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AMENDMENT 1
2006-02-01

Corrected version
2007-12-01

Series 1 freight containers — Specification and testing —

Part 3: Tank containers for liquids, gases and pressurized dry bulk

AMENDMENT 1: Testing of the external restraint (longitudinal) dynamic

Conteneurs de la série 1 — Spécifications et essais —

Partie 3: Conteneurs-citernes pour les liquides, les gaz et les produits solides en vrac pressurisés

AMENDEMENT 1: Essais de sollicitation extérieure (longitudinale) dynamique

Reference number
ISO 1496-3:1995/Amd.1:2006(E)

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Foreword

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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.

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.

Amendment 1 to ISO 1496-3:1995 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 2, *Specific purpose containers*.

This corrected version of ISO 1496-3:1995/Amd.1:2006 incorporates the following corrections:

— Text has been added at the end of D.2.4 b).

— In Figure D.1 and Table D.1, the term “acceleration” has been replaced by “standard acceleration of freefall”.

Series 1 freight containers — Specification and testing —

Part 3:
Tank containers for liquids, gases and pressurized dry bulk

AMENDMENT 1: Testing of the external restraint (longitudinal) dynamic

Page 1, Clause 2

Add the following Normative reference:

ISO 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

Pages 2 and 3

Add the following definitions:

3.14
test platform
device, either stationary or moving, used to support the tank container under test and directly receiving the impact

3.15
damping ratio
ratio of actual damping coefficient to critical damping coefficient

3.16
single degree of freedom system
SDOF system
system for which only one coordinate is required to completely describe that system at any instant of time

3.17
shock response spectrum
SRS
plot of the maximum response experienced by a **single degree of freedom system**, as a function of its own natural frequency, in response to an applied shock

3.18
minimum shock response spectrum
minimum SRS
reference curve representing the minimum shock response spectrum for a test to be valid (see Figure D.1)

3.19
octave
doubling of frequency

Page 9, Subclause 6.6

Amend the title and text to read as follows:

6.6 Tests No. 5 — Internal restraint (longitudinal) (dynamic)

6.6.1 General

This test shall be carried out to prove the ability of tank containers to withstand longitudinal internal restraint under dynamic conditions of railway operation.

6.6.2 Procedure

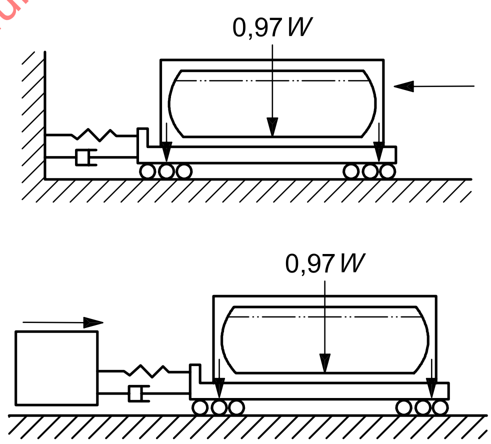
This test shall be conducted in accordance with the procedure specified in Annex D.

6.6.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality that will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

Page 16, Figure A.7

Replace Figure A.7 by the new figure below:

A.7	Internal restraint (longitudinal) dynamic Test No. 5	

Page 16

Delete Figure A.8.

Pages 16, 17, and 18

Renumber Figures A.9 to A.23 as A.8 to A. 22.

Page 24

Insert new Annex D as follows:

Annex D
(normative)

Dynamic longitudinal impact test

D.1 Test sample

Ensure the tank container under test (hereafter referred to as container-under-test) is representative of the tank container design for which conformity confirmation is being sought (design type).

Permitted design variations:

a) a reduction of 10 % or an increase of 20 % in capacity (resulting from variations in diameter and length);

b) a decrease in maximum gross mass;

c) an equal or greater thickness, independent of design pressure and temperature;

d) a change to the grade of material of construction provided that the permitted yield strength meets or exceeds that of the tested container;

e) a change of location or a modification to nozzles and manways.

D.2 Test apparatus

D.2.1 Test platform

The test platform may be any suitable structure having securing devices in accordance with ISO 1161, which is capable of achieving and sustaining without permanent damage the prescribed shock severity with the container-under-test mounted securely in place. The test platform shall be

a) configured so as to allow the container-under-test to be mounted as close as possible to the impacting end;

b) fitted with four securing devices in good condition;

c) equipped with a cushioning device for the purpose of achieving a suitable duration of impact.

D.2.2 Impact creation

The impact may be created by:

a) the test platform striking a stationary mass, or

b) the test platform being struck by a moving mass.

When the stationary mass consists of two or more railway vehicles connected together, each railway vehicle shall be equipped with cushioning devices. Free play between the vehicles shall be eliminated and the brakes on each of the railway vehicles shall be applied.

D.2.3 Measuring/recording system

D.2.3.1 Unless otherwise specified within this International Standard, the measuring system shall comply with ISO 6487.

