



U.S. ATOMIC ENERGY COMMISSION

July 1973

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 5.10

SELECTION AND USE OF PRESSURE-SENSITIVE SEALS ON CONTAINERS FOR ONSITE STORAGE OF SPECIAL NUCLEAR MATERIAL

A. INTRODUCTION

Paragraph 70.22(b) of 10 CFR Part 70, "Special Nuclear Materials," requires that certain applicants for licenses to possess special nuclear material (SNM) provide a full description of their procedures for control of and accounting for the SNM possessed under license, including procedures used in storing said material. Paragraph 70.32(c) requires that licenses authorizing possession of certain quantities of SNM contain and be subject to a condition requiring the licensee to maintain fundamental material controls identified in Part 70 and other material control procedures deemed essential by the Commission for the safeguarding of SNM. Section 70.56 requires licensees to perform, or permit the Commission to perform, tests appropriate or necessary for the administration of the regulations in 10 CFR Part 70, including tests of equipment and devices used in connection with the production, utilization, or storage of SNM.

Pressure-sensitive seals on containers used for onsite storage of SNM are passive devices that indicate, upon inspection, whether tampering or entry has occurred. These seals may also serve as labels. This guide provides criteria acceptable to the Regulatory staff for selecting, affixing, and testing pressure-sensitive seals used for tamper-safing in connection with the onsite storage of SNM for compliance with the Commission's regulations with respect to material control.

B. DISCUSSION

The effective use of pressure-sensitive seals for tamper-safing containers of SNM in onsite storage should consider such basic elements as (1) composition, (2) seal properties, (3) method of affixing, (4) seal control, and (5) quality assurance.

1. **Composition.** The seal is basically a backing on one surface of which is a layer of adhesive covered by a protective liner.

The backing of pressure-sensitive labels or seals is usually made of paper, vinyl film, or plastic-coated paper and may be composed of more than one layer. To provide a consistent degree of adhesion, the adhesive on the backing should be aggressively tacky at room temperature and not require activation by water, solvents, or heat to form a bond to the container to which it is to be applied. Curing adhesives which harden as a result of exposure to air are not recommended because the initial adhesion should be adequate, and further adhesion only increases the difficulty of cleaning old seals from reusable containers.

The surface of the seal should carry a logotype to identify the licensee, and the complete surface of the seal should be covered with a regular and fine design to reveal erasures.

All seals should provide enough space to write by hand the type of material; the composition, weight, and serial number of items; the initials or signature of the person responsible for the statement of content; and the date of application of the seal.

Lettering on the seal, other than the logotype, should be large enough to be easily readable. The writing materials used to record information on the seals should be specified on the basis of qualification tests that establish compatibility with the surface of each type of seal.

2. **Seal Properties.** From the point of view of tamper resistance, the backing, adhesive, and ink of the seal should resist without damage all chemicals normally

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present in the environment where the seal is to be used. For example, paper-base seals in general are sensitive to weather exposure; consequently, seals for exterior use should be made with a plastic base.

Any chemical capable of destroying or softening the adhesive should also destroy either the backing or the ink of the printing. This is particularly true of paper seals with acrylic adhesives that are most likely to tear when mechanical removal is attempted but are very permeable to solvents that attack the adhesive. Since the paper backing is usually not affected by the solvent, the ink used in the printing must be sensitive to such solvents in order to provide indication of tampering.

In general, paper backing on seals provides a surface capable of accepting various inks well because of the ease of wetting of the paper. Conversely, plastic backings, which are useful in applications requiring exposure to weather, tend to repel inks and have poor penetration, thus requiring special inks with surface active agents that ensure proper wetting of most plastics.

The seal backing should have a tear strength sufficiently low to provide an indication of tampering by careful peeling of the seal. The tear strength of the backing can be reduced and the peel force of the adhesive increased to the point where the peel test is satisfied. Another method of preventing peeling without tearing is to provide cross-shaped cuts in the backing.

Seals should be capable of withstanding normal or reasonably abnormal wear in use, without damage that would render the writing illegible or impair the detection of tampering.

3. Method of Affixing. It is important to affix seals properly in order to assure that SNM cannot be removed from a container without destroying either the seal or the container. Surfaces to which seals are to be applied should be clean and smooth. It is recommended that, for sealing cans, the seals be designed so they can be applied completely across the lid, extending at each end beyond the lid onto the body of the container for more than an inch. One such seal might consist of a T-shaped backing; the cross of the tee is the label with boxes for the handwritten information, and the upright of the tee is a tape long enough to extend completely across the lid.

4. Seal Control. Without adequate control of seals, replacement and subsequent duplication of the affixed seal would be more readily possible. There are two simple methods of preventing this type of replacement: strict control of the seal blanks and sequential numbering of the seals. As strict control of the seal blanks is difficult to maintain and verify, sequential numbering is preferred. However, for sequential numbering of seals to be effective, the seal numbers should be included in the record system, and the length of the number sequence should be adequate to prevent

duplication of numbers in use at the facility. Only designated custodians or their alternates should have access to the seals or affix them to containers. The properties of the inks to be used for printing and recording have in common a sensitivity to the solvents that attack the adhesive. Thus seal numbers printed with such inks could be lost if accidentally damaged by solvents. To prevent this loss of identification of the container, the numbers should be printed with solvent-resistant inks or as perforations through the backing.

5. Quality Assurance. The licensee is responsible for demonstrating that the seals have and maintain the required resistance to and indication of tampering. Such a demonstration should include:

- a. A solvent test in which an affixed seal sample is tested with a solvent to determine the effect on the adhesive, backing, and inks.
- b. A peel test in which a tensile tester is used to determine the acceptability of the tear strength.
- c. An erasing test in which rubber erasers and solvents are used to determine if any writing or printing can be erased without a clear indication of erasure.

