TECHNICAL REPORT

ISO TR 15070

First edition
1996-08-15

Series 1 freight containers — Rationale for structural test criteria

Conteneurs de la série 1 — Fondements des critères de résistance

Reference number
ISO/TR 15070:1996(E)

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Printed in Switzerland

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.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 15070, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 104, *Freight containers,* Subcommittee SC 1, *General purpose containers.*

Introduction

The tests specified in ISO 1496, relative to the ISO series 1 container, were established in the earliest days of the development of containerization in the 1960s. They have proved appropriate ever since and are quoted extensively in subsequent standards. In particular, the development of European Standards (EN) for swap bodies relies on the quality of the work of ISO/TC 104, the Technical Committee charged by ISO with the development and the maintenance of standards for freight containers.

At publication of this Technical Report, there are nearly 8,4 million twenty-foot equivalent units (TEU) of containers in free circulation in the world.

ISO/TC 104 is concerned that all who operate ISO containers are aware of the principles which govern the tests included in ISO 1496.

These principles were established in the early stages of the standards' development by engineers who are now retiring or have already retired.

This Technical Report has been prepared for use as a concise reference. Included, in annex A, is a reference list detailing the source documents, some 30 years old, where the avid reader will find additional information.

ISO/TC 104/SC 1/WG 1 has issued this Technical Report retaining the tests concerning ISO series 1 containers as described in ISO 1496-1.

It is intended that this Technical Report be updated and completed to include the tests for other general purpose containers and specific purpose containers as specifed in ISO 1496-2, in ISO 1496-3, in ISO 1496-4 and in ISO 1496-5, which may, because of the nature and utilisation of these containers, be different in some respects.

Series 1 freight containers — Rationale for structural test criteria

1 Scope

This Technical Report gives the rationale for the structural test criteria for ISO series 1 freight containers, based on the tests specified in ISO 1496-1.

2 References

ISO 1161:1984, *Series 1 freight containers — Corner fittings — Specification.*

ISO 1496-1:1990, *Series 1 freight containers — Specification and testing — Part 1: General cargo containers for general purposes.*

ISO 1496-2:1996, *Series 1 freight containers — Specification and testing — Part 2: Thermal containers.*

ISO 1496-3:1995, *Series 1 freight containers — Specification and testing — Part 3: Tank containers for liquids, gases and pressurized dry bulk.*

ISO 1496-4:1991, *Series 1 freight containers — Specification and testing — Part 4: Non-pressurized containers for dry bulk.*

ISO 1496-5:1991, *Series 1 freight containers — Specification and testing — Part 5: Platform and platform-based containers.*

ISO 3874:1988, *Series 1 freight containers — Handling and securing.*

3 Explanatory notes on test procedures

3.1 General

The test procedures and tests specified in ISO 1496-1:

a) concern IAAA, IAA, IA, IBBB, IBB, IB, ICC, IC and 1D containers;

b) are based on the assumption that all containers are stowed longitudinally and lashed athwartship;

c) are intended to demonstrate:

1) the ability of a container to withstand, without failure of any kind during its service life, the loads encountered under the dynamic and normal operating conditions of various forms of intermodal transportation;

2) the operational interchangeability of containers;

d) shall be carried out on all new containers intended for international use (see 3.3.1);

e) are intended to simulate the dynamic stresses exerted on containers during the various modes of transportation employed in use. For reasons of reproduciblity and ease of handling, all tests are carried out in the static mode. They shall be carried out individually, at the frequency detailed in ISO 1496-1, and independently from each other (see.3.3.2).

3.2 Test loads

The test criteria, in particular for maximum gross mass, *R*, are the recommended minimum for testing and the maximum allowable for operation.

3.3 Remarks

3.3.1 The actual design specification of the containers shall include the capability to withstand these loads. The ISO test loads include a safety factor to account for fatigue, corrosion and damage to which the container may be subjected during its expected operational life.

3.3.2 The test loads are based on the assumption that there is no synergistic combination of dynamic forces due to handling or the effects of any transportation mode.

3.3.3 Attention needs to be paid to the order of tests only when so noted in the standard specific to each type of container.

3.3.4 All the tests assume a homogeneous cargo and an even weight distribution. Particularly dense cargoes may cause concentrated loads. This should be borne in mind when stowing and lashing the cargoes.

