ista | OVERVIEW

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ISTA General Simulation Performance Test PROJECT*

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For complete listing of Procedure Changes and Version Dates go to www.ista.org

ISTA, Distributing Confidence, Worldwide™

General Simulation tests

- Challenge the capability of the package and product to withstand transport hazards, **but**
- Utilize general simulation of actual transport hazards, **and**
- Do not necessarily comply with carrier packaging regulations.

When properly executed, ISTA procedures will provide tangible benefits of:

- Product to market time reduction
- Confidence in product launch
- Reduction in damage and product loss
- Balanced distribution costs
- Customer satisfaction contributing to increased market share

There are two sections to this procedure: Overview and Testing

- **Overview** provides general knowledge required before testing **and**
- **Testing** presents the specific instructions to do laboratory testing.

Two systems of weights and measures are presented in ISTA test procedures: English system (Inch-Pound) or SI (Metric). Inch-Pound units are shown first followed by the Metric units in parentheses; there may be exceptions in some tables (when shown separately).

Familiarity with the following units and symbols used in this document is required:

For measuring	English units and symbols	Metric units and symbols
Weight	pounds (lb)	kilograms (kg) or grams (gm)
Force	pounds force (lbf)	newtons (N)
Distance	feet (ft) or inches (in)	meters (m) or millimeters (mm)
Velocity	inches per second (in/sec)	meters per second (m/sec) or millimeters per second (mm/sec)
Volume	cubic inches (in^3)	cubic centimeters (cm^3) or cubic meters (m^3)
Density	pounds per cubic inch (lb/in^3)	kilograms per cubic meter (kg/m^3)
Temperature	Fahrenheit (°F)	Celsius (°C)

- Either system may be used as the unit of measure, **but**
- The units chosen shall be used consistently throughout the procedure.
- Units are typically converted to two significant figures **and**
- Not exact equivalents.

OVERVIEW OF PROJECT 3M

Packaged-Product Types

- **Palletized, initially shipped palletized** (on standard or custom pallet)
  - Selling unit is the unchanged palletized load
  - Selling unit is *other* than the unchanged palletized load, including elongated and flat package-products
- **Floor-loaded, large initially shipped floor-loaded** packaged-products, including elongated and flat packaged-products
  - A floor-loaded packaged-product is considered **Large** if it
    - Weighs 50 lb (23 kg) or more **or**
    - The longest dimension is 24 in (610 mm) or greater **and** the next-longest dimension is 20 in (510 mm) or greater **and** the shortest dimension is 20 in (510 mm) or greater **or**
    - Any of the length, width, or height dimensions are 30 in (760 mm) or greater
- **Floor-loaded, small initially shipped floor-loaded** packaged-products, including elongated and flat packaged-products
  - A floor-loaded packaged-product is considered **Small** if it does not meet the definition of **Large** above.

Definitions

- **Floor-Loaded.** Products which are initially shipped without being unitized or palletized, initially loaded directly into a transport vehicle or ocean container, where the store quantity is a case or unit.
- **Selling Unit.**
  - The packaged-product(s) typically shipped at any one time to an individual end consumer.
- **International Shipment.** Where the initial point of origin is outside the U.S.
- **Unitized Load**
  - Multiple articles or packages bound together (with straps, shrink- or stretch-film, etc.) for handling and transportation as one unit.
  - A group of packaged-products may be shipped from the manufacturer or producer in a unitized load, but the load may subsequently be disassembled into smaller groups or individual packaged-products for shipment to the fulfillment center (FC), distribution center (DC), or end consumer.
- **Standard and Custom Pallet.** A standard pallet is a design which is in wide industry use, with published specifications, quality, and applications, used within those specifications and in a typical application. Standard pallets have information, provided by their manufacturers or distributors, available on the internet. A custom pallet is one designed for a specific product or narrow range of products, and with its design and performance characteristics not widely known or published.
- **Elongated Packaged-Product**
  - A packaged-product where the longest dimension is 36 in (910 mm) or greater **and**
  - both of the other dimensions are each 20 percent or less of the longest dimension
- **Flat Packaged-Product**
  - A packaged-product where the shortest dimension is 8 in (200 mm) or less **and**
  - the next longest dimension is four (4) or more times larger than the shortest dimension, **and**
  - the volume is 800 in^3 (13,000 cm^3) or greater

  NOTE: If a packaged-product is both Elongated and Flat in accordance with the above definitions, it should be tested as Elongated.
- **Transloading.** The process of transferring cargo from one transportation mode to another—such as ocean containers to rail cars or trucks—at specialized facilities. Common uses include transferring goods from 40-foot ocean containers to 53-foot domestic trailers.
- **Slip Sheet.** A flat sheet of material with tabs on one or more sides, used as a base upon which to assemble, store, handle and transport goods and materials as a unit load.

