ISTA 1 Series Non-Simulation Integrity Performance Test Procedure

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Last TECHNICAL Change: MARCH 2014

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

Preface

ISTA, Distributing Confidence, Worldwide™

ISTA 1 Series are the most basic category of performance tests.

- They challenge the capability of the package and product to withstand transport hazards, **but**
- They are not simulations of actual transport hazards, **and**
- Do not necessarily comply with carrier packaging regulations.

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

- Shortened packaged development time and confidence in product launch
- Protection of products and profits with reduced damage and product loss
- Economically balanced distribution costs
- Customer satisfaction and continued business.

There are two sections: Overview and Testing

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

Two systems of weights and measures are presented in ISTA test procedures. They are the English system (Inch-Pound) and the international system SI (Metric). Inch-Pound units are shown first with Metric units in brackets, except in some tables where they are shown separately.

- 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.

OVERVIEW OF PROCEDURE 1E

Test Procedure 1E is an integrity test for unitized loads of the same retail or institutional packaged-products. A unitized load is defined as one or more products or packaged-products usually on a skid or pallet, but always secured together or restrained for distribution as a single load. Examples would be a stretch wrapped pallet load of individual containers, a single non-packaged machine banded to a pallet and a pallet with a corrugated tray, tube and a cap.

- It can be used to evaluate the performance of a packaged-product.
- It can be used to compare relative performance of package and product design alternatives.
- 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 may be appropriate for different conditions or to meet different objectives.

- Consider ISTA General Simulation Performance Test Procedure 3E.

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

1E

OVERVIEW OF PROCEDURE 1E

Scope

Test Procedure 1E covers testing of unitized loads, made up of either single or multiple products or packages of the same products.

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.

For additional information on this determination process refer to *Guidelines for Selecting and Using ISTA Procedures and Projects*.

Samples

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

Number of samples required:

- One sample is required for the tests in this procedure.

Replicate Testing Recommended:
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 new samples with each test.

NOTE:
Packages that have already been subjected to the rigors of transportation cannot be assumed to represent standard conditions. In order to insure testing in perfect condition, products and packages shipped to certified laboratories for testing must be:

- over-packaged for shipment to the laboratory **or**
- repackaged in new packaging at the laboratory.

Test Sequence

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

Sequence #	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning	Temperature and Humidity	Ambient	Required
2	Vibration (Alternative methods allowed – select one test type)	Vertical Linear Fixed Displacement	1 in (25mm) peak to peak at a frequency to be determined	Required
		Random	Overall G_{rms} level of 1.15	
3	Shock (Alternative methods allowed – select one test type)	Incline Impact (Conbur)	69 in (1.7 m) per second impact velocity	Required
		Horizontal Impact	69 in (1.7 m) per second velocity change	
4	Shock	Rotational Edge Drop	8 in (200 mm)	Required

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EQUIPMENT REQUIRED FOR PROCEDURE 1E

Equipment Required Vibration

The following alternatives are acceptable for the equipment required for the Vibration Test:

Fixed Displacement Vibration Test:

- Vibration Test System with a 1 in (25 mm) fixed or controlled displacement complying with Method A1 or A2 of the apparatus section of ASTM D 999.
  Only vertical linear motion of the platform is acceptable; rotary motion is not acceptable.
- Metal shim 0.06 in (1.5 mm), thick approximately 2 in (50 mm) wide and at a convenient length.
- Tachometer or suitable indicator for determining vibration frequency in cycles per second (Hz) or cycles per minute (CPM).
- Automatic timer or stopwatch.

Random Vibration Test:

- Random Vibration Test System complying with the apparatus section of ASTM D 4728.

