

ISTA 3 Series
General Simulation
Performance
Test PROJECT*

VERSION DATE
May 2009
Initial Release

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

ISTA, Distributing Confidence, Worldwide™

ISTA 3-Series tests are advanced tests and are designed to:

- 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 three sections to this procedure: Overview, Testing, and Reporting

- **Overview** provides general knowledge required before testing **and**
- **Testing** presents the specific instructions to do laboratory testing **and**
- **Reporting** indicates what data shall be recorded to submit a test report to ISTA.

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)
Distance	feet (ft) or inches (in)	meters (m) or millimeters (mm)
Volume	Cubic inches (in ³)	Cubic centimeters (cm 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 (standard units), **but**
- The standard units chosen shall be used consistently throughout the procedure.
- Units are converted to two significant figures **and**
- Not exact equivalents.

VERY IMPORTANT:

The entire document shall be read and understood before proceeding with a test.

* Notes Regarding ISTA “Projects” and “Procedures”

- ISTA 3B is currently an ISTA “Project”, first released in May 2009. New ISTA test protocols are given the designation “Project” during their implementation phase. After a minimum one-year period and required evaluation, a “Project” will either be adopted as an established “Procedure”, revised and kept as a “Project” for another period of time, or be dropped. Therefore, a “Project” is potentially subject to greater and more frequent revision than a “Procedure”.
- Comments regarding this Project and its use are encouraged and welcome. Please contact ista@ista.org.
- ISTA members may use either Procedures or Projects for package certification.

Preface

Project 3B is a general simulation test for packaged-products shipped through a motor carrier (truck) delivery system, where different types of packaged-products, often from different shippers and intended for different ultimate destinations, are mixed in the same load. This type of shipment is called LTL (Less-Than-Truckload). Project 3B is appropriate for four different types of packages commonly distributed in LTL shipments as described below:

Package Types

- **Standard**, 200 lb (91 kg) or less, including elongated and flat packages
- **Standard**, over 200 lb (91 kg), including elongated and flat packages
- **Cylindrical**, including elongated cylinders
- **Palletized or Skidded** – Individual container, bulk container, or unitized load on or incorporating a base or platform which allows the entry of lift truck forks

Definitions

- **Elongated Package or Cylinder**
 - A **Standard** or **Cylindrical** package where the longest dimension is 36 in (910 mm) or greater **and**
 - both of the package's other dimensions (or the cylinder's diameter) are each 20 percent or less of the longest dimension
- **Flat Package**
 - A **Standard** package 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 in³ (13,000 cm³) or greater
- **Non-Rigid Container**
 - Any **Standard** (regardless of weight) or **Palletized or Skidded** container where the outer package may offer insufficient protection from concentrated low-level impacts **or**
 - the design has large unsupported spans of outer packaging material **or**
 - the outer package utilizes a stretch- or shrink-wrap design, uses a thin-flute or light grade corrugated board, uses a paper wrap or similar lightweight material only, etc. **or**
 - the outer package wall is in direct contact with the product

Note: If a packaged-product is both Elongated and Flat in accordance with the above definitions, it should be tested as Elongated.

General

- Testing can be used to evaluate the protective performance of a packaged-product related to vibrations, shocks and other stresses normally encountered during handling and transportation in a Less-Than-Truckload (LTL) delivery system.
- Test levels are based on general data and may not represent any specific distribution system.
- The package and product are considered together and not separately.
- Some conditions of transit, such as moisture, pressure, or unusual handling may not be covered.

Other ISTA Procedures or Projects may be appropriate for different conditions or to meet different objectives.

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

Note: Hazardous material packaging that passes this test procedure may not meet international, national or other regulatory requirements for the transport of hazardous materials. **This test is not a substitute** for United Nations and/or any other required test standards for the transport of hazardous materials, but may be used as an additional test in conjunction with them.

Scope

Project 3B covers the testing of packaged-products prepared for shipment via a Less-Than-Truckload (LTL) delivery system carrier. LTL is defined as motor carrier (truck) shipment, where different types of packaged-products, often from different shippers and intended for different ultimate destinations, are mixed in the same load.

Product Damage
Tolerance and
Package
Degradation
Allowance

The shipper shall determine the following prior to testing:

- 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.

Samples

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

Samples should be an untested actual package and product, but if one or both are not available, the substitutes shall be as identical as possible to actual items.

One sample is required for this test procedure.

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

- Requires the procedure to be performed one time, **but**
- Recommends performing the procedure five or more times using a new sample for each test.

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

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.

Basis Weight

Basis Weights of Corrugated Board

When the outer package is a corrugated box, it is strongly recommended that the basis weights of the papers/paperboards used to make the box be determined and documented. It has been determined that basis weights are better indicators of box equivalence than ECT or Burst ratings.

Refer to *Guidelines for Selecting and Using ISTA Procedures and Projects* for additional information on documentation and basis weight determination.

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

Test Sequence
STANDARD,
200 lb (91 kg)
or Less

3B – STANDARD, 200 lb (91 kg) or less

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Ambient	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and Humidity chosen from chart	Optional
3	Shock TEST BLOCK 2	Tip/Tip Over	Use a 22 degree tip angle	Required for packages ≥ 48 in. (1.2 m) tall and ≥ 100 lb. (45 kg) weight and any one base dimension $< \frac{1}{2}$ the height; or for packages ≥ 30 in. (760 mm) tall and with a center of gravity vertical location $> \frac{1}{2}$ the package height
4	Shock TEST BLOCK 3	Free-Fall Drop	6 drops - height varies with packaged-product weight	Required
5	Vertical Vibration TEST BLOCK 7	Random With Top Load	Overall G_{rms} level of 0.54	Required
6	Shock TEST BLOCK 10	Concentrated Corner Impact	Hazard Box free-fall dropped or pendulum, 15 in (380 mm)	Required only for Non-Rigid Containers
7	Shock TEST BLOCK 11	Free-Fall Drop	6 Drops - height varies with packaged-product weight.	Required
8	Shock TEST BLOCK 16	Full Rotational Drop	1 drop	Required only for Elongated packages
9	Shock TEST BLOCK 17	Bridged Impact	Hazard Box dropped 16 in (410 mm)	Required only for Elongated packages
10	Shock TEST BLOCK 16	Full Rotational Drop	2 drops	Required only for Flat packages
11	Shock TEST BLOCK 18	Concentrated Edge Impact	Hazard box dropped 16 in (410 mm)	Required only for Flat packages

Test Sequence
STANDARD,
Over
200 lb (91 kg)

3B – STANDARD, Over 200 lb (91 kg)

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Ambient	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and Humidity chosen from chart	Optional
3	Shock TEST BLOCK 2	Tip/Tip Over	Use a 22 degree tip angle	Required for packages ≥ 48 in. (1.2 m) tall and ≥ 100 lb. (45 kg) weight and any one base dimension $< \frac{1}{2}$ the height; or for packages ≥ 30 in. (760 mm) tall and with a center of gravity vertical location $> \frac{1}{2}$ the package height
4	Shock TEST BLOCK 5	Rotational Drop	9 in. (230 mm) Rotational edge and corner drops	Required
5	Shock TEST BLOCK 6	Incline or Horizontal Impact, optional Free-Fall Drop	48 in/sec (4 ft/sec) (1.2 m/sec) impacts or 3 in. (76 mm) drops	Required
6	Vertical Vibration TEST BLOCK 7	Random With Top Load	Overall G_{rms} level of 0.54	Required
7	Shock TEST BLOCK 10	Concentrated Corner Impact	Hazard Box free-fall dropped or pendulum, 15 in (380 mm)	Required only for Non-Rigid Containers
8	Shock TEST BLOCK 13	Rotational Drop	9 in. (230 mm) Rotational edge and corner drops	Required
9	Shock TEST BLOCK 14	Incline or Horizontal Impact, optional Free-Fall Drop	48 in/sec (4 ft/sec) (1.2 m/sec) impacts or 3 in. (76 mm) drops	Required
10	Shock TEST BLOCK 16	Full Rotational Drop	1 drop	Required only for Elongated packages
11	Shock TEST BLOCK 17	Bridged Impact	Hazard Box dropped 16 in (410 mm)	Required only for Elongated packages
12	Shock TEST BLOCK 16	Full Rotational Drop	2 drops	Required only for Flat packages
13	Shock TEST BLOCK 18	Concentrated Edge Impact	Hazard box dropped 16 in (410 mm)	Required only for Flat packages

Test Sequence
CYLINDRICAL

3B – CYLINDRICAL

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Ambient	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and Humidity chosen from chart	Optional
3	Shock TEST BLOCK 4	Free-Fall Drop	6 Drops - height varies with packaged-product weight	Required
4	Vertical Vibration TEST BLOCK 8	Random With and Without Top Load	Overall G_{rms} level of 0.54	Required
5	Shock TEST BLOCK 12	Free-Fall Drop	5 Drops - height varies with packaged-product weight	Required
6	Shock TEST BLOCK 12	Drop on Hazard	1 Drop - height varies with packaged-product weight	
7	Shock TEST BLOCK 16	Full Rotational Drop	1 drop	Required only for Elongated cylinders
8	Shock TEST BLOCK 17	Bridged Impact	Hazard Box dropped 16 in (410 mm)	Required only for Elongated cylinders

3B – PALLETIZED OR SKIDDED

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Ambient	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and Humidity chosen from chart	Optional
3	Shock TEST BLOCK 2	Tip/Tip Over	Use a 22 degree tip angle	Required for palletized or skidded loads ≥ 30 in. (760 mm) tall and center of gravity vertical height > the smallest base dimension
4	Shock TEST BLOCK 5	Rotational Drop	Rotational edge and corner drops Height varies with packaged-product weight	Required
5	Shock TEST BLOCK 6	Incline or Horizontal Impact, optional Free-Fall Drop	48 in/sec (4 ft/sec) (1.2 m/sec) impacts or 3 in. (76 mm) drops	Required
6	Vertical Vibration TEST BLOCK 9	Random With Top Load	Overall G_{rms} level of 0.54	Required
7	Shock TEST BLOCK 10	Concentrated Corner Impact	Hazard Box free-fall dropped or pendulum, 15 in (380 mm)	Required only for Non-Rigid containers
8	Shock TEST BLOCK 15	Fork Lift Handling	Flat Push and Rotate tests	Required
9	Shock TEST BLOCK 15	Fork Lift Handling	Elevated Push and Pull tests	Required
10	Shock TEST BLOCK 15	Fork Lift Handling	Elevated Rotate tests	Required
11	Shock TEST BLOCK 15	Fork Lift Handling	Stability Test over a handling course	Required
12	Shock TEST BLOCK 13	Rotational Drop	Rotational edge and corner drops Height varies with packaged-product weight	Required
13	Shock TEST BLOCK 14	Incline or Horizontal Impact, optional Free-Fall Drop	48 in/sec (4 ft/sec) (1.2 m/sec) impacts or 3 in. (76 mm) drops	Required

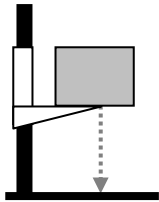
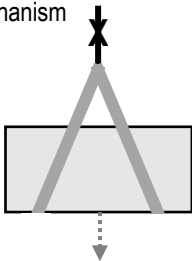
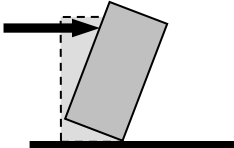
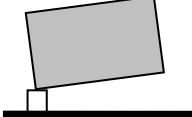
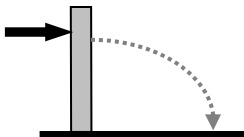
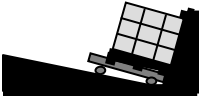
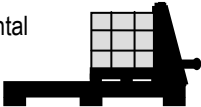
EQUIPMENT REQUIRED FOR PROJECT 3B

Atmospheric 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.

