THE VOLLRATH COMPANY, L.L.C.

VOLLRATH SYSTEM WORK INSTRUCTION

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1.0 PURPOSE

This purpose of this document is to provide general guidelines and information to test and qualify packaged components, accessories and finished products. The tests described herein have been designed to ensure that the packaging used for Vollrath Company products will provides sufficient protection from the hazards encounter in transportation, storage and distribution shipping to the final customer.

2.0 SCOPE

This procedure applies to all packaging used by The Vollrath Company for shipping palletized product and non-palletized product thru all distribution environments. Combinations of tests described are used during initial package design and package qualification. Tests are to be performed in the order that they are listed in this specification. Exceptions to this procedure will be documented in the Purchase Order Process. All exceptions to this procedure must be approved by Vollrath Purchasing.

This document shall be used world-wide by Vollrath engineers, product teams, suppliers, OEM's (Original Equipment Manufacturers), and others that design, test, qualify and/or approve Vollrath packaging for shipment.

Any questions or concerns about this document, tests to be conducted, test levels and acceptance criteria should be directed to Vollrath Purchasing or Quality Assurance, who will then escalate to Engineering, as necessary.

3.0 REFERENCED DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

ASTM D642 Test Method for Determining Compressive Resistance of Shipping Containers, Components, and Unit Loads, American Society for Testing and Materials
ASTM D 880 Test Method for Impact Testing for Shipping Containers and Systems, American Society for Testing and Materials
ASTM D951 Standard Test Method for Water Resistance of Shipping Containers by Spray Method, American Society for Testing and Materials
ASTM D996 Terminology of Packaging and Distribution Environments, American Society for Testing and Materials
ASTM D999 Test Methods for Vibration Testing of Shipping Containers for Shipping Containers and Systems, American Society for Testing and Materials
ASTM D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing, American Society for Testing and Materials
ASTM D4728 Test Method for Random Vibration Testing of Shipping Containers, American Society for Testing and Materials
ASTM D5276 Test Method for Drop Test of Loaded Containers by Free Fall, American Society for Testing and Materials.

4.0 TERMINOLOGY

4.1 Definitions—General definitions for the packaging and distribution environments are found in Terminology ASTM D996.

5.0 SIGNIFICANCE AND USE

This procedure provides a guide for the evaluation of Vollrath packaging in accordance with a uniform system, using established test methods at levels representative of those occurring in actual distribution. The recommended test levels are based on available information on the shipping and handling environment, and current industry/government practice and experience. *These tests should be performed sequentially on the same package/Shipping Unit in the order given.*

For use as a performance test, this procedure requires that the package/Shipping Unit tested *remain unopened until the sequence of tests is completed.*

If used for other purposes, such as package development, it may be useful to open and inspect shipping units at various times throughout the sequence. This may, however, prohibit evaluating the influence of the container closure on container performance.

6.0 SHIPPING UNIT CLASSIFICATION

6.1 Shipping unit type: The levels of stress encountered by the package in the distribution environment depend on both the distribution environment and the packaging shipping unit type.

6.2 The Vollrath Company has identified three major shipping unit types as follows:

- Type 1 (Single – Non Palletized Products (Master Pack)
- Type 2 (Single Palletized/Crated Heavy Products)
- Type 3 (Multiple Product Unitized/Palletized Products – including bulk packs)

A product may have several shipping unit types, each for a different portion of its distribution. All must be evaluated. Each shipping unit design to be tested must be classified according to one of the following Type definitions.

6.2.1 TYPE 1: Single or multiple products boxed - Non-Palletized (Master Pack): Can be carried by one or two people. An individually packaged product which could be shipped as a single unit to an end user is defined as type 1, even if the packaged product moves in pallet load quantities during a portion of its physical distribution. This class also represents multiple, like units, combined in a single shipping container, typically non-palletized.

6.2.2 TYPE 2: Single Product- Palletized: This class represents the individual product, packaged or prepared for shipment such that it would only be handled by mechanical equipment and could not normally be carried by two people. Type 2 shipping units could include individually palletized product (i.e., cushioned pallet) or a large cabinet type product shipped unpackaged which would not realistically be carried by two people.