Equipment Required Shock

Rotational Edge Drop Test:

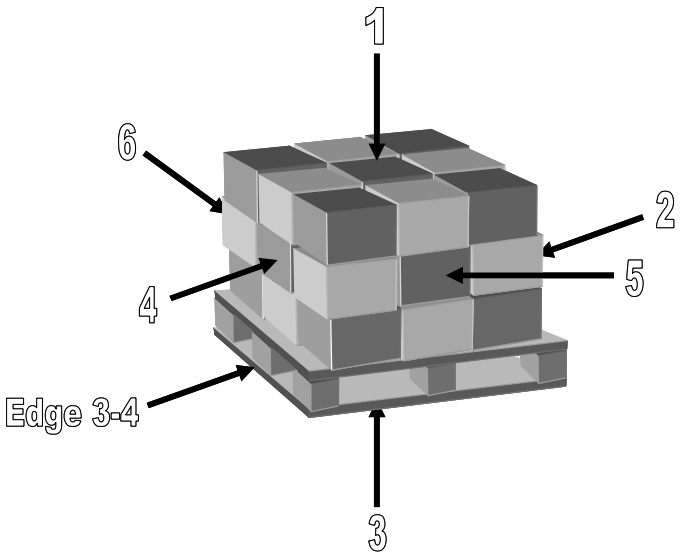
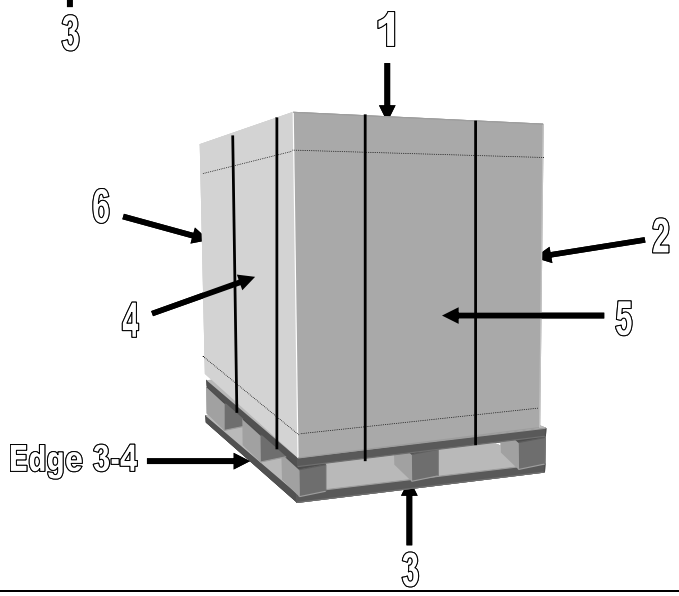
- Rotational Edge Drop Test System complying with the apparatus section of ASTM D 6179.

The following alternatives are acceptable for the equipment required for the **Impact Test**:

Type of Shock Test	Equipment	In compliance with the apparatus section of:
Incline Test	Incline impact tester (conbur)	ASTM D 880
Horizontal Test	Horizontal impact test system	ASTM D 4003

BEFORE YOU BEGIN PROCEDURE 1E

Prior to beginning the tests identify the faces, edges and corners according to the procedure below.

Step	Action
1	Place the unit load in its designed transport orientation.
2	Position one of the smallest width faces of the unit load directly in front of you.
3	**Identify faces** according to the diagram below.  
4	**Identify edges** using the numbers of the two faces forming that edge. Example: Edge 3-4 is the edge formed by face 3 and face 4 of the unit load.

BEFORE YOU BEGIN PROCEDURE 1E

Weight and Size Measurement

You shall know the unit load's:

- gross weight in pounds (kg), **and**
- outside dimensions of Length, Width and Height (L x W x H) in inches (mm or m)

Before You Begin Atmospheric Conditioning
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Required Preconditioning:
The packaged-product shall be preconditioned to laboratory ambient temperature and humidity for twelve (12) hours prior to testing.

Before You Begin Vibration Testing

CAUTION:
A restraining device or devices shall be used with the vibration test system to:

- Prevent the test specimen from moving off the platform **and**
- Maintain test orientation of the packaged-product, **but**
- The device or devices shall not restrict the vertical motion of the test specimen during the test.

Select Fixed Displacement Vibration or Random Vibration as a test method.