Optional Atmospheric Conditioning

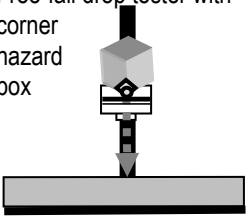

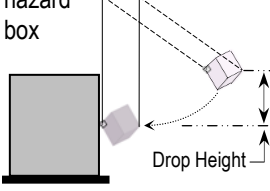
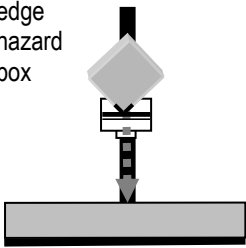
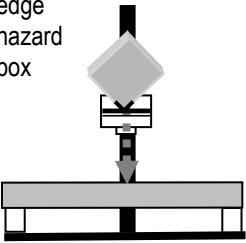
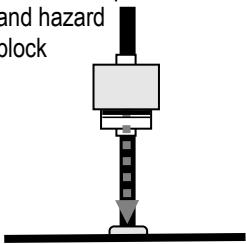
- Chamber and Control apparatus complying with the apparatus section of ASTM D 4332 or ISO 2233.

Type of Shock Test	Type of Equipment	In compliance with the apparatus sections of...	Additional Required Equipment
Free-Fall Drop Tests	Free-fall drop tester 	ASTM D 5276 or ISO 2248	
Free-Fall Drop Tests (Alternate)	Slings and Quick-Release mechanism 	ASTM D 5276 or ISO 2248	
Tip/Tipover Tests		ASTM D 6179 or ISO 2876	
Rotational Edge and Corner Drop Tests	1) Support Block 	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.
Full Rotational Drops		ASTM D 6179 or ISO 2876	
Impact Tests (Alternates)	Incline  Horizontal 	ASTM D 880 or ASTM D 4003 or ISO 2244	

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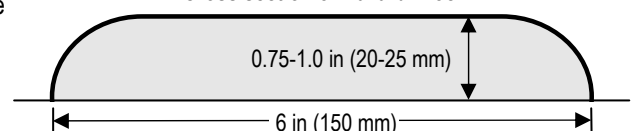
Equipment
Required
Shock
(continued)

Type of Shock Test	Type of Equipment	In compliance with the apparatus sections of...	Additional Required Equipment
Concentrated Corner Impact Tests	Free-fall drop tester with corner hazard box 		Concentrated Corner Hazard Box Wood box of any size but having a total weight of 3 lb (1.4 kg) and with a 1.25 in (32 mm) diameter ball-shaped steel impacting corner. 
Concentrated Corner Impact Tests (Alternate)	Pendulum with corner hazard box 		Corner Hazard Box Pendulum Two flexible lightweight cords of at least 72 in (1.8 m) in length are used to suspend the Concentrated Corner Hazard Box described above. The box is drawn back to achieve the specified drop height (vertical distance).
Concentrated Edge Impact Tests	Free-fall drop tester with edge hazard box 		Concentrated Edge Hazard Box 12 x 12 x 12 in (305 x 305 x 305 mm) wood box with a total weight of 9 lb (4.1 kg). Any required ballast weight should be dense flowable material in a bag or bags, held in place with suitable void fill. The impact edge of the box shall be covered with angle iron.
Bridged Impact Tests	Free-fall drop tester with edge hazard box 	ASTM D 5265 with the exception of the Hazard Box (Impactor).	Concentrated Edge Hazard Box and Support Blocks See above for description of the Concentrated Edge Hazard Box. Support blocks (2 ea.) shall be 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.
Drop Onto Hazard	Free-fall drop tester and hazard block 		Hazard Block See below.

Hazard Block

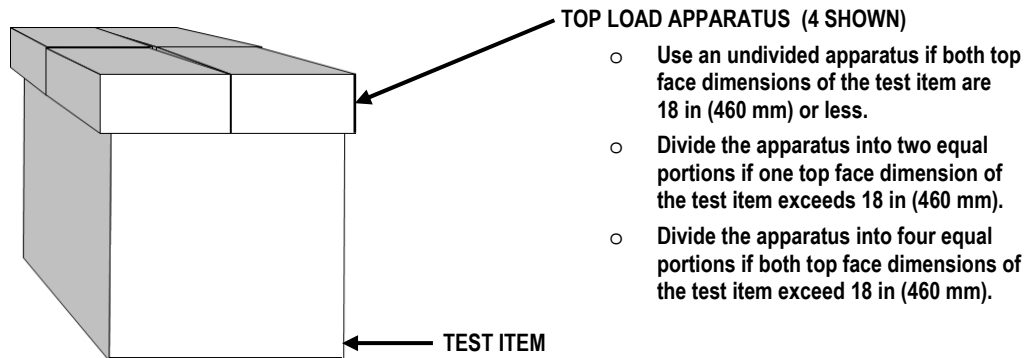
The block shall be made of hardwood or metal. The height shall be 0.75 to 1 in (20 to 25 mm) and the width shall be 6 in (150 mm). The length shall be at least 8 in (200 mm) longer than the longest package dimension which will impact. The long top edges of the block shall be rounded to a radius equal to the height of the block.

Cross section of Hazard Block



Equipment
Required
Vibration

- Vertical Random Vibration Test System complying with the apparatus section of ASTM D 4728 or ISO 13355.
- Top-load apparatus as described and shown below, including:
 - A fiberboard box or similar container 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 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 equal portions if one of the top face dimensions of the test item exceeds 18 in (460 mm), and into 4 equal portions if both of the top face dimensions of the test item exceed 18 in (460 mm).




The Top Load is to simulate the effects of 6 lb/ft³ (0.0035 lb/in³) (96 kg/m³) of assorted freight on top of a floor loaded packaged-product in an LTL trailer 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.
- Means must be provided to prevent the test item from moving off the vibration system's platform, without restricting the vertical motion of the test item.

Equipment
Required
Additional

Fork Lift Handling Tests

- A fork lift truck of sufficient capacity to handle the test specimens and complying with the requirements below.
- A fork lift handling course as shown on the following page.

Type of Test	Type of Equipment	In compliance with the apparatus section of...	Additional Required Equipment
Fork Lift Handling	Fork lift truck 	ASTM D 6055 or ISO 10531	Handling Course, see following page

Equipment
Required
Additional
(continued)

Fork Lift
Handling Course

The Handling Course is comprised of eleven plates, fabricated from steel or similar sufficiently dense, rigid, and tough material, bolted to a concrete floor in the pattern shown here. Details of the individual plates are given below this overall layout.

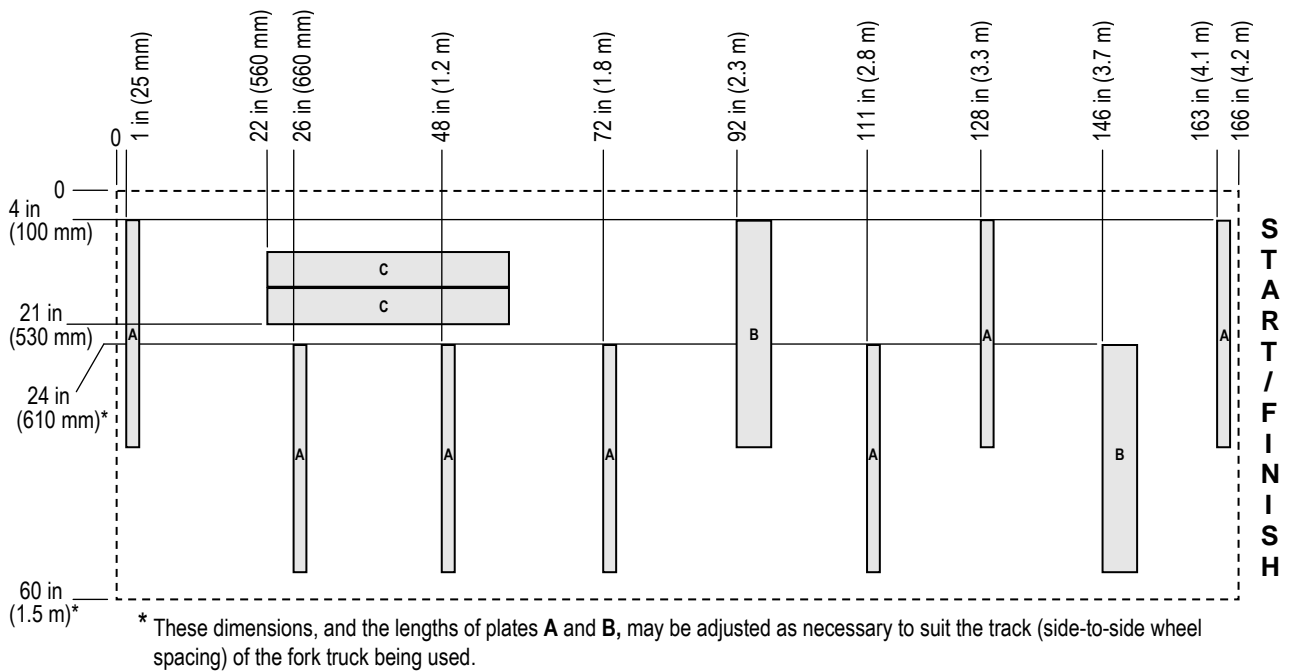


Plate details

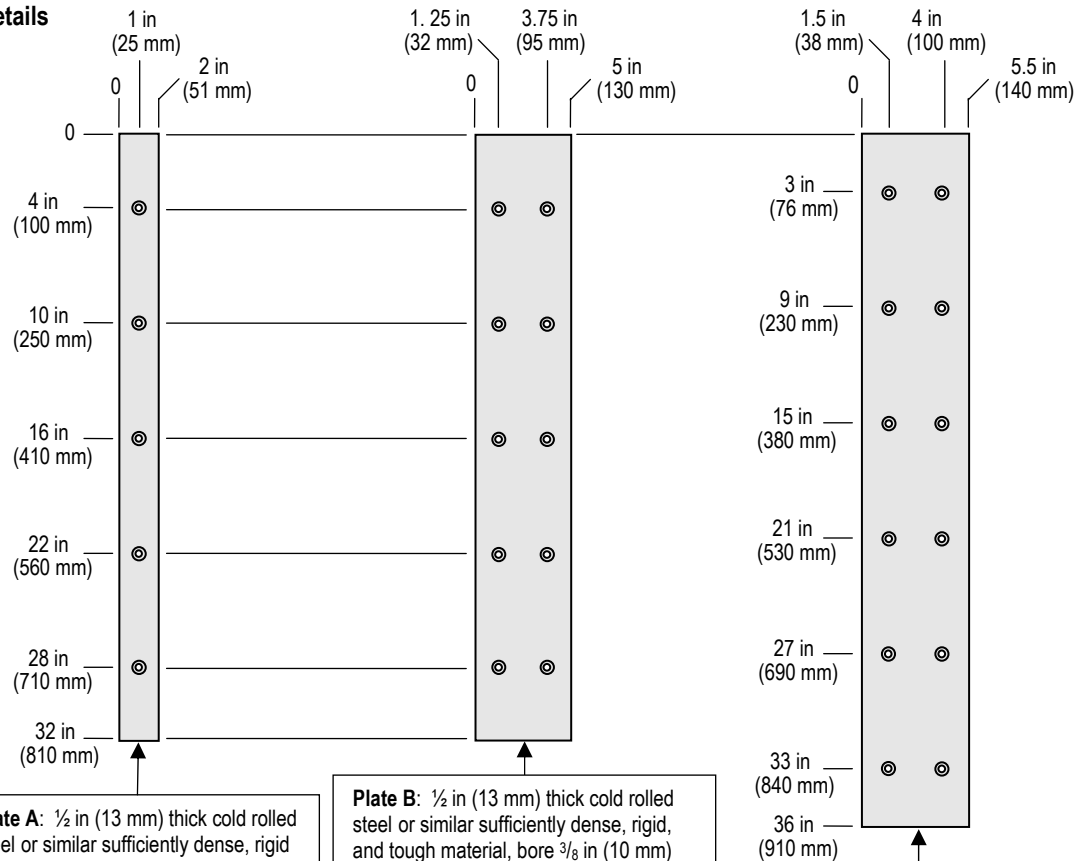


Plate A: 1/2 in (13 mm) thick cold rolled steel or similar sufficiently dense, rigid and tough material, bore 3/8 in (10 mm) through, countersink for flathead cap screws, 5 places. Round all sharp edges. **7 pieces required.**