A special case exists for type 2 units. It is recognized that if a type 2 unit is relatively small or lightweight, it will likely not be handled mechanically but rather manually, similar to a type 1, during its distribution. Therefore if a type 2 unit weighs less than 150 pounds (68 kg), it is to be tested according to the methods, orientations and levels specified for a type 1 shipping unit.

6.2.3 TYPE 3: Multiple products - Unitized/Palletized on pallet: This class represents multiple products which are unitized and shipped only on pallets. This classification would include “bulk packed” products. “Bulk pack” packaging refers to a design which holds and transport multiples of the same product, shipped as a whole unit, on pallets. Unlike a pallet load of boxed units, where an individual unit could be withdrawn from the unitized load and shipped by itself, a bulk packed unit cannot be shipped in any other configuration. Protection from the distribution environment exists only in the conglomerate bulk pack, as opposed to individual protection around each product. Bulk pack shipping units require mechanical handling and cannot realistically be carried by two people.

7.0 TEST SPECIMEN

Test specimens consist of representative samples of a complete shipping unit, 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. Dummy test loads are acceptable if testing the actual product might be hazardous. If a dummy load is used, it should be instrumented to determine if the fragility level of the actual product has been exceeded. Take care to duplicate the load characteristics of the actual product, and avoid unnecessary pre-handling.

Care must be taken to ensure that no degradation has occurred to either the product or the package if the test packages have been shipped to the test site. If any doubt exists as to the condition of the package, repack the product in new packaging material before testing.

The number of test replications depends on the desired objectives of the testing and the availability of duplicate products and shipping containers. Replicate testing is recommended to improve the reliability of the test results.

8.0 SPECIFIC TESTS AND TEST LEVELS

The package must provide acceptable levels of product protection from the distribution environment. Establishing appropriate packaging tests and test levels will help minimize distribution damage.

Vollrath manufactures a variety of products that range in size, weight, and price. The determination of the appropriate test levels is ultimately determined by the Vollrath Company. Several products may have specific additional tests and unique requirements beyond what is covered in this document. Those specific tests required and the test levels are ultimately determined and established by the responsible Vollrath Company.

Whenever possible, it is highly recommended to compare the type and quantity of damage that occurs during package testing with the damage that occurs during actual distribution for similar products. That information can be very useful to help determine appropriate packaging tests and test levels for Vollrath's different products and multiple distribution environments.

The test levels specified in this document are based on Vollrath experience, current industry standards and Vollrath competitors' benchmarking information. A more severe test level can be used to lower probability of damage occurrence but usually means higher packaging and logistics costs. Likewise, a test level that is set too low has the potential for higher product damage, higher product return costs and increased customer dissatisfaction.

9.0 TEST SCHEDULE

The tests and limits described in this document are designed to evaluate a packaged product's ability to withstand specific levels of dynamic and static stresses it may experience in the distribution environment. However, it does not evaluate package performance relative to unusual and unexpected environmental conditions (i.e., long-term outdoor storage conditions, punctures from lift truck forks, accidental drop from the rear of a truck during transit, etc.). The fragility of the bare product is also a factor in the product's ability to survive the distribution environment and arrive at the final customer without degradation or damage.

The purpose of these tests is to simulate dynamic and static stresses, which can occur in the distribution and warehouse/storage systems. The following test sections will provide the appropriate test method and recommended minimum test levels. Tests are to be used as the final validation of a package design as deemed appropriate for the packaging shipping unit type and the planned/intended distribution system.

The test schedule and tests to be preformed are:

Test Schedule

No	Test Name	Shipping Unit Classification	ASTM Test Method
13	Impact/Free Fall Drop	Type 1	D880
14	Compression	Type 1, 2 & 3	D642
15	Random Vibration	Type 1	D4728
16	Fixed Displacement Vibration	Type 2 & 3	D999
17	Rotational Edge Drop	Type 2 & 3	D6179 Method A
18	Rotational Corner	Type 2 & 3	D6179 Method B
19	Rotational Flat Drop	Type 2 & 3	D6179 Method C
20	Tip Test	Type 2 & 3	D6179 Method F
21	Tipover	Type 2 & 3	D6179 Method G
22	Field Test	Type 1, 2 & 3	Optional

10.0 CONDITIONING

10.1 Conduct the test at standard conditions and compensate for the effects of any climatic condition. Condition the shipping units to a standard atmosphere of 73.4 ± 2°F (23 ± 1°C) and 50 ± 2 % relative humidity. Condition fiberboard/corrugated containers in accordance with Practice D4332. The same atmospheric condition should be used for each test procedure. A conditioning period of 72 hours or sufficient time to reach equilibrium of all parts of the package and product is recommended. Tests should be conducted in the conditioned atmosphere whenever possible. If not possible, conduct the tests as soon after removal from the conditioning atmosphere as practicable. Recondition the shipping units to the standard atmosphere as necessary during the test plan.

