PUBLICLY AVAILABLE SPECIFICATION

ISO/PAS 17712

Second edition
2006-07-01

Freight containers — Mechanical seals

Récipients de fret — Joints mécaniques

Reference number
ISO/PAS 17712:2006(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/PAS 17712 was prepared by Technical Committee ISO/TC 104, *Freight Containers*.

This second edition cancels and replaces the first edition (ISO/PAS 17712:2003), which has been technically revised.

Freight containers — Mechanical seals

1 Scope

This Publicly Available Specification establishes uniform procedures for the classification, acceptance and withdrawal of acceptance of mechanical freight container seals. It provides a single source of information on mechanical seals which are acceptable for securing freight containers in international commerce.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 9001, *Quality management systems — Requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
seal
mechanical device marked with a unique identifier, which is externally affixed to the container doors, and designed to evidence tampering or intrusion through the doors of a container and to secure closed the doors of a container

NOTE In addition, depending on its construction, the seal provides varying degrees of resistance to an intentional or unintentional attempt to open it or to enter the freight container through the container doors.

3.2
high security seal
seal constructed and manufactured of material such as metal or metal cable with the intent to delay intrusion

NOTE High security seals generally must be removed with quality bolt cutters or cable cutters. They require inspection to indicate whether tampering has occurred or entry has been attempted.

3.3
security seal
seal constructed and manufactured of material that provides limited resistance to intrusion and requires lightweight tools for removal

NOTE Security seals require inspection to indicate whether tampering has occurred or entry has been attempted.

3.4
indicative seal
seal constructed and manufactured of material that can easily be broken by hand or by using a simple snipping tool or shear

NOTE Indicative seals require inspection to indicate whether tampering has occurred or entry has been attempted.

4 Mechanical seal types and requirements

4.1 Wire seals

Wire seals consist of a length of wire secured in a loop by some type of seizing device.

EXAMPLES Crimp wire, fold wire and cup wire seals.

4.2 Padlock seals

Padlock seals consist of a locking body with a bail attached.

EXAMPLES Wire shackle padlock (metal or plastic body), plastic padlock and keyless padlock seals.

4.3 Strap seals

Strap seals consist of a metal or plastic strap secured in a loop by inserting one end into or through a protected (covered) locking mechanism on the other end.

4.4 Cable seals

Cable seals consist of a cable and a locking mechanism. On a one-piece seal, the locking or seizing mechanism is permanently attached to one end of the cable. A two-piece cable seal has a separate locking mechanism which slips onto the cable or prefabricated cable end.

4.5 Bolt seals

Bolt seals consist of a metal rod, threaded or unthreaded, flexible or rigid, with a formed head, secured with a separate locking mechanism.

4.6 Cinch or pull-up seals

Cinch or pull-up seals are indicative seals consisting of a thin strip of material, serrated or non-serrated, with a locking mechanism attached to one end. The free end is pulled through a hole in the locking mechanism and drawn up to the necessary tightness. Cinch or pull-up type seals may have multiple lock positions. These seals are generally made of synthetic materials such as nylon or plastic. They should not be compared to simple electrical ties.

4.7 Twist seals

Twist seals are made of steel rod or heavy-gauge wire of various diameters, which is inserted through the locking fixture and twisted around itself by use of a special tool.

4.8 Scored seals

Scored seals consist of a metal strip which is scored perpendicular to the length of the strip. The strip is passed through the locking fixture and bent at the score mark. Removal of the seal requires bending at the score mark which results in breakage of the seal.

4.9 Label seals

Label seals are frangible seals consisting of a paper or plastic backing with adhesive. The combination of backing and adhesive are chosen to cause the seal to tear when removal is attempted.

4.10 Barrier seals

Barrier seals are designed to provide a significant barrier to container entry. A barrier seal may, for example, enclose a portion of the inner locking rods on a container. Barrier seals may be designed to be reusable.

5 General requirements and marks

5.1 General

Security and high security seals shall be strong and durable so as to prevent accidental breakage and early deterioration (due to weather conditions, chemical action, etc.).

All classes of seals shall be capable of being affixed easily and quickly and shall be designed and constructed to prevent undetectable tampering under normal usage.

Seals shall be identified by unique marks (such as a logotype) and unique numbers that are readily legible; markings intended for unique identification of the seal shall be considered permanent. All seals shall be uniquely numbered and identified.

