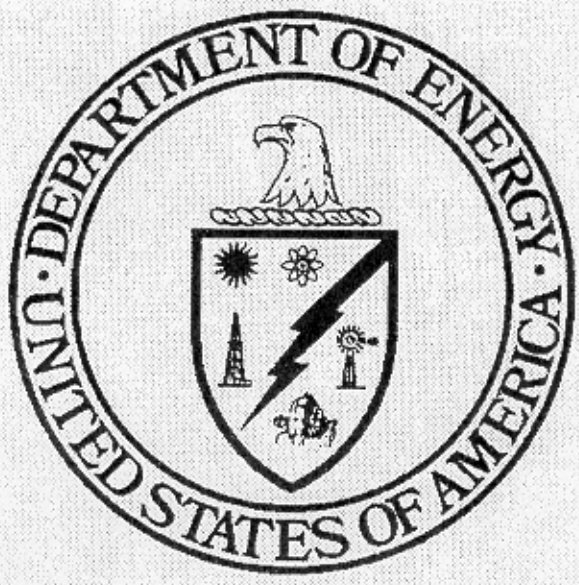
SAFEGUARDS SEALS REFERENCE GUIDE



Issued by the
Office of Safeguards and Security
Office of Security Affairs
Office of Nonproliferation
and National Security
U.S. Department of Energy

September 1995

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PREFACE

This guide is a revision of the *Safeguards Seal Reference Manual*, issued by the Office of Safeguards and Security, Assistant Secretary for Defense Programs, U. S. Department of Energy (January 1991). The guide addresses the use of seals in the control and accountability of nuclear materials. DOE Order 5633.3B, "CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS," requires that "each facility shall have a documented program, administered by the materials control and accountability organization, for control of tamper-indicating devices [seals] and to assure that tamper-indicating devices are used to the extent possible to detect violations of container integrity." This guide is intended to assist Operation Office and contractor personnel in implementation of seals programs at their facilities. The guidance provided in this document is intended for seals programs at facilities with Category I and II quantities of material. Much of the guidance should also be of use in developing seals programs at facilities with Category III and IV quantities of material. Although policy requirements from DOE 5633.3B are restated in this guide to facilitate its use, it does not establish or originate policy.

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CHAPTER 1

INTRODUCTION

This guide is a revision of the 1991 *Safeguards Seal Reference Manual* (Reference 1). It provides general guidance for developing a safeguards seals program to meet a specific need as well as guidance for the selection and use of safeguards seals at Department of Energy (DOE) facilities.

The development of a seals program must consider site-specific differences, concerns, and environmental conditions which dictate the type of safeguards seals and the detailed procedures for their use. Users should refer to this guide when preparing: (1) a seals program implementation plan, and (2) administrative procedures to meet the needs of each organization. Its purpose is to provide a framework for an effective seals program.

1.1 Role of Seals

The role of a safeguards seal is to alert authorities to unauthorized covert tampering with or opening of a container, package, door, or other object to which a seal has been affixed. A violated seal indicates possible tampering and signals facility personnel to begin investigative and corrective actions. Seals can be used in several areas of safeguards and security operations. Except for Appendix F which addresses seals used in physical security, the guidance in this document is limited to seals used for the control and accountability of nuclear materials. Where there is a need to distinguish between seals used for materials control and accountability (MC&A) and seals used for other purposes, the term "safeguards seal" will be used for seals used in MC&A, and the term "security seal" will be used for seals used in other security functions.

1.2. Seal Characteristics

Seals have been used for many centuries to authenticate or to verify the integrity of physical objects and containers. In the nuclear industry safeguards seals are used for the same purpose. In various publications, these devices have been called tamper-indicating devices (TIDs), safeguards seals, or simply seals. These three terms are used interchangeably in this guide. Effective seals have the following characteristics:

- **Fragile.** Seals can easily be violated and they are not intended as deterrents to an adversary willing to risk detection.

- **Telltale Tampering.** Once a seal is violated, it is difficult to repair without leaving telltale signs of tampering.

- **Unique.** Seals have unique identification characteristics.

1.3 Seals Usage in MC&A

DOE nuclear materials are either in item or bulk form. Seals are used in the management, control, and accountability of nuclear material items. An item, as defined in the *Safeguards and Security Definitions Guide* (Reference 2), is "a single piece or container of nuclear material which has unique identification, a known nuclear material mass, and whose presence can be visually verified." Seals allow for more cost-effective control and accountability of items.

Providing effective safeguards for an item is usually much easier than safeguarding bulk materials since the item is or is not in its authorized location. Once an item is created, it needs monitoring to assure that its integrity is not violated (theft or diversion of all or part of material in the item). An intact seal (see paragraph 6.1) in conjunction with a material surveillance program allows the custodian to verify the integrity of an item by making a confirmation measurement instead of a verification measurement. Generally confirmation measurements can be performed more quickly, are less costly, and involve less radiation exposure than verification measurements. Automation of seals information pertaining to bar code labels, part numbers, nomenclature, serial numbers, dates, and part classifications should be considered to enhance efficiency and effectiveness of the seal program.

Seals aid in safeguards and security alarm assessments and response determination. An intact seal suggests that a false alarm has occurred and/or material containment has not been violated. Conversely, discovery of a violated seal provides an indication of possible theft or diversion of nuclear material and should result in additional material verification activities as well as appropriate investigation and reporting. Verification measures should include at a minimum remeasurement of the items with violated TIDs and may need to include remeasurement of other parts of the nuclear material inventory as well. The assumption to be made when finding a broken seal is that potential tampering may have occurred. It is important that prompt action be taken to determine whether or not tampering did occur.

Seals also act as a psychological deterrent in that potential violators are made aware that safeguards and security measures are in effect. The psychological role of seals is enhanced by vigorous, comprehensive, and documented investigation of all anomalies involving seals, even if they are found to be accidental.

1.4 Seals as a Part of Safeguards and Security Systems

Safeguards and security systems, in general, consist of multiple elements that do not provide sufficient protection when used alone. Thoughtful selection and integration of such elements can, however, result in a system that will provide a high level of confidence that the desired level of effectiveness will be achieved. The effective integration of

multiple system elements also ensures that the system is not degraded if any single element fails to function as intended. Seals are an excellent example of elements that are important to an integrated system, but their contributions and limitations must be understood if they are to be used effectively.

Specific seals usages can usually be categorized as MC&A or physical security. Uses of seals in physical security are discussed in Appendix F. The following are some specific contributions that seals can make to an MC&A program:

- indication that container contents have not been altered since the seal was applied
- reduction in the frequency of time-consuming nuclear material verification measurements
- simplification of inspection and inventory operations
- support of special nuclear material (SNM) assessments and audits

1.5 Using Seals Effectively

Seals can be a highly reliable and cost-effective safeguards element. However, for most seals to be considered reliable for materials control purposes, they must be used with an effective material surveillance program. Additionally, the containers in which the SNM is located must be such that removal of material from a container by means that do not violate the integrity of the TID, such as cutting a hole in the container, could easily be detected by visual inspection. For items located in areas without materials surveillance programs or in areas where effective materials surveillance has been absent for a time period greater than the time needed to defeat the types of seals in use, the safeguards effectiveness of the seals should be considered to be minimal unless a "postmortem" examination is performed to assure that the seals have not been violated. Where effective materials surveillance has been absent and a postmortem examination of the seals is not performed, measurements should be made to verify that nuclear material has not been stolen or diverted.

A comprehensive seals program for nuclear materials can result in efficient inventory-taking and reduced personnel radiation exposure. DOE 5633.3B requires verification measurements for items that are not tamper-indicating[1]. Only confirmation measurements are required for items with

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[1] An item containing nuclear material is tamper-indicating if it is sealed with a tamper-indicating device or its design or structure is such that removal of nuclear material from the item can easily be detected by visual inspection.

intact seals. Confirmation measurements are usually less time-consuming and less costly than verification measurements. Seals can provide a quick and easy means of obtaining a reasonably good verification of item or system integrity.

In many cases, applying a seal can provide a quick and relatively inexpensive method of increasing the effectiveness of a safeguards system element against a specific type of insider threat. Indiscriminate and uncontrolled use of seals can, however, reduce safeguards and operational effectiveness by giving a false sense of security. Seals programs should be considered for the following:

- items in long-term storage
- off-site shipments and transfers between material balance areas (MBAs)
- waste containers
- items or containers in process or working vaults if it would save on manpower or cost of performing inventories
- reducing radiation exposure

In deciding whether or not to use seals, factors such as cost, radiation exposure, potential improvement in protection, operational impacts, and procedural or hardware alternatives should be considered. The same factors should also be used in deciding what types of seals to use. (See Chapter 3 for guidance on selecting the proper seal.)

Seals programs should

- be cost-effective (capital and manpower)
- be capable of indicating violations of the container and tampering with safeguards devices
- be designed to minimize impact to plant operations

Essential to maintaining the effectiveness of any seals program is a continuing internal review and assessment process. The program should include both scheduled and unscheduled assessments of the program. All assessments should be documented, identifying deficiencies and corrective actions taken to address them. Additionally, assessment reports and documentation should be maintained for a period determined by the cognizant operations office.

In summary, a seals program can be an effective safeguards system element when used in conjunction with other safeguards and security system elements. Additionally, a seals program can reduce the financial costs and radiation exposure associated with other elements of a safeguards program.

1.6 Seals Limitations

A primary issue in using seals is their reliability in indicating tampering. The widespread use of seals calls for low-cost seals which in turn results in fairly simple devices. The simplicity of these devices may allow for relatively unsophisticated but successful compromise techniques. For this reason, seals cannot presently be considered as one of the stronger safeguards elements. They should continue to be used, however, because of the benefits (especially deterrence) provided.

Active seals (those tied into a monitor) may provide alarms that will initiate timely response to a violated seal; however, these seals are not currently in use in the DOE complex. In general, seals currently in use and integrated into safeguards systems are <u>not</u> expected to provide the following:

- alarms which will initiate a timely response to a violated seal
- protection against overt actions (i.e., most seals do not physically delay or restrain violations)
- protection against covert actions without an adequate seal control program
- 100% assurance effectiveness

1.7 System Interfaces

Integrated systems for safeguarding SNM should have a number of system elements such as inventories, remeasurement of randomly selected items, portal monitors, two-person rules, motion detectors, and balanced magnetic switches on doors. Seals are one component of an integrated safeguards and security system whose design is based on a defense-in-depth[2] strategy; an inappropriately high reliance should not be placed on them. Overall effectiveness of a safeguards and security system depends on the interface between various elements of the system. Elements that most commonly interface with seals programs are the following:

- **Material Databases.** All MC&A systems must have a database that includes details regarding nuclear material inventories. If seals data is incorporated into these databases, timely audit goals can be achieved. Bar-coded seals may also provide a convenient and efficient way to relate sealed items to inventory. (Use of bar-coded seals would not, however, eliminate the need to check item and location numbers during physical inventories.)

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[2] Reference 2 defines defense-in-depth as "the use of multiple, independent protection elements combined in a layered manner so that system capabilities do not depend on a single component to maintain effective protection against defined threats."

- **Inspection/Verification Procedures.** Specific examination procedures for seals should be included in both operational and safeguards and security procedures.

- **Operational Procedures.** Material handling procedures should include guidance on when, where, and how to apply seals as well as what types of seals to apply. Similar information should be given for removal and disposal of seals as well as for the accountability of the seals. Often procedures for application and removal of seals are written as operational procedures. These procedures should be closely integrated with the MC&A Plan and related safeguards procedures. Additionally, information about the seals which is recorded as part of the procedure, such as seal number and item to which the seal is applied, should be included in the nuclear materials database.

- **Physical Boundaries.** The physical boundary of the container, storage location, building, etc. should be at least as difficult to defeat or bypass as the seal used to detect tampering.

- **Management.** The assignment of personnel responsibilities rests with management. DOE 5633.3B, paragraph III, 5.a requires, however, that "each facility have a documented program, administered by the materials control and accountability organization, for control of tamper-indicating devices and to assure that tamper-indicating devices are used to the extent possible to detect violations of container integrity." It is likely that responsibilities for various parts of the seals program will be shared with operations and other organizations. Thus, it is usually necessary that the efforts of all of the groups that have been assigned responsibilities be integrated into safeguards operations and planning and that the integrated effort be reflected in documented plans and procedures.

CHAPTER 2

IMPLEMENTING A SEALS PROGRAM

This chapter, used in conjunction with Chapter 4, will provide the framework around which an effective seals control system can be built.

2.1 Personnel Organization

A critical step in developing a seals program is organizing the personnel. Personnel directly or indirectly involved in the seals program should be identified in the MC&A Plan and/or the Site Safeguards and Security Plan. An organization chart showing the breakdown of personnel involved with the seals program should also be included in the MC&A Plan and/or the Site Safeguards and Security Plan. Identification of the organizational structure aids in the effective control of seals.

2.2 Task Assignment

Five key tasks need to be performed in any seals program. Personnel performing these tasks are the following:

- Vendor. The manufacturer and/or distributor from whom the seals are purchased.

- Buyer. The person(s) or operating group within the purchasing organization responsible for purchasing and receiving seals.

- Seal Administrator. The person(s) or operating group at the facility responsible for maintaining the seal supply and the associated records concerning the receipt, inspection, and distribution of seals.

- Seal Custodian. The person(s) in the operating area responsible for receipt, inspection, and distribution of the seals.

- Seal Applicator. The person(s) trained in the correct procedures for application, removal, inspection, and destruction of seals as well as documentation of their use.

Depending on the size and complexity of the organization, some overlap may occur among the functional areas listed above. The key areas to be kept separate are the control of records (the seal administrator) and the application of seals (the seal applicator). Once these components of the seals program have been identified within the organization, procedures can be developed to control the flow of seals hardware and program data between them.

2.3 The Seals Program

Seals programs should be structured to provide: (1) a reasonable level of confidence in the program, and (2) integration with other safeguards elements to assure that the compromise of a seal is not a catastrophic event.

There is little value in considering the seal by itself. The complete program within which the seal is used must be established in order for a seal to provide effective protection. The seal user must recognize that the seals program is part of a much larger and more comprehensive safeguards system. Seals provide protection that is complementary to other protection features such as containers, vaults, and results of materials accounting. Each feature provides a part of the protection required. Accordingly, the seal user and the seal program developer must understand the other elements in the overall system and utilize the appropriate approach to give the needed level of protection. This may necessitate tradeoffs among various protection system elements.