C. REGULATORY POSITION

An acceptable program using pressure-sensitive seals to assist in assuring that the diversion or theft of SNM from containers in temporary onsite storage has not occurred and also to assist in assuring the validity of previously made measurements should give particular consideration to the composition, seal properties, method of affixing, seal control, and quality assurance.

1. Composition. The composition of a pressure-sensitive seal should include:

- a. A backing or body usually made of paper, vinyl film, or plastic-coated paper;
- b. An adhesive that covers one of the surfaces of the backing and is aggressively tacky at room temperature;
- c. A liner that protects the adhesive and that is removed prior to affixing;
- d. Logotype printing on the surface of the seal identifying the licensee;
- e. A background printing of a fine design covering the complete surface of the seal;
- f. Readable lettering.

2. Seal Properties. The properties of the seal components should be selected so that any attempt to tamper with the seal will be clearly indicated. The following requirements should be included:

- a. The components of the seal should resist without damage all chemicals in the normal environment where the seal is to be used.
- b. Either the backing material or printing inks should yield to chemicals that are capable of compromising the adhesive.

c. The tensile strength of the seal should be sufficiently low that any tampering by peeling will be indicated by tearing or delamination before the joint between the lid and the container is reached.

3. Method of Affixing. The method of affixing seals should include the following requirements:

a. The surfaces to which seals are to be applied should be clean and smooth.

b. A single continuous seal, properly shaped, should be applied across opposite parts of the joint between the lid and the container, and the backing and adhesive should extend at least one inch on each side of the joint over a width of at least one-half inch. The seal should be affixed with sufficient tension to preclude the tilting of the lid allowing access to the contents without damage to the seal.

c. The seals should be applied immediately after the samples and data to identify and measure the contents have been taken.

4. Seal Control. In order to detect replacement or duplication of applied seals, strict control should be maintained over the seals in stock. Seal control should include the following requirements:

a. Seals should be available to and affixed and removed by only designated individuals responsible to material control and accounting management.

b. Seals should be sequentially numbered with sufficient alphanumeric or numeric digits to prevent duplication of numbers in use at that facility.

c. Sequential numbers on seals should be printed with solvent-resistant inks or as perforations through the backing.

d. Precise records of all the seals by number should be kept and should include pertinent data on the seal and data on the contents of the container. Such records should include any discrepancy that is observed in the container content, dates and times of application and removal of the seal, and the signatures of the individuals responsible to material control and accounting management for the data and for affixing and removing the seal.

e. Assurance should be required of the manufacturer that their masters of prenumbered seals and the scrap from fabrication are controlled.

5. Quality Assurance. The licensee should establish a quality assurance program to ensure that the seals conform to the above requirements. The quality assurance program should include qualification tests of seals at each time a new supply of seals is obtained and with existing stocks at intervals no greater than one year. The qualification tests should include a solvent test, a peeling test, and an erasing test. Tests requiring metallic surfaces should use stainless steel test panels; those requiring nonmetallic surfaces should use test panels of the same material as the container on which the seal is to be used. Acceptable test methods are described below:

a. **Solvent Test.** Samples should be prepared by affixing at least one square inch of seal material to a clean test panel of the proper material and rolling the sample with a 4-1/2-lb rubber-covered roller (ASTM Standard D2860-70, "Adhesion of Pressure-Sensitive Tape to Fiberboard at 90-Deg Angle and Constant Stress"¹). Markings should be made on the seal materials with acceptable marking materials. At least five samples of seal material chosen at random from normally available stock should be tested with each solvent in the solvent test. The test panel and the samples adhering thereto should be immersed in the reagents identified and described in ASTM Standard D543-67, "Resistance of Plastics to Chemical Reagents,"² within 5 minutes of application and remain at room temperature for one-half hour.

If for any one sample, the seal material can be slid off the test panel, or if it falls free during or at the end of the period of immersion in any solvent, and if the backing and printing on a sample so removed remain unchanged, the sample and stock should be considered to have failed the test.

b. **Peel Test.** At least five samples of the seal material should be prepared and mounted on a test panel in the same manner as in Pressure Sensitive Tape Council Standard PSTC-5, "Quick Stick,"³ except that the seal material in this test should be rolled with a 4-1/2-lb rubber-covered roller, as identified in C.5.a above, after application. The test panel should be mounted in a jig which is mounted on a tensile tester as per PSTC-5 and the tester started immediately at 0.2 inch per minute. This peel test should be conducted at a temperature of 23 ± 2 degrees Centigrade. If for any sample, as much as one-half inch of seal material can be peeled free without tearing or delamination, the sample and stock should be considered to have failed the test.

c. **Erasing Test.** Where the seal number is not perforated in the backing, at least five samples of the seal material containing the printed seal number should be affixed to a test panel. Rubber erasers and swabs moistened with all of the standard reagents as indicated in the solvent test should be used in attempts to erase the seal number. Each attempt should be limited to five minutes duration. If in any attempt, the printing can be erased without leaving a clearly apparent indication of erasure, the sample and stock should be considered to have failed the test.

¹Copies may be obtained from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

²The specific standard reagents for the solvent test are in paragraphs 4.4.3, 4.4.7, 4.4.8, 4.4.12, 4.4.13, 4.4.15, 4.4.16, 4.4.19, 4.4.21, 4.4.28, 4.4.29, 4.4.31, 4.4.42, 4.4.45, 4.4.48, and 4.4.50 of ASTM Standard D543-67.

³Copies may be obtained from Pressure Sensitive Tape Council, 1201 Waukegan Road, Glenview, Illinois 60025.