Plate B: 1/2 in (13 mm) thick cold rolled steel or similar sufficiently dense, rigid, and tough material, bore 3/8 in (10 mm) through, countersink for flathead cap screws, 10 places. Round all sharp edges. **2 pieces required.**

Plate C: 3/4 in (19 mm) thick cold rolled steel or similar sufficiently dense, rigid, and tough material, bore 3/8 in through, countersink for flathead cap screws, 12 places. Round all sharp edges. **2 pieces required, side-by-side.**

Identification of
Faces, Edges
and Corners
(Test Specimen
Members)

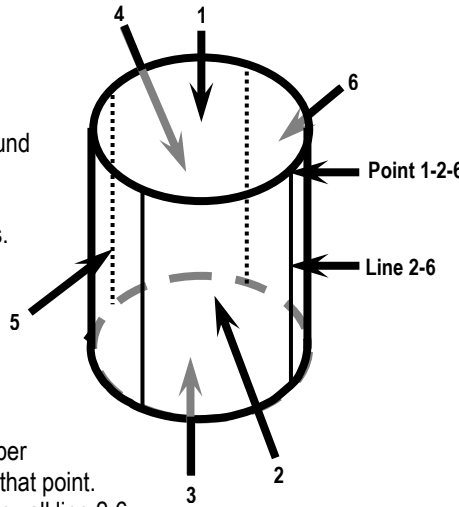
Prior to beginning the tests identify the faces, edges and corners (or other members) of the test specimen according to the procedure below.

Step	Action	
1	Place the packaged-product so the package is in its intended shipping orientation. If there are sufficient reasons for identifying the Faces, Edges, and Corners (Test Specimen Members) with the package in other than its intended shipping orientation, they must be documented and justified on the Test Report. For some situations it may be appropriate to place the package in its most stable orientation (if different from the shipping orientation), or to perform multiple tests using different Test Specimen Member identifications.	
	IF the test specimen is ...	THEN...
	Standard, Elongated, or Flat, or is Palletized or Skidded , with only six faces (2 sides, 2 ends, top and bottom)	Turn the packaged-product so that one of the smallest faces is directly in front of you. If one end of the package is noticeably heavier than the other, then position the smallest face with the heaviest end directly in front of you. Go to Step 2.
	Standard, Elongated or Flat with less than or more than six faces	Develop a method to identify each face, edge and corner or other members and document with a diagram.
	A Cylinder or Pail	Go to Step 3.
2	STANDARD	ELONGATED
	FLAT	PALLETIZED or SKIDDED
Identify faces according to the diagrams. Identify edges using the numbers of the two faces forming that edge. Example: Edge 1-2 is the edge formed by face 1 and face 2 of the packaged-product. Identify corners using the numbers of the three faces that meet to form that corner. Example: Corner 2-3-5 is the corner formed by face 2, face 3, and face 5 of the packaged-product. Identify orientation of the product inside the package.		

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Identification of
Faces, Edges
and Corners
(Test Specimen
Members)
(continued)

Step	Action
3	<p>CYLINDER OR PAIL</p> <p>Identify top and bottom as surfaces 1 and 3, according to the diagram.</p> <p>Designate four sidewall line locations, equally spaced around the perimeter of the container as shown. Identify sidewall surfaces between the lines as shown. The lines shall be designated as intersections between the sidewall surfaces. Example: line 2-6 is the intersection between sidewall surfaces 2 and 6.</p> <p>If the cylinder has one or more side seam joints, one of these seams shall be coincident with line 2-6.</p> <p>Identify points on the chimes using the top or bottom number and the numbers of the sidewall line that intersect to form that point. Example: point 1-2-6 is the intersection with top 1 and sidewall line 2-6.</p> 

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.

Before You Begin Atmospheric Conditioning

Required Preconditioning:

The packaged-product shall be preconditioned to laboratory ambient temperature and humidity for not less than twelve (12) hours prior to testing.

Optional Conditioning Recommended (to be performed after the required preconditioning):

To permit an adequate determination of packaged-product performance at anticipated atmospheric limits and where it is known that the atmospheric extremes are detrimental to the product or package, ISTA:

- **Requires** the highest temperature and humidity limits of the product be used, **but**
- **Recommends** that both the highest and lowest atmospheric conditions be used.

Condition packaged-products according to one or more of the conditions listed in the table below. The best approach is to perform all tests directly in the conditioned atmosphere. If this is not possible, then tests should be performed quickly after removal of test items from the conditioned atmosphere.

If more than one conditioning sequence is selected, a new and complete test should be performed following each condition.

Optional Conditions	Time in Hours	Temperature in °C ±2°C (°F ±4°F)	Humidity in %
Extreme Cold, Uncontrolled RH	72	-29°C (-20°F)	Uncontrolled RH
Cold, Humid	72	5°C (40°F)	85% RH ± 5%
Controlled Conditions	72	23°C (73°F)	50% RH ± 5%
Hot, Humid	72	38°C (100°F)	85% RH ± 5%
Hot, Humid then Extreme Heat, Moderate RH	72 then 6	38°C (100°F) then 60°C (140°F)	85% RH ± 5% then 30% RH ± 5%
Elevated Temperature, Uncontrolled RH	72	50°C (120°F)	Uncontrolled RH
Extreme Heat, Dry	72	60°C (140°F)	15% RH ± 5%
Severe Cold, Uncontrolled RH	72	-18°C (0°F)	Uncontrolled RH
User Defined High Limit	72	Based upon known conditions	Known conditions
User Defined Low Limit	72	Based upon known conditions	Known conditions
User Defined Cycle	72	Based upon known conditions	Known conditions

Before You Begin Shock Testing

Drop Testing Flat or Elongated Packages

- When drop testing Flat or Elongated Packages on small or narrow faces, or edges and corners adjoining those faces, the package should be prevented from falling over and incurring a second impact unless safety is a major concern. A restraining system may be used, or the package may be caught manually. Document in the test report whether or not the package was caught and/or restrained.
- Catching a package after a drop test may be dangerous. Great care should be taken to insure the safety of anyone catching a package after an initial drop.

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Before You Begin Shock Testing (continued)

Tip/Tipover Tests

- The Tip/Tipover tests are a combination of two types of tests (Tip test and Tipover test). First, tip the test item to a 22° angle from the vertical orientation. If the test item begins to tip over and fall at or before the angle is reached, it should be allowed to do so. If it does not tip over and fall at a 22° angle, return it gently to its upright position. Test in all potentially unstable directions.

Inclined or Horizontal Impacts

- The required impact tests may be accomplished with either an inclined or horizontal machine (or with free-fall drops, if feasible and appropriate). If an inclined-impact machine is used, the minimum required impact velocity must be 48 in/sec (4 ft/sec) (1.2 m/sec). If a horizontal-impact machine is used, the minimum required velocity change must be 48 in/sec (4 ft/sec) (1.2 m/sec) and the required shock must be a nominal 10 millisecond half sine pulse.
- If any velocity of an impact test is below the required minimum, that test must be repeated until the velocity meets the minimum.

Before You Begin Vibration Testing

Number of axes and package orientations for the vertical vibration tests:

Type of Packaged-Product	Number of Axes / Orientations to Test
Standard	3
Cylindrical	2
Palletized or Skidded	1

Determination of Vibration Top Load

- First, calculate the theoretical top loads from the **Total Theoretical Top Loads** chart below.
- Next, determine the number of apparatus required from the **Division of Top Load Apparatus** chart on the next page.
- Then, go to the **Determination of Top Load Apparatus Weight** chart on the next page to determine the actual weights of the top loads to be used.

Note that different Top Loads may be required depending upon the packaged-product dimensions and how it is oriented for the vibration tests.

Total Theoretical Top Loads			
Total Theoretical Top Load Formulas		English Units (in), Load Results in lb	Metric Units (m), Load Results in kg
Theoretical Top Load with face 3 down		$(108 - H) \times L \times W \times 0.0035$	$(2.7 - H) \times L \times W \times 96$
Theoretical Top Load with face 4 down		$(108 - W) \times L \times H \times 0.0035$	$(2.7 - W) \times L \times H \times 96$
Theoretical Top Load with face 6 down		$(108 - L) \times W \times H \times 0.0035$	$(2.7 - L) \times W \times H \times 96$
Where	Represents		
TL	Total Weight of the Top-Load Apparatus	Pounds (lb)	Kilograms (kg)
108 and 2.7	Height of typical LTL trailer	Inches (in)	Meters (m)
L	Length of shipping unit (test item)	Inches (in)	Meters (m)
W	Width of shipping unit (test item)	Inches (in)	Meters (m)
H	Height of shipping unit (test item)	Inches (in)	Meters (m)
0.0035 and 96	Dynamic loading factor: 50% of the average static density of freight	0.0035 lb/in ³	96 kg/m ³
For Packaged-Products of 30 lb (14 kg) or 2 ft ³ (0.06 m ³) or less, divide the above results by 2.			

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Before You Begin
Vibration Testing
(continued)

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Division of Top Load Apparatus	
To determine if and how the vibration Top Load should be divided, orient the packaged-product for testing and follow the instructions below:	
IF the packaged-product top surface exceeds 18 in (460 mm) in...	THEN there shall be...
neither dimension	an <u>undivided</u> Top Load apparatus.
only one dimension	A <u>two portion</u> Top Load apparatus, with the two portions of equal size and weight and divided parallel to the packaged-product's long dimension.
both dimensions	a <u>four portion</u> Top Load apparatus with the four portions of equal size and weight.

Determination of Top Load Apparatus Weight	
Determine the Top Load Apparatus weight (or weights, for multiple apparatus) to be used for vibration tests as follows:	
IF the calculation from the Total Theoretical Top Loads chart (previous page) for an axis is ...	THEN ...
Less than 25 lb (11kg)	Do not use a Top Load Apparatus for that axis during vibration testing.
25 lb (11 kg) or greater and an undivided Top Load Apparatus is required	Round the Total Theoretical Top Load value up to the nearest 5 lb (2 kg) and use the rounded weight value as the total Top Load Apparatus weight for that axis.
25 lb (11 kg) or greater and two equal Top Load Apparatus are required	Divide the Total Theoretical Top Load value by 2, then round the result up to the nearest 2 lb (1 kg) and use the rounded weight value as the weight for each of the two Top Load Apparatus for that axis.
25 lb (11 kg) or greater and four equal Top Load Apparatus are required	Divide the Total Theoretical Top Load value by 4, then round the result up to the nearest 1 lb (0.5 kg) and use the rounded weight value as the weight for each of the four Top Load Apparatus for that axis.
<p><i>Examples:</i></p> <ul style="list-style-type: none"> • If the Total Theoretical Top Load value is 166 lb (75.3 kg) and only one Top Load Apparatus is required, round up to the nearest 5 lb (2 kg) and use 170 lb (or 76 kg) as the Top Load Apparatus weight. • If the Total Theoretical Top Load value is 166 lb (75.3 kg) and two Top Load Apparatus are required, divide by 2 to get 83 lb (37.6 kg), round up to the nearest 2 lb (1 kg) and use 84 lb (or 38 kg) as the weight of each of the two Top Load Apparatus. • If the Total Theoretical Top Load value is 166 lb (75.3 kg) and four Top Load Apparatus are required, divide by 4 to get 41.5 lb (18.8 kg), round up to the nearest 1 lb (0.5 kg) and use 42 lb (or 19 kg) as the weight of each of the four Top Load Apparatus. 	