Qualifying seals shall be marked or stamped in a readily legible way to identify their classification as indicative ("I"), security ("S"), or high-security ("H") seals. In order to be qualifying, the seal shall (a) meet the appropriate physical parameters in this document, and (b) be manufactured by a firm that is verifiably compliant with Annex A. Any modification of markings shall require obvious irreversible physical, chemical, heat or other damage to or destruction of the seal.

Seals shall be designed and constructed so as not to permit removal or undoing without breaking, or tampering without leaving clear visible evidence.

In the case of reusable devices, the seal number should be carried on the portion designed to be cut off so as to preclude its reuse.

Manufacturers should be able to identify their own products.

5.2 Identification marks

Regulatory authorities and private customers may require identifiers that go beyond the requirements of this document.

Seals intended for use on freight containers moving under customs laws as instruments of international trade shall be separately approved and marked as determined by the relevant customs organization or competent authority.

If the seal is to be purchased and used by customs, the seal or fastening, as appropriate, shall be marked to show that it is a customs seal by application of unique words or markings designated by the appropriate customs organization and a unique identification number.

If the seal is to be used by private industry (i.e. a shipper, manufacturer or carrier), it shall be clearly and legibly marked and uniquely numbered and identified. It may also be marked with a company name or logo.

5.3 Evidence of tampering

Different seal types evidence tampering in different ways. Some examples of this are:

— easy opening of the seal under hand pressure;

— absence of free play / rotation;

— frayed appearance of wire or cable;

— evidence of glue or application of heat;

— blushing / colour change of plastic coating;

— irregular identifiers;

— scratches or nicks adjacent to the locking mechanism;

— deformation of the locking mechanism; and

— apparent rebuilding or substitution of component parts.

6 Testing

6.1 General

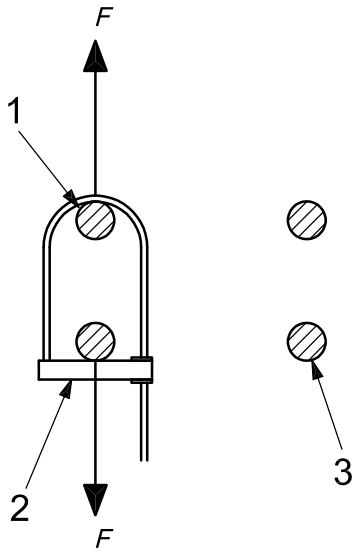
The general type of seal and its configuration shall be used to configure the appropriate test fixture.

6.2 Tensile test

A pull test shall be conducted to determine the strength of a seal's locking mechanism (see Figures 1 through 4). The test fixture shall apply a uniform load to the seal in a manner that simulates reversal of the motion used to lock the seal. The load shall be slowly applied until the seal forcibly opens or is otherwise broken.

The seal shall be classified based on the tensile force recorded at the time of failure of the seal based on the criteria set forth in Table 1.

Dimensions in millimetres



Key

F tensile force

1 pin

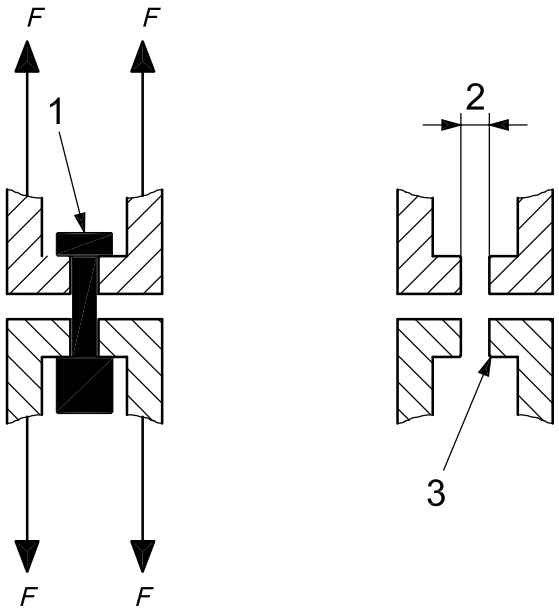
2 seal group 2 (cinch type shown)

3 6,35 ∅ pin $d_{min} < 3{,}18$ [a]
12,7 ∅ pin $d_{min} \geqslant 3{,}18$ [a]

[a] Tolerance allowed on the fixture dimensions is ± 0,254.