D.2.3.2 The following equipment shall be available for the test:

a) Two accelerometers with a minimum amplitude range of 200 g, a maximum lower frequency limit of 1 Hz and a minimum upper frequency limit of 3 000 Hz. Each accelerometer shall be rigidly attached to the outer end or side face of the two adjacent bottom corner fittings closest to the impact source, and aligned so as to measure the acceleration in the longitudinal axis. The preferred method is to attach each accelerometer to a flat mounting plate by means of bolting and to bond the mounting plates to the corner fittings.

b) A method of measuring the impact velocity.

c) An analogue-to-digital data acquisition system capable of recording the shock disturbance as an acceleration versus time history at a minimum sampling frequency of 1 000 Hz and incorporating a low-pass anti-aliasing analogue filter with a corner frequency set to a minimum of 200 Hz and a maximum of 20 % of the sampling rate and a minimum roll off rate of 40 dB/octave.

d) A method of permanently storing in electronic format the acceleration versus time histories so that they can be subsequently retrieved and analysed.

D.2.4 Procedure

a) The container under test shall be filled with a quantity of water or any other non-pressurized product to approximately 97 % volumetric capacity, ensuring that it is not pressurized during the test. However, if for reasons of overload it is not possible to fill to 97 % of the capacity, then the test mass of the container (tare and product) shall be as close as possible to R. Measure and record the as-tested payload mass.

NOTE Filling may be undertaken before or after mounting on the test platform.

b) The container under test shall be placed on the test platform as close as possible to the impacting end, with the container end considered to be more vulnerable to impact damage facing the point of impact. All four bottom corners of the container shall be locked in position by means of the corner fittings restraining movement in all directions. In so doing, ensure that any clearance between the corner fittings of the container-under-test and the securing devices at the impacting end of the test platform are minimized. In particular, ensure that impacting masses are free to rebound after impact.

c) Create an impact (D.2.2) such that for a single impact the as tested SRS at both corner fittings equals or exceeds the minimum SRS shown in Figure D.1 at all frequencies within the range 3 Hz to 100 Hz.

NOTE Repeated impacts may be required to achieve this result.

d) Examine the container under test for evidence of any faults and record the result.

D.2.5 Analysis/processing of data

D.2.5.1 Data reduction system

Reduce the acceleration time history data from each channel to the shock response spectrum, ensuring that the spectra are presented in the form of equivalent static acceleration plotted as a function of frequency. The maximum absolute value acceleration peak will be recorded for each of the specified frequency break points, thus producing what is commonly referred to as the maximal acceleration shock response spectrum. The data reduction will follow the following criteria:

1) If required, the corrected impact acceleration time history data shall be generated using the procedure outlined in D.2.5.2.

2) The time-history data shall comprise the period commencing 0,05 s prior to the start of the impact event and the 2,0 s thereafter.

3) The analysis shall span the frequency range of 2 Hz to 100 Hz with a minimum of 1/30 octave break points. Each break point, or bin in the range shall constitute a natural frequency, and,

4) A damping ratio of 5 % shall be used in the analysis.

Calculation of the test shock response curve data points shall be made as described below. For each frequency bin:

a) Calculate a matrix of relative displacement values, ξ_i, using all data points from the shock input acceleration time history using the following equation:

$$\xi_i = -\frac{\Delta t}{\omega_\mathrm{d}} \sum_{k=0}^{i} \ddot{X}_k e^{-\zeta \omega_\mathrm{n} \Delta t (i-k)} \sin\left[\omega_\mathrm{d} \Delta t (i-k)\right] \qquad \text{(D.1)}$$

where

Δt is the time interval between acceleration values;

ω_d is the damped natural frequency $= \omega_\mathrm{n}\sqrt{1-\zeta^2}$;

i is the integer number, varies from 1 to the number of input acceleration data points;

k is the parameter used in summation which varies from 0 to the current value of i;

$\ddot{X}_k$ is the kth value of acceleration input data;

ζ is the damping ratio;

ω_n is the undamped natural frequency (in rad/s).

b) Calculate a matrix of relative accelerations, ξ_i, using the displacement values obtained in step 1) in the following equation:

$$\ddot{\xi}_i = 2\zeta \omega_\mathrm{n} \Delta t \sum_{k=0}^{i} \ddot{X}_k e^{-\zeta \omega_\mathrm{n} \Delta t (i-k)} \cos\left[\omega_\mathrm{d} \Delta t (i-k)\right] + \omega_\mathrm{n}^2 \left(2\zeta^2 - 1\right) \xi_i \qquad \text{(D.2)}$$

c) Retain the maximum absolute acceleration value from the matrix generated in step 2) for the frequency bin under consideration. This value becomes the shock response spectrum (SRS) curve point for this particular frequency bin. Repeat step 1) for each natural frequency until all natural frequency bins have been evaluated.

d) Generate the test shock response spectrum curve.

D.2.5.2 Method for scaling measured acceleration versus time history values to compensate for under or over mass containers.