4 Tests

4.1 Test No. 1 – Stacking

4.1.1 General

This test is carried out to prove the ability of a fully loaded container to support a superimposed mass of containers, taking into account the conditions aboard ships at sea and the relative eccentricities between superimposed containers.

4.1.2 Purpose and requirements

4.1.2.1 History and evolution

In the initial version of ISO 1496-1 the test was conducted to prove the ability of a container to withstand five superimposed containers of the same dimensions, each with a load of 1,8*R*.

4.1.2.1.1 Load eccentricities

The eccentricity requirements are based on the fact that a minimum of play is needed to allow for proper operation of the containers when being lowered in or lifted out of the ship's cell guides.

The maximum values of the eccentricity as required by the test procedure are:

laterally: 25,4 mm, i.e. 1 in;

longitudinally: 38 mm, i.e. 1,5 in.

The actual in-service values are derived from the data in table 1.

Table 1

Characteristics	Dimension	Nominal length of container	
		20 ft	40 ft
Usual cell guide dimensions of container ships	Width	2 460 mm	2 460 mm
	Length	6 091 mm	12 234 mm
Container dimensions and tolerances	Width	2 438 mm $^{0}_{-5}$ mm	2 438 mm $^{0}_{-5}$ mm
	Length	6 058 mm $^{0}_{-6}$ mm	12 192 mm $^{0}_{-10}$ mm
Container dimensions at mean construction tolerances	Width	2 435,5 mm	2 435,5 mm
	Length	6 055 mm	12 187 mm
Actual play for containers at mean construction tolerances	Width	24,5 mm [1]	24,5 mm [1]
	Length	36 mm [2]	47 mm [3]

1) In general, the actual play is close to this value.

2) In general, the actual play is less than this value.

3) In general, the actual play is greater than this value (see 4.1.3.1).

4.1.2.1.2 Conditions on board ship

According to studies made in 1964 and the acceleration measured on board ships under the worst sea and wind conditions (Beaufort 11), a load factor of 1,8 represents an average which is perfectly adapted to the requirements for container testing. Subsequent studies have shown the continued validity of this value despite evolving vessel design, regardless of its capacity[2].

4.1.2.2 Current practice in testing

In order to promote uniform end-frame design for containers of 40 ft, 30 ft and 20 ft nominal capacity and considering the current operations with such containers in a nine-high stack aboard ship, a stacking load based on eight containers, superimposed on a ninth, each loaded to 24 000 kg, was adopted in ISO 1496-1:1990. This decision led to the adoption of a corner-post stacking test load of 86 400 kg regardless of container dimensions (see ISO 1496-1:1990, note in table 3).

The total load on the bottom container is equal to 24 000 N $\times$ 9,81 $\times$ 8 $\times$ 1,8 = 3 390 kN. The force on each end is thus 1 695 kN, and the total load for this test is 24 000 $\times$ 8 = 192 000 kg.

4.1.2.3 Operation

Observations of actual operating conditions show that the average actual gross mass of 40 ft and 20 ft containers stowed aboard ship rarely reaches the average value of 24 000 kg. Furthermore, for stability requirements of the ship, lighter containers are stowed in the upper levels. Therefore an average value of 24 000 kg represents a maximum that is never reached in normal situations.

4.1.3 Possible changes for future needs

4.1.3.1 Load eccentricities

— The load eccentricities are sufficient to cover the actual eccentricity of 20 ft containers when stacked in 20 ft cells;

— Although the data in 4.1.2.1.1 indicate that the load eccentricities are not sufficient to cover the actual eccentricity of 40 ft containers when stacked in 40 ft cells, practical experience has shown that this is not a problem.

4.1.3.2 Forces applied during stacking test

Although there is a tendency to increase the value of the maximum gross mass for 20 ft containers, there is no need to change the present test requirements because

— the average actual gross mass will in practice be less than the permissible maximum;

— the actual gross mass of containers has not so far been limited due to road regulations;

— acceleration values of 1,8*g* are still considered a valid upper limit by shipbuilders. Containers tested for this acceleration value can be stacked on new-generation container vessels which have higher stacking capability but whose overall dimensions limit in-service vertical acceleration to below 1,8*g*.

4.2 Test No. 2 — Lifting from the four top corner fittings

4.2.1 General

This test is carried out to prove the ability of a container, whether in a loaded or empty condition, to withstand being lifted vertically using its top corner fittings. It demonstrates the lifting capability not only of the top frame but also of the entire container frame and floor structure of the container.