Figure 1 — Suggested test apparatus — Tensile test — Wire seals

Dimensions in millimetres



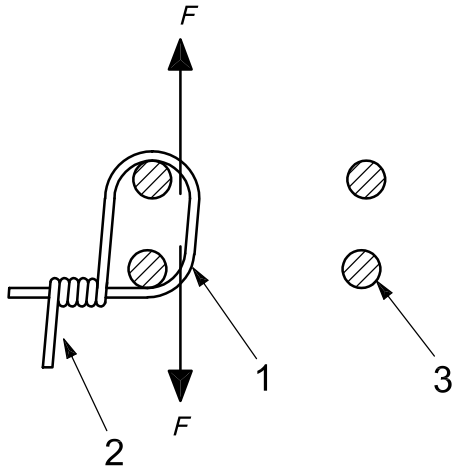
Key

F tensile force
1 seal group 3 (rigid bolt shown)
2 5 % to 10 % larger than cross sectional dimension
3 0,508 × 45° chamfer, typical [a]

[a] Tolerance allowed on the fixture dimensions is ± 0,254.

Figure 2 — Suggested test apparatus — Tensile test — Bolt seals

Dimensions in millimetres



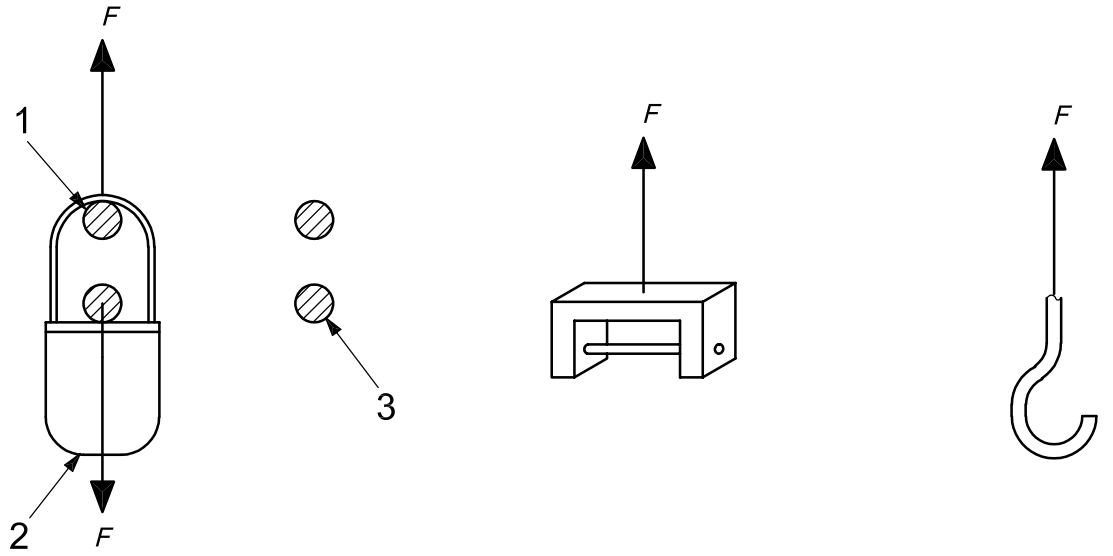
Key

F tensile force
1 pin
2 seal group 4 (twist rod shown)
3 6,35 ∅ pin $d_{min} < 3{,}18$ [a]
12,7 ∅ pin $d_{min} \geqslant 3{,}18$ [a]

[a] Tolerance allowed on the fixture dimensions is ± 0,254.

Figure 3 — Suggested test apparatus — Tensile test — Twist seals

Dimensions in millimetres



Key

F tensile force

1 pin

2 seal group 5 (padlock type shown)

3 6,35 ∅ pin $d_{min} < 3,18$ [a]
12,7 ∅ pin $d_{min} \geqslant 3,18$ [a]

[a] Tolerance allowed on the fixture dimensions is $\pm$ 0,254.