Top Load Apparatus Axis Definitions

The Top Load Apparatus shall be defined as:

- **TL-H** for the Apparatus used when the packaged-product is positioned for testing with **face 3** down.
- **TL-W** for the Apparatus used when the packaged-product is positioned for testing with **face 4** down.
- **TL-L** for the Apparatus used when the packaged-product is positioned for testing with **face 6** down.

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**Before You Begin
Vibration Testing
(continued)**

Vibration Test Time

- The vibration test time durations calculated below and in TEST BLOCKS 7, 8, and 9 are based on a time compression of 5:1 (with an associated increase in spectrum Grms) and an average vehicle speed of 60 mi/hour (97 km/hour). The maximum required total vibration test time shall not exceed 240 minutes.
- Vibration test time per axis is total vibration test time divided by the number of axes to test.
- The user must decide upon a travel distance to be simulated, then use the table below to calculate vibration test times per axis. If the calculation exceeds the Maximum Minutes for Each Axis (right column below), use the Maximum Minutes.

Test Time for any Axis in Minutes			
Determine the amount of test time in minutes to be used for each axis as follows:			
Type of Packaged-Product	Transport Miles divided by...	Transport Kilometers divided by...	Maximum Minutes for Each Axis
Standard	15	24	80
Cylindrical	10	16	120
Palletized or Skidded	5	8	240

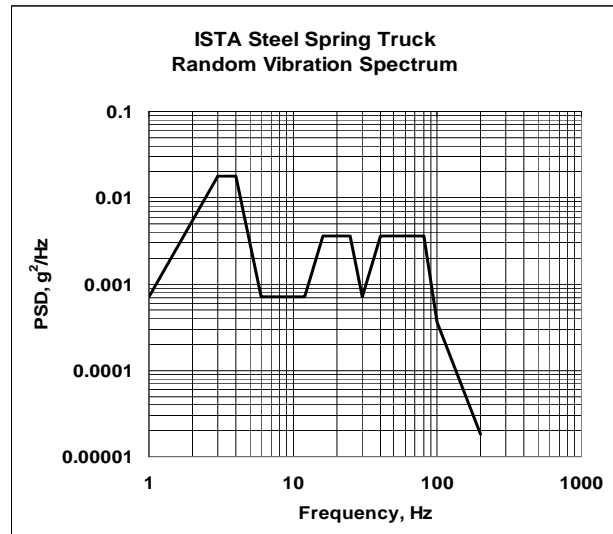
Examples:

- If the estimated travel distance is 750 miles for a Standard Package, the Test Time would be 50 minutes per axis.
- If the estimated travel distance is 1000 km. for a Palletized or Skidded Package, the total Test Time would be 125 minutes.

Random Vibration Spectrum

The acceleration vs. frequency spectrum to be used for the random vibration tests is shown below. The overall Grms is 0.54 and the theoretical stroke required is 1.777 in (45.13 mm) peak-to-peak.

Frequency (Hz)	PSD (g^2/Hz)
1	0.00072
3	0.018
4	0.018
6	0.00072
12	0.00072
16	0.0036
25	0.0036
30	0.00072
40	0.0036
80	0.0036
100	0.00036
200	0.000018



The following TEST BLOCKS contain tables indicating the required steps for each test in the procedure. Start with TEST BLOCK 1 below for all packaged-product types covered by this procedure.

TEST BLOCK 1
Atmospheric
Conditioning

TEMPERATURE AND HUMIDITY		
Step	Action	
1	The packaged-product must be stored at laboratory ambient temperature and humidity for not less than twelve (12) hours prior to testing.	
2	Is optional conditioning going to be performed? <ul style="list-style-type: none"> • If Yes, go to the next Step. • If No, go to Step 7. 	
3	Select an anticipated condition from <i>Before You Begin Atmospheric Conditioning</i> .	
4	Check the conditioning apparatus to insure that the temperature and humidity are at the required levels.	
5	Place the packaged-product in the conditioning apparatus.	
6	At the completion of the selected conditioning, remove the packaged-product from the conditioning apparatus.	
7	Conditioning is now complete. When testing starts (according to the appropriate TEST BLOCK as indicated below), record the ambient temperature and humidity. At the end of all testing record the ambient temperature and humidity.	
8	Perform the remaining test sequences as quickly as possible.	
9	Determine the next TEST BLOCK to be used:	
	IF the packaged-product type is...	THEN go to Shock ...
	Standard , 200 lb (91 kg) or less	TEST BLOCK 3 (Shock: Free-Fall Drop)
	Standard , 200 lb (91 kg) or less, and , in its intended shipping orientation, is ≥ 48 in (1.2 m) tall and ≥ 100 lb (45 kg) weight and any one base dimension $< \frac{1}{2}$ the height; or for packages ≥ 30 in (760 mm) tall and with a center of gravity vertical location $> \frac{1}{2}$ the package height.	TEST BLOCK 2 (Shock: Tip/Tipover)
	Standard , over 200 lb (91 kg)	TEST BLOCK 5 (Shock: Rotational Drop)
	Standard , over 200 lb (91 kg) and , in its intended shipping orientation, is ≥ 48 in (1.2 m) tall and any one base dimension $< \frac{1}{2}$ the height; or for packages ≥ 30 in (760 mm) tall and with a center of gravity location $> \frac{1}{2}$ the package height.	TEST BLOCK 2 (Shock: Tip/Tipover)
	Cylindrical	TEST BLOCK 4 (Shock: Free-Fall Drop)
	Palletized or Skidded	TEST BLOCK 5 (Shock: Rotational Drop)
	Palletized or Skidded , and , in its intended shipping orientation, is ≥ 30 in (760 mm) tall and with a center of gravity vertical location $>$ smallest base dimension.	TEST BLOCK 2 (Shock: Tip/Tipover)

TEST BLOCK 2

Shock:
Tip/Tipover

SHOCK: TIP/TIPOVER

Complete this TEST BLOCK for the following types of packaged-products only:

- **Standard**, 200 lb (91 kg) or less, **and**, in its intended shipping orientation, ≥ 48 in (1.2 m) tall **and** ≥ 100 lb (45 kg) weight **and** any one base dimension $< \frac{1}{2}$ the height; **or** for packages ≥ 30 in (760 mm) tall **and** with a center of gravity vertical location $> \frac{1}{2}$ the package height.
- **Standard**, over 200 lb (91 kg) **and**, in its intended shipping orientation, ≥ 48 in (1.2 m) tall **and** any one base dimension $< \frac{1}{2}$ the height; **or** for packages ≥ 30 in (760 mm) tall **and** with a center of gravity vertical location $> \frac{1}{2}$ the package height.
- **Palletized or Skidded**, **and**, in its intended shipping orientation, ≥ 30 in (760 mm) tall **and** with a center of gravity vertical location $>$ smallest base dimension.

Tip/Tipover tests are to be conducted in all of the packaged-product's potentially unstable directions.

Step	Action	
1	Place the packaged-product on the floor in its intended shipping orientation.	
2	Using any method, but without sliding or moving the packaged-product horizontally, slowly tilt it from its vertical position to a 22° tip angle in one of the potentially unstable directions.	
3	IF the packaged-product...	THEN ...
	Begins to tip over and fall at or before the specified angle is reached	Allow it to fall and impact the floor.
	Does not tip over and fall at a 22° angle	Slowly and gently return the packaged-product to its upright orientation.
4	Repeat steps 2 and 3 of this TEST BLOCK for all potentially unstable directions of the packaged-product.	
5	This Shock: Tip/Tipover TEST BLOCK is now complete. Determine the next TEST BLOCK from the following table:	
	IF the packaged-product type is ...	THEN ...
	Standard , 200 lb (91 kg) or less	Go to TEST BLOCK 3 (Shock: Free-Fall Drop)
	Standard , over 200 lb (91 kg)	Go to TEST BLOCK 5 (Shock: Rotational Drop)
	Palletized or Skidded	Go to TEST BLOCK 5 (Shock: Rotational Drop)

TEST BLOCK 3

Shock:
Free-Fall Drop,
First SequenceFor STANDARD
200 lb (91 kg)
or Less

SHOCK: FREE-FALL DROP

Complete this TEST BLOCK for the following type of packaged-product only: **Standard**, 200 lb (91 kg) or Less

Step	Action					
1	Use the table below to determine height and orientation for free-fall drops. Perform drops in the order listed.					
	Drop Number	Free-Fall Drop Heights based on Packaged-Product Weights				Orientation of Drop
		Drop Heights for Weights ≤ 40 lb (18 kg)	Weights > 40 lbs (18 kg) but ≤ 80 lb (36 kg)	Weights > 80 lbs (36 kg) but ≤ 100 lb (45 kg)	Weights > 100 lbs (45 kg) but ≤ 200 lb (91 kg)	
	1	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Face 1
	2	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Face 2
	3	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Face 6
	4	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Corner 2-3-5
	5	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Edge 3-4
	6	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Face 3
2	This Shock: Free-Fall Drop TEST BLOCK is now complete. Go to TEST BLOCK 7 (Vibration)					

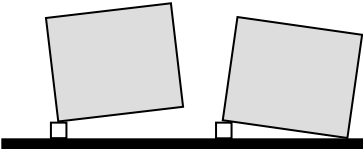
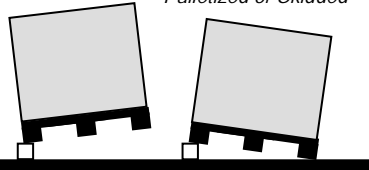
TEST BLOCK 4
Shock:
Free-Fall Drop,
First Sequence

For CYLINDRICAL

SHOCK: FREE-FALL DROP						
Complete this TEST BLOCK for the following type of packaged-product only: Cylindrical						
Step	Action					
1	Use the table below to determine height and orientation for free-fall drops. Perform drops in the order listed.					
	Drop Number	Free-Fall Drop Heights based on Packaged-Product Weights				Orientation of Drop
		Drop Heights for Weights ≤ 40 lb (18 kg)	Weights > 40 lbs (18 kg) but ≤ 80 lb (36 kg)	Weights > 80 lbs (36 kg) but ≤ 100 lb (45 kg)	Weights > 100 lbs (45 kg) but ≤ 200 lb (91 kg)	
	1	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Face 1 (Top)
	2	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Line 2-5
	3	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Line 4-5
	4	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Point 3-4-6
	5	12 in (305 mm)	10 in (250 mm)	8 in (200 mm)	7 in (180 mm)	Point 3-4-5
	6	32 in (810 mm)	26 in (660 mm)	20 in (510 mm)	16 in (410 mm)	Face 3 (Bottom)
2	This Shock: Free-Fall Drop TEST BLOCK is now complete. Go to TEST BLOCK 8 (Vibration)					

