

2 Test criteria: FCCs and Flexitank Materials

Section A

Flexitank/Container Combination Rail Impact Test Criteria

1. General

- 1.1. This test method is intended to prove the ability of Flexitanks and their installations in ISO shipping containers to withstand the effects of a longitudinal impact.
- 1.2. Testing shall be conducted by facilities that meet the test provisions for the COA impact test and are approved for this purpose by the COA.
- 1.3. The test container shall be built according to ISO standards to meet ISO criteria and shall be a used container, with normal wear and tear and be rated at 30 tonnes gross for 20ft units and 32 tonnes gross for 40ft units, which represents containers in general service.
- 1.4. Any scheduled test shall be announced to the COA with at least 3 weeks lead-time.

2. Permitted design variations

- 2.1. The following variations in Flexitank design from an already tested prototype are permitted without additional testing:
 - a. A decrease in the tested design capacity, not reducing material layer thickness or strength characteristics.
 - b. Installation of a top-valve.
 - c. An increase in any material layer thickness provided the thickness stays within the range permitted by the material testing procedures specifications.
 - d. Specifically, any modification to or removal of any ancillary equipment applied during any testing shall not be permitted without submission of the changes or removal request to the COA's Flexitank Management Group for approval or without further testing in accordance with the requirements set out in this document.
- 2.2. Any other change in specification of the material, construction or fittings will not be covered and should be tested separately. Specifically no increase in the capacity of the flexitanks is permitted.

3. Test apparatuses

- 3.1. Test platform

The test platform may be any suitable structure capable of sustaining without significant damage a shock of the prescribed severity with the container-under-test mounted securely in place. The test platform shall be:

 - a. equipped with means of ensuring a direct load transfer through the bottom corner fittings at the end of impact, e.g. solid stop blocks.
 - b. Equipped with four devices, in good condition, for securing the container-under-test in accordance with ISO 1161:1984 (Series 1 Freight containers Corner fittings Specification); and
 - c. Equipped with a cushioning device to provide a suitable duration of impact.
- 3.2. Impact creation

The impact shall 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 set.

4. Measuring and recording system

- 4.1. Unless otherwise specified, the measuring and recording system shall comply with ISO 6487:2002 (Road vehicles Measurement techniques in impact tests Instrumentation).
- 4.2. 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 3000 Hz. Each accelerometer shall be rigidly attached to the container-under-test at the outer end or side face of the two adjacent bottom corner fittings closest to the impact source. The accelerometers shall be aligned so as to measure the acceleration in the longitudinal axis of the container. 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 means of measuring the velocity of the moving test platform or the moving mass at the moment of impact.
 - c. An analogue-to-digital data acquisition system capable of recording the shock disturbance as acceleration versus time history at a minimum sampling frequency of 1000 Hz. The data acquisition system shall incorporate a low-pass antialiasing 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 means of storing the acceleration versus time histories in electronic format so that they can be subsequently re-trieved and analysed.
 - e. A means to record deformations of the container side walls, the front wall and the doors at a minimum of per figure 1 to 4 defined locations plus spots of maximum deformation at least before and after each test to a minimum accuracy of 1mm. The preferred method is to span a plane adverted to the outer faces of the wall-dedicated corner fittings that can be taken as a reference plane for each measurement; and
 - f. A means to monitor that any fitted valve does not touch the container interior before, during and after each impact.

5. Procedure

- 5.1. The Flexitank Manufacturer shall be responsible for fitting the Flexitank, lining, bulkhead and other required installations to the test container and this must be in accordance with the Flexitank Manufacturer's installation guide.
- 5.2. Filling of the Flexitank may be undertaken before or after mounting on the test platform. The Flexitank shall be filled with water to 100% of the Flexitank nominal capacity.
- 5.3. The mass of the container including the fitted Flexitank shall be measured and recorded for the empty and filled state.
- 5.4. The container-under-test shall first be oriented in a way that the container doors are facing the impact. The container shall be secured on the test platform using all four of its corner fittings so as to restrain its movement in vertical and transverse directions. Any clearance between the corner fittings of the container-under-test and the load transfer devices in longitudinal direction at the impacting end of the test platform shall be minimised. In particular, impacting masses shall be free to rebound after impact.
- 5.5. An impact shall be created (see 3.2) such that for a single impact an acceleration amplitude of 2G (gravitational unit) at a given low-pass filtering of 16Hz (4-pole Butterworth) is registered in the accelerometer signals from the bottom corner fittings. Repeated impacts may be required to achieve this result but the test results for each impact shall be considered individually.
- 5.6. The container-under-test shall then be oriented in a way that the container front wall is facing the impact with all arrangements as described in 5.4 and an impact shall be created as per 5.5.
- 5.7. Following an impact described in 5.5, the Flexitank, its installations and the container-under-test shall be examined and the results recorded.
- 5.8. The objectives of the test

- a. The Flexitank/Container combination shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and transfer from one means of transport to another shall be satisfied.
- b. The bulkhead (if installed) and any other installation shall not be touching the doors either before or after each impact, while any fitted valve may not be touching the container interior at any time.
- c. The maximum container deformations are to be measured as described in 4.2e with:
 - i. The deformations after each impact test should not exceed:
 - Front wall: 40mm.
 - Side walls: 40mm.
 - Doors: 6mm.
 - ii. The maximum permanent/residual deformations after discharge as per ISO/TR15070:1996/Amd1:2005(E)¹ should not exceed:
 - Front wall: 7mm.
 - Side walls: 8mm.

6. Reporting

- 6.1. The above tests shall be reported and documented by a recognised company, accepted by the COA in the form of a COA Standard Rail Impact Test Report.
- 6.2. The recorded acceleration-time history of all performed impacts per 5.5 shall be filed with the COA for archiving.
- 6.3. COA Full members reserve the right to witness an announced test.

¹Reference: Amendment 1 to ISO/TR 15070:1996 was prepared by Technical Committee ISO/TC 104, Freight containers, Subcommittee SC1, General purpose container)