Where the sum of the as-tested payload mass plus tare mass of the container under test is not the maximum rated mass of the container under test, apply a scaling factor to the measured acceleration time histories for the container-under-test as follows:

Calculate the corrected acceleration-time values, $Acc(t)_{\text{(corrected)}}$, from the measured acceleration time values, by use of the following formula:

$$Acc(t)_{\text{(corrected)}} = Acc(t)_{\text{(measured)}} \times \frac{1}{\sqrt{1+\frac{\Delta M}{M_1+M_2}}} \quad \text{(D.3)}$$

where

$Acc(t)_{\text{(measured)}}$ is the actual measured-time value;

M_1 is the mass of the test platform, without the container under test;

M_2 is the actual test mass (including tare) of the container under test;

$\Delta M = R - M_2$

where R is the maximum rated mass (including tare) of the container under test.

The test SRS values shall be generated from the $Acc(t)_{\text{(corrected)}}$ values.

D.2.6 Defective instrumentation

D.2.6.1 Defective accelerometer signal

In the case where the acquired signal is defective, the test may be validated with the SRS from the functional accelerometer after three consecutive impacts provided that the SRS from each of the three impacts meets the minimum requirements.

D.2.7 Optional test method

In the case where the SRS curves obtained have correct features but remain below the minimum SRS curve, the test may be validated if three successive impacts are performed as follows:

— first impact at a speed higher than 90 % of the critical speed;

— second and third impact at a speed higher than 95 % of the critical speed.

In addition all of the following conditions shall be met:

a) A critical speed shall already have been established. The critical speed corresponds to the speed where the cushioning devices reach their maximum travel and energy absorption capacity, beyond which it has been determined that the minimum SRS curve is normally obtained or exceeded.

b) The critical speed has been established after at least five documented tests using five different tank containers. Each of the tests shall have been performed using the same equipment, measuring system and procedure.

c) The design of the container under test is significantly different from any other 20-ft. tank container having been successfully subjected to the dynamic longitudinal impact test.

D.2.8 Recording of data

The following data, as a minimum, shall be recorded in the application of this procedure:

a) date, time, ambient temperature, and location of test;

b) tank container tare mass, maximum rated mass, and as-tested payload mass;

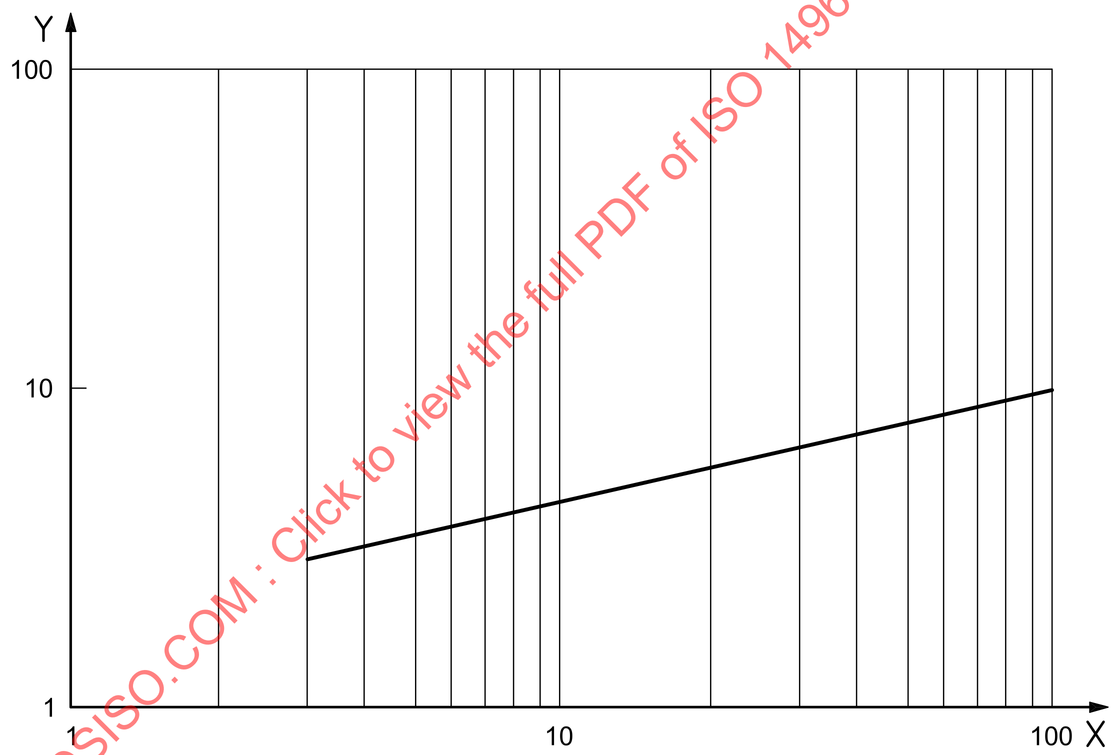
c) tank container manufacturer, tank type, registration number if applicable, certified design codes and approvals if applicable;

d) test platform mass;

e) impact velocity;

f) direction of impact with respect to tank container;

g) for each impact, an acceleration versus time history for each instrumented corner fitting.



Key

X Frequency (Hz)

Y Standard acceleration of freefall, g (m/s^2)

Equation for generating the above minimum SRS curve: $ACCEL = 1{,}95\ FREQ^{\,0{,}355}$ (D.4)

Figure D.1 — Minimum SRS Curve (5 % Damping)