10.2 In some circumstances, it may be necessary to conduct some or all of the tests at special climatic conditions, such as those given in Practice D4332, or Test Method D951, or others (salt, spray, water immersion, humidity, or temperature).

11.0 ACCEPTANCE CRITERIA

11.1 The package must provide acceptable levels of product protection from the distribution environment and also withstand storage stresses. This section provides a basis for determining what constitutes damage or failure of both the product and the package.

11.2 The representative from the Vollrath Quality Assurance department will establish specific acceptance criteria prior to EACH test procedure. The acceptance criteria must be suitable for their purpose, considering the required condition of both the product and package upon receipt to the final customer. Below are some guidelines for defining PRODUCT and PACKAGING damage.

11.3PRODUCT DAMAGE: this can be any condition which causes the product not to meet its performance specifications. It includes both structural and cosmetic damage which makes the product unacceptable to the customer. It is recommended the same standards for final inspection during manufacturing be used to determine acceptable levels of cosmetic damage. Examples of general acceptance criteria are as follows:

- Product is damage-free; no structural damage including no detached, loose, fractured or deformed materials beyond allowable manufacturing tolerances.
- Product cosmetic areas are not degraded beyond manufacturing or final acceptance criteria.
- Cosmetic damage is any abnormality that makes the product unacceptable to the customer.
- The product should meet all product data sheet and manufacturing specifications and tolerances after testing.
- The product functions to specification.

11.4PACKAGING DAMAGE: the package's purpose is to absorb or modify the energy imparted by the distribution environment, (sustaining ordinary degradation as a result), and to protect and preserve the product in its original undamaged condition (see 10.2.1 product damage). Some package degradation is expected and is acceptable. Unacceptable package degradation can be defined as, but is not limited to:

- Any change in package condition, including fractured or deformed materials that result in product damage or permanent displacement of the product and accessories from their intended position.
- Edge ruptures to the extent that it can no longer contain the product or support the product's weight.
- Failure of packaging joints or surfaces which result in internal packaging to lose original configuration.
- No conductive particles should be present from abrasion or other sources.
- Some cushion deformation and cracking is acceptable. Complete cushion material fracture and/or cushion damage such that adequate product protection is absent is unacceptable.
- Multiple fractured cushion pieces may cause customer concerns, dissatisfaction and possibly product returns (even if the product still functions to specification).
- Severe damage to packaging materials/mediums is not acceptable.

12.0 PRODCEDURE

12.1 *Define Shipping Unit*—Describe shipping unit in terms of size, weight, and form of construction.

12.2 *Determine Acceptance Criteria*—Acceptance criteria are related to the desired condition of the product and package at the end of the distribution cycle. The responsible WD Branded entity or Mechanical Engineering department must establish specific acceptance criteria prior to each test procedure.

12.3 Select Samples for Test—See Section 6.

12.4 Condition Samples—See Section 7.

12.5 *Perform Tests*— Perform tests as directed in the referenced ASTM standards and as further modified in the special instructions for each test schedule.

12.6 *Evaluate Results*— Evaluate results to determine if the shipping units meet the acceptance criteria. See Section 8.

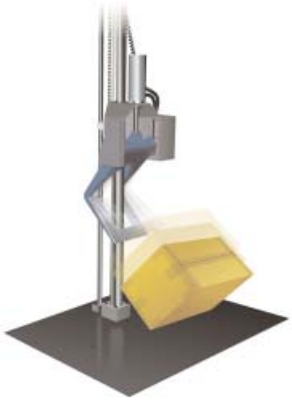
12.7 *Document Test Results*—Document test results by reporting each step. See Section 17.

12.8 *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.

TEST SCHEDULE:

13.0 IMPACT/FREE-FALL DROP TEST:

Tests are to be performed on a Free-Fall Drop tester (as seen in the image below and as described in ASTM D5276). The package is to be dropped onto a flat, firm, non-yielding steel base.



