

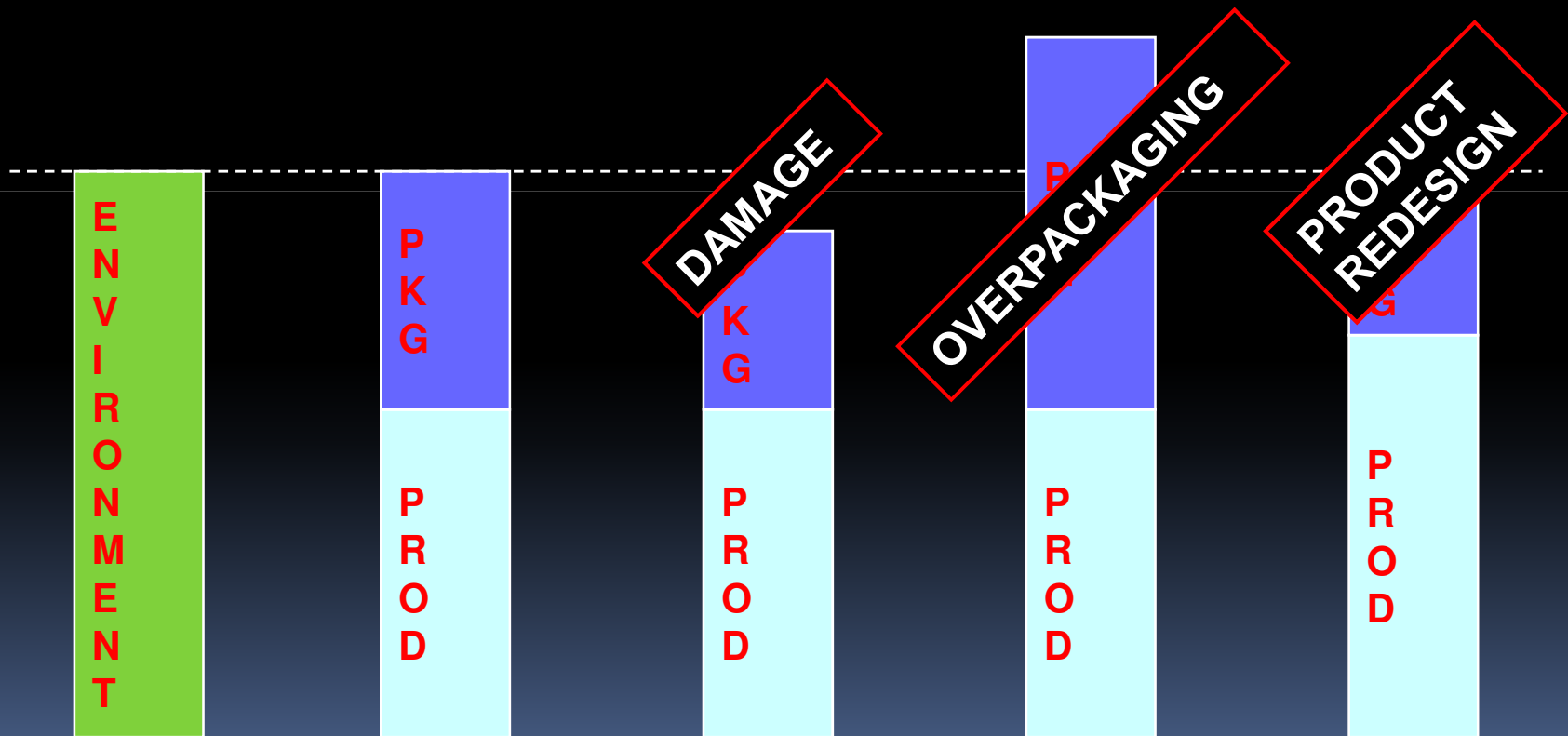


TRANSPORT SIMULATION TEST

This presentation describes the test-procedure for a single packaging or a combination of pallet-packaging's

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TRANSPORT SIMULATION TEST

- History and background

- A "world-wide accepted" packaging standard is the:
ASTM (American Society for Testing and Materials) international D 4169-08 Performance of shipping containers and systems. Therefore it's decided to use this standard as the guideline to specify the test-procedure for the packaging's.