TEST BLOCK 5
Shock:
Rotational Drop,
First Sequence

For STANDARD
Over 200 lb (91 kg),
and PALLETIZED
or SKIDDED

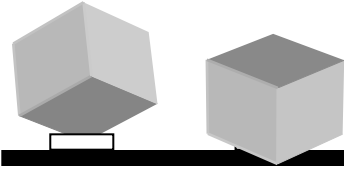
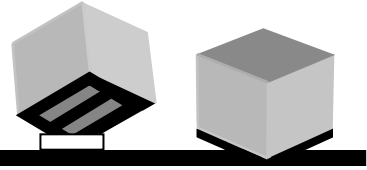
SHOCK: ROTATIONAL DROP		
Complete this TEST BLOCK for the following types of packaged-products only, using the drop heights indicated:		
<ul style="list-style-type: none"> • Standard, over 200 lb (91 kg) – drop height 9 in (230 mm) • Palletized or Skidded – drop height 9 in (230 mm) for packaged-products weighing 500 lb (230 kg) or less, drop height 6 in (150 mm) for packaged-products weighing over 500 lb (230 kg) 		
Step	Action	
1	Perform a rotational edge drop as described in the table below.	
	Sequence #	Action
	1	Place the packaged-product on a flat, rigid surface such as steel or concrete with face 3 down.
	2	Support edge 3-5 with a timber or support 3.5 to 4.0 in (90 to 100 mm) in height and width.
	3	Lift the opposite edge (3-6) to the prescribed drop height as indicated at the beginning of this Test Block.
	4	Release the edge so that it falls freely onto the flat, rigid surface.
<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;"> <p><i>Standard</i></p>  </div> <div style="text-align: center;"> <p><i>Palletized or Skidded</i></p>  </div> </div>		

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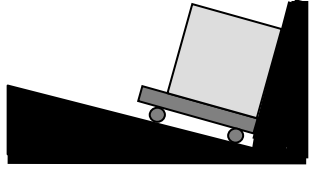
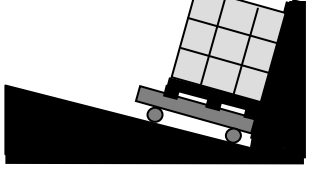
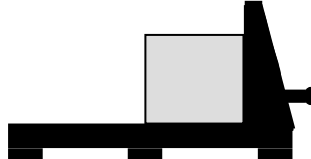
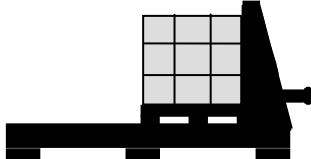
TEST BLOCK 5 Shock: Rotational Drop, First Sequence (continued)

For STANDARD
Over 200 lb (91 kg),
and PALLETIZED
or SKIDDED

SHOCK: ROTATIONAL DROP		
Step	Action	
2	Perform a rotational corner drop as described in the table below.	
	Sequence #	Action
	1	Place the packaged-product on a flat, rigid surface such as steel or concrete with face 3 down.
	2	Support corner 2-3-6 with a timber or support 3.5 to 4.0 in (90 to 100 mm) in height and width.
	3	Lift the opposite corner (3-4-5) to the prescribed drop height as indicated at the beginning of this Test Block.
	4	Release the corner so that it falls freely onto the flat, rigid surface.
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><i>Standard</i></p>  </div> <div style="text-align: center;"> <p><i>Palletized or Skidded</i></p>  </div> </div>		
3	This Shock: Rotational Drop TEST BLOCK is now complete. Go to TEST BLOCK 6 (Shock: Impact)	

TEST BLOCK 6 Shock: Impact, First Sequence

For STANDARD
Over 200 lb (91 kg),
and PALLETIZED
or SKIDDED

SHOCK: IMPACT	
Complete this TEST BLOCK for the following types of packaged-products only:	
<ul style="list-style-type: none"> • Standard, over 200 lb (91 kg) • Palletized or Skidded 	
Step	Action
1	These impact tests may be performed with an inclined or horizontal impact machine, or optionally with a 3 in (76 mm) free-fall drop. Is the optional free fall drop test going to be performed? <ul style="list-style-type: none"> • If Yes, go to Step 4. • If No, go to the Next Step.
2	Center the packaged-product on the carriage, with its front surface in contact with the backstop or sail and parallel to the leading edge of the carriage. For a Palletized or Skidded item, if the pallet or skid overhangs the load, place the front edge of the pallet in contact the backstop or sail and parallel to the leading edge of the carriage. In this case there will be a gap between the front surface of the load and the backstop or sail. Go to Step 3.
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><i>Standard</i></p>  </div> <div style="text-align: center;"> <p><i>Palletized or Skidded</i></p>  </div> </div> <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 20px;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> <p><i>Horizontal Impact</i></p>  </div> </div>	

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TEST BLOCK 6
Shock: Impact,
First Sequence
(continued)
For STANDARD
Over 200 lb (91 kg),
and PALLETIZED
or SKIDDED

Step	Action		
3	Draw the carriage back and impact test the packaged-product on each of the two faces listed below. The minimum required <i>impact velocity</i> for an inclined-impact test is 48 in/sec (4 ft/sec) (1.2 m/sec). The minimum required <i>velocity change</i> for a horizontal impact test is 48 in/sec (4 ft/sec) (1.2 m/sec) and the shock must be a nominal 10 millisecond half sine pulse. If any velocity in the Test Sequence is below the required minimum value, that sequence event must be repeated until the test velocity meets the minimum. Then go to Step 5.		
	Sequence #	Face to Impact	
	1	Face 5	
	2	Face 6	
4	Using a drop tester or a sling-and-quick-release system (see <i>Equipment Required Shock</i>), perform 3 in (76 mm) free-fall flat drops of the packaged-product on each of the two faces listed below.		
	Sequence #	Face to Impact	
	1	Face 5	
	2	Face 6	
5	This Shock: Impact TEST BLOCK is now complete. Determine the next TEST BLOCK to be used as follows:		
	IF the packaged-product is...	THEN ...	
	Standard	Go to TEST BLOCK 7 (Vibration)	
	Palletized or Skidded	Go to TEST BLOCK 9 (Vibration)	

TEST BLOCK 7
Vertical Vibration
For STANDARD

VIBRATION			
Complete this TEST BLOCK for the following type of packaged-product only: Standard , regardless of weight.			
Step	Action	Testing Orientation	Vibration Duration in Minutes
1	Place the packaged-product on the center of the vibration table so that Face 3 rests on the platform.	Face 3 on table surface	Transport miles ÷ 15 Not to exceed 80 minutes (Transport Kilometers ÷ 24 Not to exceed 80 minutes)
2	Place the Top Load Apparatus TL-H , as determined in <i>Before You Begin Vibration Testing</i> , on top of the test specimen. Note: <ul style="list-style-type: none">• If the calculated total theoretical top load for any axis is less than 25 lb (11 kg), do not use a Top Load Apparatus for that axis during vibration testing.• For small and light packaged-products there is a reduced theoretical top load.• For large packaged-products the top load is divided.		
3	Use some means, as described in <i>Equipment Required Vibration</i> , to maintain proper alignment of the Top Load Apparatus on the test item without restricting vertical motion of either the Apparatus or the test item.		
4	Start the vibration machine to produce the Random Vibration Spectrum indicated in <i>Before You Begin Vibration Testing</i> .		
5	After the prescribed Test Time as calculated above and in <i>Before You Begin Vibration Testing</i> , stop the test and remove the Top Load Apparatus.		

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TEST BLOCK 7
Vertical Vibration
(continued)

For STANDARD

Step	Action	Testing Orientation	Vibration Duration in Minutes
6	Repeat Steps 1 through 5 of this TEST BLOCK, but with Face 4 of the packaged-product down, and with Top Load Apparatus TL-W applied.	Face 4 on table surface	Transport miles ÷ 15 Not to exceed 80 minutes (Transport Kilometers ÷ 24 Not to exceed 80 minutes)
7	Repeat Steps 1 through 5 of this TEST BLOCK, but with Face 6 of the packaged-product down, and with Top Load Apparatus TL-L applied.	Face 6 on table surface	Transport miles ÷ 15 Not to exceed 80 minutes (Transport Kilometers ÷ 24 Not to exceed 80 minutes)
8	This Vibration TEST BLOCK is now complete. Determine the next TEST BLOCK to be used as follows:		
	IF the packaged-product...	THEN ...	
	incorporates a Non-Rigid Container (see <i>Preface, Definitions</i> for details)	Go to TEST BLOCK 10 (Shock: Concentrated Corner Impact)	
	does <i>not</i> incorporate a Non-Rigid Container and weighs 200 lbs (91 kg) or less	Go to TEST BLOCK 11 (Shock: Free-Fall Drop)	
	does <i>not</i> incorporate a Non-Rigid Container and weighs over 200 lbs (91 kg)	Go to TEST BLOCK 13 (Shock: Rotational Drop)	

Note: If the test item is an elongated packaged-product with a non-rectangular cross-section (round tube, triangular tube, etc.), do not use a Top Load Apparatus in the large-face-down orientations.

TEST BLOCK 8
Vertical VibrationFor
CYLINDRICAL

VIBRATION			
Complete this TEST BLOCK for the following type of packaged-product only: Cylindrical			
Step	Action	Testing Orientation	Vibration Duration in Minutes
1	Place the packaged-product on the center of the vibration table so that Face 3 (the bottom) rests on the platform.	Face 3 on table surface	Transport miles ÷ 10 Not to exceed 120 minutes (Transport Kilometers ÷ 16 Not to exceed 120 minutes)
2	Place the Top Load Apparatus TL-H , as determined in <i>Before You Begin Vibration Testing</i> , on top of the test specimen. Note: <ul style="list-style-type: none"> If the calculated total theoretical top load for any axis is less than 25 lb (11 kg), do not use a Top Load Apparatus for that axis during vibration testing. For small and light packaged-products there is a reduced theoretical top load. For large packaged-products the top load is divided. 		

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TEST BLOCK 8
Vertical Vibration
(continued)For
CYLINDRICAL

Step	Action	Testing Orientation	Vibration Duration in Minutes
3	Use some means, as described in <i>Equipment Required Vibration</i> , to maintain proper alignment of the Top Load Apparatus on the test item without restricting vertical motion of either the Apparatus or the test item.	Face 3 on table surface	Transport miles ÷ 10 Not to exceed 120 minutes
4	Start the vibration machine to produce the Random Vibration Spectrum indicated in <i>Before You Begin Vibration Testing</i> .		(Transport Kilometers ÷ 16 Not to exceed 120 minutes)
5	After the prescribed Test Time as calculated above and in <i>Before You Begin Vibration Testing</i> , stop the test and remove the Top Load Apparatus.		
6	Place the packaged-product on the center of the vibration table so that Line 2-6 rests on the platform. No Top Load Apparatus is used for this portion of the test.	Line 2-6 down on table surface	Transport miles ÷ 10 Not to exceed 120 minutes
7	Start the vibration machine to produce the Random Vibration Spectrum indicated in <i>Before You Begin Vibration Testing</i> .		(Transport Kilometers ÷ 16 Not to exceed 120 minutes)
8	After the prescribed Test Time as calculated above and in <i>Before You Begin Vibration Testing</i> , stop the test.		
9	This Vibration TEST BLOCK is now complete. Go to TEST BLOCK 12 (Shock: Free-Fall Drop)		

TEST BLOCK 9
Vertical VibrationFor
PALLETIZED
or SKIDDED

VIBRATION			
Complete this TEST BLOCK for the following type of packaged-product only: Palletized or Skidded			
Step	Action	Testing Orientation	Vibration Duration in Minutes
1	Place the packaged-product on the center of the vibration table so that Face 3 rests on the platform.	Face 3 on table surface	Transport miles ÷ 5 Not to exceed 240 minutes (Transport Kilometers ÷ 8 Not to exceed 240 minutes)
2	Place the Top Load Apparatus TL-H , as determined in <i>Before You Begin Vibration Testing</i> , on top of the test specimen. <i>Note:</i> <ul style="list-style-type: none"> For large packaged-products the top load is divided. See <i>Equipment Required Vibration</i> and <i>Before You Begin Vibration Testing</i>. If the exact nature and configuration of stacking loads in shipment is known (for example, identical units loads are always stacked), it may be desirable to use those actual top loads for testing. 		
3	Use some means, as described in <i>Equipment Required Vibration</i> , to maintain proper alignment of the Top Load Apparatus on the test item without restricting vertical motion of either the Apparatus or the test item.		
4	Start the vibration machine to produce the Random Vibration Spectrum indicated in <i>Before You Begin Vibration Testing</i> .		