Test rationale: The purpose of this test is to evaluate the ability of a packaged product to withstand sudden shocks due to free fall drops within the distribution system.

13.1 TEST PROCEDURE: ASTM D880

13.2 Condition tests specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with Practice D4332.

13.3 **Test Specimen:** Both the product and packaging should be representative of the final product and be configured for shipping.

13.4 Identify package surfaces: With the packaged product in its most stable shipping position, face one end of the master box with the manufacturer's joint on the right, and identify the surfaces as follows:

13.5 Top as one (1)

13.6 Right side as two (2)

13.7 Bottom as three (3)

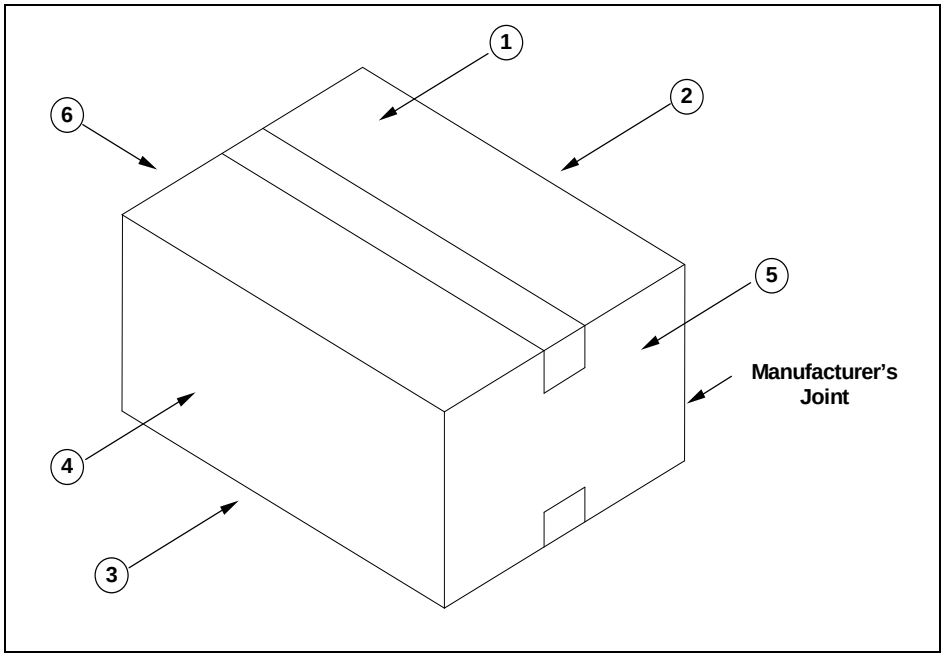
13.8 Left side as four (4)

13.9 Near end as five (5)

13.10 Far end as six (6

13.11 Identify the corner formed by faces 2, 3, and 5.

13.12 Identify the edges by faces 2-5, 3-5, and 2-3.



13.13 Drop the packaged product as specified in the following sequence (per ASTM D5276). The drop height for each test specimen varies with package weight as shown in the below.

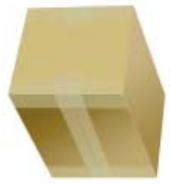
Weight	Drop Height
0 - 20.99 lbs. (0 - 9.54 kg)	30 in. (76.2 cm)
21 - 40.99 lbs. (9.55 – 18.63 kg)	24 in. (60.9 cm)
41 - 60.99lbs. (18.64 – 27.72 kg)	18 in. (45.7 cm)
61- 100 lbs. (27.73 – 45.45 kg)	12 in. (30.5 cm)

13.14 DO NOT change out the cushioning. The same set of cushioning should be used throughout the test.

DROP 1: 2-3-5 corner.

DROP 2: 2-5 Edge / shortest edge radiating from drop corner.

DROP 3: 3-5 Edge / medium edge radiating from drop corner.



DROP 4: 3-2 Edge / longest edge radiating from drop corner.

DROP 5: End 5 / smallest flat face.

DROP 6: End 6 / **opposite** smallest flat face.

DROP 7: Side 2 / Medium flat face.

DROP 8: Side 4 / opposite medium flat face.