- Test Procedure

- *Within this chapter the test-procedure for a single-packaging and a combination of pallet-packaging's will be determined and clarified. As stated before the ASTM standard D4169-08 is the one to start from.*
- *Section 8 describes the complete procedure to achieve a uniform basis of evaluating, in a laboratory, the ability of shipping units to withstand the distribution environment.*

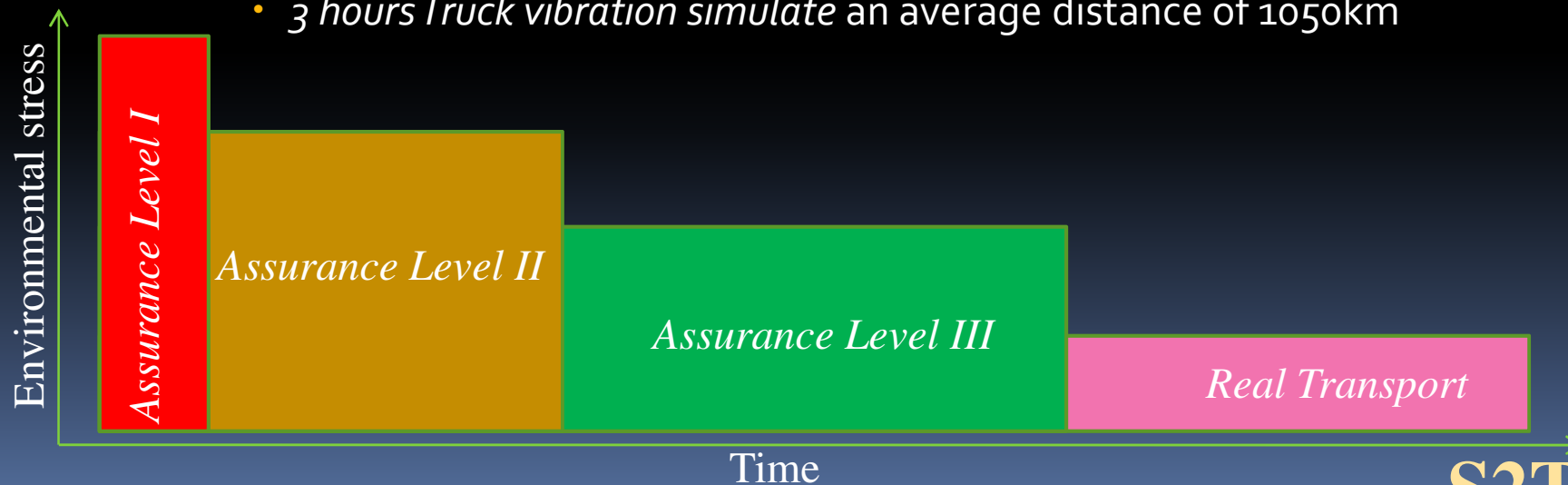
- Paragraph 8.1 *Define Shipping Units*

- *Describe shipping unit in terms of size, weight, and form of construction.*
- *Determine of the shipping unit will be manually or mechanical handled*



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- Paragraph 8.2 *Establish Assurance Level*
 - *There are three levels described in the ASTM D 4169-08.*
 - *Assurance Level I (Worldwide simulation level)*
 - *3 hours Truck vibration simulate an average distance of 4200km*
 - *Assurance Level II (Europe simulation level)*
 - *3 hours Truck vibration simulate an average distance of 2100km*
 - *Assurance Level III (Benelux simulation level)*
 - *3 hours Truck vibration simulate an average distance of 1050km*