For Fixed Displacement Vibration:

Familiarity with the following formula is required to calculate the test duration after the frequency required to bounce the packaged-product is determined in the Vibration Test Block:

$$\text{Test Duration in Minutes} = \frac{\text{11,800 Vibratory Impacts}}{\text{Cycles Per Minute (CPM) or [Cycles Per Second (Hz) x 60]}}$$

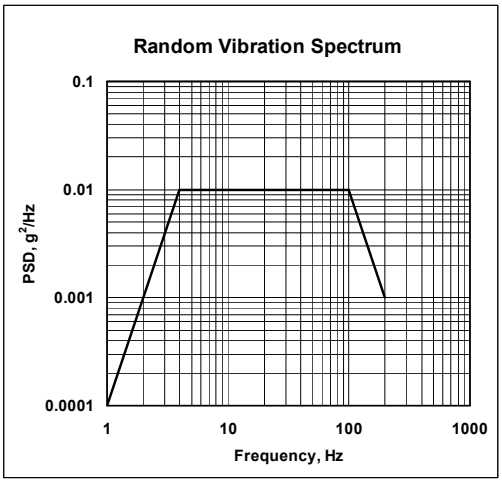
The chart below shows **example** Test Duration's calculated for several frequencies:

CPM	Hz	Test Duration in Minutes
150	2.5	79
180	3.0	66
210	3.5	57
240	4.0	50
270	4.5	44
300	5.0	40

For Random Vibration:

The following breakpoints shall be programmed into the vibration controller to produce the acceleration versus frequency profile (spectrum) below with an overall G_{rms} level of 1.15. The theoretical stroke required to run this vibration profile is 22.45 mm (0.884 in) peak to peak.

Frequency (Hz)	PSD Level, g^2/Hz
1.0	0.0001
4.0	0.01
100.0	0.01
200.0	0.001



BEFORE YOU BEGIN PROCEDURE 1E

CAUTION:

If the Unit Load:

- has a length equal to or greater than twice the width **and**
- a center of gravity above the midpoint of the height.
- there is the possibility that Unit Load could tip over when testing one of the longest edges, **therefore**
- you may conduct the Rotational Edge Drop test on both of the shortest edges.

Test the unitized load at a minimum of 69 in per second (1.7 m per second).

NOTE:

69 in per second is equal to 5.75 ft per second.

When using impact velocity or velocity change, if any velocity in a Test Sequence is below the required minimum level, that sequence event must be repeated until the test velocity meets the minimum.

TEST SEQUENCE FOR PROCEDURE 1E

The test blocks that follow contain tables that indicate the required steps for each test in the procedure.

TEST BLOCK 1 Atmospheric Conditioning
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TEMPERATURE AND HUMIDITY	
Step	**Action**
1	PRE-CONDITIONING: The packaged-product should be stored at laboratory ambient temperature and humidity for twelve (12) hours prior to testing.
3	Record the ambient laboratory temperature and humidity when testing starts.
4	At the end of testing record temperature and humidity.
5	Go to TEST BLOCK 2 (Vibration).

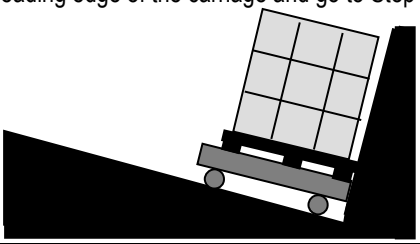
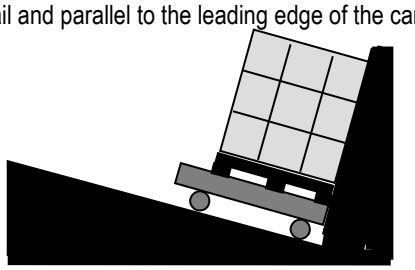
TEST BLOCK 2 Vibration (Fixed Displacement)

VIBRATION - FIXED DISPLACEMENT		
Step	**Action**	
1	Determine if testing is going to be Fixed Displacement or Random Vibration.	
	IF Vibration testing is going to be …	**THEN go to …**
	Fixed Displacement	Step 2.
	Random	TEST BLOCK 3 (Vibration – Random)~~)~~.
2	Put the unitized load on the vibration table so that face 3 rests on the platform.	
3	Start the test machine to vibrate at 1 in (25 mm) total displacement at the machine's lowest frequency using vertical linear motion only.	
4	Maintain a fixed displacement at 1 in (25 mm) and slowly increase the frequency (speed) of the vibration table until the packaged-product begins to momentarily leave the surface of the platform.	
5	Can a metal shim be intermittently moved between the bottom of the longest dimension of the packaged-product and the surface of the platform? • If **Yes**, hold that frequency and then continue to the next Step (Step 6). • If **No**, then slowly increase the frequency until the requirement of this Step (Step 5) is met, and hold that vibration frequency.	
6	Determine test duration in minutes using the formula indicated in Before You Begin Vibration Testing and the CPM or Hz frequency identified in Step 5.	
7	Begin timing the vibration test duration.	
8	Complete the vibration duration.	
9	Vibration testing is now complete. Go to TEST BLOCK 4 (Shock).	

