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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF  
DANGEROUS GOODS AND ON THE GLOBALLY  
HARMONIZED SYSTEM OF CLASSIFICATION  
AND LABELLING OF CHEMICALS**

**Sub-Committee of Experts on the  
Transport of Dangerous Goods**  
**(Twenty-first session, 1-10 July 2002  
agenda item 6 (b))**

**PACKAGINGS (including IBCs and large packagings)**

**Vibration test**

**Transmitted by the expert from the United States of America**

1. The expert from Spain has proposed to include a vibration test in the Model Regulations for packagings, including IBCs and large packagings in ST/SG/AC.10/C.3/2002/2. The expert from the United States of America supports this proposal and notes that it is consistent with the decision taken by the Sub-Committee at its seventeenth session where it was decided in principle that a vibration test should be included in the Model Regulations, (see ST/SG/AC.10/C.3/34, paragraph 100). The expert from Spain agreed to work on the vibration test with the cooperation of other countries and we commend him for responding to this commitment. The proposed method is consistent with the repetitive shock test methods specified in ISO 2247 and ASTM 999-01.

2. In the United States of America, our national regulations have included a vibration test method for UN packagings for more than 15 years. We believe that a vibration test is an essential and necessary component for assessing a packaging's ability to resist the complex dynamic forces imposed by the transport environment. A vibration test is necessary to ensure that packagings are capable of safely containing dangerous goods when subjected to the vibration present in transport and handling operations. Exposure to vibration can result in failures of the inner or outer packagings, leakage through closures and loss of contents. The expert from the United States of America agrees that dynamic shocks and stresses imposed by vibration on a packaging in transport should be accounted for in the packaging design qualification testing requirements of the Model Regulations.

3. The expert from Spain has proposed a repetitive shock vibration test that we believe is an effective method of assessing a packaging's ability to withstand the vibrations experienced in the dangerous goods transport environment. The proposed method is suitable for testing packaging of any form, material kind, design, size, or weight. We believe that the test proposed by Spain meets the criteria for simplicity and reproducibility while closely simulating the type of vibration that may be imposed on a packaging in transport. While we generally support Spain's proposal we believe that it is incomplete because specific methods are not proposed for IBCs or large packaging and in certain respects the method is lacking necessary details. We are providing suggestions and comments for improving the proposed test methods and the pass/fail criteria.

4. The expert from Spain proposes a variable test duration on the basis of packing group assignment (i.e. PG I - 1.5 hours, PG II - 1 hour and PG III - 30 minutes). We do not agree that a variable approach based on packing group is necessary and alternatively propose a standard 1 hour duration for all packing groups. We also believe that further details relevant to the test specimens, procedure, conditioning, test apparatus and guidance for interpreting results are needed to ensure consistency in the application of the test method and correlation of results. Additionally, specific tests should also be included in the IBC and Large Packaging test sections of the Model Regulations. In Chapter 6.1 we are proposing to remove the cooperage test consistent with earlier decisions to remove references to wooden barrels in the packing instructions and to include the vibration test in place of the cooperage test in 6.1.5.7. Revised test methods consistent with the one proposed by Spain are provided in paragraph below.

### **Proposal**

5. It is proposed that the existing text in 6.1.5.7 be replaced with the following:

#### ***Vibration test***

6.1.5.7 All packaging design types shall be subjected to a vibration test.

6.1.5.7.1 *Number of test samples:* Three sample packaging, selected at random, shall be filled and closed as for transport including the configuration of inner packaging and articles and the tightening of closures. All packaging shall be prepared for testing as specified in 6.1.5.2. For packages intended for the transport of solid materials the packaging shall be filled to not less than 95% of their intended capacity with a substance of relative density 1 (e.g a mixture of sand and plastics granules). Packaging intended to be used for the transport of liquids shall be filled to not less than 98% of their maximum capacity with water.

6.1.5.7.2 *Test method:* Test specimens may be tested together or individually. The packaging may be tested in a unit load or palletized configuration if they are transported in such a configuration; if a unit load or palletized configuration is tested, three complete unit loads or pallets must be tested. The specimen(s) shall be placed on the test machine platform in the normal transport orientation. The test shall be conducted with a machine that produces a vertical or rotary motion vibration resulting in double amplitude (peak to peak displacement) of approximately  $25\text{mm} \pm 5\%$ . The specimen(s) shall be restrained horizontally to prevent them from falling off the platform, but shall be left free to move vertically. Restraining devices may be used to prevent the specimens from moving horizontally off the platform and to restrict excessive rocking. Fences, barricades and other restraints shall be adequately secured to protect the safety of the operator. The restraining devices shall in no case restrict vertical movement. The restraining devices shall not restrict the free horizontal movement to less than  $10\text{ mm} \pm 5\%$  in any horizontal direction from the initial placement of the specimen on the platform.