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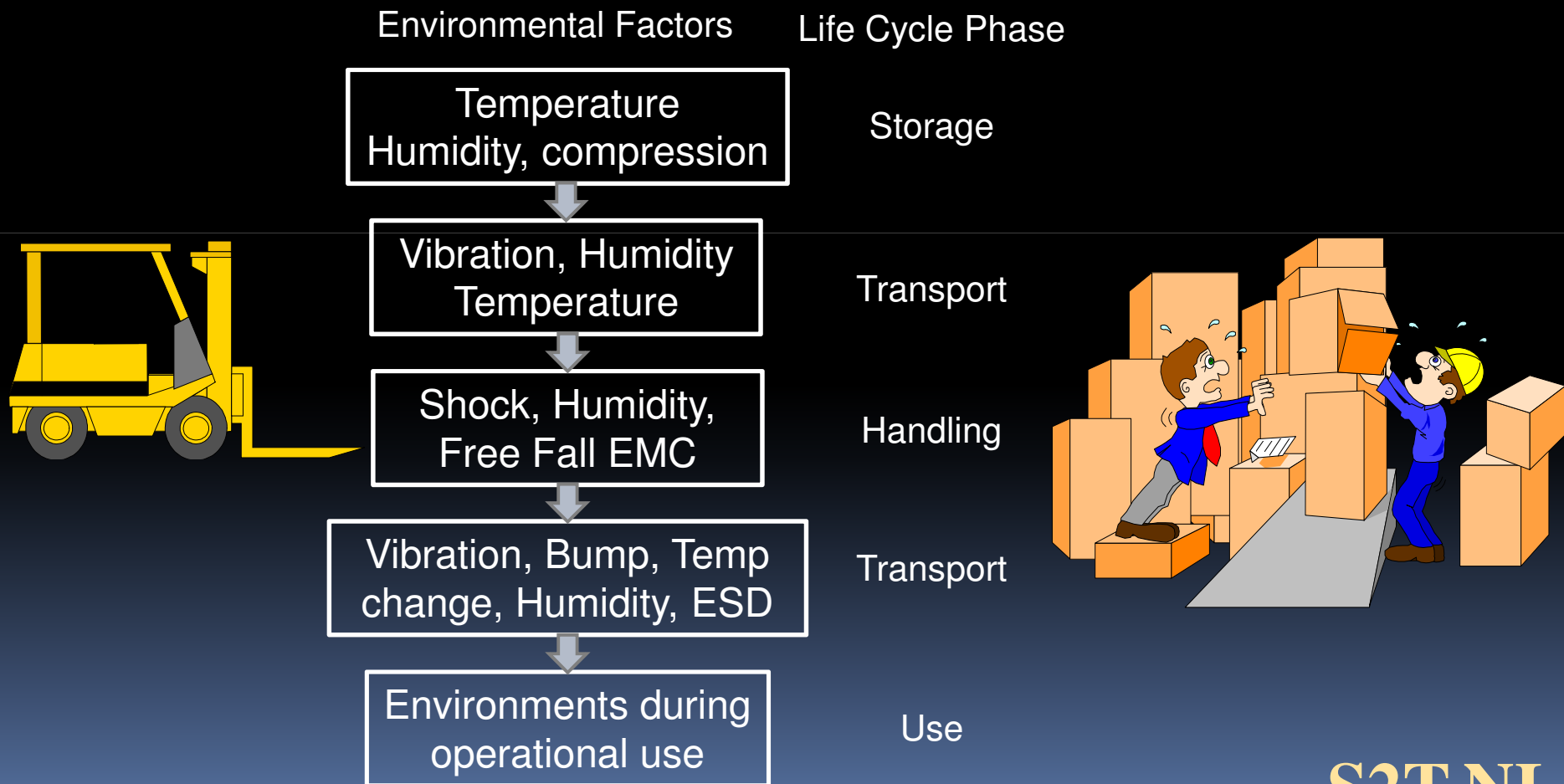
- Paragraph 8.3 *Determine Acceptance Criteria*
 - *In many cases, the acceptance criteria can be the following:*
 - *Criterion 1 – Product is damage-free*
 - *Criterion 2 – Package is intact*
 - *Criterion 3 – Both*