DROP 9: Bottom 3 / largest flat face.

DROP 10: Top 1 / opposite largest flat face.

13.15 Compile data from all drops, photographs and any other associated test records.

13.16 Perform Pass/Fail Assessment and prepare report.

14.0 COMPRESSION TEST:

The purpose of this test is to ensure the packaged product will survive compressive loading and maintain load integrity during worldwide warehousing and distribution. All tests are performed on a dynamic compression tester equipped with computerized control system as seen in the image below and described in ASTM D642.

REQUIRED COMPRESSION STRENGTH: The required compressive strength of a shipping container is based upon the gross weight of one container and the anticipated height of like containers stacked on top. Unlike standard engineering materials, corrugated board's physical strength becomes unpredictable within its normal range of use. As a result, a safety factor is used to account for variations in relative humidity, stack misalignment, length of storage time and other such conditions. WD recommends a Safety Factor of five (5) for qualifying empty corrugated boxes if 100% of the compressive load is being supported by the corrugated and paper-based interior packaging.

The minimum required compressive strength of an individual container is based upon the following formula:

Compression Load (pounds) = 0.007 x (108 – H) x L x W x 5

14.1 TESTING PROCEDURE: ASTM D642

14.2 Condition test specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

14.3 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping. For crated or palletized product, a top load hazard - pallet of similar size and shape is required.

14.4 Calculate the compression load required: **using the formula above, where:**

- 0.007 = Average density of freight in pounds per cubic inch (12 lbs. per cubic foot)
- 108 = Maximum height (inches) of package stack in transit
- H = Height of shipping unit (inches)
- L = Length of shipping unit (inches)
- W = Width of shipping unit (inches)
- 5 = Safety Factor to account for humidity, time and stacking pattern

14.5 Set up the compression tester to run at a rate of 0.5 inches (13 mm) per minute. Center the package on the lower platen of the compression tester. Place the top-load pallet hazard device on top of the test sample.

14.6 Run test per ASTM D642 until the calculated target compression load is met or the test package fails. Record maximum compression load obtained.

14.7 Perform pass/fail assessment and prepare report based upon calculated and recorded results.

VIBRATION TESTS:

Vibrations are present in all methods of transport and can be a source of damaging input. Vibrational damage can be regarded in two broad categories: (1) Damage due to relative motion of one part against another, most commonly observed as scuffing or abrasion. (2) Damage due to resonance conditions, which may be observed as a range of physical damage. The greater proportion of damage occurs in the frequency ranges of 3 to 30 Hz.

The following test methods are to be used for various modes of transportation or product/packaging development purposes. **The responsible Vollrath entity or Engineering department will establish which tests are to be conducted for qualification and the specific acceptance criteria prior to testing.**

15.0 RANDOM VIBRATION TEST:

Random vibration tests are performed on computer controlled servo hydraulic vibration table (as seen in the image below and as described in ASTM D4728) in an attempt to mimic the combination of overlying vibration frequencies that occur simultaneously in transportation.

Shaping the power spectrum by defining power spectral density (PSD) versus frequency breakpoints allows for representative excitation at the dominant forcing frequency ranges found within each mode of transport while avoiding overstress across the entire spectral bandwidth. The fragility of the bare product is also a factor in the product's ability to survive the distribution environment and arrive at the final customer without degradation or damage.

15.1 The following power spectral densities, as defined by the mode of transport, frequency and amplitude breakpoints, and test duration are recommended.

Truck

Frequency, Hz	PSD, g2/Hz*
1	0.0001
4	0.02
16	0.02
40	0.002
80	0.002
200	0.00002
Overall, g rams	0.73
Duration, mines	180