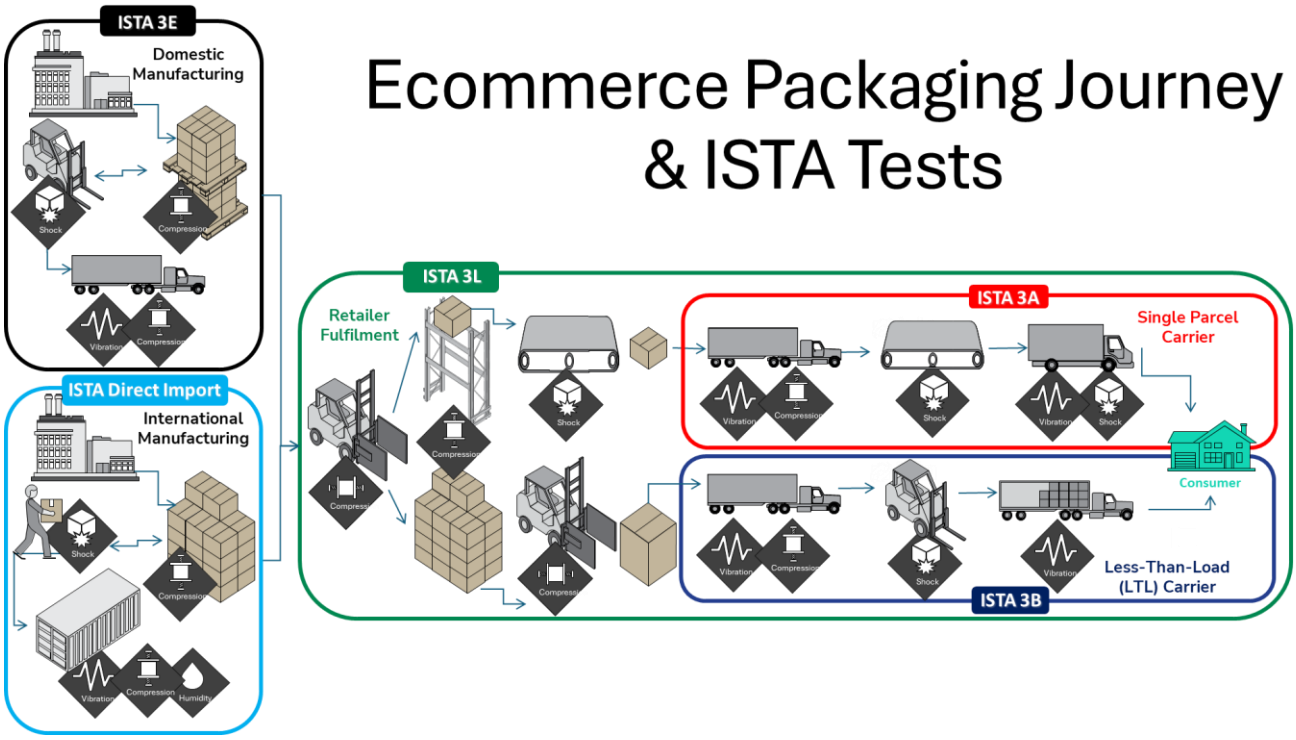
OVERVIEW OF PROJECT 3M

Scope

Project 3M, Direct Import, covers testing of packaged products prepared for international shipment from Asia-Pacific manufacturing sites to a U.S. Distribution Center (DC) or a retailer Fulfillment Center (FC). Packaged products are typically shipped from the manufacturer in sea containers, either floor loaded or palletized. The shipment configuration may be changed at a DC or during transloading to support system needs, meet FC requirements, or prepare for delivery to the end consumer. Handling may include manual handling, forklifts, clamp trucks, and other equipment.

This test is intended to expose a packaged product to hazards commonly encountered during the extended international inbound leg to a retailer's FC. It may be paired with other ISTA tests, such as 3L, which addresses offload at the retailer FC through final delivery by parcel or less-than-truckload (LTL). Together, these tests help assess package protection across the full supply-chain journey. The included generalized distribution map shows the correlation between a packages journey, common distribution hazards, and ISTA tests.