- Paragraph 8.4 *Select Distribution Cycle (DC)*
 - *Out of table 1 of the ASTM D 4169-08, DC should be chosen which correlates to the projected distribution. This is categorized from DC 1 till DC 18*
 - *Remark: the measured vibration accelerations of a boat is not higher than 0,9 g-peak. The truck simulation on assurance level I is the acceleration 2,2 g peak. In this case the truck simulation overrule the boat acceleration values.*



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- Paragraph 8.4 *Select Distribution Cycle (DC)*



Example of environmental factors within each environmental phase



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- Paragraph 8.4 *Select Distribution Cycle (DC)*

Out of the test schedule the complete test-procedure is derived:

- **Schedule A** is described in section 10.
 - *In this case (see paragraph 8.1) a single packaging or a combination of pallet packaging's are supposed to be handled manual or mechanical from the distribution centre to the "end customer".*
- **Schedule D or E** is described in section 12.2.
 - *Underneath section 12.1 the random test is considered to be the preferred one. Recommended intensities and durations are given in 12.4.*
 - *If only one single packaging is available and you will simulate a pallet packaging then it is recommended to put a concentrated load as calculated in section 11.4. This test is also called Schedule C Vehicle Stacking plus vibration.*



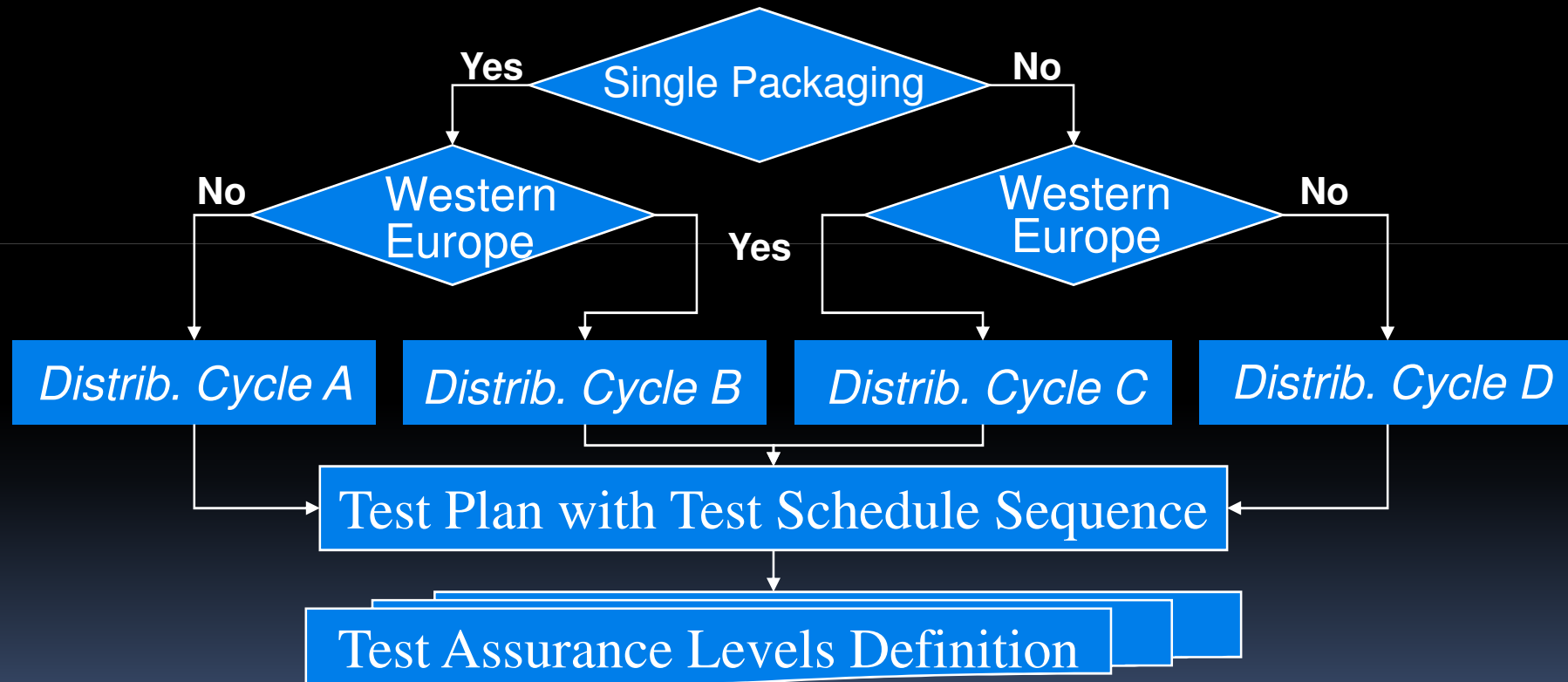
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- Paragraph 8.4 *Select Distribution Cycle (DC)*
 - **Schedule F** is described in section 13.1.
 - *This test determine the ability of the shipping unit to withstand the repetitive shocks occurring during transportation of loose loads. For example whipping/slamming of a boat or a bad way.*
 - **Schedule J** is described in section 17.1.
 - *This test provides a simulation of anticipated low level concentrated impacts as received by packages during sorting operations and in transit.*
 - **Schedule A** has to be repeated as described before
 - *Only for the single packaging is the last impact of the last manual handling sequence different. The impact should be made at twice the specified height. This is the final drop in the sequence (not an additional drop). The drop should be in the impact orientation most likely for a drop to occur, usually the largest face or the bottom. For distribution cycles where any drop orientation is possible, this drop should be in the most critical or damage-prone orientation, as define in test Method D 5276 98.*