*Power Spectral Density Level, g2/Hz

15.2 TEST PROCEDURE: ASTM D4728

15.3 Condition test specimens 73.4 ± 2°f (23 ± 1°c), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

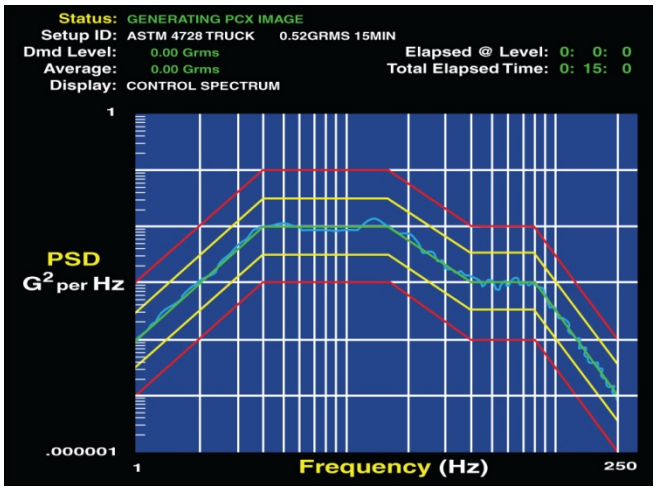
15.4 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping.

15.5 Instrumentation: when required, instrument a pre-tested functional product on the base – clear of obstructions. Photograph the open package with the instrumented product. Close the container using specified shipping tape.

15.6 Test orientation: each package will be tested in all 3 axes. Packages will be attached to the table in a manner that restrains the horizontal motion for each orientation. No vertical hold down restraint shall be used over the top of the load.

15.7 Set up: program the computer controlled servo hydraulic vibration system to reproduce a random truck vibration profile - representing the Vollrath cross country truck distribution environment as indicated in the spectra profile in 13.1.

The PSD profile for the truck transportation will look similar as shown below:



15.8 Set the duration for the truck sequence at 60 minutes.

15.9 Perform test in accordance with ASTM D4728. Test all of the package's axes which may be subjected to vertical transportation vibration. Total test duration is to be distributed evenly between the orientations tested.

15.10 If using instrumentation, record any peculiar frequency/resonance or other note worthy observations that may negatively affect the product.

15.11 When testing is complete, conduct a complete physical evaluation of the shipping container and the product. Photograph any note worthy or questionable damage.

15.12 Perform pass/fail assessment and prepare report.

16.0 FIXED DISPLACEMENT VIBRATION - REPETITIVE SHOCK TEST:

Repetitive Shock tests are suitable for tests of individual containers that are transported unrestrained on the bed of a vehicle. The test level and the test methods of this portion of the distribution cycle are intended to determine the ability of the shipping unit to withstand the repetitive shocks occurring during transportation of bulk or loose loads. The test level and test method account for amplitude, direction, and duration of the repetitive shocks.

Repetitive Shock tests can be performed on a servo hydraulic vibration or a vertical mechanical table (as described in ASTM D999 Method A1) or on a rotary mechanical vibration table (as shown below and described in ASTM D999 Method A2).

16.1 TEST PROCEDURE: ASTM D999 TEST METHOD A1 OR A2

16.2 Condition test specimens 73.4 ± 2°f (23 ± 1°c), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

16.3 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping.

16.4 Test orientation: each package will be tested in all 3 axes. Packages will be attached to the table in a manner that restrains the horizontal motion for each orientation. No vertical hold down restraint shall be used over the top of the load.

16.5 Set up: a metal shim is to be used in methods A1 and A2 for determining when the shipping container is leaving the testing platform by a sufficient amount as described in ASTM D999. Specifications for the metal shim used in methods a1 and a2 are:

- Width: 50 mm (2.0 in.) minimum
- Thickness: 1.6 mm (0.063 in.)
- Length: 254 mm (10.0 in.) minimum

16.6 Perform Test: in accordance with ASTM D999, start the vibration of the platform at a frequency of about 2 Hz, and steadily increase the frequency until the metal shim can be inserted under one long edge of the container and moved intermittently along the entire length of the container. When inserted, the shim must be flat, not at an angle. When the shim is inserted a minimum of 100 mm (4in.) under the shipping container, the proper test frequency has been reached. Test all of the package's axes which may be subjected to vertical transportation vibration.

16.7 Total test dwell time of 60 minutes is to be distributed 50 % along normal vertical shipping axis and remaining 50 % evenly along all other possible shipping orientations.

16.8 When testing is complete, conduct a complete physical evaluation of the shipping container and the product. Photograph any note worthy or questionable damage.