NOTE: This test is not intended to account for the air freight shipping environment or the specific distribution events that could occur while a ship is out of port.



Product Damage Tolerance and Package Degradation Allowance

The shipper, manufacturer, and/or other stakeholders shall determine the following prior to testing, to permit the determination of *pass* or *fail* at the conclusion of the tests:

- what constitutes damage to the product **and**
- what damage tolerance level is allowable, if any, **and**
- the correct methodology to determine product condition at the conclusion of the test **and**
- the acceptable package condition at the conclusion of the test.

For additional information on these determinations refer to *Guidelines for Selecting and Using ISTA Test Procedures and Projects.*

Additional Information, *IMPORTANT*

The shipper, manufacturer, and/or other stakeholders shall also provide information regarding the selling quantity, pallet type, initial shipment configuration, approved container loading diagram, details of shipment and configurations within the distribution system as required to determine proper testing parameters. Many of the TEST BLOCKS require such information for proper implementation; see the individual TEST BLOCKS for specific details.

OVERVIEW OF PROJECT 3M

Samples

Both products and packages should be as close as possible to actual production items. Pre-production prototypes such as hand-made samples, CAD-generated one-of-a-kind or short run samples, etc. are usually not sufficiently representative of production items to yield meaningful test results. It may be appropriate to conduct preliminary tests of a product and package early in the development cycle, but final official testing should be performed with actual production items.

One sample is required for this test procedure. If the sample is a palletized or unitized load, it may be required to select individual case or unit samples from that load for further testing as directed.

When multiple identical specimens are tested, all specimens must pass all tests.

To permit an adequate determination of representative performance of the packaged-product, ISTA:

- *Requires* the test procedure, with the required number of samples, to be performed one time, **but**
- *Recommends* performing the entire test procedure five or more times using new samples for each test.

Refer to *Guidelines for Selecting and Using ISTA Test Procedures and Projects* for additional information.

NOTE:
In order to ensure testing in perfect condition, products and packages shipped to an ISTA Certified Laboratory for testing shall be:

- Adequately over-packaged for shipment **or**
- Repackaged in new packaging at the laboratory.

NOTE:
Any pallet or skid used in this procedure should be of a type and condition which is typical of what is in actual field use for the packaged-product being tested.

NOTE:
It is important to thoroughly document the configuration, materials, and construction of the tested product and package. Significant variations in performance can sometimes be caused by seemingly insignificant differences. Photo documentation is strongly recommended to supplement detailed written descriptions.

OVERVIEW OF PROJECT 3M

The tests shall be performed on each test sample in the sequence indicated in the following tables:

Initially Shipped on Standard or Custom Pallet

Note: Also use this test for items which are *unitized* and initially shipped floor-loaded on a slipsheet, but which are ultimately placed on a pallet for shipment *as a unit*. Properly secure the unit to a standard pallet (with several layers of stretch wrap, with strapping, or with other appropriate means).

Sequence Number	Distribution Scenario	Hazard Type	Test Method	Test Level (Intensity/Duration)	Remarks	Reference (ISTA Test; Test Block)
1	Warehouse storage and container loading in Asia	Atmospheric Conditioning	Controlled Temperature and Humidity	Hot & Humid (100F 85RH) 72 Hours	Required	6-Amazon.com-SIOC; Test Block 1 (Based on ISTA 2024 China field data collection)
2	Warehouse & sea container stacking	Compression, Vertical	Compression Machine	Calculated from formula Maintain force for 1 hour or apply and release(additional 1.4 factor)-	Required	6-Sam's Club; Test Block 4
3	Handling; sea container loading & port handling of sea container	Shock	Inclined or Horizontal Impact	42 in/sec (3.5 ft/sec) (1.1 m/sec) impact velocity or velocity change Impact all 4 vertical faces of pallet load	Required	6-Sam's Club; Test Block 2
4	Handling: Sea container handling at port of origin	Shock	Rotational Flat Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 3
5	Transport; Truck from manufacturing location (Asia) to port of origin	Vibration, Vertical	Random	Overall Grms level of (0.46) for 3 hours	Required	6-Sam's Club; Test Block 8
6	Handling; Sea container at port of arrival	Shock	Rotational Edge Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 9
7	Handling; Rail impacts	Shock	Long Duration Horizontal Impact	6 mph (2.7 m/s) 300 ms Trapezoidal	Required for Rail Shipments	ISTA 3H; Test Block 9
8	Transport; Port to FC	Vibration, Vertical	Random	Overall Grms level varies with mode of transport for duration based upon distance	Required	ISTA 3H; Test Block 5
9	Handling; Clamping during crossdocking at Transloader	Compression, Horizontal	Clamp or Compression Machine	Calculated from formula Clamp in multiple orientations	Required **if** the "selling unit" is *not* the unchanged pallet load	6-Amazon.com-SIOC; Test Block 9