TEST BLOCK 3 Vibration (Random)

VIBRATION - RANDOM	
Step	**Action**
1	Put the packaged-product on the vibration table so that face 3 rests on the platform.
2	Start the vibration system to produce the random vibration spectrum indicated in Before You Begin Vibration Testing.
3	Stop the vibration testing at the end of 60 minutes.
5	Vibration testing is now complete. Go to TEST BLOCK 4 (Shock).

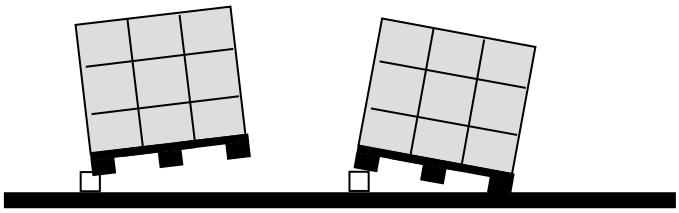
TEST SEQUENCE FOR PROCEDURE 1E

SHOCK - IMPACT	
Step	**Action**
1	Do the packaged-products overhang the edge of the pallet? • If **Yes**, then go to Step 3. • If **No**, then continue with the next Step.
2	Center the unitized load on the carriage with the pallet edge flat against the backstop or sail and parallel to the leading edge of the carriage and go to Step 4. 
3	Center the unitized load on the carriage with the vertical face of the unitized load flat against the backstop or sail and parallel to the leading edge of the carriage. 
4	Test the unitized load at a minimum of 69 in per second (1.7 m per second). If any velocity in the sequence is below the required 69 in per second (1.7 m per second) minimum, that sequence event must be repeated until it meets the minimum. Follow the sequence in the table below.

Sequence #	Orientation	Specific face
1	Face	one of the smallest vertical faces
2	Face	opposite small vertical face
3	Face	one of the largest vertical faces
4	Face	opposite large vertical face

5	Impact testing is now complete. Go to TEST BLOCK 5 (Shock - Rotational Edge Drop).

TEST SEQUENCE FOR PROCEDURE 1E

<table>
<tr><th colspan="3">SHOCK - ROTATIONAL EDGE DROP</th></tr>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>1</td><td colspan="2">Perform rotational edge drops. Follow the sequence in the table below.</td></tr>
<tr><td></td><td>Sequence #</td><td>Action</td></tr>
<tr><td></td><td>1</td><td>Place the unitized load onto a flat, rigid surface such as steel or concrete.</td></tr>
<tr><td></td><td>2</td><td>Support one of the shortest face 3 edges with a timber or support 3.5 to 4.0 in (90 to 100 mm) in height and width.</td></tr>
<tr><td></td><td>3</td><td>Lift the opposite face 3 edge to 8 in (200 mm) off the surface.</td></tr>
<tr><td></td><td>4</td><td>Release the edge so that it falls freely onto the flat, rigid surface.
  </td></tr>
<tr><td>2</td><td colspan="2">Does the Unit Load have a length equal to or greater than twice the width and a center of gravity above the midpoint of the height?
• If Yes, then go to Step 4.
• If No, then continue with the next step.</td></tr>
<tr><td>3</td><td colspan="2">Repeat Step 1 on one of the face 3 edges radiating 90° from the edge just tested in Step 1 Sequence 4. Then go to Step 5.</td></tr>
<tr><td>4</td><td colspan="2">Repeat Step 1 on the face 3 edge opposite the edge just tested in Step 1 Sequence 4. Then go to the next Step.</td></tr>
<tr><td>5</td><td colspan="2">All testing is now complete.</td></tr>
</table>

This Test Procedure is published by:
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