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- Paragraph 8.5 *Write Test Plan*





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Single Packaging

Distribution Cycle A: Outside of Western Europe (Truck/Air/Boat Simulation)

Drop Test: **A** - Manual Handling / 1nd sequence / Level II

Compression Test: **C** - Vehicle Stacking / Level I

Repetitive Shock Test: **F** - Loose Load Vibration / Level I

Vacuum Test: **I** – Low Pressure / 4267m / 60min

Random Vibration Test: **E + C** - Truck Vibration / Level I / 60min

Random Vibration Test: **E + C** - Air Vibration / Level I / 120min

Sorting Operations Test: **J** - Concentrated Impact / 5,4J (0,8m)

Drop Test: **A** - Manual Handling / 2nd sequence / Level I



TRANSPORT SIMULATION TEST

Single Packaging

Distribution Cycle B: Inside of Western Europe (Truck simulation)

Drop Test: **A** - Manual Handling / 1nd sequence / Level II

Case Compression Test: **C** - Vehicle Stacking / Level II

Repetitive Shock Test: **F** - Loose Load Vibration / Level II

Random Vibration Test: **E + C** - Truck Vibration / Level II / 3h

Sorting Operations Test: **J** - Concentrated Impact / 5,4J (0,8m)

Drop Test: **A** - Manual Handling / 2nd sequence / Level II



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Combination of a
Pallet Packaging

Distribution Cycle C: Inside of Western Europe (Truck Simulation)

Case Pallet Drop Test: **A** – Mech. Handling / Fork Lift Truck / Level II

Side Impact Test: **A** - Mechanical Handling / Truck / Level II

Case Repetitive Shock Test: **F** - Loose Load Vibration / Level II

Random Vibration Test: **D or E** - Truck Vibration / Level II / 180min

Pallet Drop Test: **A** – Mechanical Handling / Fork Lift Truck / Level II

Side Impact Test: **A** - Mechanical Handling / Truck / Level II



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Combination of a
Pallet Packaging