Seals programs generally consist of a seals program plan (as a segment of the MC&A Plan and/or the Site Safeguards and Security Plan); the seals themselves; the containers or objects to be protected; and the procedures, techniques, and devices necessary for their effective use.

2.4 Seals Program Documentation

A facility's MC&A Plan or Site Safeguards and Security Plan should specify the contributions seals provide within the overall safeguards and security system. Additionally, DOE 5633.3B, paragraph III, 5.a. requires that "the tamper-indicating device control program shall specify, as a minimum, the following elements:

(1) Acquisition/procurement/destruction;

(2) Types of tamper-indicating devices utilized;

(3) Assurance of unique tamper-indicating device identification;

(4) Storage;

(5) Issuance;

(6) Personnel authorized to apply, remove, and dispose of tamper-indicating devices;

(7) Containers on which tamper-indicating devices are to be applied;

(8) Procedures for application of tamper-indicating devices;

(9) Frequency and method of tamper-indicating devices verification;

(10) Response procedures for tamper-indicating devices violations;

(11) Assurance that tamper-indicating devices cannot be reused after violation;

(12) Frequency and method of internal program audits; and

(13) Procedures for reporting tamper-indicating device violations."

A seals plan as a part of an overall MC&A Plan can provide the proper perspective on the role that seals play within the total safeguards system.

2.5 Seals Program Details

Figure 2-1 shows the seals program as a subsystem of the total safeguards and security system. The seals program contributes to the overall effectiveness of the safeguards and security program. Each step within the seals program has been numbered; this allows each area to be related to the other areas in Figures 2-2 through 2-8.

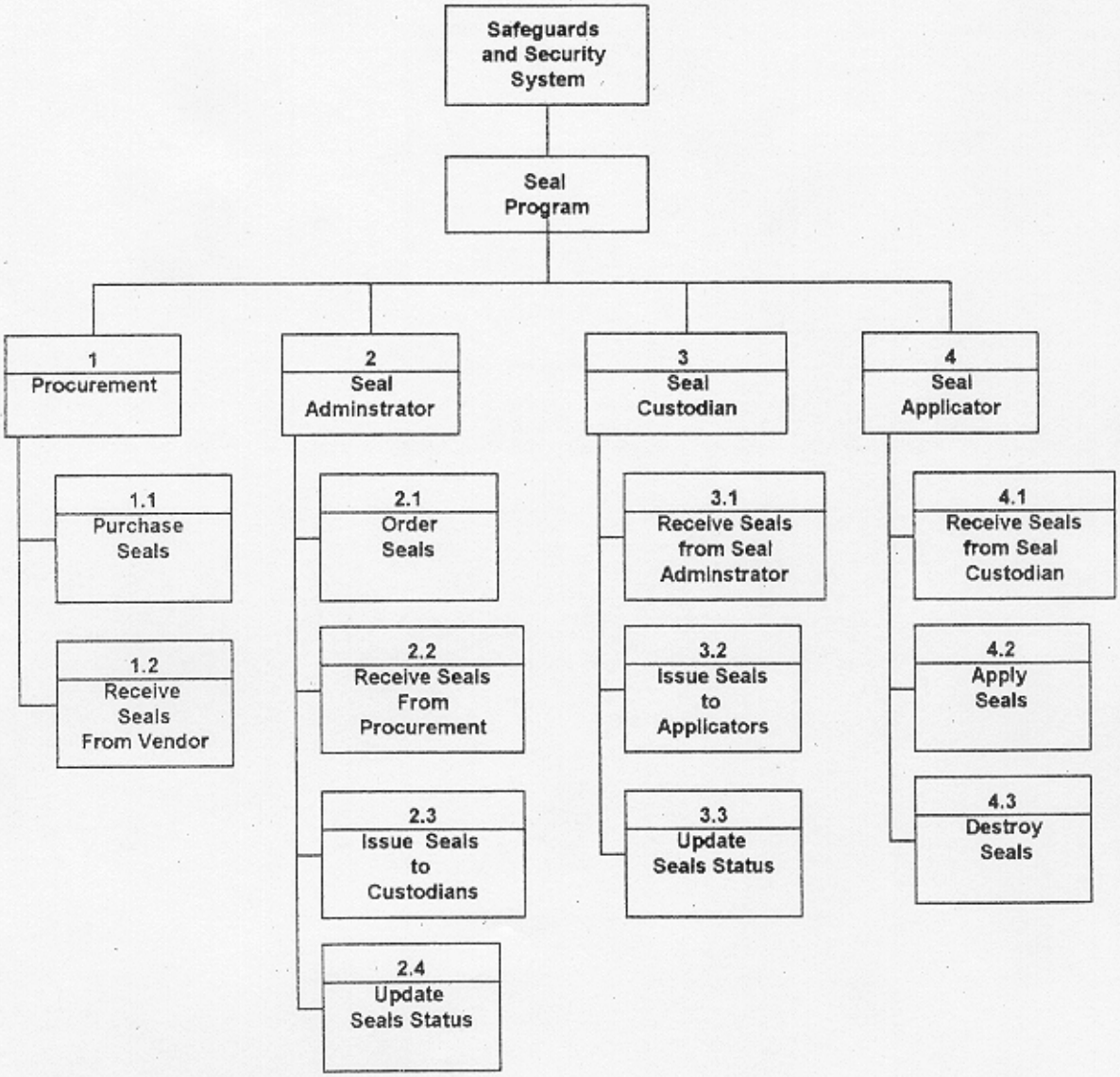


Figure 2-1. Overview of a Seals Program

Figures 2-2 and 2-3 present an overall view of the hardware and data flows. The figures show how various components interrelate as envisioned in the procedures.

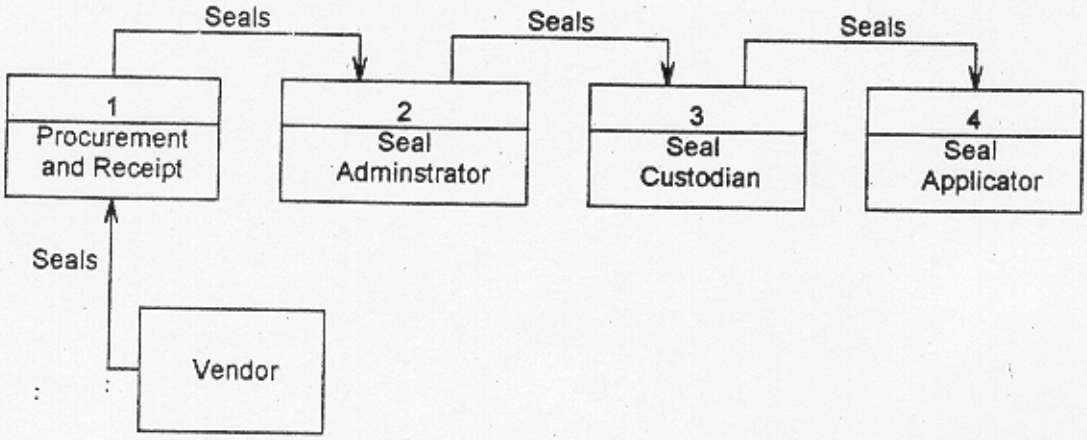


Figure 2-2. Seals Program Hardware Flow

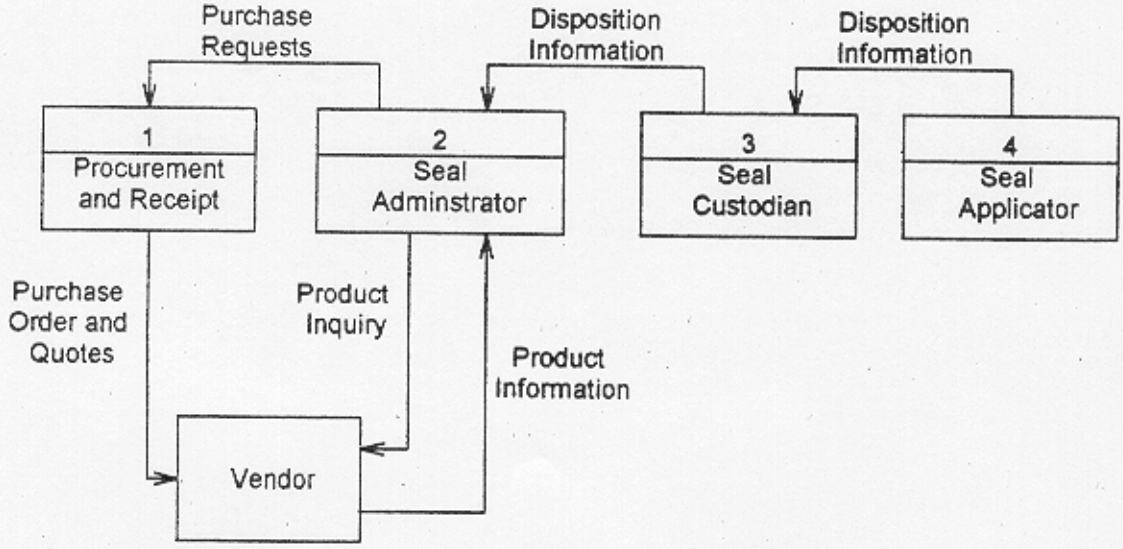


Figure 2-3. Seals Program Data Flow

Figures 2-4 and 2-5 show block diagrams of the functions of the seal administrator.

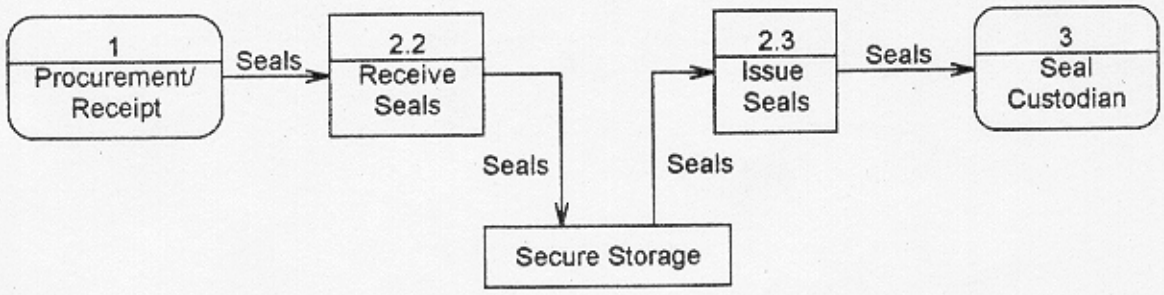


Figure 2-4. Seal Administrator - Hardware Flow

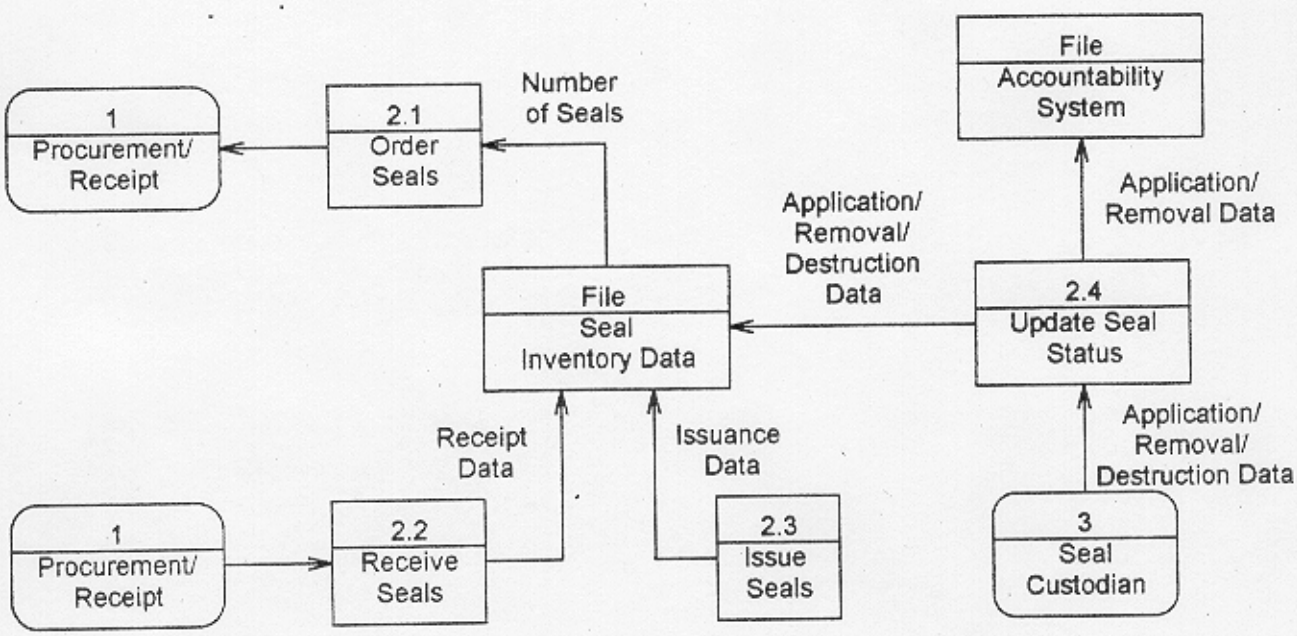


Figure 2-5. Seal Administrator - Data Flow

Orders (Box 2.1): Seal Administrator is responsible for maintaining the supply of seals and for replenishing that supply when it is depleted.

Receives (Box 2.2): Seal Administrator receives and inspects seals from the receiving department and stores those seals in a secure repository.

Issues (Box 2.3): Seal Administrator issues seals to authorized custodians.

Updates Status (Box 2.4) Seal administrator maintains records on the status of each seal in his/her inventory.

Figures 2-6 and 2-7 display the responsibilities of the seal custodian.