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TEST BLOCK 9
Vertical Vibration
(continued)For
PALLETIZED
or SKIDDED

Step	Action						
5	After the prescribed Test Time as calculated above and in <i>Before You Begin Vibration Testing</i> , stop the test and remove the Top Load Apparatus.						
6	This Vibration TEST BLOCK is now complete. Determine the next TEST BLOCK to be used as follows:						
	<table> <tr> <th>IF the packaged-product...</th><th>THEN ...</th></tr> <tr> <td>incorporates a non-rigid container (see <i>Preface, Definitions</i> for details)</td><td>Go to TEST BLOCK 10 (Shock: Concentrated Corner Impact)</td></tr> <tr> <td>does <u>not</u> incorporate a non-rigid container</td><td>Go to TEST BLOCK 15 (Shock: Fork Lift Handling)</td></tr> </table>	IF the packaged-product...	THEN ...	incorporates a non-rigid container (see <i>Preface, Definitions</i> for details)	Go to TEST BLOCK 10 (Shock: Concentrated Corner Impact)	does <u>not</u> incorporate a non-rigid container	Go to TEST BLOCK 15 (Shock: Fork Lift Handling)
IF the packaged-product...	THEN ...						
incorporates a non-rigid container (see <i>Preface, Definitions</i> for details)	Go to TEST BLOCK 10 (Shock: Concentrated Corner Impact)						
does <u>not</u> incorporate a non-rigid container	Go to TEST BLOCK 15 (Shock: Fork Lift Handling)						

TEST BLOCK 10
Shock:
Concentrated
Corner ImpactFor
STANDARD,
and PALLETIZED
or SKIDDED

SHOCK: CONCENTRATED CORNER IMPACT (NON-RIGID CONTAINERS)	
<p>Complete TEST BLOCK for the following types of packaged-products only, where the container is Non-Rigid:</p> <ul style="list-style-type: none"> • Standard, regardless of weight • Palletized or Skidded <p>Non-rigid containers are defined (see <i>Preface, Definitions</i>) as having one or more of the following characteristics:</p> <ul style="list-style-type: none"> ○ the outer package may offer insufficient protection from concentrated low-level impacts ○ the design has large unsupported spans of outer packaging material ○ the outer package utilizes a stretch- or shrink-wrap design, a thin-flute or light grade corrugated board, a paper wrap or similar lightweight material only, etc. ○ the outer package wall is in direct contact with the product 	
Step	Action
1	Determine faces of the container, and locations on those faces, to be impacted. In addition to determinations in accordance with the characteristics defined above, it may be desirable to impact taped closures or other container features to assess their performance. Generally the impact location should be in the geometrical center of the face. Standard packaged products in actual distribution may potentially receive concentrated impacts on any surface. Palletized or Skidded packaged-products may potentially receive concentrated impacts only on the top and sides. Thoroughly document all impact locations on the Test Report.
2	Will a free-fall drop of the Hazard Box be used to impact the packaged-product's face positioned horizontally, or will a Hazard Box pendulum be used to impact a vertical face? <ul style="list-style-type: none"> • IF free-fall drop with impact face horizontal, THEN go to the next Step. • IF pendulum impact onto a vertical face, THEN go to Step 7.
3	Place the packaged-product on a flat, rigid surface such as steel or concrete with the face to be impacted in the uppermost position.
4	Position the Hazard Box above the packaged-product in a corner-drop orientation with the ball-shaped corner down. Carefully align the Hazard Box on the Drop Tester or with the Sling and Quick-Release Mechanism (see <i>Equipment Required Shock</i>) so that the desired location on the face will be impacted. Set the drop height to 15 in (380 mm) above the packaged-product's top surface.
5	Release the Hazard Box to impact the packaged-product.
6	Return to Step 2 of this TEST BLOCK to perform Hazard Box free-fall and/or pendulum impacts until all locations on the packaged-product as determined in Step 1 have been impacted. Then go to Step 11.

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TEST BLOCK 10
Shock:
Concentrated
Corner Impact
(continued)

For
STANDARD,
and **PALLETIZED**
or **SKIDDED**

Step	Action								
7	Place the packaged-product on a flat, rigid surface such as steel or concrete with the face to be impacted positioned vertically. Brace the packaged-product if necessary so that it does not move when impacted.								
8	Carefully position the Hazard Box pendulum and/or the packaged-product such that the desired location on the face will be impacted, and that the face is perpendicular to the path of the swinging pendulum (see <i>Equipment Required Shock</i>). Draw the Hazard Box pendulum back until the drop height (vertical distance) is 15 in (380 mm).								
9	Release the Hazard Box pendulum to impact the packaged-product.								
10	Return to Step 2 of this Test Block to perform Hazard Box free-fall and/or pendulum impacts until all locations on the packaged-product as determined in Step 1 have been impacted. Then go to Step 11.								
11	This Shock: Concentrated Corner Impact TEST BLOCK is now complete. Determine the next TEST BLOCK to be used as follows:								
	<table> <tr> <th>IF the packaged-product type is ...</th><th>THEN ...</th></tr> <tr> <td>Standard, 200 lb (91 kg) or less</td><td>Go to TEST BLOCK 11 (Shock: Free-Fall Drop)</td></tr> <tr> <td>Standard, over 200 lb (91 kg)</td><td>Go to TEST BLOCK 13 (Shock: Rotational Drop)</td></tr> <tr> <td>Palletized or Skidded</td><td>Go to TEST BLOCK 15 (Shock: Fork Lift Handling)</td></tr> </table>	IF the packaged-product type is ...	THEN ...	Standard , 200 lb (91 kg) or less	Go to TEST BLOCK 11 (Shock: Free-Fall Drop)	Standard , over 200 lb (91 kg)	Go to TEST BLOCK 13 (Shock: Rotational Drop)	Palletized or Skidded	Go to TEST BLOCK 15 (Shock: Fork Lift Handling)
IF the packaged-product type is ...	THEN ...								
Standard , 200 lb (91 kg) or less	Go to TEST BLOCK 11 (Shock: Free-Fall Drop)								
Standard , over 200 lb (91 kg)	Go to TEST BLOCK 13 (Shock: Rotational Drop)								
Palletized or Skidded	Go to TEST BLOCK 15 (Shock: Fork Lift Handling)								

TEST BLOCK 11
Shock:
Free-Fall Drop,
Second Sequence

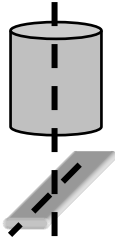
For **STANDARD**
200 lb (91 kg)
or Less

SHOCK: FREE-FALL DROP						
Complete this TEST BLOCK for the following type of packaged-product only: Standard , 200 lb (91 kg) or Less						
Step	Action					
1	Use the table below to determine height and orientation for free-fall drops. Perform drops in the order listed.					
	Drop Number	Free-Fall Drop Heights based on Packaged-Product Weights				Orientation of Drop
		Drop Heights for Weights ≤ 40 lb (18 kg)	Weights > 40 lbs (18 kg) but ≤ 80 lb (36 kg)	Weights > 80 lbs (36 kg) but ≤ 100 lb (45 kg)	Weights > 100 lbs (45 kg) but ≤ 200 lb (91 kg)	
	1	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Edge 2-3
	2	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Corner 3-4-6
	3	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Edge 4-5
	4	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Corner 1-4-6
	5	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)	Edge 1-6
	6	32 in (810 mm)	26 in (660 mm)	20 in (510 mm)	16 in (410 mm)	Face 3
2	This Shock: Free-Fall Drop TEST BLOCK is now complete. Determine the next TEST BLOCK or action as follows:					
	IF the packaged-product...			THEN ...		
	is Elongated or Flat (see <i>Preface, Definitions</i>)			Go to TEST BLOCK 16 (Shock: Full Rotational Drop)		
	is <u>neither</u> Flat <u>nor</u> Elongated			All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.		

TEST BLOCK 12

Shock:
Free-Fall Drop,
Second Sequence

For CYLINDRICAL

SHOCK: FREE-FALL DROP					
Complete this TEST BLOCK for the following type of packaged-product only: Cylindrical					
Step	Action				
1	Use the table below to determine height and orientation for free-fall drops. Perform drops in the order listed.				
	Drop Number	Free-Fall Drop Heights based on Packaged-Product Weights			
		Drop Heights for Weights ≤ 40 lb (18 kg)	Weights > 40 lbs (18 kg) but ≤ 80 lb (36 kg)	Weights > 80 lbs (36 kg) but ≤ 100 lb (45 kg)	Weights > 100 lbs (45 kg) but ≤ 200 lb (91 kg)
	1	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
	2	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
	3	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
	4	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
	5	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
	6	18 in (460 mm)	14 in (360 mm)	11 in (280 mm)	9 in (230 mm)
<p>Drop 6 is a drop onto the Hazard Block (see <i>Equipment Required Shock</i>). Drop the packaged-product so that it strikes the hazard centered on Face 3. The required drop distance is to the impact surface, not to the top of the Hazard Block. The accompanying diagram shows this concept.</p>					
2	This Shock: Free-Fall Drop TEST BLOCK is now complete. Determine the next TEST BLOCK or action as follows:				
	IF the packaged-product...		THEN ...		
	is Elongated (see <i>Preface, Definitions</i>)		Go to TEST BLOCK 16 (Shock: Full Rotational Drop)		
	is <u>not</u> Elongated		All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.		

TEST BLOCK 13

Shock:
Rotational Drop,
Second Sequence

For STANDARD
Over 200 lb (91 kg),
and PALLETIZED
or SKIDDED

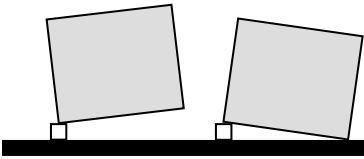
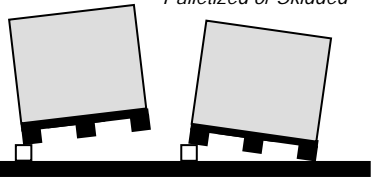
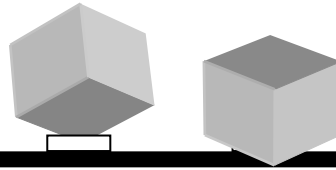
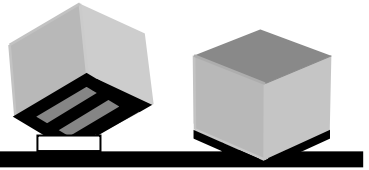
SHOCK: ROTATIONAL DROP		
Complete this TEST BLOCK for the following types of packaged-products only, using the drop heights indicated:		
<ul style="list-style-type: none"> Standard, over 200 lb (91 kg) – drop height 9 in (230 mm) Palletized or Skidded – drop height 9 in (230 mm) for packaged-products weighing 500 lb (230 kg) or less, drop height 6 in (150 mm) for packaged-products weighing over 500 lb (230 kg) 		
Step	Action	
1	Perform a rotational edge drop as described in the table below.	
	Sequence #	Action
	1	Place the packaged-product on a flat, rigid surface such as steel or concrete with Face 3 down.
	2	Support edge 3-4 with a timber or support 3.5 to 4.0 in (90 to 100 mm) in height and width.
	3	Lift the opposite edge (2-3) to the prescribed drop height as indicated at the beginning of this TEST BLOCK.