Distribution Cycle D: Outside of Western Europe (Truck/Air/Boat Simulation)

Pallet Drop Test: **A** – Mechanical Handling / Fork Lift Truck / Level I

Side Impact Test: **A** - Mechanical Handling / Truck / Level I

Repetitive Shock Test: **F** - Loose Load Vibration / Level I

Vacuum Test: **I** – Low Pressure / 4267m / 60min

Random Vibration Test: **D or E** - Truck Vibration / Level I / 60min

Random Vibration Test: **D or E** - Air Vibration / Level I / 120min

Pallet Drop Test: **A** – Mechanical Handling / Fork Lift Truck / Level I

Side Impact Test: **A** - Mechanical Handling / Truck / Level I



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- Paragraph 8.6 *Select Samples for Test*
 - *Tests specimens consist of representative samples of complete shipping units, including actual contents. Products with blemishes or minor defects may be used if the defective component is not to be studied by the test and if the defect is documented in the report*

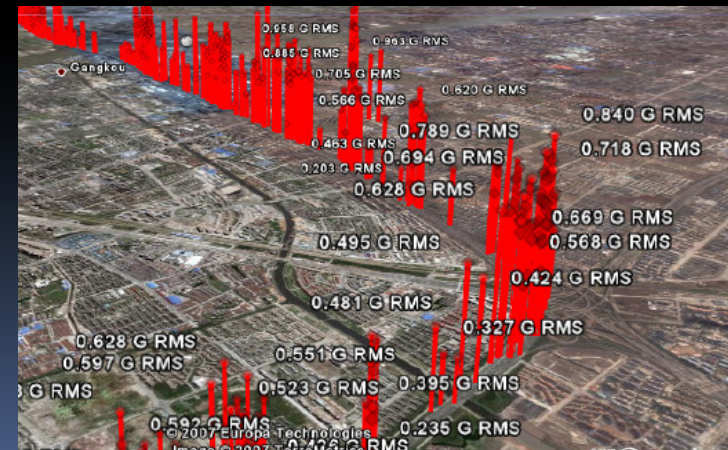
- Paragraph 8.7 *Condition samples*
 - Normal condition to 23 +/- 1°C, 50 +/-2 % relative humidity with a (pre)conditioning of 72h. See also section 6.

- Paragraph 8.8 *Perform tests*
 - Perform test in accordance with the test plan in paragraph 8.5, as directed in the referenced ASTM standards and in the special instructions for each test schedule.



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- Paragraph 8.9 *Evaluate Results*
 - Evaluate results to determine if the shipping units meet the acceptance criteria as defined underneath paragraph 8.3.
- Paragraph 8.10 *Document Test Results*
 - Document test results by reporting each step. See section 18.
- Paragraph 8.11 *Monitor shipments*
 - When possible, obtain feedback by monitoring shipments of the container that was tested to ensure that the type and quantity of damage obtained by the laboratory testing correlates with the damage that occurs in the distribution cycle. This information is very useful for the planning of subsequent tests of similar shipping containers.





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Referenced documents

Six step method from Lansmont Corporation

Environmental Engineering Handbook from Swedish Environmental Engineering Society

Transportation Stresses from Committee of European Environmental Engineering

Societies Department of Defense Test Method Standard MIL-STD 810 F

ASTM Standards

- D4169-08 Standard Practice for performance Testing of Shipping Containers and systems
- D996-04 Standard Terminology of Packaging and Distribution Environments
- D5276-98(04) Standard Test Method for Drop Test of Loaded Containers by Free Fall
- D880-92(2002) Standard Test Method for Impact Testing for Shipping Containers and Systems
- D6179-07 Standard Test Methods for Rough Handling of Unitized Loads and Large Shipping Cases and Crates
- D999-01 Standard Methods for Vibration Testing of Shipping Containers
- D4728-06 Standard Test Method for Random Vibration Testing of Shipping Containers
- D6344-04 Standard Test Method for Concentrated Impacts to Transport Packages