16.9 Perform pass/fail assessment and prepare report.

17.0 ROTATIONAL EDGE DROP TEST:

17.1 TEST PROCEDURE: ASTM D6179 TEST METHOD A

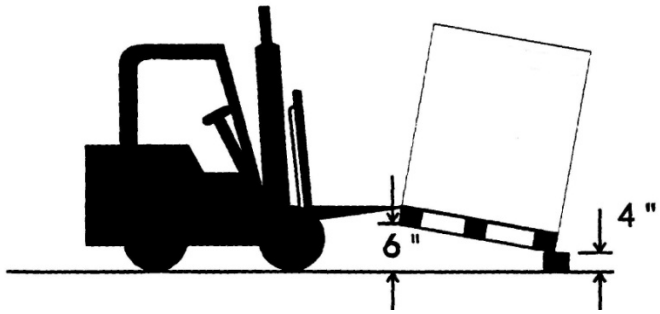
17.2 Condition test specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

17.3 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping.

17.4 Raise one end of the case or crate and set it upon a 4” (10 cm) timber or other support, placed at right angles to the length of the case or crate.

17.5 The height of the support shall be sufficient to ensure that there will be no support for the base between the ends of the test item when dropping takes place, but should not be high enough to cause the test item to slide on the support when the drop end is raised for the drop.

17.6 Raise the impact edge 6” (15cm) high off impact surface while opposite edge is supported on 4” (10 cm) tall timber. Release case or crate to-fall freely to impact surface. See image below:



17.7 Repeat drop on each of four edges - specific order is not important.

17.8 Where test items are tall or top heavy, provision must be made to prevent the test item from tipping over after the drop is made.

17.9 Perform pass/fail assessment and prepare report.

18.0 ROTATIONAL CORNER DROP TEST:

18.1 TEST PROCEDURE: ASTM D6179 TEST METHOD B

18.2 Condition test specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

18.3 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping.

18.4 Start up by setting up the case or crate as defined for the Rotational Edge Drop Test (section 17).

18.5 Place the 4 in. (10 cm) block flat under one corner of the end already supported in order to raise one corner higher than the other so that impacts on the diagonally opposite corner can be obtained.

18.6 Raise the unsupported end of the test item so that the lower corner of that end reaches 6” (15cm) high from the impact surface. Release case or crate to-fall freely to impact surface.

18.7 Repeat drop on each of four corners - specific order is not important.

18.8 Where test items are tall or top heavy, provision must be made to prevent the test item from tipping over after the drop is made.

18.9 Perform pass/fail assessment and prepare report.

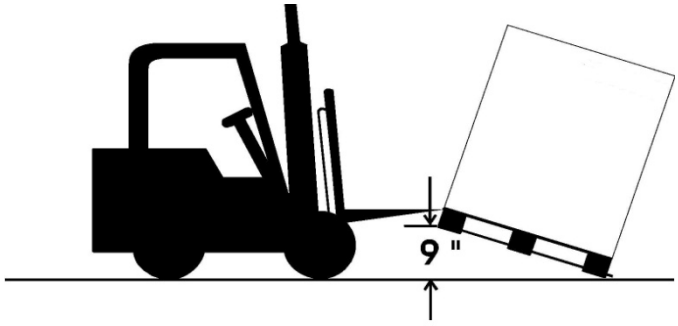
19.0 ROTATIONAL FLAT DROP TEST:

19.1 TEST PROCEDURE: ASTM D6179 TEST METHOD C

19.2 Condition test specimens 73.4 ± 2°f (23 ± 1°c), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

19.3 Test specimen: both the product and packaging should be representative of the final product and be configured for shipping.

19.4 With one edge of the case, crate or unitized load supported by the floor, raise the other end to 9” (23cm) high and release to free fall flat on the impact surface. See image below:



19.5 Repeat the drop on each of four sides - specific order is not important.

19.6 Where test items are tall or top heavy, provision must be made to prevent the test item from tipping over after the drop is made.