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TEST BLOCK 13
Shock:
Rotational Drop,
Second Sequence
(continued)

For STANDARD
 Over 200 lb (91 kg),
 and PALLETIZED
 or SKIDDED

Step	Action	
1 (cont.)	4	<p>Release the edge so that it falls freely onto the flat, rigid surface.</p> <p><i>Standard</i></p>  <p><i>Palletized or Skidded</i></p> 
2	Perform a rotational corner drop as described in the table below.	
	Sequence #	Action
	1	Place the packaged-product on a flat, rigid surface such as steel or concrete with face 3 down.
	2	Support corner 2-3-5 with a timber or support 3.5 to 4.0 in (90 to 100 mm) in height and width.
	3	Lift the opposite corner (3-4-6) to the prescribed drop height as indicated at the beginning of this TEST BLOCK.
	4	<p>Release the corner so that it falls freely onto the flat, rigid surface.</p> <p><i>Standard</i></p>  <p><i>Palletized or Skidded</i></p> 
3	This Shock: Rotational Drop TEST BLOCK is now complete. Go to TEST BLOCK 14 (Shock: Impact)	

TEST BLOCK 14
Shock: Impact,
Second Sequence

For STANDARD
 Over 200 lb (91 kg),
 and PALLETIZED
 or SKIDDED

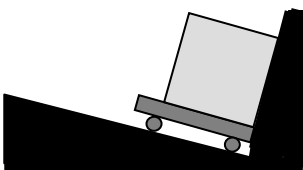
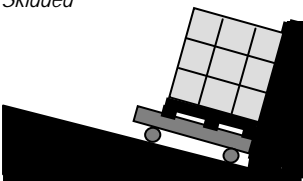
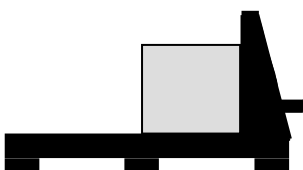
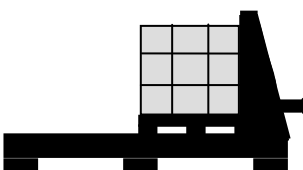
SHOCK: IMPACT	
<p>Complete this TEST BLOCK for the following types of packaged-products only:</p> <ul style="list-style-type: none"> • Standard, over 200 lb (91 kg) • Palletized or Skidded 	
Step	Action
1	<p>These impact tests may be performed with an inclined or horizontal impact machine, or optionally with a 3 in (76 mm) free-fall drop. Is the optional free fall drop test going to be performed?</p> <ul style="list-style-type: none"> • If Yes, go to Step 4. • If No, go to the Next Step.
2	<p>Center the packaged-product on the carriage, with its front surface in contact with the backstop or sail and parallel to the leading edge of the carriage. See illustrations on the following page. For a Palletized or Skidded item, if the pallet or skid overhangs the load, place the front edge of the pallet in contact the backstop or sail and parallel to the leading edge of the carriage. In this case there will be a gap between the front surface of the load and the backstop or sail.</p> <p>Go to Step 3.</p>

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TEST BLOCK 14
Shock: Impact,
Second Sequence
(continued)

 For STANDARD
 Over 200 lb (91 kg),
 and PALLETIZED
 or SKIDDED

Step	Action								
2 (cont.)	<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p><i>Standard</i></p>  </div> <div style="text-align: center;"> <p><i>Palletized or Skidded</i></p>  </div> </div> <p style="text-align: center;"><i>Inclined Impact</i></p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center;"><i>Horizontal Impact</i></p>								
3	<p>Draw the carriage back and impact test the packaged-product on each of the two faces listed below. The minimum required <i>impact velocity</i> for an inclined-impact test is 48 in/sec (4 ft/sec) (1.2 m/sec). The minimum required <i>velocity change</i> for a horizontal impact test is 48 in/sec (4 ft/sec) (1.2 m/sec) and the shock must be a nominal 10 millisecond half sine pulse. If any velocity in the Test Sequence is below the required minimum value, that sequence event must be repeated until the test velocity meets the minimum. Then go to Step 5.</p> <table border="1"> <thead> <tr> <th>Sequence #</th><th>Face to Impact</th></tr> </thead> <tbody> <tr> <td>1</td><td>Face 2</td></tr> <tr> <td>2</td><td>Face 4</td></tr> </tbody> </table>	Sequence #	Face to Impact	1	Face 2	2	Face 4		
Sequence #	Face to Impact								
1	Face 2								
2	Face 4								
4	<p>Using a drop tester or a sling-and-quick-release system (see <i>Equipment Required Shock</i>), perform 3 in (76 mm) free-fall flat drops of the packaged-product on each of the two faces listed below.</p> <table border="1"> <thead> <tr> <th>Sequence #</th><th>Face to Impact</th></tr> </thead> <tbody> <tr> <td>1</td><td>Face 2</td></tr> <tr> <td>2</td><td>Face 4</td></tr> </tbody> </table>	Sequence #	Face to Impact	1	Face 2	2	Face 4		
Sequence #	Face to Impact								
1	Face 2								
2	Face 4								
5	<p>This Shock: Impact TEST BLOCK is now complete. Determine the next TEST BLOCK or action as follows:</p> <table border="1"> <thead> <tr> <th>IF the packaged-product...</th><th>THEN ...</th></tr> </thead> <tbody> <tr> <td>is Standard and either Elongated or Flat (see <i>Preface, Definitions</i>)</td><td>Go to TEST BLOCK 16 (Shock: Full Rotational Drop)</td></tr> <tr> <td>is Standard, but <u>neither</u> Elongated <u>nor</u> Flat</td><td>All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.</td></tr> <tr> <td>is Palletized or Skidded</td><td>All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.</td></tr> </tbody> </table>	IF the packaged-product...	THEN ...	is Standard and either Elongated or Flat (see <i>Preface, Definitions</i>)	Go to TEST BLOCK 16 (Shock: Full Rotational Drop)	is Standard , but <u>neither</u> Elongated <u>nor</u> Flat	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.	is Palletized or Skidded	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.
IF the packaged-product...	THEN ...								
is Standard and either Elongated or Flat (see <i>Preface, Definitions</i>)	Go to TEST BLOCK 16 (Shock: Full Rotational Drop)								
is Standard , but <u>neither</u> Elongated <u>nor</u> Flat	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.								
is Palletized or Skidded	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.								

TEST BLOCK 15
Shock:
Fork Lift
Handling

 For PALLETIZED
 or SKIDDED

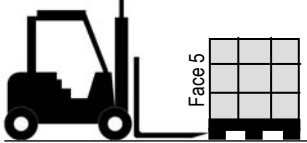
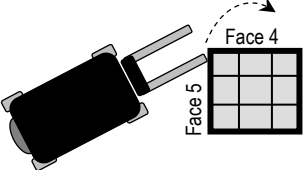
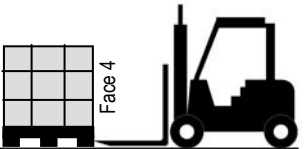
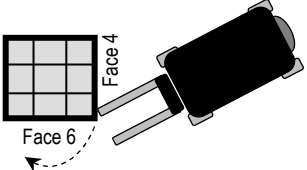
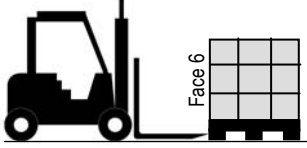
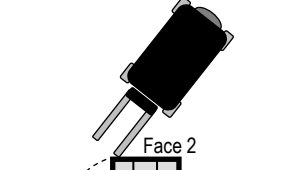
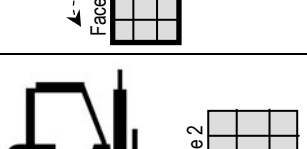
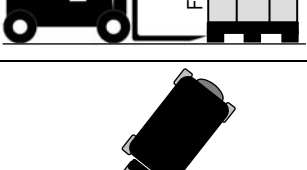
SHOCK: FORK LIFT HANDLING		
Complete this TEST BLOCK for the following type of packaged-product only: Palletized or Skidded		
Step	Action	
1	Perform flat push and rotate tests as described in the sequence table below.	
	Sequence #	Action
	1	Place the Palletized or Skidded packaged-product so that face 3 rests flat on a level floor.
	2	Align the two fork truck blade tips with the pallet/skid stringers or blocks on side (Face) 5.

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TEST BLOCK 15
Shock:
Fork Lift
Handling
(continued)

For PALLETIZED
or SKIDDED

Step	Action		
1 (cont.)	Sequence #	Action	
	3	Starting with the blade tips touching the stringers or blocks nominally half way up their vertical height, push the pallet/skid straight forward a minimum of 40 in (1 m). Push the required distance in approximately 2 to 3 seconds.	
	4	Contact the pallet/skid with one fork blade at corner 3-4-5. Do not lift the pallet/skid.	
	5	Using the fork blade, rotate the pallet/skid 90 degrees from its original orientation.	
	6	Repeat the flat push test of Sequence #1 through 3 of Step 1 of this TEST BLOCK, but push the pallet/skid from side (Face) 4.	
	7	Repeat the flat rotate test of Sequence #4 and 5 of Step 1 of this TEST BLOCK, rotating in the same direction by contacting the pallet/skid at corner 3-4-6.	
	8	Repeat the flat push test of Sequence #1 through 3 of Step 1 of this TEST BLOCK, but push the pallet/skid from side (Face) 6.	
	9	Repeat the flat rotate test of Sequence #4 and 5 of Step 1 of this TEST BLOCK, but rotating in the opposite direction from Sequence #7 by contacting the pallet/skid at corner 2-3-6.	
	10	Repeat the flat push test of Sequence #1 through 3 of Step 1 of this TEST BLOCK, but push the pallet/skid from side (Face) 2.	
	11	Repeat the flat rotate test of Sequence #4 and 5 of Step 1 of this TEST BLOCK, rotating in the same direction as in Sequence #9 by contacting the pallet/skid at corner 2-3-5.	

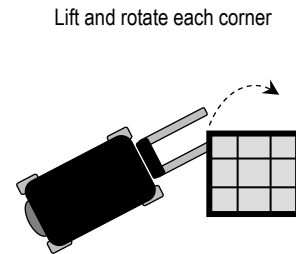
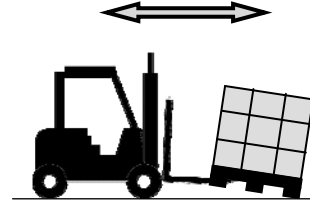
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TEST BLOCK 15
Shock:
Fork Lift
Handling
(continued)

For PALLETIZED
or SKIDDED

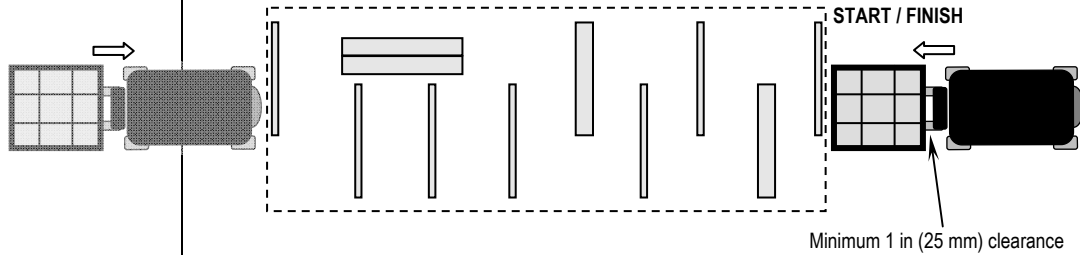
Step	Action	
2	Perform elevated push and pull tests as described in the sequence table below.	
	Sequence #	Action
	1	Place the Palletized or Skidded packaged-product so that Face 3 rests flat on a level floor.
	2	Enter the pallet/skid with the fork blades to a depth sufficient to lift one edge and so that the blades will not become disengaged during Sequence #4 (the elevated pull test) below. Lift the edge a minimum of 4 in (100 mm) off the floor, leaving the opposite edge in contact with the floor.
	3	Push the pallet/skid straight forward a minimum of 40 in (1m). Push the required distance in approximately 2 to 3 seconds.
	4	Repeat Sequence #1 through 3 of Step 2 of this TEST BLOCK, but <u>pull</u> (rather than <u>push</u>) the pallet/skid.
	5	Repeat Sequence #1 through 4 of Step 2 of this TEST BLOCK for all other possible directions of entry of the pallet/skid; i.e. a total of 2 push-pull tests for a two-way-entry pallet/skid, and a total of 4 push-pull tests for a four-way-entry pallet/skid.
3	Perform elevated rotate tests as described in the sequence table below.	
	Sequence #	Action
	1	Place the Palletized or Skidded packaged-product so that Face 3 rests flat on a level floor.
	2	Enter the pallet/skid with one fork blade at a corner. Use that blade and corner to lift the pallet/skid edge a minimum of 4 in (100 mm) off the floor, leaving the opposite edge in contact with the floor.
	3	Using the fork blade, rotate the pallet/skid 90 degrees from its original orientation.
	4	Repeat Sequence #1 through 3 of Step 3 of this TEST BLOCK, using the other three corners of the pallet/skid for rotation.
4	Perform a Fork Lift Load Stability test as described in the Sequence table below.	
	Sequence #	Action
	1	Place the Palletized or Skidded packaged-product so that face 3 rests flat on a level floor.
	2	Enter the pallet/skid with the fork blades centrally positioned and spaced to approximately half the dimension of the side of entry, or centered in the intended entry positions. Enter to at least three quarters the dimension of the direction of entry, but leave at least 1 in (25 mm) clearance between the pallet/skid or the load and the vertical (upright) part of the blades. Lift the pallet/skid a minimum of 4 in (100 mm) off the floor, and ensure that the blades and pallet/skid are nominally level and parallel to the floor.