OVERVIEW OF PROJECT 3M

Initially Shipped Floor-Loaded into a Transport Vehicle or Ocean Container, Packaged-Product Defined as Large

Note: *If the item is unitized* and initially shipped floor-loaded on a slipsheet, but which are ultimately placed on a pallet for shipment *as a unit* then use test sequence "Initially Shipped on Standard or Custom Pallet."

Test Sequence Initially Shipped Floor-Loaded, Packaged-Product Defined as *Large*

Sequence Number	Distribution Scenario	Hazard Type	Test Method	Test Level (Intensity/Duration)	Remarks	Reference (ISTA Test; Test Block)
1	Warehouse storage and container loading in Asia	Atmospheric Conditioning	Controlled Temperature and Humidity	Hot & Humid (100F 85RH) 72 Hours	Required	6-Amazon.com-SIOC; Test Block 1 (Based on ISTA 2024 China field data collection)
2	Warehouse & sea container stacking	Compression, Vertical	Compression Machine	Calculated from formula Maintain force for 1 hour or apply and release(additional 1.4 factor)-	Required	6-Sam's Club; Test Block 4
3	Handling; sea container loading & port handling of sea container	Shock	Inclined or Horizontal Impact	42 in/sec (3.5 ft/sec) (1.1 m/sec) impact velocity or velocity change Impact 4 & 6 faces	Required	6-Sam's Club; Test Block 2
4	Handling: Sea container handling at port of origin	Shock	Rotational Flat Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 3
5	Transport; Truck from manufacturing location (Asia) to port of origin	Vibration, Vertical	Random With Top Load	Overall Grms level of (0.46) for 3 hours with Top Load at bulk density 0.0035 lbs/in3 (96 kg/m3)	Required	6-Sam's Club; Test Block 8
6	Handling; Sea container at port of arrival	Shock	Rotational Edge Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 9
7	Handling; Clamping during crossdocking at Transloader	Compression, Horizontal	Clamp or Compression Machine	Calculated from formula Clamp in multiple orientations	Required	6-Amazon.com-SIOC; Test Block 9
8	Handling; Rail impacts	Shock	Long Duration Horizontal Impact	6 mph (2.7 m/s) 300 ms Trapezoidal	Required for Rail Shipments	ISTA 3H; Test Block 9
9	Transport; Transfer from Transloader to FC	Vibration, Vertical	Random With Top Load	Overall Grms level of 0.54 for 3 hours with Top Load at bulk density 0.0035 lbs/in3 (96 kg/m3)	Required Test in intended orientation	6-Amazon.com-SIOC; Test Block 13

OVERVIEW OF PROJECT 3M

Initially Shipped Floor-Loaded into a Transport Vehicle or Ocean Container, Packaged-Product Defined as Small

Note: *If the item is unitized* and initially shipped floor-loaded on a slipsheet, but which are ultimately placed on a pallet for shipment *as a unit* then use test sequence "Initially Shipped on Standard or Custom Pallet."