4.2.2 Purpose and requirements

4.2.2.1 History and evolution

The test conditions, unchanged since the publication of the original requirements[4][7], are the following:

a) the container is loaded to a combined tare and payload mass equal to 2*R*;

b) lifting is accomplished via twistlocks or other fittings engaging the four top corner fittings;

c) the direction of application of the lifting force is vertical, except for 10 ft containers;

d) in the case of a 10 ft container being lifted by use of slings connected to a single point above the top of the container, the direction of application of the lifting force is at least 60° above the horizontal;

e) the minimum acceleration or deceleration in lifting should be applied;

f) the base of the container is free to deflect;

g) the container is suspended for at least 5 min.

4.2.2.2 Current practice

Generally, containers are lifted vertically using the methods described in 4.2.2.1.

4.2.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1.

4.2.2.2.2 Construction

The use of separate corner castings welded to posts and rails has remained constant and standard in the industry. The use of fittings or apertures complying with the design requirements of ISO 1161, but integral to the post, is also acceptable.

4.2.2.3 Operations

Vertical lifting through the upper apertures of the four top corner fittings is the preferred method of lifting containers. As far as is known, no problems concerning vertical top lifting have been reported to ISO/TC 104. Moreover, tests conducted on forces imposed on containers during crane operation show maximum acceleration values that remain within the present ISO test criteria[12].

4.2.3 Possible changes for future needs

The current test is quite satisfactory, provided the container is lifted cleanly and vertically by all four corner fittings. If the vertical load on any corner fitting exceeds 150 kN, resulting from an increase in maximum gross mass above 30 480 kg or from other operational changes, the design, construction and test requirements must be reviewed.

4.3 Test No. 3 — Lifting from the four bottom corner fittings

4.3.1 General

This test is carried out to prove the ability of a container, whether in a loaded or empty condition, to withstand being lifted using the bottom corner fittings, in accordance with ISO 1161,.via slings which transmit the lifting force from the bottom corner fittings obliquely to a single transverse spreader beam.

4.3.2 Purpose and requirements

4.3.2.1 History and evolution

The test conditions, unchanged since the publication of the original requirements[4][7], are the following:

a) the container is loaded to a combined tare and payload mass equal to $2R$;

b) lifting is accomplished via fittings engaging the lateral aperture of the four bottom corner fittings;

c) the lifting force originates from a single point, and is transmitted via a transverse spreader beam to slings attached from either side of the beam to bottom corner fittings on the respective sides of the container;

d) the slings are situated vertically in the transverse plane, at a maximum of 38 mm (1,5 in) from the sides of the container, in order to avoid overloading the lateral face of the corner fittings around the opening;

e) slings on the same side are placed in the same longitudinal plane, at the following minimum angles from the horizontal:

— 30° for 40 ft containers;
— 37° for 30 ft containers;
— 45° for 20 ft containers;
— 60° for 10 ft containers.

The arrangements given in a) to e) lead to a comparable loading pattern of the bottom corner fittings of containers of different length:

— negligible acceleration or deceleration in lifting is detected;

— the base of the container is free to deflect;

— the container is suspended for at least 5 min and then lowered to the ground.

4.3.2.2 Current practice

While containers are generally lifted using the top corner fittings, the lifting method using the bottom corner fittings may be used.

4.3.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1.

4.3.2.2.2 Construction

The use of separate corner castings welded to the posts and rails has remained constant and standard in the industry. The use of fittings or apertures complying with the design requirements of ISO 1161, but integral to the post, is also acceptable.

4.3.2.3 Operations

This is the only recognized method of using slings connected to the bottom corner fittings to lift ISO containers. It is rarely used. As far as is known, no problems concerning bottom lifting have been reported to ISO/TC 104.

Care must be taken that the maximum offset of 38 mm and the minimum angle of the slings are not exceeded.

4.3.3 Possible changes for future needs

No changes are envisaged.

4.4 Test No. 4 — Longitudinal external restraint

4.4.1 General

This test is carried out to prove the ability of a container to withstand longitudinal external restraint under dynamic conditions of railway operations.

4.4.2 Purpose and requirements

4.4.2.1 History and evolution

The longitudinal restraint test was developed assuming an acceleration of 2*g*.

From the beginning of the standardization process, longitudinal accelerations and decelerations of 2*g* have been accepted as satisfactorily representing common practice.

During the test, the container was subjected to a uniformly distributed load of *R*, but for the calculation of the restraint force a design load factor of 1,25 was used.

