needed. A cut sheet is available from OPS. Switch is a normally closed switch.

3. Plunger alarm switches need to "open" electrically as soon as the vitrine top is raised but is still within it's "groove" in the base. Careful attention needs to be paid to the smoothness and size of the hole through which the plunger passes to avoid splinters and rough edges from interfering with the switch's operation.

4. Alarmed vitrine cases should be protected with both alarm switches and a shock sensor. The preferred shock sensor for a hard-wired exhibit is an IEI (International Electronics Inc) 834L Viper Plus. They are screwed to the front side of the inside of the case as close to the juncture of the base and removable top as possible. Cases with Vitrine tops longer than 30-inches in any direction must be provided with two shock sensors, one at the inside front and one at a side. For larger cases, two sensors provide greater sensitivity with less chance for nuisance alarms. In order to accommodate sensitivity adjustment to the shock sensors at time of initial testing and during the life of the exhibit, the sensors must be accessible at all times to permit an alarm technician to reach into the case to adjust the device.

5. Fabricator is to set the Viper Plus DIP switch 1 to ON (LED enabled) and DIP switch 2 to ON (double knock disabled). Fabricator is to power up the device(s) with a 12-volt power supply per manufacturer's cut sheet and adjust sensitivity to trip the LED from a solid, strong, single hit on the front, side and top of the case. (Disable power and repower for each subsequent test.) Test cannot be performed until the case is 100% assembled.

Alarming of non-Vitrine type cases

1. Cases with hinged doors require alarm contacts on the operable side. Doors higher than 1500mm require an alarm switch top and bottom. Shorter doors in height that can be pried open more than 12mm require alarm contacts top and bottom (wired together as one alarm zone.). Either an alarm switch or a magnetic contact may be suitable, depending on aesthetics. Suggested items are a Sentrol 3005 recessed roller plunger switch or an 1145 series ultra-miniature magnetic switch could be considered.

2. Cases with removable front Acrylic/glass panels require alarm contacts on the left and right ends of the panels. If the panel can be pried open more than 12mm at any location, additional alarm contacts will be required to detect this. Case design will dictate whether alarm plunger switches or magnetic contacts are more effective or more aesthetically pleasing. Generally speaking, plunger-type alarm switches are preferred over magnetic switches because they will provide an alarm indication before the glass is moved far enough to reach inside a case to access an object. A preferred alarm switch is the Sentrol 3005 recessed roller plunger switch, or the Sentrol 3015 recessed pin-plunger switch.

3. If there are multiple doors that could provide access to valuable artifacts, each door requires alarm switches. A limited number of doors---not more than five---can be wired together as one alarm zone.

4. Placement of switches or magnetic contacts along the top of the Acrylic or glass often minimizes their presence.

5. Where glass is used and mounted frameless, the magnets associated with magnetic switches should be epoxied to the glass. The use of double sticky tape is not an acceptable method.

6. Alarm magnetic contacts (as well as shock sensor cases and motion detector housings) can be painted to match case components. When painting motion detector housings, the plastic sensor “window” cannot be painted.

7. Hinged doors which are alarmed, cannot have any play in the door where the alarm switch(s) are located. Looseness causes intermittent alarms and impacts the ability of a shock sensor to sense a hit on the case. If door looseness is not anticipated during design, yet shows up at time of final assembly, then additional door locks or concealed, protected door pins must be added as a change order at time of installation.

8. Shock sensors are to be placed as close to the front glass doors as practical in order to sense vibration. Mounting on rear surfaces usually do not transmit vibrations.

Alarms for access doors

1. Hinged access doors concealing alarm equipment connection points require a substantial lock which will resist efforts to pry it open, and require a magnetic alarm contact. A typical contact is a Sentrol 1085T. It should be wired as a separate alarm zone.

2. Access doors concealing alarm equipment/wiring without hinges must be securely fastened to prevent attempts to pry it open and require a magnetic alarm contact on opposite sides of the door panel. A typical contact is a Sentrol 1085T. It should be wired as a separate alarm zone.

Alarms for cases with light attics

Cases with light attics with light diffuser panels need to have alarm contacts provided on the light attic doors. If hinged and longer than 900mm, two switches within 50mm of each end are required. If secured without hinges, contacts on all four corners may be needed if any corner can be lifted more than 6mm. Wire the light attic door switches together as a separate alarm point.

Unusual locations of alarm devices

Alarm switches and shock sensors protecting cases on stands, or otherwise accessible from under an exhibit case must be protected against alarm wire tampering. One practical solution is to provide a screwed-on enclosure to prevent access to the alarm contacts or shock sensors, and provided with an alarm tamper switch to detect removal of the cover. The wiring must be as protected as the devices. The tamper alarm can be tied to the device being protected.

Terminal strips

1. Case alarm wiring is to terminate on a barrier-type terminal strip inside the case. A barrier type strip utilizes “partitions” between each set of screw terminals that prohibit stray bare wire strands from shorting to the adjacent set of screw terminals. The minimum size wire attachment screw is to be an 8-32. Although a variety of strips are available, one manufacturer is the BEAU series 21000, available from Allied Radio at 1.800.433.5700, or other suppliers. Wiring from devices within the case are to be connected along one side of the terminal strips; wiring extending beyond the case (to alarm data gathering panels) will be connected to the opposite side of the terminal strip.

2. Although it is preferred that the terminal strips be installed in the bottom of the case behind an alarmed access door, some case designs featuring substantially built, lockable light attics can have their alarms terminate on a barrier-type terminal strip located inside and along one side of the light attic. This eliminates the need for an access door at the bottom of the case. The light attic access door will need alarm contacts (separate alarm zone) to detect unauthorized access to the wiring terminals. The terminal strip cannot be located at the back of the case---it must be reachable by a technician on a ladder in front of the case.

