ISTA 1 Series Non-Simulation Integrity Performance Test Procedure

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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 1A

Test Procedure 1A is an integrity test for individual packaged-products.

- 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.

Specific suggestions:

- To use random vibration instead of fixed displacement vibration, use ISTA Test Procedure 1G and not 1A.
- For packaged-products where a minimum compression value should be tested, use ISTA Test Procedure 1C.
- For packaged-products intended for international distribution consider ISTA Partial-Simulation Performance Test Procedure 2A.
- For packaged-products that may be transported in a small parcel delivery system consider ISTA General Simulation Performance Test Procedure 3A.

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

1A OVERVIEW OF PROCEDURE 1A

Scope

Test Procedure 1A covers testing of individual packaged-products weighing 150 lb (68 kg) or less when prepared for shipment.

EXCEPTION:
Individual packaged-products on a visible skid or pallet and that weigh more than 100 lb (45 kg) may be tested according to Test Procedure 1B or 1E.

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

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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	Fixed Displacement	1 in (25mm) peak-to-peak at a frequency to be determined	Required
3	Shock (Alternative methods allowed – select one test type)	Drop	Height varies with packaged-product weight	Required
		Incline-Impact (Conbur)	Impact Velocity varies with packaged-product weight	
		Horizontal Impact	Impact Velocity varies with packaged-product weight	

EQUIPMENT REQUIRED FOR PROCEDURE 1A

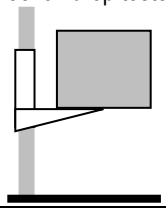
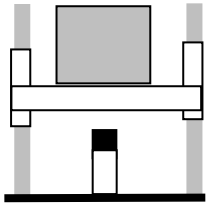
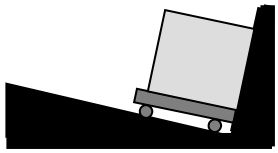
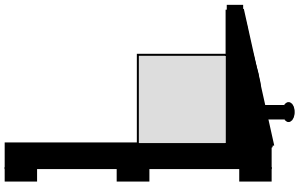
Equipment Required Vibration

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.
  Rotary or vertical linear motion of the platform is 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.

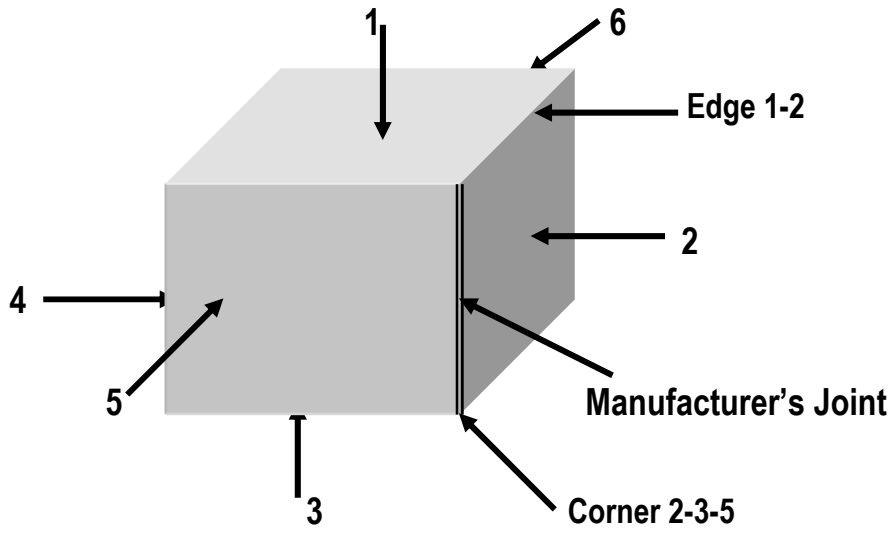
Equipment Required Shock

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

Type of Shock Test	Type of Equipment	In compliance with the apparatus section of …
Drop Test	Free fall drop tester 	ASTM D 5276
Vertical Shock Test	Shock test machine 	ASTM D 5487
Alternative Incline Test	Incline impact tester (conbur) 	ASTM D 880
Alternative Horizontal Test	Horizontal impact test system 	ASTM D 4003

BEFORE YOU BEGIN PROCEDURE 1A

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

Step	Action
1	Place the packaged-product in its intended shipping position as determined by shipper. If the shipping position can be variable, place the packaged-product so that the primary shipping label location is on the top face.
2	Does the packaged-product have only six faces (2 sides, 2 ends, top and bottom)? • If **Yes**, then go to Step 5. • If **No**, continue to next Step.
3	Develop a method to identify each face, edge and corner and document with a diagram.
4	Go to next page for further Before You Begin details.
5	Is the package a corrugated container? • If **Yes**, continue to next Step. • If **No**, then go to Step 8.
6	Does the package have a manufacturer's joint connecting a side and an end face? • If **Yes**, continue to next Step. • If **No**, then go to Step 8.
7	Turn the packaged-product so that you are looking directly at a face with the manufacturer's joint on the observer's right and go to Step 9.
8	Position one of the smallest width faces of the packaged-product directly in front of you.
9	**Identify faces** according to the diagram below. 
10	**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.
11	**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.
12	Go to next page for further Before You Begin details.