Figure 4 — Suggested test apparatus — Tensile test — Padlock seals

Table 1 — Tensile test seal classification requirements

Load to failure kN [a]	**Seal classification**
10,0	High security seal
2,27	Security seal
< 2,27	Indicative seal

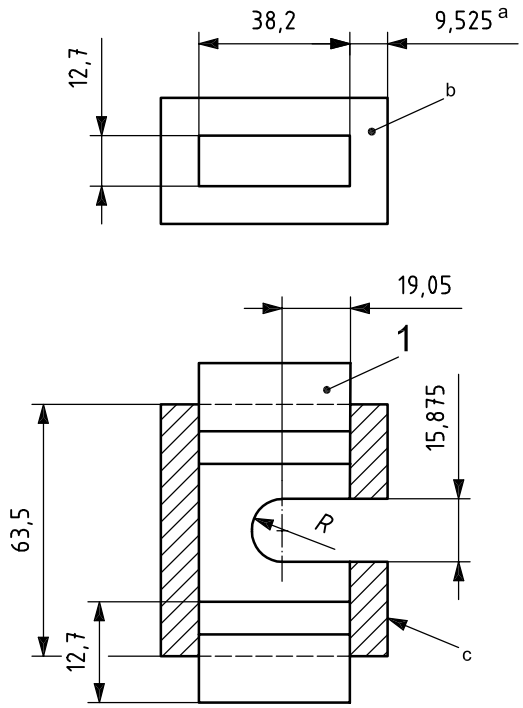
[a] 1 J = 0,737 562 1 ft-lbf
1 N = 0,224 808 9 lbf
1 kg-f = 2,204 585 5 lbf
1 Nm = 0,737 562 1 ft-lbf

6.3 Shear test

A shear test (see Figure 5) shall be conducted to test the ability of a seal to withstand cutting with shearing blades, as might be implemented with bolt cutters. The cutting blades used in the test fixture shall be sufficiently well aligned that seals are cut and not merely deformed as might occur with a thin, flexible seal and misaligned blades. The compressive load shall be applied slowly until the seal is severed.

The seal shall be classified based on the compressive load recorded at the time of failure of the seal based on the loads set forth in Table 2.

Dimensions in millimetres



Key

1 two cutting blades machined from cutter jaws

a Wall type.

b One- or two-piece construction is acceptable.

c Approximate dimensions depend on final ground size of cutting blades.

Figure 5 — Suggested apparatus for conducting shear tests

Table 2 — Shear test seal classification requirements

Load to failure kg-f [a]	**Seal classification**
341	High security seal
227	Security seal
< 227	Indicative seal

a 1 J = 0,737 562 1 ft-lbf
1 N = 0,224 808 9 lbf
1 kg-f = 2,204 585 5 lbf
1 Nm = 0,737 562 1 ft-lbf

