

ELECTRONIC SEALS

Objective

Electronic seals (e-Seals) provide enhanced security by locking trailers and containers and producing a shipment audit trail of them by wirelessly transmitting information about an unauthorized attempt to open, damage, or tamper with the seal.



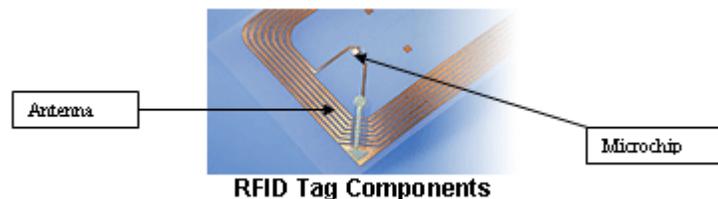
Electronic Seal and Mobile Reader

Background on Different Seals for Cargo Security

Cargo security can be enhanced through the use of both mechanical and electronic seals. Both mechanical cargo seals and e-Seals act as barriers against pilferage, smuggling, and sabotage of cargo within containers and trailers en route to their destination. If either type of seal is found to be broken or if its identification (ID) number is different from the one on the cargo document, it is an indication that the container or trailer door may have been opened by an unauthorized person at some point in the transportation route. The unique ID numbers on both mechanical and e-Seals provide tracking information. It is expected that the ID number on either type of seal will be recorded at each handoff in the chain of custody to provide information about when and where the container or trailer was handed over and its status at that time.

E-Seal Description

As noted above, an e-Seal has all the properties and functions of a conventional mechanical cargo seal, but it has additional intelligence capability from the electronics embedded within it. The most widely used e-Seals are passive and active radio frequency identification (RFID) devices that incorporate both a mechanical locking mechanism and an RFID module to transmit wireless information. As shown in the figure below, an RFID module or tag consists of a micro-chip, which stores data, and an antenna, which transmits the data to a reader.



The simplest type of e-Seal is a passive e-Seal which has read-only capabilities and derives power from a reader versus its own power source. Many passive e-Seals only contain a seal ID number,

container ID number. Active e-Seals can initiate alerts and record the date and time of tampering. They have their own batteries and can send and receive information at any time. Data on active e-Seals can be reused and modified because of their read-write capabilities.

E-Seals communicate with mobile or stationary readers that consist of one or more antennas emitting and receiving radio waves to and from the e-Seal within the reader field. The reader initiates communication using a pre-defined command, and the e-Seal responds to it with appropriate data. One exception is an alert message, which is initiated by an active e-Seal. Information from readers is transferred to a computer system in digital form and stored in the specific application database on the computer.

Because they have their own power source (battery) and transmitter, active e-Seals can send back information by transmitting a continuous signal to a reader versus reflecting back a signal from a reader. The distance that an e-Seal can be read and the rate of this communication are determined by the radio frequency used by these systems. Active e-Seals have a typical read range up to about 300 feet, whereas the range of readability for passive e-Seals is typically up to about 30 feet.

Application

E-Seals enable the process from pick-up to the delivery of goods to be tracked and checked for integrity at every stage giving a greater level of control to ensure timely delivery, deter pilfering, and reduce costs. Some reusable seals generate a random seal number each time the seal is closed, which remains unchanged until the seal is opened again.

E-Seals can be integrated with other sensors to relay information relating to conditions inside a container, such as temperature, light, and chemical detection. Some e-Seals incorporate embedded sensors to provide an alert of any attempt at moving, opening, bypassing, or tampering. The enhancement of immediately reporting a breach or tamper event can be accomplished by some e-Seals within a limited area, such as a terminal, or by other technologies that use satellite or cellular communications for a much wider reach. Supporting these devices are readers, terminals, and specialized software that can monitor many devices simultaneously, in real time and while cargo is in transit.

E-Seals can be read when containers are loaded on and off ships, when entering or departing facilities/sites, and while awaiting transfer. All of this information is available in a database. When breaches are detected, response strategies and initiatives can be initiated, such as addressing malfunctions of the e-Seals or alerting authorities of a detected incident. ISO 18185 is an International Standard for electronic container seals that includes protocols applicable for both simple low-cost e-Seals, as well as more sophisticated e-Seals.

Operations and Benefits

E-Seals can enhance the awareness and detection of security breaches of containers and trailers that sit unattended along shipping routes. In addition, e-Seals may simplify seal checking and speed handling. Acting as transponders, e-Seals can simplify and automate general processes, such as gate processing and equipment inventory.