In the initial Recommendation[7], the restraint force was specified as 2,5*R* (i.e. a force equivalent to a load of 2,5*R*). In the International Standard which replaced it[8], the restraint force was reduced to 2*R*.

4.4.2.2 Current practice

The practice has not subsequently changed, as there has been no indication that damage occurs due to the design load factor or the value of the acceleration/deceleration used.

4.4.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1.

4.4.2.2.2 Construction

The use of separate corner castings welded to posts and rails has remained constant and standard in the industry. The use of fittings or apertures complying with the design requirements of ISO 1161, but integral to the post, is also acceptable.

4.4.2.3 Operations

As far as is known, no problems have ever been reported to ISO/TC 104 by European or American railways concerning normal operating conditions.

4.4.3 Possible changes for future requirements

As containers are very seldom transported as single wagon loads, but usually in unit trains, shocks to the cars and the containers have been reduced. The speed of container unit trains will doubtless increase in the years to come, but because of these opposing trends, it is recommended that no changes be undertaken.

4.5 Test No. 5 — Strength of end walls

4.5.1 General

This test is carried out to prove the ability of the end walls of a container to withstand the forces caused by the cargo under the dynamic conditions of railway operations.

4.5.2 Purpose and requirements

4.5.2.1 History and evolution

The test of end wall strength was developed assuming an acceleration of 2*g* and an internal loading of 0,4*Pg* (*P* being the payload of the container), uniformly distributed over the container wall.

While the origins of the 0,4*P* factor cannot be documented, it is believed to represent a reasonable load which could be caused by cargo shifting longitudinally under dynamic conditions.

4.5.2.2 Current practice

The practice remains unchanged.

4.5.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1.

4.5.2.2.2 Construction

Each manufacturer has his own container design, including the end walls. As far as is known, there has seldom been damage to the end walls because of faulty design or manufacture, even at the door end. Most of the damage to the front end wall is caused by forklift trucks operated inside the container to move the cargoes.

4.5.2.3 Operations

As far as is known, no particular problems have been reported to ISO/TC 104.

4.5.3 Possible changes for future needs

No change is foreseen. However, it is recognized that different end-wall heights equate to different point loadings and that certain cargoes, such as loose bulk cargoes, can cause the load on the walls to be distributed unevenly.

4.6 Test No. 6 — Strength of side walls

4.6.1 General

This test is carried out to prove the ability of the side walls of a container to withstand the forces caused by cargo under dynamic conditions of ship movement.

4.6.2 Purpose and requirements

4.6.2.1 History and evolution

The conditions are the following:

a) internal loading of 0,6*Pg* uniformly distributed over the wall;

b) the ship's rolling is assumed to be an isochronous, simple harmonic-type motion;

c) the time period for one complete roll is assumed to be at least 13 s;

d) the maximum angle of roll from the ship's upright condition is assumed to be 30°;

e) the maximum height of the centre of gravity of a container above the ship's centre of roll is assumed to be 13,7 m.

4.6.2.2 Current practice

The practice has not changed since it was first established.

4.6.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1.

4.6.2.2.2 Construction

Each manufacturer has his own container design, including the side walls. As far as is known, there has seldom been damage to container side walls because of faulty design or manufacture. In fact, the test criteria have proved adequate throughout evolving side-wall design.

4.6.2.3 Operations

As far as is known, no problems concerning side walls have been reported to ISO/TC 104 that warrant reconsideration of the present test criteria.

4.6.3 Possible changes for future needs

No change is foreseen. However, it is recognized that different side-wall heights and lengths equate to different point loadings and that certain cargoes, such as loose bulk cargoes, can cause the load on the walls to be distributed unevenly.

NOTES

1 Although container ships have become much larger than was foreseen at the beginning of containerization, as far as is known, no request has been made to ISO/TC104 to include 0.6Pg as the test criterion for side walls on their list of new work items;

2 The factor 0,6 was originally linked with the maximum gross mass of the container[2], but this had already been changed to 0,6P[4]. Since that time it has been specified as such in all parts of the ISO 1496 series of International Standards (see [7]).

4.7 Test No. 7 — Roof strength

4.7.1 General

This test is carried out to prove the ability of the rigid roof of a container, where fitted, to withstand loads imposed by persons walking on it.

4.7.2 History and evolution

The value of 300 kg was selected to represent the weight of two men equipped with tools and working on the roof under adverse dynamic conditions.