3. For very large cases, the terminal strip might be located within a metal, alarm tampered enclosure precluding the need for any alarms on the light attic door. The terminal strip must be accessible to an alarm technician without having to lean far over the case.

Wiring

Where it is desirable to have exhibit cases pre-wired off-site before delivery to SI, the following wiring guidelines will generally apply.

1. Wire for alarm switches is to be two-conductor 22 AWG stranded, shielded twisted pair (Beldon 8737) or equivalent.

2. Where powered devices are used such as shock sensors or motion detectors the power circuit for those devices is to be two conductor 18 AWG stranded, shielded, twisted pair with one red and one white conductor (Beldon 8790) or equivalent (colors of conductors may not be varied.) Red is for the "+" or positive side of the line, and failure to maintain polarity could permanently damage a sensor.

3. Each pair of wires (both "alarm" and "power" wiring) is to terminate onto an adjacent pair of terminals on the provided terminal strip. Even when two alarm switches (i.e.: opposite sides of a vitrine) will ultimately be wired as a single alarm zone the two switches are to be wired separately to adjacent sets of screw terminals. Crimp connectors shall be used (with the proper crimp tool.) No bare wire outside the crimp will be accepted.

4. Each pair of screw terminals needs to be clearly numbered. Terminals may be marked with black marker onto to the wood base alongside the terminal strip, or with a screwed-in-place plastic laminate label. Stick-on labels are not acceptable.

5. There are to be no splices in the wire runs between devices and their termination points unless the switch being used comes with a wire pigtail necessitating a splice. Where splices must be made, the wires are to be twisted three complete turns, soldered and provided with a crimp connector. The crimp is to be secured with the tool specified by the crimp manufacturer. Bare copper strands may not

extend out beyond the connector. Neither wire nuts nor plastic electrical tape will be accepted.

9. Wiring for alarm devices must be routed inside the case, and protected from tampering. Wiring may not be accessible from under cases.

10. Each alarm zone within the case will require a set of end-of-line resistors for alarm supervision and will be wired in place on the case wiring side of the terminal strips. OPS, or a security consultant, will provide resistance values and a wiring diagram. If the resistors are installed by the case fabricator, they are to be wired and enclosed within clear shrink-wrap tubing for mechanical strength.

11. A computer generated spreadsheet is to be produced for each case's terminal strip. It shall include the drawing set case number, and the case "name" as defined by the museum. Each terminal strip connection point is to be identified and the precise location of the device connected to each terminal shown (i.e.: left door, lower alarm switch.) Each terminal strip is uniquely numbered. One copy is to be provided in a permanently attached plastic sleeve at the terminal strip, and a second copy provided to the security office.

Motion detectors on platforms

Some objects on exhibit platforms can be successfully protected with motion detectors if several limiting factors are kept in mind. (A) The protection pattern will likely extend many, many feet beyond the platform unless a wall is erected to block it. Anyone crossing the protection pattern that extends beyond the platform could cause an inadvertent alarm. (B) The protection pattern typically expands with distance from the detector; careful detector placement is necessary to avoid inadvertent alarms. (C) The presence of the unit on the platform may be objectionable. (D) A motion detector gives little advance warning that an object is about to be touched or taken.

1. A typical single curtain motion detector is the Sentrol AP475.

2. Motion detector wiring is identical to that described above for the Viper Shock sensor.

3. Motion detector cases can be painted, but the plastic lens over the sensing element cannot be painted.

4. Typically, a local sounder may be mounted at the platform location as a deterrent to individuals who may have trespassed into the alarm zone. A timer can be provided to silence the alarm after a preset time. Additional wiring to the security management system is required.

Wireless Alarms

The preferred alarm system of choice is a wired system with connecting cabling between the exhibit case and the electronic security system because of the dependability, reliability and supervisory assurance these systems provide. It is recognized however that situations arise where cabling is impractical and wireless devices are necessary.

1. Wireless alarms require that battery powered transmitters be installed in the cases. Because they have to "transit" radio signals to another location, they cannot be shielded or mounted in an all-metal enclosure (or within a metal case.) Because batteries are used, access to the transmitters is routinely needed for battery replacement, and the alarms need to be periodically activated to test the system. The transmitter must remain accessible at all times to an alarm technician.

2. A decision to use wireless alarms changes the selection of shock sensors and motion detectors because of the limited wireless security equipment available, and the difficulty in obtaining a satisfactory and dependable level of shock sensor protection. Wireless alarms are not recommended for high security cases.

4. Wireless case alarms need to transmit a radio signal to a wireless receiver located within range of the exhibit. If a receiver is not presently in range, the cost of the receiver, its installation and wiring to the electronic security system will become museum costs. The receiver needs to be in a secure area, with 110 volt power on the building's emergency power circuits.

5. Frequently, a wireless "repeater" is needed between the transmitter and the receiver. The repeater needs to be in a secure area, with 110 volt power on the building's emergency power circuits. All power, equipment and installation costs will be museum costs.

Locks

1. The preferred lock for cases is one that has a captive key; the key can be removed "only" if the lock is "locked." The line of Kenstran/Medeco locks offer this feature.

2. Locks typically are installed by the case fabricator and locks should be selected that permit the SI Locksmith Shop to re-key them before artifacts are placed in the cases. Cut sheets of proposed locks should be submitted for SI review to ensure that rekeying is possible. Locks that cannot be rekeyed should not be used, except in the most unusual of circumstances, due to the loss of key control that would result.

3. The preferred lock for access doors and light attics should have a bolt-throw of one-inch. The Olympus Lock cutsheets for rekeyable cylinders for Schlage “C” or “E” keyways, and for Medeco cylinders have had a good SI track record.

Exhibitdesign32906