Sequence Number	Distribution Scenario	Hazard Type	Test Method	Test Level (Intensity/Duration)	Remarks	Reference (ISTA Test; Test Block)
1	Warehouse storage and container loading in Asia	Atmospheric Conditioning	Controlled Temperature and Humidity	Hot & Humid (100F 85RH) 72 Hours	Required	6-Amazon.com-SIOC; Test Block 1 (Based on ISTA 2024 China field data collection)
2	Warehouse & sea container stacking	Compression, Vertical	Compression Machine	Calculated from formula Maintain force for 1 hour or apply and release(additional 1.4 factor)-	Required	6-Sam's Club; Test Block 4
3	Handling; sea container loading & port handling of sea container	Shock	Free-Fall Drop Multiple Orientations	18 in (460 mm) max.	Required	6-Sam's Club; Test Block 6
4	Handling: Sea container handling at port of origin	Shock	Rotational Flat Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 3
5	Transport; Truck from manufacturing location (Asia) to port of origin	Vibration, Vertical	Random With Top Load	Overall Grms level of (0.46) for 3 hours with Top Load at bulk density 0.0035 lbs/in3 (96 kg/m3)	Required	6-Sam's Club; Test Block 8
6	Handling; Sea container at port of arrival	Shock	Rotational Edge Drop	9 in (230 mm) Test in multiple orientations	Required	6-Sam's Club; Test Block 9
7	Handling; Clamping during crossdocking at Transloader	Compression, Horizontal	Clamp or Compression Machine	Calculated from formula Clamp in multiple orientations	Required	6-Amazon.com-SIOC; Test Block 9
8	Transport; Transfer from Transloader to FC	Vibration, Vertical	Random With Top Load	Overall Grms level of 0.54 for 3 hours with Top Load at bulk density 0.0035 lbs/in3 (96 kg/m3)	Required Test in intended orientation	6-Amazon.com-SIOC; Test Block 13

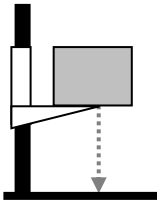
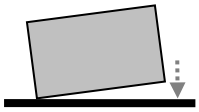
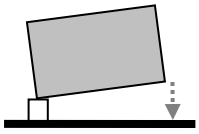
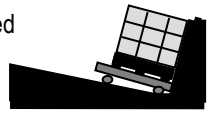
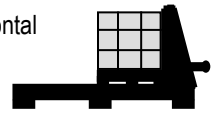
EQUIPMENT REQUIRED FOR PROJECT 3M

Atmospheric Pre-Conditioning and Conditioning:

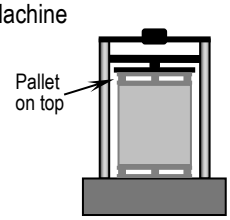
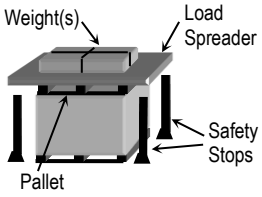
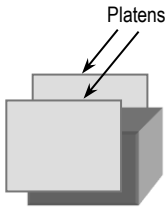
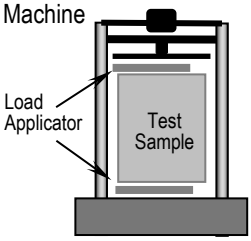
- Humidity recorder complying with of the apparatus section of ASTM D 4332 **or** ISO 2233.
- Temperature recorder complying with the apparatus section of ASTM D 4332 **or** ISO 2233.

Controlled Temperature and Humidity:

- Chamber and Control apparatus complying with the apparatus section of ASTM D 4332 **or** ISO 2233.

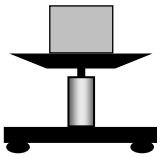
Type of Shock Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Free-Fall Drop Tests	Free-fall drop tester 	Compliance with the apparatus sections of ASTM D 5276 **or** ISO 2248.	
Rotational FLAT Drop Tests		Compliance with the apparatus sections of ASTM D 6179 **or** ISO 2876.	
Rotational EDGE Drop Tests	Support Block 	Compliance with the apparatus sections of ASTM D 6179 **or** ISO 2876.	**Support block** 3.5 to 4.0 in (90 to 100 mm) in height and width and at least 8 in (200 mm) longer than the longest package dimension to be supported.
Inclined or Horizontal Impact Tests (Alternates)	Inclined  Horizontal 	Compliance with the apparatus sections of ASTM D 880 **or** ASTM D 4003 **or** ISO 2244.	