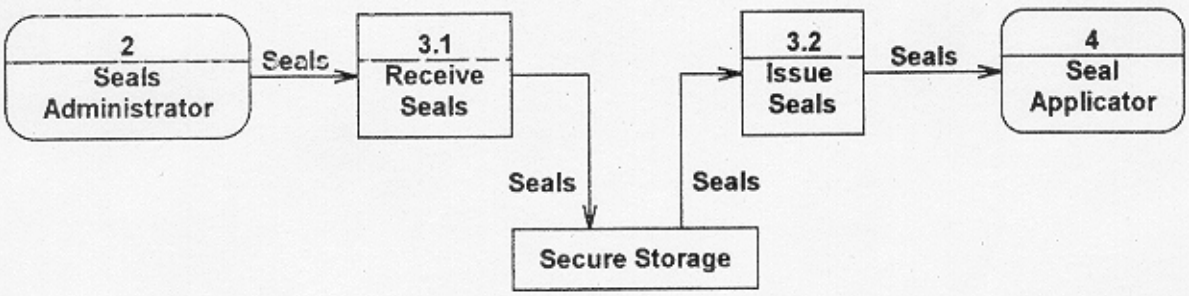


Figure 2-6. Seal Custodian - Hardware Flow

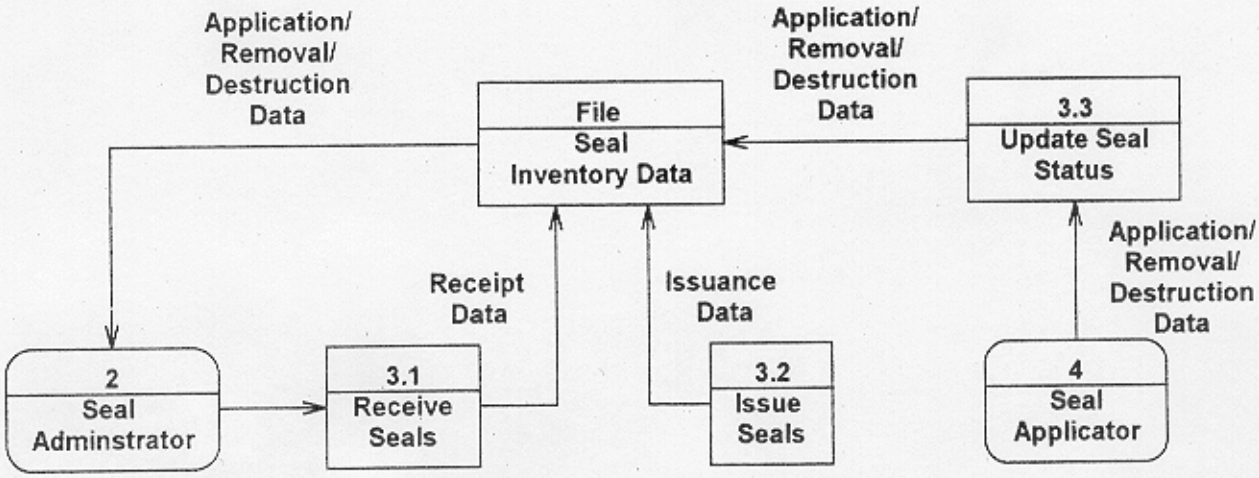


Figure 2-7. Seal Custodian - Seal Data Flow

Receives (Box 3.1): Seal Custodian receives and inspects seals from the seal administrator.

Issues (Box 3.2): Seal custodian issues seals to the seal applicator so that the seals can be applied.

Updates Status (3.3): Seal custodian maintains records on the disposition of seals charged to inventory.

Figure 2-8 displays the responsibilities of the seal applicator.

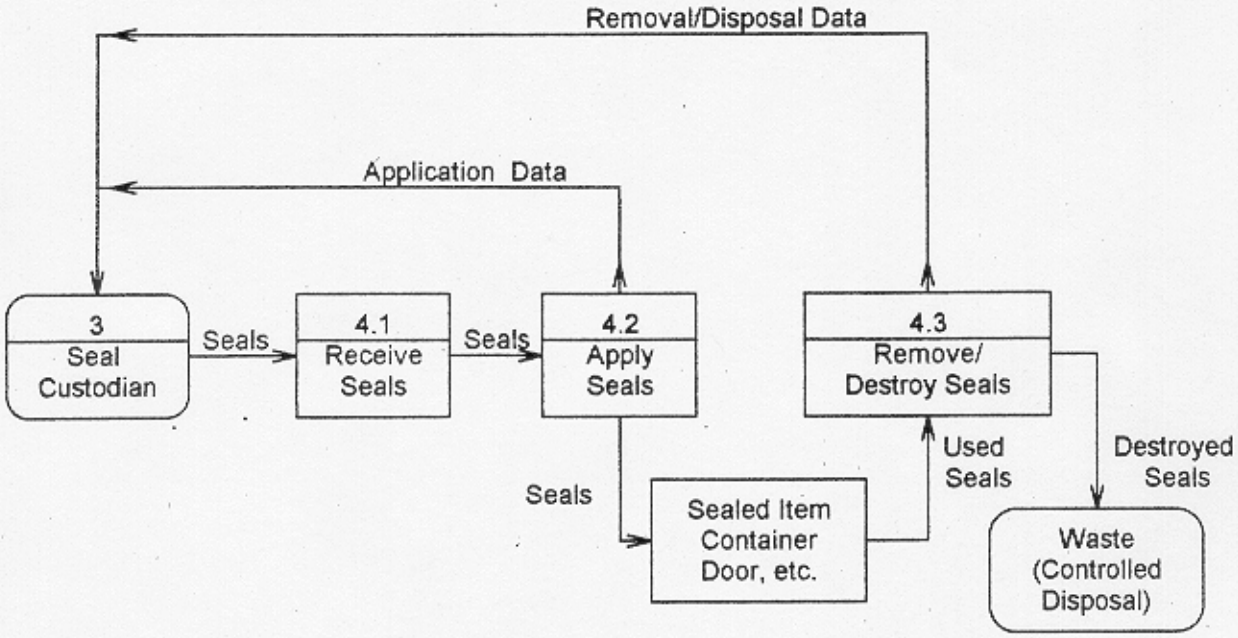


Figure 2-8. Seal Applicator - Seal Hardware and Data Flow

Receives (Box 4.1): Seal applicator/verifier receives seals from the seal custodian.

Applies (Box 4.2): Seal applicator applies seal; he/she should be trained in proper procedures for seal application.

Destroys (Box 4.3): Seal applicator destroys seals after they have been removed from an item.

All data concerning the issuing, application, and destruction of seals should be sent to the seal custodian so that a current inventory is maintained. Alternatively, seals data can be transmitted electronically to the seals record system. Some facilities may also require that destroyed seals be returned to a central control authority such as the seal administrator.

CHAPTER 3

SELECTING THE PROPER SEAL

Cup-wire (Type E) seals and Mylar or other adhesive seals are the principal safeguards seals currently used within DOE. (See sections E.1 and E.2 of Appendix E for a description of these seals.) They can be used in materials control and accountability as well as in security. This section describes some seal characteristics that should be considered in selecting a seal and some typical applications of seals.

3.1 Seal Characteristics

Selecting the proper seal for a particular application is an important part of any seals program. Making a decision about which seal to use involves the following considerations:

- Purpose of the seal. The principal purpose of the seal can be for materials control, materials accountability, security, or a combination of these.

- Type of container to be sealed. The design of the container should accommodate the seal, and the container should be tamper-indicating when used in conjunction with the seal.

- Durability. The durability of the seal should be acceptable in both the interior and exterior environments to which it will be exposed.

- Length of storage and type of area. The durability of the seal should be compatible with the expected duration of use, the impact of the storage environment on the seal, and the amount of activity involving the stored container.

- Ease of application/removal. Consideration should be given to the ease of application and removal of seals and any associated glues. The hazard (i.e., chemical or mechanical) associated with the removal of residual glues must be considered.

- Detection capabilities. The detection capability should provide indication of minimal tampering yet be sturdy enough to endure the environment in which it is used. Indications (detection) should be easily recognizable with minimal observation or verification activities. Serial numbers should also be easily recognizable.

- Uniqueness. The seals selected should be resistant to easy counterfeiting and have a unique number that cannot be easily altered or duplicated.

- Size and shape of seal. If a vinyl or other adhesive seal is to be used, the size will be primarily determined by the container and the type of closure used with the container. Consideration should be given to determining the size needed to accommodate bar codes and

other information needed on the seal or container. The seal must be applied in a manner that will indicate tampering prior to gaining access to the material in the container. This can directly impact the size and shape of the seal.

- Cost effectiveness. The cost of the seal and its application should be considered; however, the cost should not dictate the use of an unacceptable seal.

- Interface with other safeguards and security elements. Consideration should be given to other safeguards and security elements protecting the item. The role of seals should be incorporated into the MC&A Plan.

- Disposition of the sealed container. The type of seal selected for a container may differ depending on whether the container will be shipped off-site, remain in a storage area, moved within the site, or disposed of as waste.

- Reliability. Each site should make a determination that the seal selected is reliable in indicating tampering for its specific use.

3.2 Uses of Seals in Materials Control and Accountability

The following are some typical uses of seals in materials control and accountability:

- Empty shipping containers stored in a material access area or a protected areas. Empty shipping containers in transit.

- Drums, "bird cages", cans of SNM in storage vaults.

- Drums and boxes containing either clean or contaminated waste in material access areas.

- Drums and "bird cages" of SNM and other radioactive materials in transit.

- Small containers of SNM stored in 30-gallon and 55-gallon drums.

- Casks and caskets containing fuel or target material in transit or storage.

- Various small containers containing nuclear materials such as pails, metal cans, plastic bottles, and slip lid cans.

- Door hasps and cages for fuel and target tubes or assemblies storage.

- Infrequently accessed areas.

Some typical uses of seals in physical security are given in Appendix F.

Although this guide distinguishes between MC&A uses of seals and physical security uses of seals, many uses of seals have both an MC&A and a physical security function. For seals used for both purposes, the interface between MC&A and physical security needs to be considered in developing the seals program.

CHAPTER 4

GENERAL PROCEDURES GUIDE

This and the following two chapters provide a general framework for developing the procedures, responsibilities, and other program elements of a Safeguards Seals Program for a particular facility. The chapter describes the types of procedures that should be used when implementing a Safeguards Seals Program.

4.1 Procurement

At a minimum, the procurement process should require the provision of a vendor-certified statement that seals bearing the unique characteristics of the supplied seals will not be provided to another customer without approval from the purchaser. Other specific security requirements at the vendor's facility, such as stock control, die and mold control, access to product, and item accounting should be included in the contract. Background investigations and formal facility clearance may be requested of the vendors, but this precaution is only recommended in highly sensitive applications.

Seals are a manufactured disposable item. Hence, pressure sensitive seals should not be considered printed material for classification purposes.

Seals should be procured according to approved specifications and quality assurance requirements. The design, procurement, and manufacture of seals should conform to ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facility Applications (Reference 3). That standard is preferred by DOE, and the principles contained therein come from quality assurance standards that have been developed over the years within the nuclear industry. Although the title of the Standard relates to nuclear facilities, the principles provided can be applied to almost any work activity, including MC&A systems, and can be used as guidance to eliminate deficiencies and to improve the system. (The ANSI/ASME NQA-1 standard contains 18 Basic Requirements. The 18 requirements describe a comprehensive approach to managing the functions within a system to help assure that the output from the work involved is satisfactory.) Upon receipt, the seals should be inspected to assure that they are of acceptable quality. Once the seal administrator has obtained the seals from the procurement office he/she has the authority to control and issue seals for the plant as needed. Seals requisition forms and purchase order forms should be controlled to prevent easy, unauthorized use of the forms.

4.2 Control

Positive control over seals internal to the facility must be provided to prevent unauthorized substitution or modification. The seal administrator must keep all unissued seals in secure storage under controlled access and should be responsible for the following:

- Recording and maintaining a record of all seal serial numbers including those distributed to seal custodians.

- Maintaining a file of Letters of Authority (or other written authorizations) for using the seals.

- Maintaining a log of receipts and distributions for all seals.

Additionally, measures should be taken to assure that seals inventory records are secure and that false information is not entered into the records.

Individuals should be designated as seal custodians; custodians are responsible for all seals issued to them and have the authority for issuing them to others. Seal custodians should be responsible for the following:

- Preparing a procedure detailing how accountability of all seals issued to them will be maintained before issuing seals. The procedure should identify personnel having the authority and responsibility for performing each phase of the operation.

- Maintaining records of all seals issued to them including for each seal: the type of seal, the serial number, the date used, the item the seal was applied to, the persons who applied the seal, and the person who verified the seal application. The custodian should also maintain records of disposals of seals including who removed the seal, when it was removed, and if the container was resealed.

- Maintaining the seals in secure storage that has controlled access.

- Maintaining a list of approved personnel trained in the control, application, and distribution requirements for the seals.

- Reporting and investigating circumstances in which the integrity of a seal in use cannot be verified, control of seals have been compromised, or control of seals records have been compromised. (See Section 6.3 below.)

Because of the critical nature of a seal custodian's safeguards responsibilities, seal custodians must be reliable. Facility management must provide written documentation delegating authority for seal accountability functions to the custodian.

Seal applicators are responsible for maintaining control of seals issued to them. To ensure that these procedures are followed, periodic scheduled and unscheduled audits of the seals program should be performed, and physical inventory of unused seals should be conducted no less than annually. Seal numbers should be compared to those on record, seals safeguards procedures should be incorporated into the appropriate safeguards manuals, weaknesses in the seals program should be identified and where feasible corrected. Violated seals and unexplained seal discrepancies should be reported and investigated as appropriate. (See Section 6.3 for appropriate investigation and reporting of violation of seal integrity.) The audits should be provided by independent parties who are not involved in day-to-day seal operations. The scope of the audit should include the verification of data records for application and removal of seals. Any deviation from established procedures must be approved and documented. The most common problems found during audits are incomplete procedures, failure to identify containers to which TIDs are applied, improper application of TIDs, and inadequate response procedures.

Internal reviews and assessments of the effectiveness of the MC&A program by facility management are required by paragraph I.6.e.(14) of DOE 5633.3B. These internal reviews and assessments should specifically address the criteria outlined in paragraph III.6.a. of DOE 5633.3B. Checklists developed for the review and evaluation of the facility seals program may be of value to facility management during their assessment of the seals program. Sample checklists are provided in Appendix D.

4.3 Training

Facility management must assure that seal administrators, seal custodians, and seal applicators are trained and qualified to ensure that they are capable of conducting their assigned duties. Training should be done in accordance with DOE 5630.15, SAFEGUARDS AND SECURITY TRAINING PROGRAM, 8-21-92. After completing their training, candidate seal applicators should be able to correctly apply the types of seals typically used at their facility, verify the integrity of the seals, and remove the seals according to approved procedures. Additionally, candidate seal applicators should demonstrate an understanding of the appropriate procedures and data flow requirements.

Training may be provided by local instructors as approved by facility management. However, one or more of the facility's instructors should have completed the safeguards seals portion of the MC&A training program

curriculum offered by the DOE Central Training Academy (MCA-121, Tamper-Indicating Device Program). The knowledge gained at the Central Training Academy should be conveyed to the other local instructors.