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TEST BLOCK 15
Shock:
Fork Lift
Handling
(continued)For PALLETIZED
or SKIDDED

Step	Action							
4 (cont.)	Sequence #	Action						
	3	<p>Traverse the Fork Lift Handling Course (see <i>Equipment Required Additional</i>).</p> <ul style="list-style-type: none">• Begin at the Start/Finish position, travel the entire length of the course until the rear wheels of the fork lift are beyond the last plate obstacle.• Place the fork lift in reverse and travel the course in reverse (“back up” through the course), returning to the Start/Finish position, until the front wheels of the fork lift are beyond the first plate obstacle.• Control the velocity of the fork lift to traverse the course (one way) in approximately four (4) seconds. This is a velocity of approximately 3.5 feet/second (1 meter/second). <div></div>						
	4	Repeat Sequence #3 of Step 4 of this TEST BLOCK to perform a total of four (4) round trips over the Handling Course.						
	5	<table><tr><th>IF...</th><th>THEN...</th></tr><tr><td>The pallet or skid is of the two-way entry type</td><td>Go to the last step (Step 5) of this TEST BLOCK.</td></tr><tr><td>The pallet or skid is of the four-way entry type</td><td>Repeat Sequence #1 through 4 of Step 4 of this TEST BLOCK (Fork Lift Load Stability test), lifting the pallet or skid from the adjacent entry direction. Then go to the next Step.</td></tr></table>	IF...	THEN...	The pallet or skid is of the two-way entry type	Go to the last step (Step 5) of this TEST BLOCK.	The pallet or skid is of the four-way entry type	Repeat Sequence #1 through 4 of Step 4 of this TEST BLOCK (Fork Lift Load Stability test), lifting the pallet or skid from the adjacent entry direction. Then go to the next Step.
	IF...	THEN...						
The pallet or skid is of the two-way entry type	Go to the last step (Step 5) of this TEST BLOCK.							
The pallet or skid is of the four-way entry type	Repeat Sequence #1 through 4 of Step 4 of this TEST BLOCK (Fork Lift Load Stability test), lifting the pallet or skid from the adjacent entry direction. Then go to the next Step.							
5	This Shock: Fork Lift Handling TEST BLOCK is complete. Go to TEST BLOCK 13 (Shock: Rotational Drop)							

TEST BLOCK 16
Shock:
Full Rotational
DropFor STANDARD-
ELONGATED,
STANDARD -
FLAT,
and
CYLINDRICAL-
ELONGATED

SHOCK: FULL ROTATIONAL DROP		
<p>Complete this test sequence for the following types of packaged-products only:</p> <ul style="list-style-type: none"> Standard-Elongated (see <i>Preface, Definitions</i>) Standard-Flat (see <i>Preface, Definitions</i>) Cylindrical-Elongated (see <i>Preface, Definitions</i>) <p><i>Note:</i> If a packaged-product is both Elongated and Flat in accordance with the <i>Preface, Definitions</i>, it should be tested as Elongated.</p>		
STEP	ACTION	
1	IF the packaged-product is ...	THEN...
	Standard-Elongated, OR Cylindrical-Elongated (See <i>Preface, Definitions</i>)	Go to Step 2 of this TEST BLOCK.
	Standard-Flat (See <i>Preface, Definitions</i>)	Go to Step 3 of this TEST BLOCK.

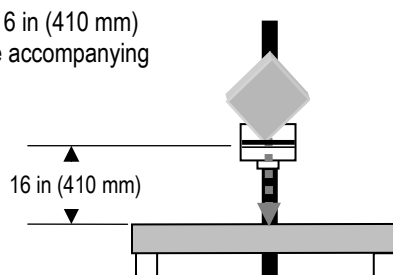
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TEST BLOCK 16
Shock:
Full Rotational
Drop
(continued)For STANDARD-
ELONGATED,
STANDARD-
FLAT,
and
CYLINDRICAL-
ELONGATED

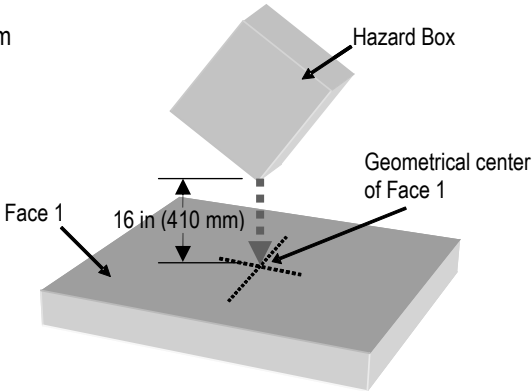
STEP	ACTION	
2	Perform one Full Rotational Drop as described in the sequence table below.	
	Sequence #	Action
	1	Place the packaged-product on the floor with the smallest or one of the smallest faces down (usually Face 5 or 6 for a Standard-Elongated packaged-product, Face 1 or 3 for Cylindrical-Elongated).
	2	Using any method, but without sliding or moving the packaged-product horizontally, slowly tilt the packaged-product until it topples over and impacts the floor. For Standard packaged-products, Face 3 must impact, for Cylinders Line 2-6 must impact.
	3	This Shock: Full Rotational Drop TEST BLOCK is now complete. Go to TEST BLOCK 17 (Shock: Bridged Impact).
3	Perform two Full Rotational Drops as described in the sequence table below.	
	Sequence #	Action
	1	Place the packaged-product on the floor with one of the smallest faces down.
	2	Using any method, but without sliding or moving the packaged-product horizontally, slowly tilt the packaged-product until it topples over and Face 3 impacts the floor.
	3	Repeat Sequence #1 through 3 above, but start with one of the <u>next largest</u> faces of the packaged-product down.
	4	This Shock: Full Rotational Drop TEST BLOCK is now complete. Go to TEST BLOCK 18 (Shock: Concentrated Edge Impact).

TEST BLOCK 17
Shock:
Bridged ImpactFor STANDARD-
ELONGATED,
and
CYLINDRICAL-
ELONGATED

SHOCK - BRIDGED IMPACT	
Complete this test sequence for the following types of packaged-products only:	
<ul style="list-style-type: none"> • Standard-Elongated (see <i>Preface, Definitions</i>) • Cylindrical-Elongated (see <i>Preface, Definitions</i>) 	
STEP	ACTION
1	Place the packaged-product so that Face 3 (for Standard) or Line 2-6 (for Cylindrical) rests on two separate support blocks (as described in <i>Equipment Required Shock</i>), which are on opposite ends of the longest dimension parallel to each other and the shortest edges.
2	Position the Hazard Box above the packaged-product in an edge-drop orientation with the reinforced edge down and perpendicular to the packaged-product's longest dimension. Carefully align the Hazard Box so that the midpoint of the packaged-product Face 1 (for Standard) or Line 4-5 (for Cylindrical) is directly under the midpoint of the Hazard Box's reinforced edge.
3	Drop the Hazard Box onto the packaged-product from a distance of 16 in (410 mm) as measured from the packaged-product's top Face or Line. See the accompanying illustration.
	
4	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this procedure.

TEST BLOCK 18
Shock:
Concentrated
Edge Impact

For STANDARD-
FLAT

SHOCK - CONCENTRATED EDGE IMPACT	
<p>Complete this test sequence for the following types of packaged-products only:</p> <ul style="list-style-type: none"> • Standard-Flat (see <i>Preface, Definitions</i>) 	
STEP	ACTION
1	Place the packaged-product so that Face 3 rests on a rigid surface such as steel or concrete.
2	Position the Hazard Box above the packaged-product in an edge-drop orientation with the reinforced edge down, parallel to the packaged-product's Face 1 surface and parallel with its width dimension. Carefully align the Hazard Box so that the geometrical center of the packaged-product's Face 1 is directly under the midpoint of the Hazard Box's reinforced edge.
3	<p>Drop the Hazard Box onto the packaged-product from a distance of 16 in (410 mm) as measured from Face 1 of the packaged-product.</p> <p>See the accompanying illustration.</p> 
4	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.

Reporting an ISTA
Test:
Completing and
Submitting an
ISTA Test Report

ISTA Test Report Forms may be downloaded from www.ista.org. Custom forms with additional information are acceptable, but information on an official ISTA Report Form is considered to be the minimum.

The packaged-product has satisfactorily passed the test if, upon examination, it meets the Product Damage Tolerance and Package Degradation Allowance.

ISTA Certified Testing Laboratories:

- Should file a test report on all ISTA Test Procedures or Projects conducted.
- Shall file a test report on all ISTA Test Procedures or Projects conducted to obtain Transit Tested Package Certification or Acknowledgement.

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

ISTA Transit Tested Program

The ISTA Transit Tested Certification Mark as shown is a:

- registered certification mark **and**
- can only be printed on certified packages **and**
- can only be used by license agreement **and**
- by a member of the International Safe Transit Association.



When a member prints this certification mark on a packaged-product, with their license number, they are showing their customer and the carrier that it has passed the requirements of ISTA preshipment testing.

In order to maintain its certified status and eligibility for identification with the TRANSIT TESTED Certification Mark, each packaged-product must be re-tested whenever a change is made in the:

- Product or
- Process or
- Package.

Changes in the product can include changes in:

- Design (configuration, components, accessories, etc.) **or**
- Size / weight (dimensions, shape, mass, center of gravity, etc.) **or**
- Materials (type, construction, fabrication, gage, etc.)

Changes in the process can include changes in:

- Manufacturing / assembly (vendor, location, automation, etc.) **or**
- Filling (equipment, speed, automation, etc.) **or**
- Distribution system (parcel delivery, LTL, intermodal, etc.)

Changes in the package can include changes in:

- Configuration (individual package or unit load, container type and sub-type, style, design, interior packaging, etc.) **or**
- Size / weight (dimensions, shape, mass, caliper, gage etc.) **or**
- Materials (corrugated, plastic, metal, glass, etc.) **or**
- Components (closures, labels, straps, pallets, skids, wraps, etc.)

If corrugated packaging is used, it is recommended that the basis weights of the constituent papers/paperboards be determined after testing and documented to provide the best indicator of equivalence or change.

As a quality control procedure, packaged-products should be re-tested frequently, for example, yearly.

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