EQUIPMENT REQUIRED FOR PROJECT 3M

Type of Compression Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Vertical Compression (Top-to-Bottom)	Compression Test Machine 	Compliance with the apparatus section of ASTM D 642 "Fixed-Platen Testing Machine".	Standard 48x40 in (1200x1000 mm) block pallet, "picture-frame", full-perimeter-base type, on top of test item. If test item is shipped on a custom pallet, use an identical custom pallet on top. Top pallet not required for Small floor-loaded items and certain Large floor-loaded items.
Vertical Compression (Top-to-Bottom) (Alternate)	Weight(s) & Load Spreader 	The Load spreader must be larger than the top face of the test item, and shall be sufficiently rigid to apply a uniform compression force.	See above for description of the pallet. Top pallet not required for Small floor-loaded items and some Large floor-loaded items. Safety stops are recommended to support the load spreader and weight(s) to prevent damage or injury in the event of a rapid collapse of the test item.
Horizontal Compression (Clamping Simulation)	Clamp Tester 	Platens must be larger than the side dimensions of the test item, and with an opening sufficient to accommodate the test item. The desired compression must be achieved with minimum overshoot.	Controls must permit applying the required clamping force smoothly at a rate of 0.02-0.1 in/sec (0.5-2.5 mm/sec) and with minimum force overshoot. Force measurement accuracy to within ± 5% of the actual value, using accepted calibration means.
Horizontal Compression (Clamping Simulation) (Alternative)	Compression Test Machine 	Compliance with the apparatus section of ASTM D 642 - Fixed Platen Only.	Rigid load applicator (such as a 3/4"{19 mm} piece of plywood or a plate of steel) that is larger than the test sample face to be tested on the compression test machine.

EQUIPMENT REQUIRED FOR PROJECT 3M

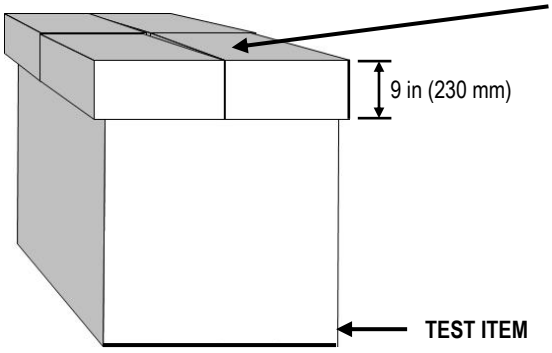
Equipment Required Vibration

Type of Vibration Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Vertical Vibration	Random Vibration Test System 	Compliance with the apparatus section of ASTM D 4728 **or** ISO 13355	Means must be provided to maintain proper alignment of the test item and any top load apparatus, and to prevent the test item from moving off the vibration system's platform, without restricting vertical motion of the test item or apparatus.

Vibration Top Load Apparatus

A **Top Load Apparatus** is required for the vibration testing of **Initially Shipped Floor-Loaded** into a transport vehicle or ocean container.

- The **Top Load Apparatus** is described and shown below, and includes:
  - A sturdy fiberboard box or similar container with a height of 9 in (230 mm), and with a minimum 0.75 in (20 mm) thick plywood load spreader covering the entire inside bottom surface.
  - Some means of adding additional weight as required so that the top load is distributed evenly over the entire inside bottom face area of the top load apparatus.
  - Adequate void fill to securely hold the weight in place to prevent it from moving or bouncing within the top load apparatus.
  - Bottom face dimensions (length and width) which are at least 2 in (50 mm) larger than the top face dimensions of the test item to which it is applied [for a minimum overhang of 1 in (25 mm) on each side], but must not be greater than 6 in (150 mm) larger than the top face dimensions of the test item [for a maximum of 3 in (76 mm) overhang on each side].
- The **Top Load Apparatus** must be divided into 2 separate equal portions if *one* of the top face dimensions of the test item exceeds 18 in (460 mm), and into 4 separate equal portions if *both* of the top face dimensions of the test item exceed 18 in (460 mm).



- **Use an undivided apparatus if both top face dimensions of the test item are 18 in (460 mm) or less.**
- **Divide the apparatus into two separate equal portions if one top face dimension of the test item exceeds 18 in (460 mm). Divide the apparatus perpendicular to the longest dimension.**
- **Divide the apparatus into four separate equal portions if both top face dimensions of the test item exceed 18 in (460 mm).**

The Top Load is to simulate the effects of 6 lb/ft^3 (0.0035 lb/in^3) (96 kg/m^3) of assorted freight on top of a floor loaded packaged-product in a truck-trailer or ocean container with an inside height of 108 in (2.7 m). This load density has been determined by empirical testing which resulted in correlation between damage in the test lab and damage in the field.

- Means must be provided to maintain proper alignment of the Top Load Apparatus on the test item (column stack fixtures, stretch wrap around the test specimen and the top load apparatus, etc.), without restricting the vertical motion of the top load apparatus and the test specimen.

Packaged-Product Weight and Size Measurement

The weight and size of the packaged-product shall be determined:

- Gross weight in pounds (lb) for English units and kilograms (kg) for Metric
- Exterior dimensions of Length, Width and Height (L x W x H) in inches (in) for English units and millimeters (mm) or meters (m) for Metric.