The initial frequency should be approximately 2 Hz and shall be steadily increased until the test specimen(s) repeatedly leaves the test surface. To ensure that the specimen is subjected to constant

repetitive shock a steel shim 50 mm  $\pm$  5% wide and 1.6mm  $\pm$  5% in thickness (e.g. a piece of steel strapping) shall be passed between the specimen and the platform over the full length of the specimen. The specimen(s) shall be vibrated at this frequency for a minimum of one hour duration. After the completion of the test the specimens shall be removed from the platform, turned on its side for a minimum duration of five minutes and inspected for damage and any leakage of the test medium from the package( s ). Packages tested in a palletized or unit load configuration would need to be removed from the unit load or pallet prior to inspection. The inspection shall include an examination of any articles, inner packagings and their closures. Any damage, deterioration or leakage shall be recorded.

6.1.5.7.3 *Criterion for passing the test:* There shall be no rupture or leakage from the packaging. No test sample should show any deterioration or any distortion liable to reduce packaging strength that could adversely affect transport safety. No test sample shall show any indication of leakage of the test medium from the inner or outer packaging or from an article. Any leakage shall be considered a failure.

6.1.5.7.4 *Use of other equivalent tests:* Other test methods, at least equally effective, may be used, if approved by the competent authority.

6. It is proposed that the existing text in 6.5.4.13 and 6.5.4.14 be numbered as 6.5.4.14 and 6.5.4.15 respectively and that a new 6.5.4.13 be inserted as follows:

#### **6.5.4.13 Vibration test**

6.5.4.13.1 For all types of IBCs except FIBCs, as a design type test.

*Comment: Through experience testing FIBCs in the United States we have determined that the test is not necessary for flexibles IBCs.*

6.5.4.13.2 *Preparation of the IBC for testing:* A sample IBC shall be selected at random and shall be filled and closed as for transport. IBCs shall be filled to not less than 98% of their maximum capacity for liquids. or 95% for solids. For IBCs intended to be used for the transport of liquids water may be used as the test medium. For solids the IBC shall be filled to its maximum gross mass.

6.5.4.13.3 *Test method:* The IBC shall be placed on the test machine platform in the normal transport orientation. The test shall be conducted with a machine that produces a vertical vibration resulting in a double amplitude (peak to peak displacement) of approximately 25 mm  $\pm$  5%. It shall be restrained horizontally to prevent it from falling off the platform, but shall be left free to move vertically. Restraining devices may be used to prevent the IBC from moving horizontally off the platform and to restrict excessive rocking. Fences, barricades and other restraints shall be adequately secured to protect the safety of the operator. The restraining devices shall in no case restrict vertical movement. The restraining devices shall not restrict the free horizontal movement to less than 10 mm  $\pm$  5% in any horizontal direction from the initial placement of the specimen on the platform.

The initial frequency should be approximately 2 Hz and shall be steadily increased until the IBC repeatedly leaves the test surface. To ensure that the specimen is subjected to constant repetitive shock a steel shim 50 mm  $\pm$  5% wide and 1.6mm  $\pm$  5% in thickness ( e.g. a piece of steel strapping) shall be passed between the platform and the IBC and verified on each corner or side of the IBC. The IBC shall be vibrated at this frequency for a minimum of one hour duration. After the completion of the test the IBC shall be inspected for damage and any leakage of the test medium. The inspection shall include an examination of all of the IBC components including the body and the closures. Any damage, deterioration or leakage shall be recorded.

6.5.4.13.4 *Criterion for passing the test:* There shall be no rupture or leakage of the test medium from the receptacle, if applicable, or the body of the IBC. No IBC should show any deterioration or any distortion liable to reduce packaging strength that could adversely affect transport safety. Any leakage shall be considered a failure.

6.5.4.13.5 *Use of other equivalent tests:* Other test methods, at least equally effective, may be used, if approved by competent authority.