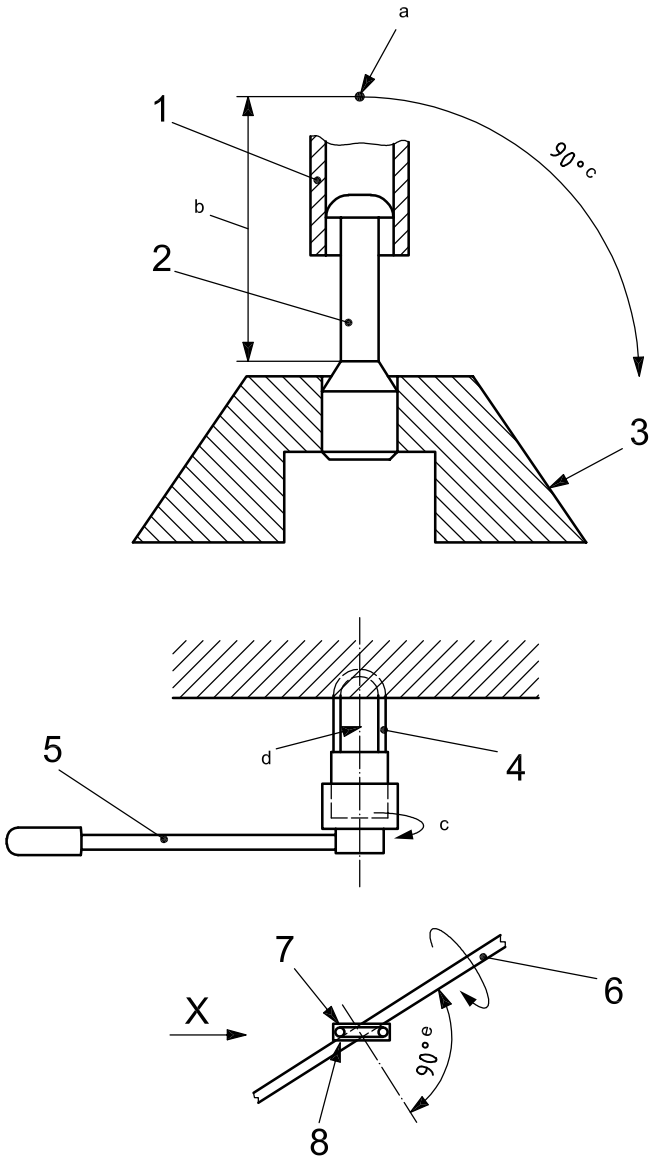
6.4 Bending tests

The bending test is conducted to determine the resistance of a seal to failure under bending loads. How the test is run shall be based on the sub-classification of the seal as either flexible or rigid. Flexible seals shall be tested for their ability to resist repeated bending cycles without failure. Rigid seals shall be tested to determine their resistance to deformation by bending.

For flexible seals, fix the locking end and flex the material adjacent to this fixed end repeatedly through an arc of 180° until failure. Record the number of cycles through this 180° arch. The classification of the seal shall be based on the number of cycles shown in Table 3.

For single-shaft rigid seals, fix the locking end and then fit a tube or other suitable lever over the remaining portion of the seal. Apply a load on the lever so as to bend the seal 90°. Record the load required to bend the seal and the distance above the fixed end of the seal (the moment arm) that the load is applied. The classification of the seal shall be based on the maximum bending moment recorded as shown in Table 3.

For rigid seals with two shafts such as in a padlock, fix the locking end and then fit a bar or rod through the opening between the two shafts. Rotate the rod or bar until it is in contact with both shafts. Continue to rotate the bar in the same direction an additional 90°. Record the torsional force needed to achieve the 90° rotation or to cause failure of the locking mechanism if that occurs prior to achieving the 90° rotation. The classification of the seal shall be based on the maximum bending moment recorded as shown in Table 3.



Key

1 tube (seal holder)
2 seal
3 holding device vise or similar object (fixture)
4 shackle gripped in vise or similar fixture
5 torque wrench
6 bar for load application (shown in rest position)
7 shackle of steel
8 body of seal (fixed in vise)

a Point of applied load.
b Moment arm.
c Apply torsional load about centreline of seal.
d Centerline of seal.
e 90° motion, first step. Return to rest, second stop.

Figure 6 — Suggested apparatus for conducting bending tests

Table 3 — Bending test seal classification requirements

Cycles to failure (flexible seals)	Bending moment to failure (rigid seals) Nm [a]	Seal classification
501	50	High security seal
251	22	Security seal
< 251	< 22	Indicative seal

[a] 1 Nm = 0,737 562 1 ft-lbf

6.5 Impact test

The impact test shall be conducted to determine the resistance of the seal to an impact load at 18 °C and −27 °C. The test fixture shall be devised so the impact load is applied at the locking mechanism of the seal in the direction opposite the direction used in locking the seal. Using apparatus similar to that employed in the tensile test, adding a provision for applying impact loads to the hardware requirements. The impact load shall be applied five times at a load equivalent to 13,56 J. Subsequent impact test sequences shall be run at a load that is 13,56 J higher than the previous five impact loads. Impacts shall be run until the seal fails or successfully withstands five impacts at 40,68 J. A second seal shall be tested at the second temperature.

If the seal fails prior to completion of the five impact cycles, it shall be classed based on the next lower set of values. The value at which the seal fails shall be recorded and used to determine the seal's classification. The values set forth in Table 4 shall be the basis for this determination.

Table 4 — Impact tests seal classification requirements

Low temperature impact load J [a]	High temperature impact load J [a]	Seal classification
40,68	40,68	High security seal
27,12	27,12	Security seal
< 27,12	< 27,12	Indicative seal

[a] 1 J = 0,737 562 1 ft-lbf
1 N = 0,224 808 9 lbf
1 kg-f = 2,204 585 5 lbf
1 Nm = 0,737 562 1 ft-lbf

7 Test report

The test report shall, at a minimum, contain the following information:

a) identification/description of the test specimen;

b) reference to this Publicly Available Specification (ISO/PAS 17712:2006);

c) results of the test: (a)..., (b)..., as specified in the individual tests;

d) (conditioning, pre-treatment, etc.);

e) temperature and the relative humidity in the test room throughout the test;

f) details of the supply and monitoring equipment and the response criteria; and

g) details of any deviation from this Publicly Available Specification or from the international standards to which reference is made, and details of any operations regarded as optional.