In order to help ensure that seal administrators, seal custodians, and seal applicators maintain an acceptable level of proficiency, it is recommended that a periodic reevaluation be conducted to determine their current knowledge of the seals program. For seal applicators, reevaluation should include testing of their ability to correctly apply, remove, and verify seals.

CHAPTER 5

SEALS AND NUCLEAR MATERIAL

5.1 Applying and Removing Seals

A detailed procedure for applying and removing seals must be established for each type of container, seal, and use. Examples of these types of procedures are given in Appendix C. When applying or removing seals, the appropriate data should be recorded. This should include the following information as applicable:

- Material identification
- Seal number
- Information on whether the seal was applied, voided, or removed
- Location of the container
- Gross weight or other information that identifies the container and its seal
- Identification of the seal applicator
- Identification of the person who witnessed the seal being applied, removed, or voided
- Date entries were made
- If applicable, the date of the final disposition of the seal or container

The seal application and removal data should be: (1) auditable through an audit trail, (2) recorded sequentially, (3) issued to user groups by the seal administrator, and (4) retained as part of the record of the seal. It should also be delivered to the seal administrator or custodian within the time period required by seal procedures or the MC&A Plan. Seal custodians and administrators should review the data to assure that it is correct and complete. In addition, application and removal data should be afforded the same protection as seals and seal logs (i.e. locked in secure storage).

Examples of some application and removal forms used for recording seals data are provided in Appendix G.

5.2 Packaging Nuclear Material

A seal should be properly applied immediately after the nuclear material is packaged in a container while the container is still under the surveillance of two people. A measurement, if needed, should be obtained on the container or discrete item within the time period permitted by facility procedures or the MC&A Plan. When accountability measurements are determined by nondestructive assay, seals should be applied prior to the measurement. When accountability measurements are determined based on a destructive analysis, seals should be applied immediately after obtaining the sample.

When it is necessary to break the original seal but not to open the container, visual surveillance of the container should be maintained by use of a strict two-person rule or other material surveillance mechanisms from the time the original seal is removed until a new seal is applied. Usually, the seal applicator and one other knowledgeable person can be used for the two-person rule.

5.3 Storing Nuclear Material

A seal should be considered for use on each nuclear material container stored in an MBA. Where possible within the permitted time, all sealed items being put into storage should receive an assay or other confirmation measurement. Additionally, where feasible, sealed containers should be positioned in storage to allow visual inspection of the seal without moving the container.

5.4 Transferring Nuclear Materials Between MBAs

When containers being transferred to or from an MBA are sealed, the seals data should be recorded on the material transfer forms required for transfer between MBAs. The data should also be recorded in the TID records system and, if appropriate, in the materials accounting system. As part of the required transfer checks, personnel responsible for shipping, transferring, and receiving material in the MBA should inspect all containers to verify that: (1) containers requiring seals are sealed, (2) seals are not broken, damaged, or improperly applied, and (3) the seal numbers correspond to any accompanying paper work and, if applicable, to the seal numbers in the TID record or materials accounting system.

5.5 Shipping Material Off-Site

Seals should be applied to all nuclear material containers being shipped off-site. All seal numbers and types should be recorded and transmitted to the receiver prior to or upon receipt of shipment. Shipping personnel should also inspect all containers prior to shipping to verify that (1) the containers are sealed; (2) the seals are not broken, damaged, or improperly applied; and (3) the seal numbers correspond to those indicated on the shipping documents. If the inspection fails to

verify these, the container should not be shipped until these problems are resolved and corrected.

5.6 Receiving Nuclear Material From Off-Site

Paragraph II, 5.a.(3) of DOE 5633.3B requires that transfer checks be made for material received from off-site immediately after receipt. As a part of the transfer checks, the receiving group should inspect the containers and seals to verify that (1) containers requiring seals are sealed, (2) seals are not broken, damaged, or improperly applied, and (3) the seal numbers correspond to those provided by the shipper. If applicable, the shipping vehicle should also be checked on arrival to assure that it is properly sealed. If the inspection fails to verify the integrity of any of these items, the group performing the inspection should report and investigate the incident as required by the appropriate safeguards and security procedures.

5.7 Removing And Disposing of Seals

Any seal removed from a container or a shipping vehicle should be examined and disposed of according to approved procedures. Seals used in safeguarding materials during off-site shipments should be disposed of as the shipper requests. When a seal is removed, it must be intentionally damaged sufficiently to preclude its reuse, and prudent steps must be taken to prevent unauthorized persons from obtaining the seal. For seals that are likely to be contaminated, disposal according to facility waste-handling procedures should be sufficient. Uncontaminated seals can be disposed of with classified or sensitive paper waste, with classified or sensitive parts waste, or by any other destructive or disposal means that makes it unlikely that the seals could be obtained by unauthorized persons.

CHAPTER 6

DETERMINING SEAL INTEGRITY

6.1 Verification of Seal Integrity

Seal integrity can be determined by verification that the seal has not been violated. Verification can be accomplished for some seals by visual inspection; other seals require a postmortem examination even though there is no apparent evidence of tampering. Verification activities should include determining that the seal is properly in place, reading the seal number, and comparing the seal number and location with facility records. If seals cannot be verified by visual inspection or have not been under an approved materials surveillance program, they cannot be relied upon unless a postmortem examination provides assurance that they have not been violated. In the latter case, a high confidence material confirmation or verification would be warranted.

The integrity of seals should be verified at the following times:

- immediately before and after seal application
- prior to removing, breaking, or voiding a seal
- prior to transferring a sealed container into an MBA
- prior to removing a sealed container from an MBA
- when sealed containers are received
- during physical inventory
- when confirmation measurements are made
- during inspections and internal reviews

6.2 Conditions That Require A Response

Appropriate actions should be taken whenever the integrity of a seal in use cannot be verified or when control of either seals or seal records has been compromised. Some conditions that require a response are:

- a missing seal
- a violated seal
- a seal number discrepancy
- a damaged seal

- an improperly applied seal
- an unauthorized seal
- uncontrolled seals or seal records

6.3 Proper Responses

RESPONSE TO ABNORMAL SITUATIONS SHOULD BE IN ACCORDANCE WITH DOE ORDERS AND APPLICABLE SITE PLANING DOCUMENTS

Each facility shall identify loss detection elements for each MBA (including the seals program) and shall establish a graded program for monitoring loss detection elements and associated data. These measures will help personnel to recognize abnormal situations and to determine and maintain an awareness of the status of nuclear material inventories. Each abnormal situation shall be assessed immediately. Unresolved situations shall be reported and investigated in accordance with DOE 5633.3B, DOE 5500.2B, and DOE 5000.3B. All information related to monitoring and assessments should be documented and retained as specified by the responsible Operations Office.

If a seal is found to be broken, damaged, or improperly applied immediately after application of the seal, the violated seal should be removed and a new one applied according to appropriate seal application and removal procedures. Except for possibly retraining the seal applicator no other action is required.

If, at a later time, a broken, damaged, unauthorized, or improperly applied seal is discovered or a seal is found to be missing, the person discovering the problem must report it immediately in accordance with established procedures. The possibility of theft or diversion of nuclear material should be investigated at once and the root cause of the problem should be determined and corrected. If feasible, measurements should be made to assure that unauthorized removal of nuclear material has not occurred. Appropriate compensatory measures should be maintained until an authorized seal is properly applied. When a seal is found to be missing or damaged before it has been applied, an occurrence report is not required, and measurements are usually not necessary.

If control of seals or seals records has been compromised, compensatory measures should be taken immediately, the possibility of theft or diversion of nuclear materials should be investigated, and the root cause of the problem should be determined and corrected. Additionally, measurements need to be made to verify that nuclear material has not been stolen or diverted.

6.4 Retention of Suspect Seals

A suspect seal is any seal in use that shows potential tampering such as being broken, damaged, unauthorized, or improperly applied.

A suspect seal should be retained until an investigation has resolved the situation involving the seal. When the situation has been resolved, management officials responsible for MC&A at the facility will prepare and distribute a report of the investigation to the parties involved. Once the investigation has been completed and the report has been issued, the seal administrator can authorize destruction and disposal of the suspect seal.

CHAPTER 7

REVIEWS, AUDITS, SURVEYS, INSPECTIONS, AND PERFORMANCE TESTING OF SEALS PROGRAMS

7.1 Requirements for Audits

Internal reviews and assessments of the MC&A system are required by paragraph I.6.e. of DOE 5633.3B. Frequencies and methods of internal reviews should be documented in the MC&A Plan. A seals program is only one of many elements in a safeguards system and as such should be appropriately valued when evaluating overall system effectiveness. In particular, the effectiveness of seals as a safeguards element will depend directly on the environment in which the seals are used.

American Audit Standards and ANSI/ASME, NQA-1, QUALITY ASSURANCE AND PROGRAM REQUIREMENTS FOR NUCLEAR FACILITIES, imply that independent audits should be made. DOE 5634.1B, FACILITY APPROVALS, SECURITY SURVEYS, AND NUCLEAR MATERIALS SURVEYS, requires that Operations Offices perform security and nuclear materials surveys of facilities with safeguards and security interests. Additionally, the Office of Security Evaluations (SE) performs inspections and evaluations of safeguards and security systems on a regular basis.

7.2 Performance Testing

The effectiveness of seals programs should be validated by performance testing. The following minimal performance requirements for seals programs are given in DOE 5633.3B, Figure I-4:

"The tamper-indicating device record system shall accurately reflect the location and identity of tamper-indicating devices in at least 99% of the cases. The tamper-indicating device program shall assure that tamper-indicating devices are properly in place in at least 95% of the cases."

Testing needed to verify that the performance requirements are met can usually be conducted at the time of physical inventory. Further guidance on meeting these requirements is given in References 8 and 9. In addition to the performance testing needed to verify these requirements are being met, tests should be conducted to assess the effectiveness of the tamper-indicating device program against specific insider scenarios. The accuracy of the record system for stocks of unused seals should also be tested.

7.3 Checklists

A checklist(s) should be developed by the survey team for review and evaluation of each facility. Three sample checklists are provided in Appendix D of this document.

REFERENCES

1. *Safeguards Seal Reference Manual*, issued by the Office of Safeguards and Security, Assistant Secretary for Defense Programs, U. S. Department of Energy (January 1991).

2. *Safeguards and Security Definitions Guide*, issued by the Office of Safeguards and Security (December 1993).

3. ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facility Applications, The American Society of Mechanical Engineers, New York, New York (1994).

4. DOE 5630.15, SAFEGUARDS AND SECURITY TRAINING PROGRAM, 8-21-92, which establishes procedures for standardizing and implementing the DOE Safeguards and Security Training Program.

5. DOE 5633.3B, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS, 9-7-94, which prescribes DOE minimum requirements for control and accountability of nuclear materials.

6. DOE 5634.1B, FACILITY APPROVALS, SECURITY SURVEYS AND NUCLEAR MATERIALS SURVEYS, 9-15-92, which establishes requirements for the conduct of onsite security or nuclear materials surveys of facilities with DOE safeguards and security interests.

7. Sastre, C.A., *The Use of Seals as a Safeguards Tool*, Brookhaven National Laboratory, BNL 13480, March 6, 1969. (Not in print.)

8. *Guide to the Evaluation of Selected Materials Control and Accountability (MC&A) Detection Elements*, issued by the Office of Safeguards and Security (May 1994).

9. *Guide for Implementation of DOE 5633.3B, "Control and Accountability of Nuclear Materials,"* issued by the Office of Safeguards and Security (April 1995).

10. Horton, Patrick R. V., and Waddoups, Ivan G., *Tamper-Indicating Devices and the Safeguards Seals Evaluation Test Report, Volume I*, Sandia Report Sand93-1726, prepared by Sandia National Laboratories - Albuquerque (December 1993).

11. Waddoups, Ivan G., and Horton, Patrick R. V., "Seals Development and Evalution," Proceeding of the Annual Meeting of the Institute of Nuclear Materials Management (1994).

12. ASTM Standard F946-85, "Standard Guide for Establishing Security Seal Control and Accountability Procedures," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (October 1985).

13. ASTM Standard F1157-90, "Standard Practice for Classifying the Relative Performance of the Physical Properties of Security Seals," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (March 1990).

14. ASTM Standard F1158-94, "Standard Guide for the Inspection and Evaluation of Security Seals, "American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (September 1994).

APPENDIX A. REQUIREMENTS FOR THE USE OF SEALS AS SPECIFIED IN DOE 5633.3B (September 7, 1994).

This appendix restates the requirements of DOE Order 5633.3B that address the use of seals in MC&A.

In general, DOE Order 5633.3B requires that tamper-indicating devices be used to the extent possible to detect violations of container integrity.

Additionally, paragraph I, 6. of DOE Order 5633.3B states that facility management should "establish a graded program to ensure the integrity and quality of materials control and accountability systems and procedures ..." including tamper-indicating device programs and procedures. In particular, paragraph I, 6.e.14. requires that facility management should establish a program to review and assess its TID programs as part of an overall review of its MC&A system.

The following list is a summary of other TID requirements found in DOE Order 5633.3B.

Chapter/ Paragraph	
Figure I-4	"Tamper-Indicating Devices. The tamper-indicating device record system shall accurately reflect the location and identity of tamper-indicating devices in at least 99% of the cases. The tamper-indicating device program shall assure that tamper-indicating devices are properly in place in at least 95% of the cases." Required confidence levels for meeting this requirement are stated in Paragraph I, 4.c.
II, 3.c.(1)	"At each facility, management shall establish and implement a system for performing inventory verification measurements on SNM items that are not tamper-indicating. A confirmatory inventory measurement shall be performed on SNM items that are tamper-indicating. Such measurements are intended to detect diversion or theft of material and shall use a statistically-based sampling plan applied in a manner consistent with the graded safeguards concept. Parameters for statistical sampling plans and inventory stratifications used with statistical sampling plans shall be defined by facility management and approved by the Manager, DOE Field Office. The Manager, DOE Field Office, may establish a material quantity threshold for inventory verification/confirmation measurements."

II, 5.a.(3) "Immediately after receipt, shipments shall be subjected to a transfer check. Transfer checks shall consist of confirmation of shipping container or item count, validation of tamper-indicating devices integrity and identification, and comparison with shipping documentation to provide assurance that the shipment was received intact. For purposes of transfer checks, receipt occurs whenever the transfer vehicle is unloaded or the transfer vehicle's integrity is breached (tamper-indicating devices removed or broken) at the receiving facility. Documented procedures shall specify actions to be taken in the event discrepancies are detected. Records of transfers checks shall be retained until the next annual DOE safeguards survey."