4.7.2 Possible changes for future needs

This test criterion will not be modified in the future.

4.8 Test No. 8 — Floor strength

4.8.1 General

This test is carried out to prove the ability of the floor of a fixed container to withstand concentrated dynamic forces imposed by wheeled vehicles placing and removing cargo.

NOTE — This requirement is separate from that requiring the container floor to retain cargo without excessive deflection when the container is being lifted (see 4.2, 4.3 and 4.11).

4.8.2 Purpose and requirements

4.8.2.1 History and evolution

The test was devised to prove the ability of the floor to withstand a rolling load imposed by a wheeled vehicle (forklift truck, etc.) carrying a load into or out of the container.

The conditions are the following:

a) the lift truck has an axle load of 5 460 kg (12 000 lb), inclusive of truck tare and cargo loads;

b) the lift truck has two wheels, with interaxial distance of 760 mm (30 in), nominal wheel width 180 mm (7 in) and footprints measuring a maximum of 142 cm² (22 in²);

c) the base of the container is free to deflect, i.e. the container may be subjected to forklift truck loads while the container understructure is not supported by the ground or a container chassis other than at the corner casting position;

d) subsequent to publication of the initial standard, it was agreed to standardize the envelope of the footprint of the lift truck such that it lay within a rectangular envelope 185 mm × 100 mm (7,25 in × 4 in).

4.8.2.2 Current practice

In the 1960s and early 1970s, fork-lift truck specifications were based on the dimensions indicated in 4.8.2.1.

While lift-truck loading remains the most severe concentrated load condition on the floor, the lift-truck specifications used, the test may be obsolete in virtually all present day-to-day loading applications.

Nevertheless, the present criteria pose no danger when cargo is loaded by a more modern truck, since these specifications impose a more severe load condition on the floor than does a present-day truck carrying the same cargo mass.

4.8.2.2.1 Testing

The test requirements have remained the same in all editions of ISO 1496-1. However, many owners specify a floor-strength test at a higher load, typically 7 260 kg (16 000 lb), while continuing to use the same lift-truck specifications contained in the standards.

4.8.2.2.2 Construction

Unlike other container components, the floor system is usually a combination of metal (typically steel) and wood. Wood is subject to different causes of deterioration than is steel. When properly designed and constructed, the floor materials tend to act in a complementary way to continue to withstand floor loads as the container ages.

4.8.2.3 Operations

As far as is known, no problems concerning floor strength have been reported to ISO/TC 104 due to design and test. The problems reported have been caused by overloading damage and deterioration of floor structures.

4.8.3 Possible changes for future needs

The specifications of fork-lift trucks may be changed to reflect more typical trucks used in practice. In general, present-day trucks have larger tyres and a wider axle track. Such a design will permit heavier cargoes to be carried by the truck without increasing the concentrated load on the floor.

4.9 Test No. 9 — Rigidity (transverse)

4.9.1 General

This test is carried out to prove the ability of a container to withstand transverse racking forces resulting from ship movement.

4.9.2 Purpose and requirements

4.9.2.1 History and evolution

This test was developed to simulate the forces induced in containers stacked on deck from racking forces incurred as a ship rolls to 30° with a period of 13 s. A test value of 125 kN was derived from a calculation based on a second-generation container vessel, i.e. with containers stacked three-high on deck. The containers were assumed to be 40-ft units with an average gross mass limited to 25 000 kg due to the current road regulations.

The original test loading of 125 kN was raised to 150 kN to align with the test requirements of ISO 1161 for corner castings[14].

4.9.2.2 Current practice

The loaded container is restrained at the bottom and a transverse force of 150 kN is applied to each corner fitting. The force is first applied towards the corner fitting and then away from the fitting. The temporary and permanent deformations are measured.

The test conditions have remained the same in all editions of ISO 1496-1. Stacks of five containers are sometimes used on larger vessels. Raising the test value from 125 kN to 150 kN was sufficient to cover the present operational practice of stacking containers five-high on deck.

It is important that lashing gear is correctly designed and applied, otherwise unknown racking stresses can be applied to a container with disastrous consequences.

4.9.3 Possible changes for future needs

The evolution of the design of vessels and lashing systems may warrant a future review.

A number of operators test their containers at 200 kN to meet their individual requirements.

4.10 Test No. 10 — Rigidity (longitudinal)

4.10.1 General

This test is carried out to prove the ability of a container to withstand longitudinal racking forces resulting from ship movement.