Annex A
(normative)

Seal manufacturers' best practices

A.1 Structure of this annex

The structure of this annex reflects the six stages in the table. Since this annex is about the best practices of seal manufacturers, the focus within each stage is on the actions within the purview of a seal manufacturer.

Table A.1 — Six stages in the life of a freight container seal

Stage number	Stage name	Role of seal manufacturers
1	**Design processes**	Total responsibility
2	**Manufacturers' best practices**	Total responsibility
3	**Distributor and reseller best practices**	Shall set standards and expectations of distributors and re-sellers. Shall help educate distributors and re-sellers.
4	**User knowledge and discipline**	Shall help educate users in the care of seals prior to their application to containers, trailers or other receptacles. Shall help educate users in correct use of seals.
5	**In-transit management**	May help users and regulators educate supply chain personnel.
6	**After-life**	Total responsibility for maintaining data on seal production, sales and ID numbers. Shall help educate distributors and re-sellers about maintaining historical data on their seal inventories and sales. Have no role in maintaining chain-of-custody information on completed cargo shipments.

A.2 Stage I — Design processes

Seal manufacturers shall design and classify relevant seal products in accordance with this Publicly Available Specification or its successor International Standard. It establishes uniform procedures for classification of mechanical seals for freight containers. The specification defines physical parameters for different levels of a seal's physical performance: indicative seals, security seals and high security seals.

Although the Publicly Available Specification is designed for marine containers, seals that conform to it are suitable for other applications, such as bulk railcars or truck trailers used in cross-border and domestic operations.

Manufacturers shall endeavour to "design in" effective tamper resistance and tamper evidence for all their seal products.

A.3 Stage II — Manufacturers' best practices

This clause describes the best practices to be applied by seal manufacturers during Stage II of the seal life cycle. As with the other stages, not every point applies in every situation. If a manufacturer elects not to apply a point because it does not apply to a particular facility, then the manufacturer documents the rationale for this action and keeps it on file for review by certification and regulatory authorities.

A.3.1 Seal manufacturers' certification

Manufacturer shall maintain ISO 9001 or equivalent certification on all company-owned manufacturing facilities.

Manufacturer shall purchase contract production services for market-ready seal products from ISO 9001 (or equivalent) certified plants.

If a manufacturer's facility or outside production facility for market-ready seal products loses its ISO 9001 or equivalent certification, notification shall be sent to the appropriate customs administrations if de-certification impacts the use of that company's specific product in international trade.

The best practices referenced herein shall be implemented in accordance with this document.

Manufacturer shall agree to random and unannounced inspections of facilities and documentation for conformance with this document; inspections shall be performed by appropriate certification bodies. The "certification bodies" shall be governmental agencies or accredited independent organizations. Nothing in this document implies that industry certifying or regulatory bodies would reveal trade secrets or proprietary information among competitors.

Manufacturer shall agree to conduct an initial security risk assessment of its facilities, periodic update reviews, and implement countermeasures and/or policies to overcome potential vulnerabilities or threats.

Manufacturer shall assign responsibility for security and product integrity to knowledgeable individual(s), with a principal point of contact.

Manufacturer shall agree to cooperate with relevant law enforcement officials.

Manufacturer shall cooperate with regulatory or certification bodies in responding to questions or issues regarding compliance, irregularities, copying, etc.

Manufacturer shall develop and maintain a crisis management strategy to prepare for and respond to tampering and other malicious, criminal or terrorist actions; the strategy shall provide guidelines to segregating and securing affected product.

Manufacturer shall promote seal security awareness among all staff. Security awareness includes identification of who in management should be alerted about potential security problems (24-hour contacts).

Manufacturer shall require background checks on all employees to the extent allowed under local law or regulation.

A.3.2 Seal product certification

Manufacturer shall agree to submit all relevant products to a testing laboratory to insure the product complies with ISO/PAS 17712 or its successor International Standard on an annual basis. The testing lab shall be certified according to ISO/IEC 17025.

Manufacturer shall mark seals with its company identity.

Manufacturer shall produce seals with unique numbers and identifiers. Manufacturer shall not re-use or duplicate these unique seal numbers or identifiers unless authorized by the bona fide user for the specific seal application.

Manufacturer shall track seal numbers and identifiers of all seals it produces or has produced for it, and so as to identify any potential duplication of identifiers. Manufacturers shall track, by seal type, number and identifier, date of finished production, date of order, date seals were shipped, and names of consignee(s). Manufacturer shall retain this information for a period of at least seven (7) years in a manner that makes it readily available upon request by a regulatory or certification body.