BEFORE YOU BEGIN PROCEDURE 1A

Weight and Size Measurement

You shall know the packaged-product'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.

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:

$$\text{Test Duration in Minutes} = \frac{\text{14, 200 Vibratory Impacts}}{\text{Cycles Per Minute (CPM) } \textbf{or} \text{ [Cycles Per Second (Hz) x 60]}}$$

The chart below shows **example** Test Durations calculated for several frequencies.

CPM	Hz	Test Duration in Minutes
150	2.5	95
180	3.0	79
210	3.5	68
240	4.0	60
270	4.5	53
300	5.0	48

Before You Begin Shock Testing

The test drop height varies with the weight of the packaged-product. Find the weight of the packaged-product in the following chart to determine a drop height or an equivalent impact velocity or velocity change to be used for a substituted drop:

Packaged-Product Weight				Drop Height			Impact Velocity	
Equal to or greater than		But Less than		Free Fall			Incline or Horizontal	
lb	kg	lb	kg	in.	mm		ft/s	m/s
0	0	21	10	30	760		13	3.9
21	10	41	19	24	610		11	3.5
41	19	61	28	18	460		10	3.0
61	28	100	45	12	310		8.0	2.5
100	45	150	68	8	200		6.6	2.0

- The test method requires the packaged-product to be dropped in several different package orientations.
- A drop test must be performed in all required orientations where dropping the packaged-product is practical.
- If dropping in a required orientation is not practical an equivalent incline or horizontal test can be substituted for that orientation.
- 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 1A

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.
2	Record the ambient laboratory temperature and humidity when testing starts.
3	At the end of testing record temperature and humidity.
4	Go to TEST BLOCK 2 (Vibration).

TEST BLOCK 2
Vibration

VIBRATION –FIXED DISPLACEMENT		
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 vibrate at 1.0 in (25 mm) total displacement at the machine's lowest frequency.	
3	Maintain a fixed displacement at 1 inch (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.	
4	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 5). • If **No**, then slowly increase the frequency until the requirement of this Step (Step 4) is met, and hold that vibration frequency.	
5	Determine the test duration in minutes using the formula indicated in Before You Begin Vibration Testing and the CPM or Hz frequency identified in Step 4.	
6	Begin timing the vibration test duration.	
7	Are you using a vertical linear motion on the vibration system? • If **Yes**, then go to Step 12. • If **No**, then continue with the next Step.	
8	Stop the vibration test after completion of one-half ($^1/_2$) of the total minutes of test duration and perform the appropriate action as indicated in the table below:	
	IF a single 90º horizontal rotation is…	**THEN perform a horizontal rotation of …**
	Possible	90º as the specimen rests on the platform.
	Not practical because of the size of the packaged-product or the stability of the packaged-product.	180º as the specimen rests on the platform.
9	Re-start the vibration system to vibrate at 1.0 in (25 mm) total displacement at the machine's lowest frequency.	
10	Maintain a fixed displacement at 1 inch (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.	
11	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 12). • If **No**, then slowly increase the frequency until the requirement of this Step (Step 11) is met, and hold that vibration frequency.	
12	Resume or continue timing the test, and complete the second half of the vibration duration.	
13	Vibration testing is now complete. Go to TEST BLOCK 3 (Shock).	

TEST SEQUENCE FOR PROCEDURE 1A

SHOCK - DROP			
Step	**Action**		
1	Determine the method(s) of test and the required drop height or impact velocity in Before You Begin Shock Testing.		
2	Do you have a packaged-product with only 6 faces as identified in Face, Edge and Corner Identification? • If **Yes**, continue with the next Step. • If **No**, then go to Step 6.		
3	Test the packaged-product according to the method(s) and level(s) determined in Step 1. Follow the sequence in the table below.		
4	**Sequence #**	**Orientation**	**Specific face, edge or corner**
	1	Corner	most fragile face-3 corner, if not known, test 2-3-5
	2	Edge	shortest edge radiating from the corner tested
	3	Edge	next longest edge radiating from the corner tested
	4	Edge	longest edge radiating from the corner tested
	5	Face	one of the smallest faces
	6	Face	opposite small face
	7	Face	one of the medium faces
	8	Face	opposite medium face
	9	Face	one of the largest faces
	10	Face	opposite large face
5	All testing is now complete. Go to the Reporting an ISTA Test section at the end of this Procedure.		
6	Select a bottom face corner to replace the corner required in Step 4 Sequence 1 to begin the test.		
7	Identify the edges of the packaged-product that meet the Step 4 Sequence 2 through 4 requirements.		
8	Select any 6 faces to replace the faces required in Step 4 Sequence 5 through 10.		
9	Using the corner, edges and faces from Steps 6 through 8 go to Step 3 and proceed.		
10	All testing is now complete.		

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