7. Amend the table in 6.5.4.3.5 as follows:

6.5.4.3.5 *Design type tests required and sequential order*

Type of IBC	Vibration	Bottom lift	Top lift <sup>a</sup>	Stacking <sup>b</sup>	Leak-proofness	Hydraulic pressure	Drop	Tear	Topple	Righting
Metal: 11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B, 31N	1 <sup>st</sup> 1 <sup>st</sup>	2 <sup>nd</sup> <sup>a</sup> 2 <sup>nd</sup> <sup>a</sup>	3 <sup>rd</sup> 3 <sup>rd</sup>	4 <sup>th</sup> 4 <sup>th</sup>	- 5 <sup>th</sup>	- 6 <sup>th</sup>	5 <sup>th</sup> <sup>e</sup> 7 <sup>th</sup> <sup>e</sup>	- -	- -	- -
Flexible <sup>d</sup>	-	-	X <sup>c</sup>	X	-	-	X	X	X	X
Rigid plastics: 11H1, 1H2, 21H1, 21H2, 31H1, 31H2	1 <sup>st</sup> 1 <sup>st</sup>	2 <sup>nda</sup> 2 <sup>nda</sup>	3 <sup>rd</sup> 3 <sup>rd</sup>	4 <sup>th</sup> 4 <sup>th</sup>	- 5 <sup>th</sup>	- 6 <sup>th</sup>	5 <sup>th</sup> 7 <sup>th</sup>	- -	- -	- -
Composite: 11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1, 31HZ2	1 <sup>st</sup> 1 <sup>st</sup>	2 <sup>nda</sup> 2 <sup>nda</sup>	3 <sup>rd</sup> 3 <sup>rd</sup>	4 <sup>th</sup> 4 <sup>th</sup>	- 5 <sup>th</sup>	- 6 <sup>th</sup>	5 <sup>th</sup> <sup>e</sup> 7 <sup>th</sup> <sup>e</sup>	- -	- -	- -
Fibreboard	1 <sup>st</sup>	2 <sup>nd</sup>	-	3 <sup>rd</sup>	-	-	4 <sup>th</sup>	-	-	-
Wooden	1 <sup>st</sup>	2 <sup>nd</sup>	-	3 <sup>rd</sup>	-	-	4 <sup>th</sup>	-	-	-

Comment/suggestion: The Sub-Committee should consider changing the order of the required tests by placing the leakproofness test 1<sup>st</sup> and keeping the order as shown in the above table with vibration second. This would allow testing laboratories to take the empty IBC and conduct the leakproofness test first and then fill the IBC and conduct the remaining test in the order presented. Currently they have to empty the IBC in the middle of the sequence to conduct the leak test and then fill it back up for the hydro test. This takes a considerable amount of time. Conducting the leakproofness test first, will also serve to verify the sealing qualities of the fittings, valves and closures prior to performing the test on a filled IBC.

<sup>a</sup> *When IBCs are designed for this method of handling.*

<sup>b</sup> *When IBCs are designed to be stacked.*

<sup>c</sup> *When IBCs are designated to be lifted from the top or the side.*

<sup>d</sup> *Required test indicated by x; an IBC which has passed one test may be used for other tests, in any order.*

<sup>e</sup> *Another IBC of the same design may be used for the drop test.*

8. Add a new paragraph 6.6.5.3.5 as follows:

**6.6.5.3.5 *Vibration test***

6.6.5.3.5.1 For all types of large packagings as a design type test.

6.6.5.3.5.2 *Preparation of large packaging for testing*

The large packaging shall be filled in accordance with 6.6.5.2.1.

6.6.5.3.5.3 *Number of test samples:* one large packaging shall be selected at random, filled and closed as for transport including the configuration of inner packagings or articles.

6.6.5.3.5.4 *Test method:* The large packaging shall be placed on the test machine platform in the normal transport orientation. The test shall be conducted with a machine that produces a vertical vibration resulting in a double amplitude (peak to peak displacement) of approximately  $25\text{mm} \pm 5\%$ . The large packaging shall be restrained horizontally to prevent it from falling off the platform, but shall be left free to move vertically. Restraining devices may be used to prevent the large packaging from moving horizontally off the platform and to restrict excessive rocking. Fences, barricades and other restraints shall be adequately secured to protect the safety of the operator. The restraining devices shall in no case restrict vertical movement. The restraining devices shall not restrict the free horizontal movement to less than  $10\text{ mm} \pm 5\%$  in any horizontal direction from the initial placement of the specimen on the platform.

The initial frequency should be approximately 2 Hz and shall be steadily increased until the large packaging repeatedly leaves the test surface. To ensure that the specimen is subjected to constant repetitive shock a steel shim  $50\text{ mm} \pm 5\%$  wide and  $1.6\text{mm} \pm 5\%$  in thickness ( e.g. a piece of steel strapping) shall be passed between the platform and the large packaging and verified on each side or each corner of the large packaging. The large packaging shall be vibrated at this frequency for a minimum of one hour duration. After the completion of the test the large packaging shall be inspected for damage and any leakage of the test medium from the large packaging including from any articles, inner packagings and their closures. Any damage, deterioration or leakage shall be recorded.

6.6.5.3.5.5 *Criterion for passing the test:* There shall be no rupture or leakage of the test medium from the large packaging, inner packagings or articles. No large packaging shall show any deterioration or any distortion liable to reduce packaging strength that could adversely affect transport safety. Any leakage shall be considered a failure.

6.6.5.3.5.6 *Use of other equivalent tests:* Other test methods, at least equally effective, may be used, if approved by the competent authority.

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