19.7 Perform pass/fail assessment and prepare report.

20.0 TIP TEST:

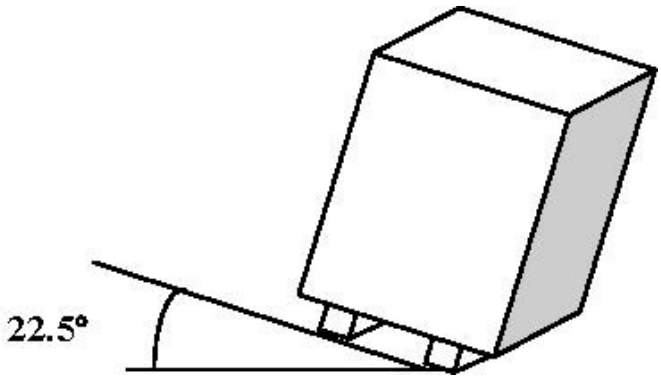
20.1 TEST PROCEDURE: ASTM D6179 TEST METHOD F

20.2 Condition test specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

20.3 Test specimen: Use a case, crate, or unitized load of shipping containers each full loaded with the actual contents. If use of actual contents is not practical, a dummy load of the same total mass, size, and weight distribution may be substituted. The contents or dummy load shall be blocked, braced, and cushioned in place. Cases and crates should be closed normally as for shipment. Unitized loads should be stretch-wrapped or strapped onto a pallet as applicable.

20.4 Loose chains, slings, or similar restraints shall be positioned around the test item to prevent a complete tipover and impact. These restraints can also provide operator protection during the test.

20.5 Tilt the test item to a 22° angle from the vertical position in the most critical direction. After releasing the test item, determine which way the test item begins to move, tip over, or return to base, and then return the test item gently back onto its base.



20.6 The test should be repeated in all potentially unstable directions.

20.7 If the test item begins to tip over in any direction when tilted to the specified angle, the center of gravity must be lowered or the dimensions of the base must be increased until the test item does not begin to tip over, or the case or crate and product must be able to pass the tipover test procedure described in Section 21.

20.8 Perform pass/fail assessment and prepare report.

21.0 TIPOVER TEST:

21.1 TEST PROCEDURE: ASTM D6179 TEST METHOD G

21.2 Condition test specimens 73.4 ± 2°F (23 ± 1°C), 50 ± 2 % relative humidity in accordance with practice ASTM D4332.

21.3 Test specimen: Use a case or crate fully loaded with the actual contents. If use of actual contents is not practical, a dummy load of the same total mass, size, and weight distribution may be substituted. The contents or dummy load shall be blocked, braced, and cushioned in place and the package closed normally as for shipment.

21.4 Place the test item in the predetermined attitude on the impact surface (such as standing on its base or one of its smaller faces).

21.5 The test item shall be slowly tipped until it falls freely without thrust onto the face opposite that of load application.

21.6 Examine the test item and record any external signs of damage.

21.7 Repeat the test with the test item standing on, or impacting onto other appropriate faces. In the case of tall test items, the repeat tests shall be carried out with the test item standing on its normal base and toppling onto each side face in turn).

21.8 In the case of flat test items (or tall test items where the normal base is not defined), the tests shall be carried out with the test item standing on each smaller face in turn and impacting onto each of the larger faces.

21.9 On completion of the test sequence, open the test item and examine the condition of the contents.

21.10 Perform pass/fail assessment and prepare report.

22.0 FIELD TEST

22.1 This test is designed to determine whether a new packaged product can survive in the planned distribution environment without being damaged. *(Caution: The results obtained from limited field shipment testing may not be statistically significant to assure damage free distribution of products in full production.*

22.2 This test should supplement, not supersede, the tests in the previous sections of this procedure.

22.3 Physical Evaluation: Conduct a physical evaluation of the shipping container and the product and a performance test of the product prior to testing.

22.4 Test Requirements/Procedure: A round trip/return shipment may be used without inspecting the packaging when it arrives at the destination if there are no local qualified resources to properly evaluate the packaging/product. Shipment must be clearly marked (see image below) and documented as to how and when the shipment was made and received.

22.5 NOTE: *It will be much more difficult to isolate what portion of the distribution environment caused the damage (if any).* Also, with a return shipment there will be 2-segments of distribution shipment rather than just 1-segment (which is normal for most products). A round trip/return shipment may also provide a first pass indication of the design margin of your package

22.6 Ship several samples of the package design (single, palletized, and/or bulk) to other locations, using various representative transportation modes, and have the local Packaging Engineer/suppliers evaluate and document the condition of the package and product upon arrival.

22.7 Have remote locations inspect, photograph and repack the product in its original packaging (repacking instructions or procedures should be provided) and return via the desired transportation mode.

22.8 Evaluate and Record: Conduct a physical evaluation of the shipping container and the product and a performance test of the product. Record the nature of any damage that occurs.