Manufacturer shall restrict the distribution of custom-designed seal application and/or removal tools to facilities authorized by the bona fide user.

Manufacturer shall segregate and render non-functional any incidental production of scrap seal product before disposal.

Manufacturer shall control access to production and storage areas, and loading docks, and store seals in secure areas.

Manufacturer shall lock all loaded trailers or containers on the premises.

Manufacturer shall "inspect what it expects," by verifying driver identification, if applicable, and verifying the load and count of inbound seal components.

Manufacturer shall implement a policy for off-hour deliveries to ensure prior notice of these deliveries. The policy shall require the presence of an authorized individual to receive these shipments. Advance notification, by phone, fax, or e-mail, should be required from all vendors/suppliers for incoming deliveries.

A.4 Stage III — Distributor and reseller best practices

Sales organizations such as distributors or resellers can enhance or undermine even the best manufacturer's security program. The manufacturer shall help educate their distributors and resellers about the importance, mutual advantage and specifics of effective seal security programs.

The manufacturer shall also set standards and undertake to ensure that their distributors and resellers comply with the following security guidelines.

Distributor/reseller shall permit manufacturer to review its security procedures.

Manufacturer, if it becomes aware of a gap in distributor/reseller security practices, shall identify that gap and recommend needed changes that will provide seals with the necessary oversight and accountability.

Distributor/reseller shall not sell seals without the manufacturer's identity marked on the seal.

Distributor/reseller shall record all aspects of a seal shipment, including source, seal numbers and identifiers, description and the name and address of the individual placing the order and the consignee for the order. Distributor/reseller shall agree to retain such records for a period of at least seven (7) years. Upon request from a government regulatory agency, the distributor/reseller will make the necessary records available to assist the agency in the investigation of a cargo shipment incident.

Distributor/reseller shall restrict the distribution of custom-designed seal application and/or removal tools to facilities authorized by the bona fide user.

Distributor/reseller shall conduct an initial security risk assessment of its facilities and implement countermeasures and/or policies to overcome potential vulnerabilities or threats.

Distributor/reseller shall control access to storage areas and loading docks, and store seals in secure areas.

Distributor/reseller shall lock all loaded trailers or containers on the premises.

Distributor/reseller shall "inspect what it expects," by verifying driver identification, if applicable, and verifying the load and count of inbound seal components.

Distributor/reseller shall implement a policy for off-hour deliveries to ensure prior notice of these deliveries. The policy shall require the presence of an authorized individual to receive these shipments. Advance notification, by phone, fax or e-mail, should be required from all vendors/suppliers for incoming deliveries.

A.5 Stage IV — User knowledge and discipline

This stage focuses upon the best practices of bona fide users, including government agencies, such as customs administrations that might apply seals to a container shipment. The influence and responsibility of seal manufacturers are limited to education. Best practice, in this instance, can be enhanced by the seal manufacturers through the inclusion of educational information about seals on product cartons, product literature, the Internet, and on-site training when appropriate.

Manufacturers shall help educate users in the importance of proper control of and record-keeping about seals prior to their application and use.

Manufacturers shall help educate users in correct and most effective use of seals, including conformance with applicable standards and regulations.

A.6 Stage V — In-transit management

Chain-of-custody of an in-transit shipment falls well beyond the responsibility of the seal manufacturer. However, manufacturers may help users and regulators educate supply chain personnel.

This help involves the application of chain-of-custody principles. Such principles may include assuring that the seal is the right type, that its number has been documented and verified, that its application is correct, and that an audit trail is established. In addition, the principles may include a seal anomaly policy, such as procedures to follow if tampering is noted during a shipment.

A.7 Stage VI — Post shipment chain of custody (Seal after-life)

Most of the post-shipment stage in the life cycle of a seal relates to maintaining chain-of-custody information about the shipment of goods. Seal manufacturers have no role in maintaining chain-of-custody information on completed cargo shipments.

Manufacturers' responsibilities and best practices relate to data about the seals themselves. These responsibilities and practices are covered in Stages II, III and, to a lesser extent, IV. Manufacturers retain:

— Total responsibility for maintaining the manufacturer's data on seal production, sales, and unique numbers and identifiers; and

— Responsibility to educate distributors and re-sellers about maintaining historical data on their seal inventories and sales, and to educate users about maintaining historical data on their seal inventories.

ICS 58.180.10

Price based on 14 pages