II, 5.b.(4) Referring to internal transfers the order states "Materials shall be subjected to a transfer check within one workday after receipt. These checks shall include verification of shipping container or item count, tamper-indicating devices integrity, and identification number. These transfer checks shall be compared to appropriate documentation. All irradiated SNM requires only a transfer check."

III, 1.c. "Equipment Access. Each facility shall have a graded program to control access to data-generating and other equipment used in material control activities, thereby assisting in providing assurance of the integrity of equipment and data used for material control. Such equipment includes measurement equipment, data recording devices, and tamper-indicating devices."

III, 5.a. "Tamper-Indicating Devices. The reliance on tamper-indicating devices as a safeguards measure is directly dependent on the environment in which the tamper-indicating device resides and the material being tamper-safed. Each facility shall have a documented program, administered by the materials control and accountability organization, for control of tamper-indicating devices and to assure that tamper-indicating devices are used to the extent possible to detect violations of container integrity. DOE-wide standardized tamper-indicating devices should be used when available through DOE standardized procurement (see DOE 5630.17, SAFEGUARDS AND SECURITY (S&S STANDARDIZATION PROGRAM). Testing of tamper-indicating device integrity, location, and application and the tamper-indicating device record system shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16A and applicable Department directives and guidance. Performance requirements for tamper-indicating devices are contained in Chapter I, paragraph 4, of this Order. The Safeguards Seal Reference Manual, issued by the Office of Safeguards and Security, can facilitate in the selection, application, and verification of tamper-indicating devices. The tamper-indicating device control program shall specify, as a minimum, the following elements:

(1) Acquisition/procurement/destruction;

(2) Types of tamper-indicating devices utilized;

(3) Assurance of unique tamper-indicating devices identification;

(4) Storage;

(5) Issuance;

(6) Personnel authorized to apply, remove, and dispose of tamper-indicating devices;

(7) Containers on which tamper-indicating devices are to be applied;

(8) Procedures for application of tamper-indicating devices;

(9) Frequency and method of tamper-indicating devices verification;

(10) Response procedures for tamper-indicating devices violations;

(11) Assurance that tamper-indicating devices cannot be reused after violation;

(12) Frequency and method of internal program audits; and

(13) Procedures for reporting tamper-indicating device violations."

APPENDIX B. STATUS OF SEALS RESEARCH AND DEVELOPMENT ACTIVITIES

Much of the current seals research and development work is being done to support treaty verification and international safeguards activities. Since the requirements are more stringent in these environments, most of technologies under development are intended for very high security applications as compared to the typical domestic applications which are the focus of this guide. The domestic arena can surely benefit from these developments by usage and understanding of the general concepts. The domestic climate is changing to allow for significant benefits, such as inventory period extensions, through using advanced and more secure technologies. The following discussion is not intended to be a comprehensive summary of everything being done but is representative of the ongoing research and development activities within the government circles. Also included are some advanced commercially available technologies which have not been used in domestic safeguards. Table B-1 on the next page summarizes most of the work at present. Private industry continues to produce new and better products, but these are usually not released until production capability is achieved after research and development work has been completed.

The fiber optic seals are being developed because they offer the opportunity to monitor, either actively or passively, a loop which is more difficult to defeat than many other loop designs. The Fiber-Lock is being used by customers with high security needs and several thousands of them have been marketed. The Cobra seal is being used in much smaller quantities within the international safeguards community. The Python and PTILS are proven technologies that have not yet been commercialized. The LLNL Fiber Optic Loop is in the final development phases. The VACOSS/LoCOSS and active loops are commercially available and are seeing some usage for special applications.

The Tamper Tape is basically the 3M "Confirm" technology which is being improved through on-going efforts but is available for application.

The BDM MSLITS device uses a reflective particle signature body and special loop materials which resist and reveal covert attacks.

The Shrink Wrap is being used to tamper protect parts during shipment and storage within the weapons community.

The AECL (Atomic Energy Canada, Ltd) and JRC (Euratom's Joint Research Center) Ultrasonic seal are used in special purpose applications for underwater seals but could possibly have domestic applications. LANL is working on Acoustic Resonance Spectroscopy which may have some unique outputs which could be used to constitute an identifier similar to the ultrasonic signature.

Seal	Developer and/or Supplier	Status	Primary Applications
Fiber-Lock	E. J. Brooks	Commercially Available	High-level Security
Cobra	Sandia/Aquila	Commercially Available	International Safeguards and Treaty Verification
Python	Sandia	Development Complete	International Safeguards and Treaty Verification
Star	LLNL	In development	Treaty Verification
VACOSS, LoCOSS	KFA/Aquila	Commercially Available	International Safeguards
Active loops		Commercially Available	Intrusion Detection, Operational Monitoring
PTILS,	BDM	Development Complete	Treaty Verification
AFOS, RIVA	Sandia	In development	International Safeguards and Treaty Verification
Fiber Optic Loop	LLNL	In development	Treaty Verification
Tamper Tape	3M/PNL	Commercially available but being enhanced	Treaty Verification
MSLITS	BDM	Development Complete	Treaty Verification
Shrink Wrap	BNL/Sandia/ Progressive Packaging	Commercially Available	Treaty Verification
Ultrasonic	Sandia/AECL/ JRC/PNL	Limited use	International Safeguards and Treaty Verification

Table B-1. Summary of Advanced Seals

Fiber-Lock	E.J. Brooks, 164 North 13th Street, P.O. Box 7070, Newark, New Jersey 07107 ph. 201-483-0335
Cobra, VACOSS, LoCOSS	Aquila Technologies Group, Inc., 8401 Washington Place NE, Albuquerque, NM 87113, ph. 505-828-9100
Python, AFOS, RIVA	John Matter, MS0656, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, ph. 510-423-7509
Star	Sang Sheem, L407, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550, ph. 510-423-7509
Active Loops	Bob Heimbecker, Interactive Technologies, Inc., ph. 800-777-1415 Ext. 655; Sandra Reynolds, Fiber Sensys, Inc, 9640 SW Sunshine Court, #400, Beaverton, OR 97005 ph. 503-641-8150; Frederick Wiese, Valve Security Systems, Inc. 11356 West 107th Place, Westminster, CO 80010 ph. 314-230-5455; Steve Koonce, Inovonics Corp, 2100, Central Avenue, Boulder, CO 80301, ph. 800-782-2709
PTILS, MSLITS	Randy Cabeen, BDM, 1801 Randolph Road, Albuquerque, NM 87106, ph. 505-848-5277
Fiber Optic Loop	Robert Rumble, L398, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550, ph. 510-422-8611
Tamper Tape	Halvor Undem, K648, Battelle Northwest PNL, P.O. Box 999, Richland, WA 99352 ph. 509-376-4547; David Osten, Identification and Converters Systems Division, 3M Center, Building 230-BS-20, St. Paul/Minneapolis, MN 55144-1000, ph. 612-736-4613.
Shrink Wrap	Bob Courtney, MS-0971, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, ph. 505-844-7867; Kevin Henrics, Progressive Packaging and Design, Inc., P.O. Box 13825, Milwaukee, WI, 53213, ph. 414-453-7775
Ultrasonic	Halvor Undem, K648, Battelle Northwest PNL, P.O. Box 999, Richland, WA 99352 ph. 509-376-4547

Table B-2. Contacts for More Information on Advanced Seals

APPENDIX C. SAMPLE PROCEDURES FOR APPLICATION AND REMOVAL OF SAFEGUARDS SEALS

The sample procedures contained in this appendix are to be used as guidance. Site specific procedures should be developed for each facility.

The following sections describe the process for applying and removing cup-wire (Type E) seals and vinyl or other adhesive seals.

Application of Cup-Wire (Type E) Seals

The cup-wire seal consists of two metallic parts that, when snapped together, form a numbered enclosure around the joined ends of a length of wire. The wire is attached to the object to be sealed in a manner that requires breaking the wire or destroying the seal to open the object. This procedure defines the technique for proper application of the cup-wire seal.

Procedure

NOTE: Two authorized seal applicators must be present when cup-wire seals are applied to nuclear material containers.

1. Obtain the following equipment and material:

   a) Cup-wire seals (tops and bottoms).
   b) Seven-by-seven (49 strand), 175-lb. braided wire.
   c) Crush-type sleeves.
   d) Electrician pliers (capable of crimping collars) and a pair of wire cutters.

2. Apply the seal to a strategic location that will ensure that the container cannot be opened without destroying the device's integrity.

3. Estimate the length of wire needed and cut that amount from the roll. (Exact length will depend on the container to be sealed.)

4. Run the wire through the fixture and bring ends to approximately equal length. For drums, insert wire through the hole in the bolt, into the gap in the split lug of the ring, and across one half of the lug. At all times, remove any slack in the wire by pulling it "finger-tight." Then pull the end of the wire around the half-lug, through the gap, and around the other half-lug, through the gap, and around the other half-lug in a "Figure-8."

5. Run the wire ends through the holes in the numbered cup.

6. Slip the cup down the wire until it is in position near the fixture.

7. Place ends through a sleeve.

8. Pull ends of the wire to move the sleeve into position near the seal top.

9. Use electrician pliers to crush sleeve firmly on the wire.

10. Trim the wire ends, leaving approximately 1 inch beyond each sleeve end.

11. Loop the remaining ends of wire into the inner cup area, then pull on the cup while pushing the wire and collar into the inner cup area, ensuring that there is no interference with closure of the seal.

NOTE: Before performing Step 12, check that serial numbers of the seal bottom and top cups are identical.

12. Place the numbered bottom cup over the numbered top cup and apply firm pressure with fingers around the rim of the bottom to ensure full closure.

13. Inspect the seal and wire. If the wire was damaged during application or full closure was not achieved, cut the wire, remove the seal (according to the cup-wire seal removal procedure), and apply another.

14. Complete

    a) the material identification, location, seal number, and date portion of the appropriate transfer form, and

    b) a seal application and removal form.

15) Deliver the seal application and removal form to the custodian within the specified time. Both the applicator and witness sign the seal application and removal form.

Removal of Cup-Wire (Type E) Seals

This procedure defines requirements for the removal of cup-wire seals.

Procedure

NOTE: Two authorized seal applicators must be present when cup-wire seals are removed from nuclear material containers.

1. Before a previously-applied cup-wire seal is removed, it will be inspected by an authorized seal applicator to verify:

    a) That the seal is not broken, damaged, or improperly applied.

    b) That the seal number corresponds to the number on the latest seal log listing, shipper back-up papers, and container label.

2. If the inspection fails to verify (a) or (b) above, the seal applicator will initiate the required response procedure.

3. To remove the seal, the wire must be cut at least 2 inches away from the seal, then the seal/wire is removed from the container.

4. The seal applicator will record the date the used seal is removed, examine it for tampering and incorrect application, and dispose of it in a manner that prevents its reuse and that is consistent with procedures for disposal of controlled waste. The date of disposal will be recorded in the seal accountability records.

5. The seal applicator will deliver the seal application and removal form to the seal custodian as soon as possible but no later than 24 hours.

Application of Vinyl or Other Adhesive Seals

The vinyl or other adhesive seal is a nontransferable strip. An attempt to remove these seals from the application surface will fracture the seal. When removal is attempted, the material will destruct and leave identifying marks showing that it has been violated. The seal is applied to containers or other objects in a manner that requires destroying the device to open the object.

Procedure

NOTE: Two authorized seal applicators must be present when seals are applied to nuclear material containers.

1. Using water, remove any dust that may have accumulated on the outer surfaces of the container. If grease is present on the surface, remove with alcohol or other solvent(s) approved by safety and environmental organizations.

2. Remove any previously applied labels and seals. If a previously-applied label cannot be peeled off the can, apply the seal over the old label.

3. Slip the seal through any handle (if present) on top of the container. Peel the label/seal portion of the seal away from the backing material by lifting one of the corners and slowly separating the seal from the backing.

4. Apply the bar code portion of the seal, if applicable, to the container so the bar code is on the side near the top edge and the tape extending from the top of the bar code is applied across the top of the container and down the opposite side. Exercise care to ensure that the bar code is applied close enough to the top edge to allow the tape to reach across the top of the container and extend down the opposite side at least 1 inch. Both ends of the seal should extend at least 1 inch down the sides of the can. For drums, place the seal behind the bolt. The seal should be reduced from 13 inches in length to 9 inches in length. Cut on the end opposite the bar code. This cut should be square with existing dimensions and made with a pair of scissors.

NOTE: The locking ring should be bolted down so the gap in the ring behind the bolt is as small as possible. The seal should be centered over this gap. The end opposite the bar code should be on the side of the drum, between the top edge and the first rolling hoop. No part of the decal should be below the first rolling hoop.

5. Apply firm pressure to the entire surface of the seal with an application squeegee (or thumb and fingers) to ensure that the seal adheres to the surface. Give special attention to the edges of the seal. Be careful not to fold or wrinkle the device where it laps over the edges of the can. Apply the seal smoothly to prevent wrinkles, especially in the area of the bar code and the sequential number.

6. Inspect the seal to verify:

   a) That the seal is applied across the top of the container with at least 1 inch extending down opposite sides of the top of the container.

   b) That the seal is not torn.

   c) That the seal has adhered to the surface of the can.

   d) That the bar code and sequential number block are not wrinkled and are readable.

   e) That both seal and ID numbers are properly recorded.

7. If the seal is not properly placed on the can, is torn, of if the numbers do not match, the seal will be voided according to the procedure for breaking or voiding vinyl or other adhesive seals. A new seal can then be applied.

8. Complete

   a) the material identification, location, seal number, seal date, and gross weight portion of the appropriate transfer documents, and

   b) seal application and removal form.

9. Deliver the removal form to the seal custodian within 24 hours.

NOTE: If it is not possible to apply the seal completely across the top of the container due to the size, apply it to one side of the container lid such that lifting the lid will break the seal, as approved by the seal-administrator.

Removal of Vinyl or Other Adhesive Seals

Resealing, relabeling, recanning, or opening a nuclear material container that is sealed with a vinyl or other adhesive seal requires breaking or voiding the seal. This procedure defines the inspection, recording, and notification requirements for breaking or voiding applied seals.

Procedure

NOTE: Two authorized seal applicators must be present when vinyl or other adhesive seals are applied to nuclear material containers are broken or voided.