Other benefits of using e-Seals include:

- Facilitating the tracking of container or trailer movements and inventory throughout the transportation chain, which can increase efficiency and security

- Increasing security by electronically monitoring and indicating the time, date and location of an intrusion into a

container or trailer

Providing enforcement agencies and shippers accurate and immediate information about a container or trailer identification, contents, chain of custody, and/or travel patterns

Reducing the processing time and number of errors associated with documentation, inspections, and intermodal transfers of containers or trailers

Using e-Seals can help expedite deliveries of goods, since each e-Seal can automatically be interrogated to quickly determine information about its departure and arrival. The opening and closing times of the seals can be compared with each day's routing schedule to identify potential delivery delays. If the system indicates that a trailer or container has not been delivered and opened at the expected time, the operators of the system can contact the driver to find out why there has been a delay.

RFID technology has evolved rapidly in the last few years, and the types and uses of e-Seals are expected to continue to grow. More capability and combinations of sensors, sophisticated encryption techniques, new types of monitoring technologies, various anti-tamper technologies, and tamper indicating markers at the nano-level hold significant potential in the future development of e-Seals and related technology to protect shipments.

Limitations

Passive e-Seals provide important levels of authentication, but they may not provide total security if the original seal is duplicated and replaced prior to a checkpoint. Also, not all breaches of containers come directly through the doors. It is possible to remove hinges or breach the top, sides, or floor of the container. However, sensors inside the container that measure changes in temperature, humidity, or light could be linked to the e-Seal to identify these types of breaches.

Another important consideration with the use of e-Seals is the assurance that electrical sparks will not fly from the device around flammable or explosive-type substances. The US Department of Defense Hazards of Electromagnetic Radiation Ordinance (HERO) addresses the danger of accidental actuation of electro-explosive devices...because of RF electromagnetic fields. Technology that is HERO certified is especially important in the conveyance of weapons systems and in areas where weapons systems are stored, moved, or used.

Costs

RFID technology has evolved rapidly in the last few years; therefore, the cost of e-Seals depends upon new technological advances, as well as the types and numbers of e-Seals purchased. The price of active e-Seals can range from \$20 to \$400 per unit, while passive e-Seals can be \$20 dollars or less per unit. The inclusion of readers and various other sensors to the system incur additional costs.

Vendors

Alien Technologies

18220 Butterfield Blvd.
Morgan Hill, CA 95037
Phone: 408-782-3900

<http://www.alientechnology.com/products/>

EJ Brooks

8 Microlab Road
Livingston, NJ 07039
Phone: 973-597-2900
Fax: 973-597-2919

Toll Free: 800-458-7215

<http://www.brookstechsolutions.com>

<p>GlobalTrak System Planning Corporation 1000 Wilson Boulevard Arlington, VA 22209-2211 Phone: 703-351-8284 http://www.globaltrak.com</p>	<p>Kaba Mas 749 W. Short Street Lexington, KY 40508 Phone: 859-977-3536 Fax: 859-255-2655 http://www.Kaba-mas.com</p>
<p>Lat-Lon, LLC 4251 South Natches Court Unit C Sheridan, CO 80110 Phone: 303-937-7406 Fax: 303-531-5754 Toll Free: 877-300-6566 www.lat-lon.com</p>	<p>Navigational Sciences, Inc. 2420 Mall Drive Suite 100 Corporate Square 1 Charleston, SC 29406 Phone: 843-329-0525 www.navsci.com</p>
<p>PeopleNet 1107 Hazeltine Blvd, Suite 350 Chaska, Minnesota 55318 Phone: 888-346-3486 Fax: (952) 368-9320 http://www.peoplenetonline.com</p>	<p>Savi Technology, Inc. 351 E. Evelyn Avenue Mountain View, CA 94041-1530 Phone: 650.316.4700 Fax: 650.316.4750 http://www.savi.com</p>
<p>Terahop 1225 Old Alpharetta Rd., Suite 210 Alpharetta, GA 30005 Phone: 678-455-8844 Fax: 770-663-0877 http://www.terahop.com</p>	<p>Wherenet 2858 De La Cruz Blvd. Santa Clara, CA 95050 Phone: 800-490-2261 http://www.wherenet.com/</p>

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