4.10.2 Purpose and requirements

4.10.2.1 History and evolution

The test was developed to simulate longitudinal forces resulting from ships pitching to an angle of 15° with a period of 8 s and with up to four containers stacked above deck.

4.10.2.2 Current practice

The loaded container is restrained at the bottom. The longitudinal force is applied to each top corner fitting. The temporary and permanent deformations are measured.

By applying a force of 75 kN under the pitching conditions given in 4.10.2.1, an adequate safety margin has been built into this test.

The test requirements have remained the same in all editions of ISO 1496-1.

4.10.3 Possible changes for future needs

No modifications are foreseen; no problems are known or reported.

4.11 Test No. 11 — Lifting from fork-lift pockets

4.11.1 General

This test is carried out on any container which is fitted with fork-lift pockets to demonstrate its ability to be lifted by fork-lift equipment.

4.11.2 Purpose and requirements

4.11.2.1 History and evolution

ISO/TC 104 originally intended to allow for fork-lift pockets only in 1D and 1E type containers. As the lifting ability of fork-lift trucks increased, operation with a fork-lift truck became a popular optional feature, especially for handling 1C containers.

4.11.2.2 Current practice

The calculation of strength of the side wall structure given in reference [16] indicates that the maximum bending moment in any case of lifting with fork-lift pockets is always lower than the bending moment experienced in test No. 3 (lifting by four bottom corner fittings under a load of 2*R*).

4.11.3 Possible changes for future needs

No modification is foreseen; no problems are known or have been reported since the design factor was raised to 1,6*R*, apart from damages resulting from the use of inappropriate equipment.

4.12 Test No. 13 — Weatherproofness

4.12.1 General

This test is carried out to prove the ability of a container to remain watertight after a stream of water has been applied on all exterior joints.

4.12.2 Purpose and requirements

4.12.2.1 History and evolution

The test was included to ensure that the container remained watertight under normal operating conditions.

4.12.2.2 Current practice

The jet(s) of water are applied in the manner specified in ISO 1496-1.

4.12.2.3 Operations

As far as is known, there have been no problems regarding the test. Many operators have specified that the test be carried out last to ensure that the box remains watertight after it has undergone all other tests.

4.12.3 Possible changes for future needs

No changes are envisaged, though it is likely that a note will be added recommending that the test be carried out last.

5 Other factors

5.1 Side lifting

5.1.1 General

Containers are sometimes lifted by side-lifting equipment. There are three recognized methods, which are described in ISO 3874. These lifting methods create rotational forces in the container.

No specific test has been developed for this side-lifting method. However, the existing tests for transverse rigidity and top lifting have proved to adequately demonstrate a container's ability to withstand these forces when lifted under the conditions specified in ISO 3874. The creation of an additional test is therefore not necessary.

5.1.2 Current practice

Significant experience with the side-lifting method has shown that vertical accelerations of 1,6*g* are imposed on the container during normal terminal operations. There is a potential for higher accelerations and loads than have been accounted for by these parameters, due to future changes in operating conditions. These changed conditions may require the development of an additional test, particularly with regard to the strength of the attachment of the corner fitting to the post.

5.2 Evolution of operating conditions

In the future, operating conditions may lead to higher accelerations and forces than those accounted for with the present ISO tests.

Individuals who implement operations inconsistent with those that form the basis of the existing ISO tests need to be aware of the potential need for additional testing, or testing to test loads higher than those required by ISO.

These conditions will be carefully monitored and may require the revision of certain tests or the development of a new test.

NOTE — It is envisaged that these efforts will be undertaken within the framework of the systematic 5-year review of each International Standard.

Annex A

Bibliography

NOTE — Although all possible care has been given to trace the history of general purpose containers built in accordance with ISO 1496-1, certain aspects may have been overlooked. As the history has been carefully reviewed, the chance of a "missing link" can only be very small.

[1] ISO/TC 104 N 79, *Third draft proposal on dimensions and ratings of freight containers and explanatory report*, 1964-08-03.

[2] ISO/TC 104 N 80, *Second draft ISO proposal for the specification, testing and marking of series 1 freight containers having a maximum gross mass of 10 t and 20 t*, 1964-08-03.

[3] ISO/TC 104 N 81, *Second draft proposal for the testing of series 1 freight containers having a maximum gross mass of 10 t and 20 t*, 1964-08-03.

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