1) When voiding an unapplied vinyl or other adhesive seal, the seal applicator must destroy the seal and return a completed seal application and removal form to the seal custodian within 24 hours.

2) Prior to breaking or voiding an applied vinyl or other adhesive seal, a seal applicator will inspect the seal to verify:

   a) That the seal is not broken, damaged, or improperly applied.

   b) That the number of the seal matches the number of the shipping documents.

3) If the inspection fails to verify these criteria, the authorized seal applicator will initiate the required response procedure.

4) If the inspection verifies the integrity of the seal, it may be broken or considered void for authorized resealing, relabeling, recanning, or opening.

5) The authorized seal applicator will complete and deliver a seal application and removal form to the seal custodian by hand within 24 hours.

6) The seal custodian will record in the seal log book the date that the seal is destroyed, broken, or voided and ensure that it has been disposed of in a manner that prevents its reuse.

7) The seal custodian will deliver the seal application and removal form to the seal administrator.

APPENDIX D. CHECKLISTS

A checklist(s) should be developed by the survey team for review and evaluation of each facility's seals program. The following sample checklists provide examples that can be used by survey teams in developing facility specific checklists. The references in italics are to sections of this document.

SEALS PROGRAM CHECKLIST

1. Does the facility have a documented program for the use of seals to detect violations of container integrity? (*Section 2.4, Seals Program Documentation*)

2. Does the facility have a documented program that specifies procedures for application, removal, and destruction of seals? (*Section 2.4, Seals Program Documentation*)

3. Do access controls for seals include procedures to assure that procurement, storage, and distribution of seals are controlled? (*Section 4.1, Procurement; Section 4.2, Control*)

4. Do procedures exists for verification of seals integrity at specified frequencies? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation*)

5. Are the seal procedures documented? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation*)

6. Does the seals program specify the type of seal to use for each type of container? (*Section 2.3, The Seals Program, Section 5.1, Applying And Removing Seals*)

7. Does the program for the control of seals specify the frequency and method of seal verification? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation*)

8. Does the seals control program specify methods of assuring that seals cannot be reused after having been violated or voided? (*Section 2.3, Seals Program Documentation; Section 5.7, Removing And Disposing of Seals*)

9. Does the seals control program specify methods of assuring that each seal has a unique identification? (*Section 1.2, Seal Characteristics; Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation; Section 3.1, Seal Characteristics; Section, 4.1 Procurement*)

10. Is the process by which tampering is indicated described for each type of seal? (*Section 2.3, The Seals Program*)

11. Do the procedures address abnormal situations (e.g. seal number discrepancy; damaged, broken, missing, and improperly applied seals)? (*Section 2.3, The Seals Program; Section 6.2, Conditions That Require A Response; Section 6.3, Proper Responses*)

12. Does the facility have an internal review program that includes audits and assessments of the seals program? (*Section 1.5, Using Seals Effectively; Section 4.2, Control; Chapter 7, Reviews, Audits, Surveys, And Inspections of Seals Programs*)

13. Is the seal custodian trained and is there a record of this training? (*Section 4.3, Training*)

14. Are there training records for those who apply, verify, remove, and destroy seals? (*Section 4.3, Training*)

CHECKLIST FOR CONTROL OF SEALS

1. Does the facility have a program for control of seals during procurement, storage, distribution, application, removal, and disposal? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation, Section 4.1, Procurement; Section 4.2, Control*)

2. Does the facility have a documented program for control of seals which includes procedures for applying the seals? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation; Section 5.1, Applying and Removing Seals*)

3. Does the facility have a documented program for control of seals which has procedures for response to and reporting of seal violations? (*Section 2.3, The Seals Program; Section 2.4, Seals Program Documentation; Section 6.2, Conditions That Require A Response; Section 6.3, Proper Responses*)

4. Does the facility have a documented program that specifies personnel authorized to apply, remove, and dispose of seals? (*Section 2.4, Seals Program Documentation; Section 4.2, Control*)

5. Does the facility's program for control of seals specify the frequency and method of internal program audits? (*Section 1.5, Using Seals Effectively; Section 4.2, Control; Chapter 7, Reviews, Audits, And Inspections of Seals Programs*)

6. Do access controls for seals include procedures to assure that individuals with responsibility for control of seals storage and distribution are designated? (*Section 4.2, Control*)

7. Does the facility have an access control program for seals that includes procedures to assure weaknesses are identified, corrective actions are completed, and seal access controls are effective? (*Section 1.5, Using Seals Effectively; Section 4.2, Control*)

CHECKLIST FOR SEAL USE

1. Are SNM containers tamper-indicating? (*Section 1.5, Using Seals Effectively; Section 3.1, Seal Characteristics*)

2. Is every seal at the DOE facility (or in transit off-site) listed in the seals accountability system? (*Section 4.2, Control; Section 5.1, Applying and Removing Seals; Section 5.5, Shipping Material Off-Site; Receiving Nuclear Material From Off-Site*)

3. Are sealed items that are found with damaged or misapplied seals reported? Are the items remeasured using verification or confirmation measurements? (*Section 4.2, Control; Section 6.3, Proper Responses*)

4. Does the two-person rule for seal application and destruction include reading, recording, and transferring of seal identification number, container identification number, and other data including location of the container? (*Section 5.1, Applying and Removing Seals*)

5. Is access to the seals accountability system controlled so that seal applicators do not have access to the seals accountability system and that personnel with access to the seals accountability system are not allowed to apply seals? (*Section 2.1, Task Assignments*)

6. Are seals checked for indications of tampering? (*Section 6.1, Verification of Seal Integrity*)

7. Are seal requisition forms and purchase order forms controlled to prevent easy, unauthorized access to the forms? (*Sections 4.1, Procurement*)

8. Is there a check to verify that the quantity of seals shipped is the same as seals received by the receiving office? By the receiving administrator? (*Section 4.1 Procurement*)

9. Are unused seals stored in a secure storage area? Is access to the storage area controlled? (*Section 4.2 Control*)

10. How is the seals inventory data secured? Can an unauthorized person insert false information into the seals inventory records? (*Section 4.2, Control*)

11. How are seals destroyed? (*Section 5.7, Removing and Disposing of Seals*)

12. Are the number of broken or misapplied seals consistent with an adequate seals control program? (*Section 4.2, Control*)

13. Are all seals discrepancies reconciled? (*Section, 4.2 Control; Section 6.3, Proper Responses*)

14. How are the internal audits of the seal program carried out? How often? (*Section 4.2, Control; Section 7, Reviews, Audits, Surveys, and Inspection of Seals Control Programs*)

15. Are seals custodians familiar with the procedures for handling seals? Are they properly trained and qualified? (*Section 4.2, Control; Section 4.3, Training*)

16. Are procedures for applying, removing, verifying, and destroying complete? Are the procedures followed? (*Section 4.2, Control; Section 5.1, Applying and Removing Seals; Section 5.2, Removing and Disposing of Seals; Section 6.1, Verification of Seal Integrity*)

17. Who is authorized to add names to the authorized list of seals applicators? (*Section 2.4, Seals Program Documentation; Section 4.2, Control*)

18. Are there notification and response procedures established in the event of discovery of a violated seal? (*Section 6.2, Conditions That Require a Response; Section 6.3, Proper Responses*)

APPENDIX E. SEAL SURVEY - TYPES OF SEALS COMMERCIALLY AVAILABLE

(Conducted by Sandia National Laboratories - Albuquerque)

During the last couple of years, efforts have increased in private industry and government facilities to improve existing seal technologies and to come up with new seals that can meet the demands of a changing world. Seal technologies developed at National laboratories for domestic and international needs are being transferred to private industry where they can be better utilized in the manufacturing process. As communication between government facilities and industry increases, some new commercial seal designs are showing up that are easier to apply and more cost effective. DOE facilities that handle nuclear materials use a variety of seals depending on the application and the level of security dictated by the materials being protected. A brief description of some types of seals follows. No specific seal or manufacturer is recommended; inclusion of seals and manufacturers does not imply recommendation or that they are appropriate for safeguarding nuclear material. Sections E.1 through E.6 describe seals that are currently used for nuclear materials. Sections E.7 and E.8 discuss common seals that are not usually associated with nuclear materials. The fiber optic seals in Section E.9 provide a higher-security seal which may see some domestic safeguards use in the future.

E.1 Cup-wire (Type E) Seal

The seal consists of two metal parts that when snapped together form a closed box about the knot or crimp on the wire passing through the hasp. One or both halves of the box are numbered or marked. This seal is commonly used throughout the DOE complex for sealing containers, drums, and other openings.

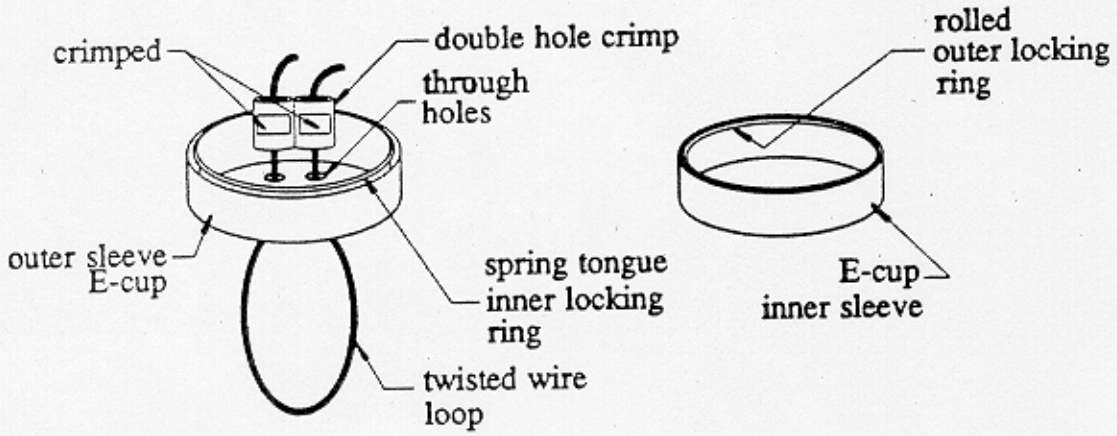
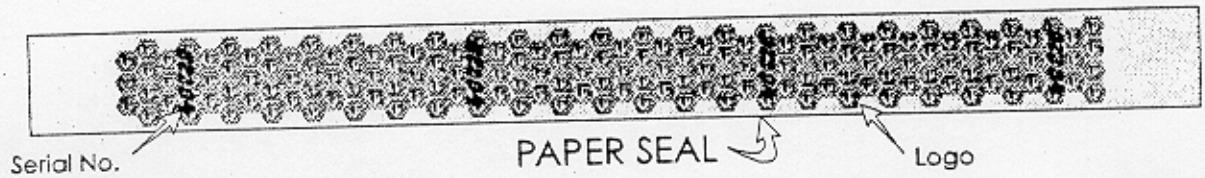


Figure E-1. Cup-Wire (Type E) Seal

E.2 Pressure Sensitive "Adhesive" Seal

Pressure Sensitive Seals used by DOE facilities have either paper, vinyl, or mylar outer coats with an adhesive backing. The majority of DOE facility Pressure Sensitive Seals use acrylic-based adhesives that require a cure time of about 24 hours after application. Adhesive-backed seals can be made of one or more layers of material. Paper and vinyl Pressure Sensitive Seals are single layered. Mylar Pressure Sensitive Seals have a clear outer coat and a colored, metalized inner coat where the logo and serial numbers can be found. After application these seals are difficult to remove without an indication (tearing or delamination) that tampering has occurred. The mylar seal's color coat, to which the adhesive is attached, usually has the word "VOID" throughout the length of the seal body. When removed, the word "VOID" appears on the container surface in its shiny metalized form and the rest of the color coat stretches and develops a satin finish. With attempts to reapply the seal, the stretched color coat will not realign properly and the contrast in the color coat finish is evident. The paper seal is very delicate with a rice paper quality to it. Vinyl seals usually have a cross-cut [+] repeatedly made along the length of the seal body making peeling very difficult without tearing which usually starts at the cross-cuts. These types of seals are commonly used on special nuclear material containers.



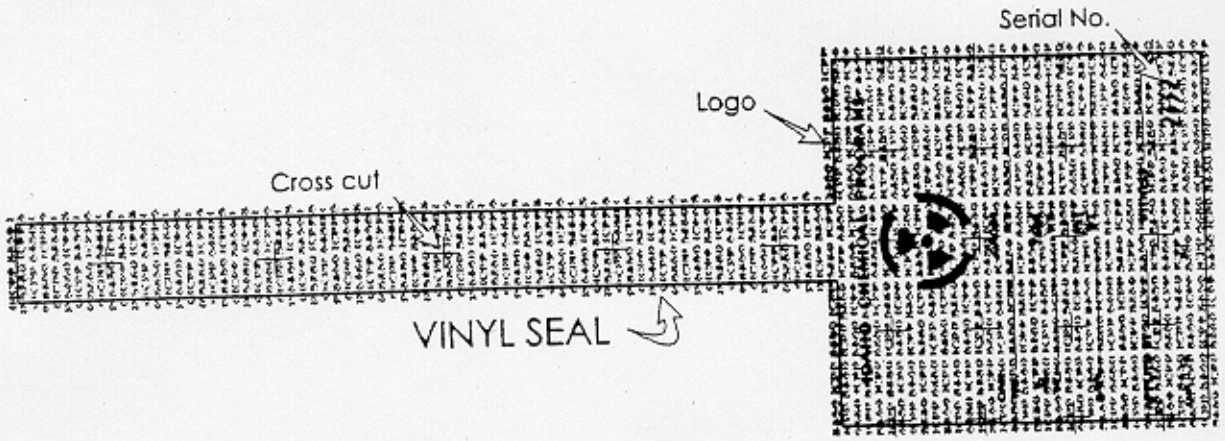


Figure E-2. Pressure Sensitive Seals

E.3 Multi-Lock (DOE #8909412) Seal

The free end of a twisted-wire cable is passed through a hasp and then inserted into a hole in a metal box having spring loaded balls that allow the wire to pass by when initially inserted but bind with attempts to retract the wire. The metal box is usually numbered, but the wire is not.

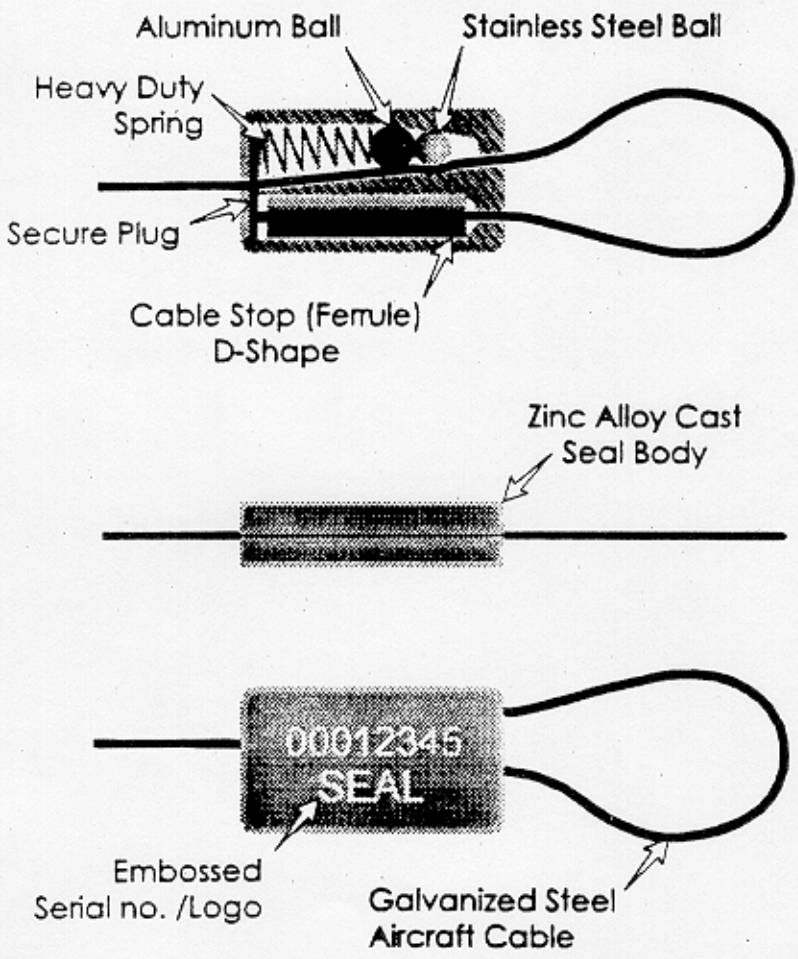


Figure E-3. Wire Lock Seal

E.4 Crimp Cable Seal

The heavy steel cable offers flexibility, strength, and is plated for weather resistance. It fits all types of hasps and should be drawn up tightly for maximum security. The cable can be provided in any length desired. The sleeve is made of a unique combination of alloyed metals and tempered for maximum holding power. It is weather resistant and available in a wide range of colors. The seal assembly requires a massive distortion of material to be locked into place. The special crimping tool is not sold by retail outlets, and the manufacturer will not sell tools to individuals or others who are not using the cable seal. The cable comes with the sleeve point crimped to one end of the cable. The loose end of the cable is passed through the hasp, threaded through the remaining open portion of the sleeve, and crimped twice for maximum strength.

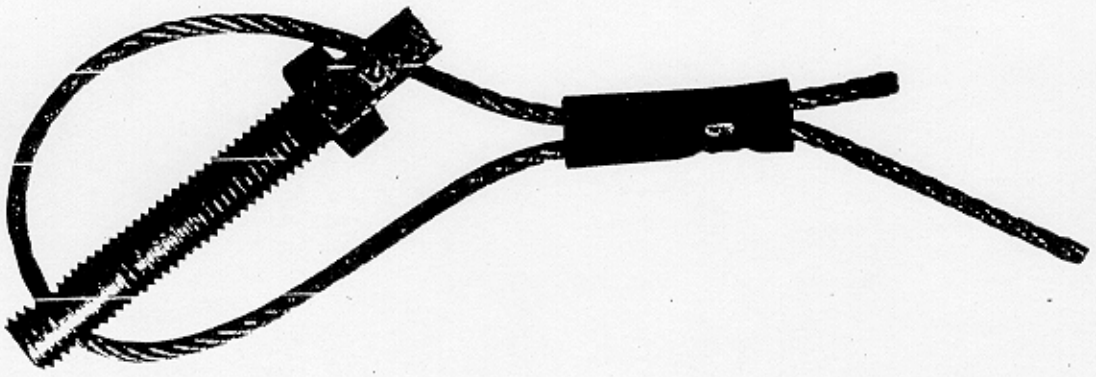


Figure E-4. Cable Seal

E.5 Notched Metal Seal

The seal is a notched metal strip. The strip is either passed through the hasp and bent at the notch or bent around a string or wire. Removing the seal requires bending the metal strip at the notch again; this breaks the seal. The seals can be numbered. Sometimes tools are required to apply these seals.

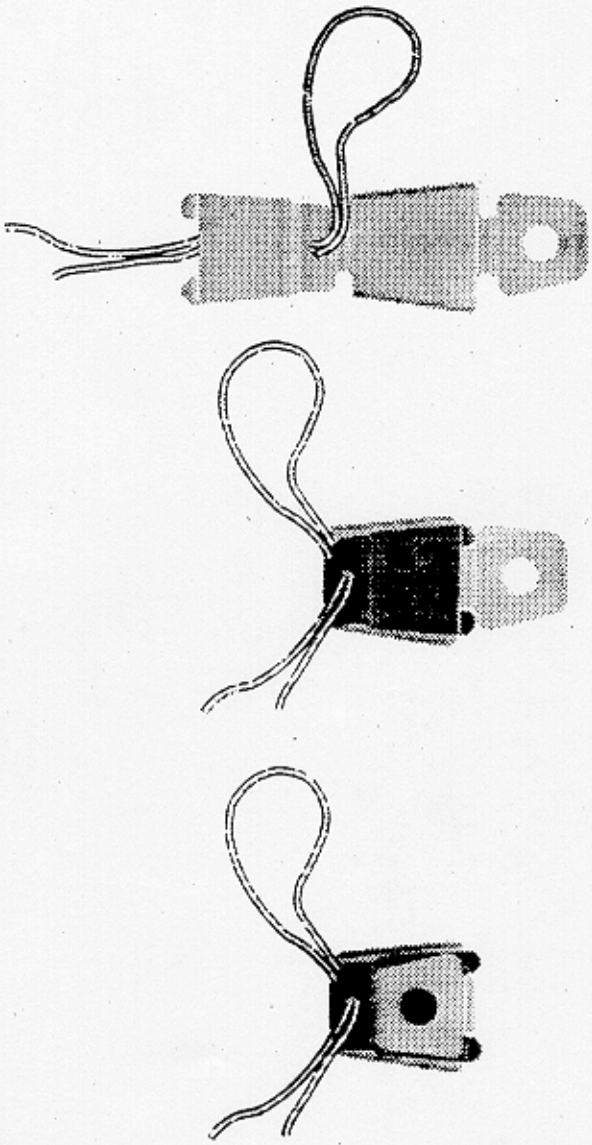


Figure E-5. Notched Metal Seal

E.6 Steel Keyless Padlock Seal

This is a sturdy keyless lock. A U-shaped shackle is passed through the hasp and then inserted into a steel block; expansion rings inside the block fall into grooves in the shackle ends when the shackle is seated properly. Removing this seal requires the use of bolt cutters. The steel block is usually numbered where you normally would find the key hole in the bottom of the body.

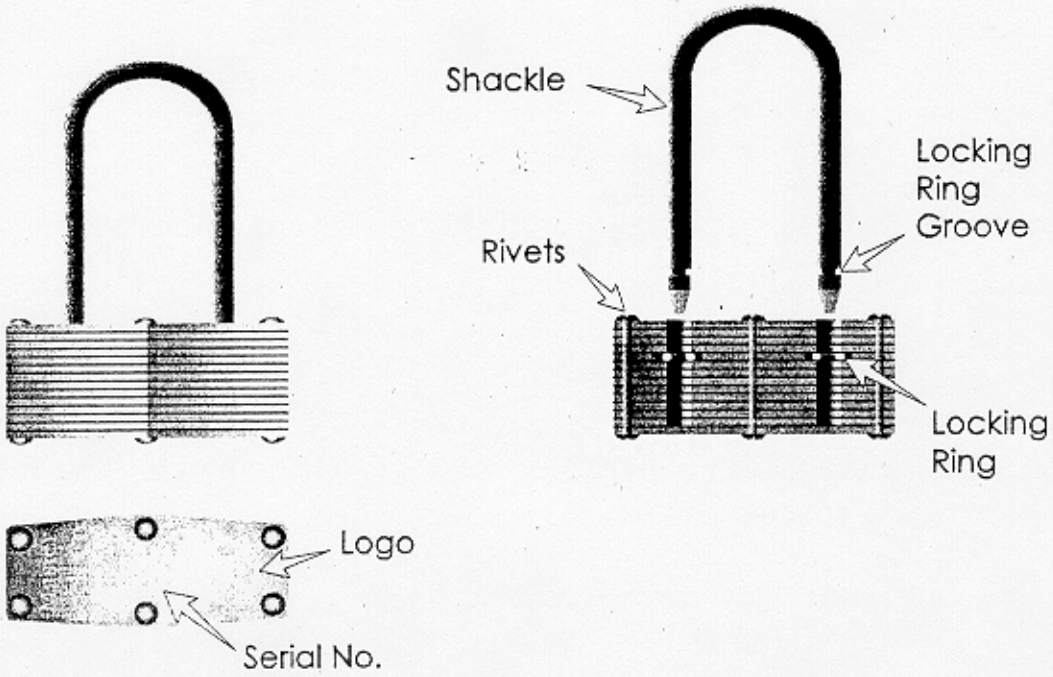


Figure E-6. Keyless Padlock Seal

E.7 Boxcar Seal

The railroad boxcar seal employs a metal or plastic strip, which is passed through the hasp. The ends of the strap are locked together inside a box or ball at the time of closure. Various spring clips and wire catches are used to prevent the ends from separating once they are connected.

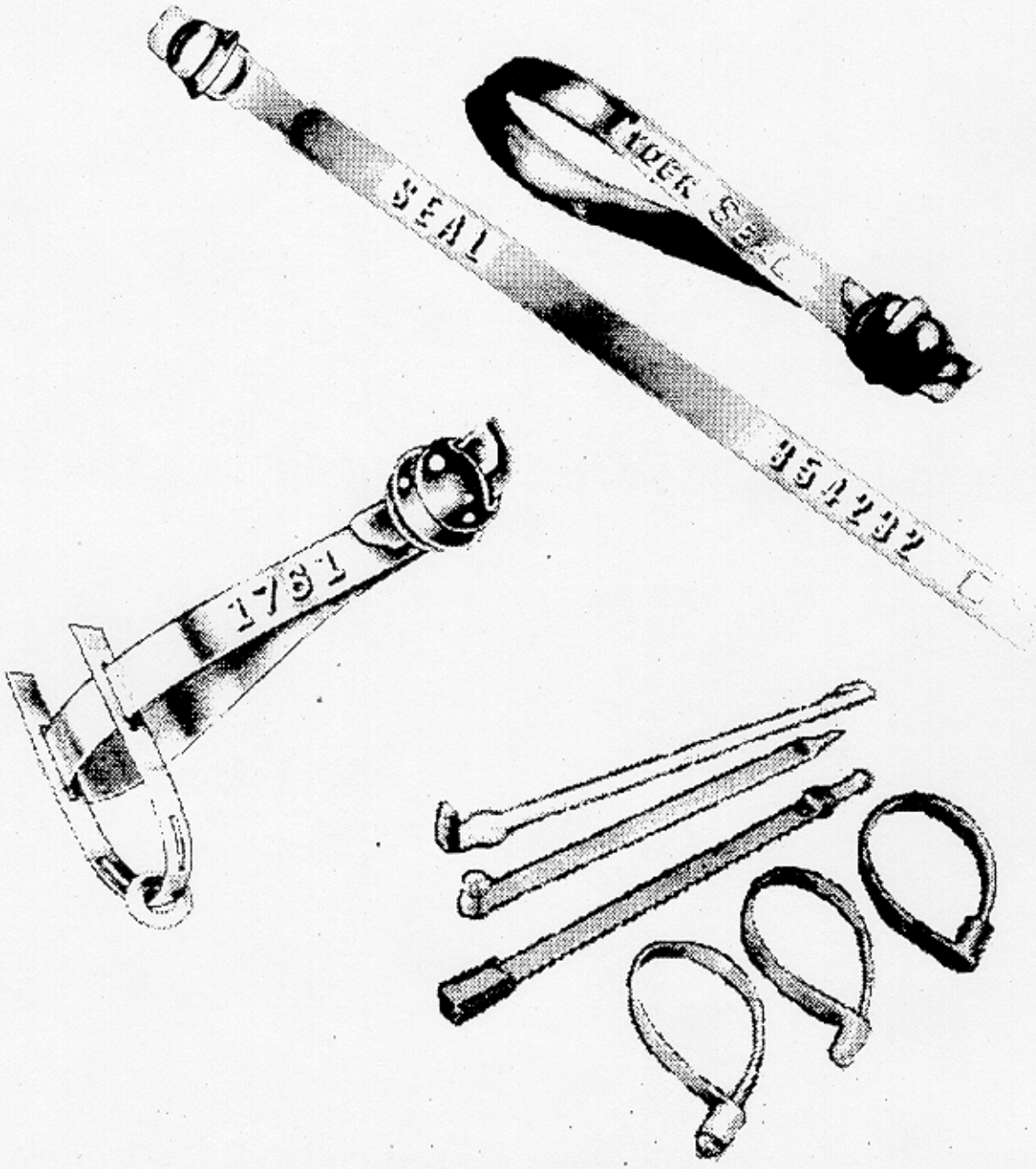


Figure E-7. Boxcar Seal

E.8 Self-Locking Padlock

This seals uses a flexible wire or plastic loop which passes through the hasp or lock on a container and is inserted in a plastic block shaped in such a way so that, once the wire springs into position, it cannot be removed without tearing or deforming the plastic. The plastic block can be numbered, color-coded, and marked with the facility name.

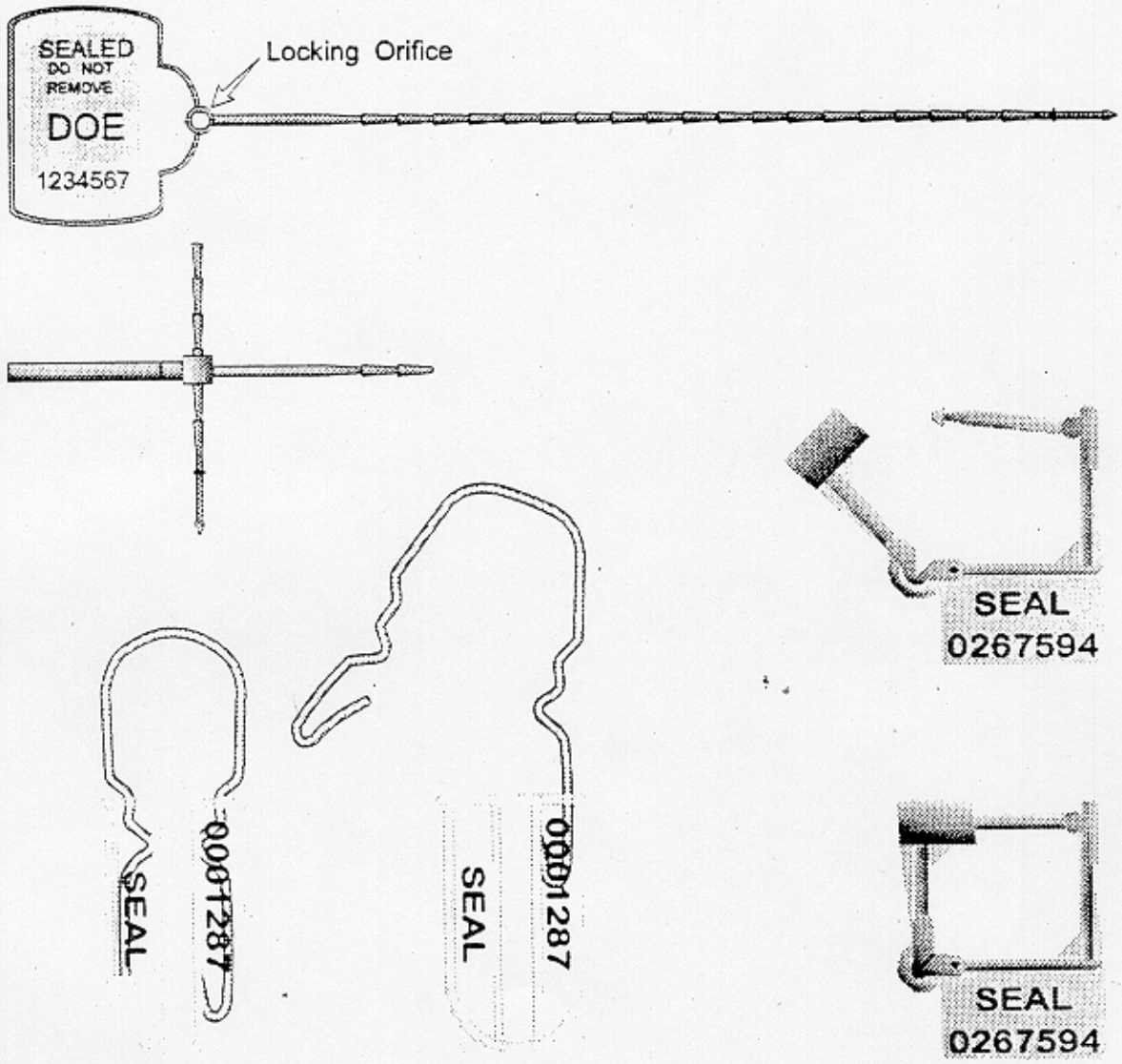
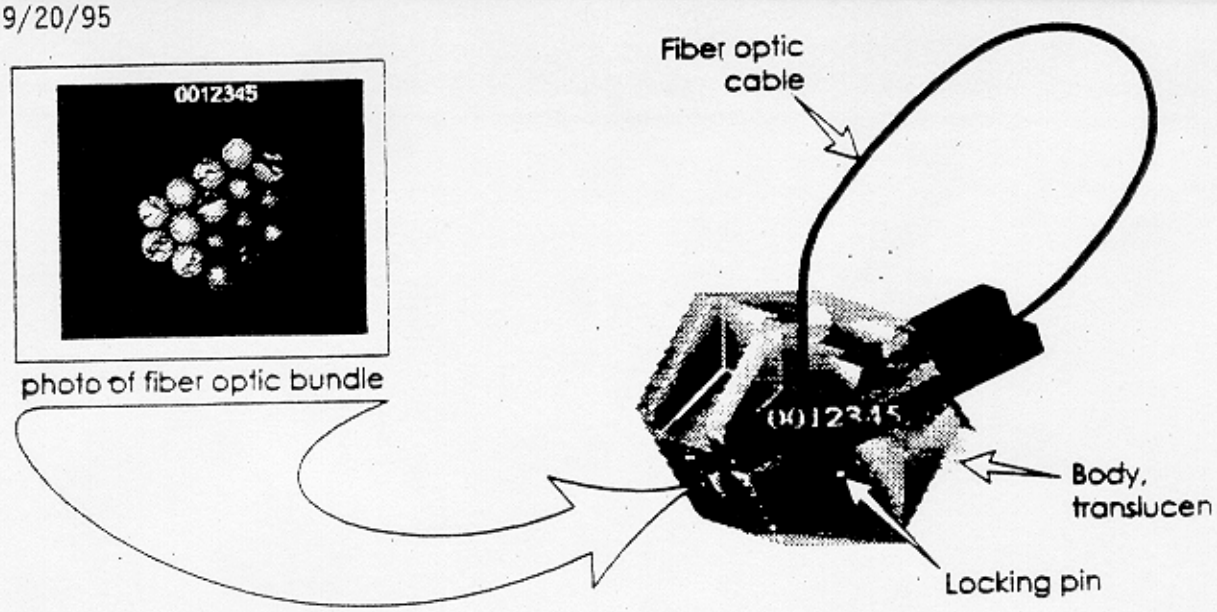


Figure E-8. Self-Locking, Plastic Padlock Seal

E.9 Fiber Optic

A fiber optic sealing system utilizes a fiber optic cable bundle that houses as few as one fiber to as many as 64. The cable usually consists of a durable black polyethylene of PVC jacket covering randomly (more than one fiber) positioned acrylic or glass optical fibers. The cable is secured in a clear or opaque plastic body. A fiber optic seal's integrity can be verified as easily as shining a light through one end and seeing some light through the opposite end. Most often the seal is verified by using a camera system to photograph the fiber bundle's unique pattern at installation and then again during inspection. The bodies can have a serial number and logo on them, located in a way that they can be viewed for inventory purposes and used to verify a seal body associated with a unique bundle pattern in a photograph.



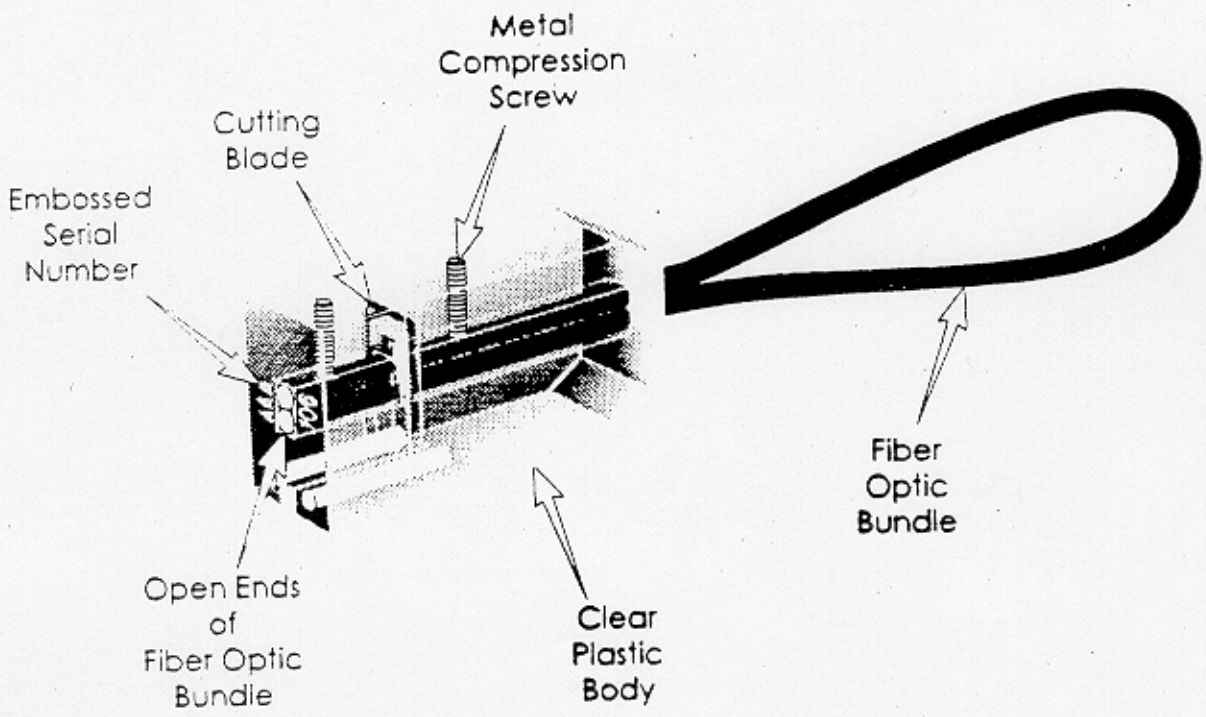


Figure E-9. Fiber Optic Seals

E.10 Seal Manufacturers Addresses and Phone Numbers

Advertape, Inc. (516)286-0100	1189 Montauk Highway P.O. Box Drawer 2160 East Patchogue, NY 11772	Vinyl or Other Adhesive
American Casting & Padlock Mfg. Corp. (516)349-7010	51 Commercial St. Plainview, NY 11803	Plastic, Boxcar, Twist Wire, Cable, Steel Padlock, Snaplock, Type E
Brammal, Inc. (219)665-3176	P.O. Box 208 Angola, Indiana 46737	Cable, Bolt, Boxcar, Twist Wire
E.J. Brooks Co. (201)483-0335	164 N. 13th St. P.O. Box 7070 Newark, NJ 07107	Snaplock, Notched Metal, Plastic Padlock, Boxcar, Fiber Optic, Wire Lock
Decals Inc. (303)425-0510	P.O. Box 208 Wheat Ridge, CO 80034	Vinyl or Other Adhesive
Designer Decal, Inc. (509)535-0267	North 131 Pittsburg Spokane, WA 99202	Vinyl or Other Adhesive
A.C.Gibson Co (716)838-5960	875 Englewood Ave. P.O. Box 89 Buffalo, NY 14223	Boxcar
Porter Safety Seal Co. (312)455-8050	9230 West Grand Ave. Franklin Park, IL	Boxcar, Steel 60131 Padlock, Wire Lock, Plastic Padlock,
Stoffel Seals Corp. (914)353-3800	400 High Avenue Nyack, NY 10960	Plastic Padlock, Notched Metal, Wire Lock, Boxcar
Tapecon Inc. (716)854-1322	701 Seneca St. Buffalo, NY 14210	Vinyl or Other Adhesive
Tyden Seal Co. (616)945-9501	210 N. Industrial Park Rd. Hastings, MI 49058	Boxcar
United Seal Co. (614)443-7633	2002 Fairwood Ave. Columbus, OH 43207	Steel Padlock, Plastic Padlock, Boxcar, Wire Lock
York Tape & Label Co. (717)846-4840	1953 Stanton Street York, PA 17405	Vinyl or Other Adhesive

E.11 Additional Information

Safeguards and security personnel working for DOE or DOE contractors may obtain additional information about the effective use of these seals from Ivan Waddoups at the following address:

Sandia National Laboratories
MS 0759
Albuquerque, NM 87185

APPENDIX F: PHYSICAL SECURITY USES OF SEALS

This guide focuses on the use of seals in the control and accountability of nuclear materials. Seals also play an important role in the physical protection of nuclear materials and other DOE property. Some examples of the physical security uses of seals are:

- to indicate that an ammunition container has not been opened.

- to indicate unauthorized access to security instruments, equipment, or records.

- to indicate that undetected access or egress has not occurred through a physical boundary.

- to verify that an electronically generated alarm was either real or false (e.g., verification that seals on alarmed doors or gates have not been violated.)

- to eliminate the routine inspection of areas that otherwise require physical inspection (e.g. seals on automobile trunks or cargo areas.)

Differences in the Uses of Physical Security Seals and MC&A Seals

Physical security uses of seals usually differ from MC&A uses of seals in the following ways:

- Security seals are often used to protect items of much less value than SNM.

- Security seals are usually checked more frequently than MC&A seals.

- MC&A seals are used in conjunction with a materials surveillance program, while security seals are usually used without a complementary materials surveillance program.

- Physical security seals used on doors or other access points are often used in conjunction with an alarmed sensor such as a motion detector or a balanced magnetic switch.

Because of these differences and because of the varying usages of seals in physical security, the scope and extent of physical security seals programs should be jointly determined by facility management and the cognizant Operations Office. Much of the material in this guide is, however, just as applicable to security seals as to safeguards seals. In particular, the information in Chapters 2, 3, and 4 can be used as a general outline for developing and implementing a security seals program, although some of the control measures can usually be scaled back. Additionally, the information in Appendix E on commercially available seals should be useful in deciding what types of security seals to use.

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APPENDIX G. SEAL FORMS FROM VARIOUS LOCATIONS

TID SEAL ACCOUNTABILITY LOG

TID Seal #	Signature of Recipient	Badge No. Issued To	Location Issued To	Date	Time	Check One: Disassembly	New Receipt	Seal Replacement	*Voided (Broken In Application)

When checking this column, two signatures are required.

				TID APPLICATION AND REMOVAL					No.			
Material I.D.	TID Number	CHECK ONE Applied	Voided/ Removed	LOCATION Building	Room	Gross Weight	Applied/ Removed/Voided By	Witnessed By	Date		Disposition	Di
Date				Authorized Signature								

TID APPLICATION AND REMOVAL

TID SERIAL NUMBER	CONTAINER ID	LOCATION	CHECK ONE		TYPE OF TID	APPLICATOR	WITNESSED BY	DATE
			APPLIED	VOIDED/ REMOVED				

CUSTODIAN SIGNATURE _____ DATE _____

TID VERIFICATION

FOR

SHIPPING & WASTE DRUMS

TID SERIAL NUMBER	DRUM NUMBER	RSWD or SR NUMBER	CHECKED	TID SERIAL NUMBER	DRUM NUMBER	RSWD or SR NUMBER	CHECKED

TID CUSTODIAN _____ _____ DATE _____