



ISTA, Your Alliance in Transport Packaging, is the world leader in Performance Tests for Packaged-Products.

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 three sections: Overview, Testing and Report

- **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 **and**
- **Report** 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. 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 1C

Preface

Test Procedure 1C 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. Refer to *Guidelines for Selecting and Using ISTA Procedures and Projects* for additional information.

## Scope

Test Procedure 1C 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 1E or Procedure 3E.

Product Damage  
Tolerance and  
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 and/or the other is 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	Compression Conditioning	Machine or Static	Calculated Test Load or Force	Required
2	Vibration (Alternative methods allowed – select one test type)	Fixed Displacement	1 in (25mm) peak to peak at a frequency to be determined	Required
		Random	Overall G <sub>rms</sub> level of 1.15	
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	

# 1C

Equipment  
Required  
Atmospheric

## EQUIPMENT REQUIRED FOR PROCEDURE 1C

Atmospheric Measurement:

- Humidity recording apparatus complying with the apparatus section of ASTM D 4332-01.
- Temperature recording apparatus complying with of the apparatus section of ASTM D 4332-01.

Equipment  
Required  
Compression  
Conditioning

The following alternatives are acceptable for the equipment required for the Compression Conditioning:

Type of Compression Test	Equipment	In compliance with the apparatus section of ...
Apply and Release Test	Compression test system	ASTM D 642-00
Apply and Hold Test	Compression test system	ASTM D 642-00
Apply and Hold Test	Weight and load spreader	NA

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 999-01.  
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.

Random Vibration Test:

- Random Vibration Test System complying with the apparatus section of ASTM D 4728-01.

Equipment  
Required  
Shock

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

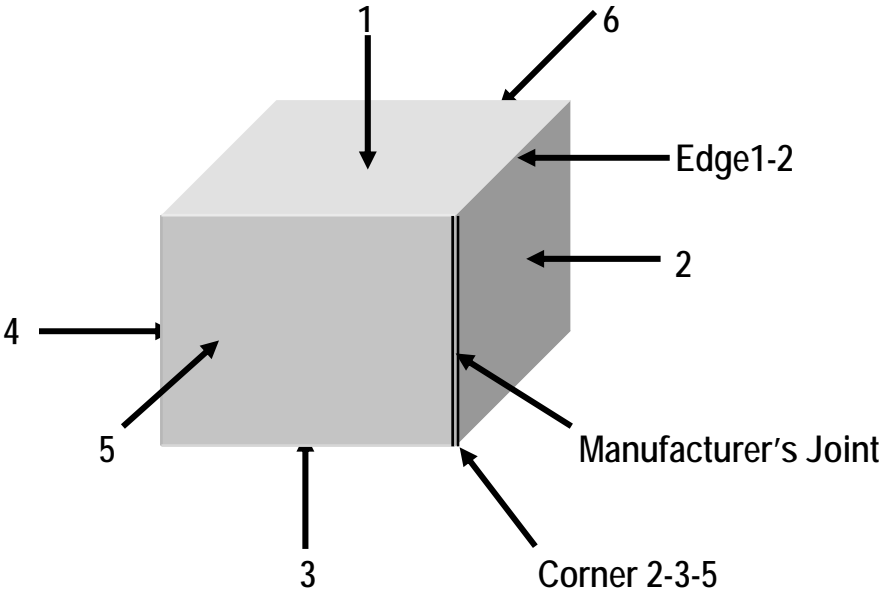
Type of Shock Test	Equipment	In compliance with the apparatus section of ...
Drop Test	Free fall drop tester	ASTM D 5276-98
Vertical Shock Test	Shock test machine	ASTM D 5487-98(02)
Alternative Incline Test	Incline impact tester (conbur)	ASTM D 880-92(02)
Alternative Horizontal Test	Horizontal impact test system	ASTM D 4003-98

# 1C

## Identification of Faces, Edges and Corners

### BEFORE YOU BEGIN PROCEDURE 1C

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)? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, then go to Step 5.</li> <li>• If <b>No</b>, continue to next Step.</li> </ul>
3	Develop a method to identify each face, edge and corner and document with a diagram.
4	Go to the next Block.
5	Is the package a corrugated container? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, continue to next step.</li> <li>• If <b>No</b>, then go to Step 8.</li> </ul>
6	Does the package have a manufacturer's joint connecting a side and an end face? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, continue to next step.</li> <li>• If <b>No</b>, then go to Step 8.</li> </ul>
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	<p>Identify faces according to the diagram.</p> 
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 Block.

## BEFORE YOU BEGIN PROCEDURE 1C

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)

### CAUTION

When using weights and a load spreader, use extreme care to prevent injury.

### NOTE:

This is only a conditioning requirement before the vibration and impact tests begin:

- it is not a compression performance test **or**
- a predictor of warehouse or vehicle stacking capability.
- there is a minimum test force or load **and** a maximum test force or load.

Familiarity with the following formulas is required:

Compression Test System	Test Force	English Units - Pounds Force (lbf)	Metric Units – Newtons (N)
Apply & Release Test Force	AR	$[300 + W_i + [3 \times (L + W)]] \times 1.4$	$[1300 + (W_i \times 9.8) + [530 \times (L + W)]] \times 1.4$
Apply & Hold Test Force	AH	$300 + W_i + [3 \times (L + W)]$	$1300 + (W_i \times 9.8) + [530 \times (L + W)]$
Weight & Load Spreader	Test Load	English Units Pounds (lb)	Metric Units Kilograms (kg)
Dead Weight Test Load	DW-AH	$300 + W_i + [3 \times (L + W)]$	$135 + W_i + [54 \times (L + W)]$

### Where

$W_i$	Total weight of the packaged-product	Pounds	Kilograms
	Minimum value for Ramp and Release	300 lbf	1300 N
	Minimum value for Apply and Hold -Machine	300 lbf	1300 N
	Minimum value for Apply and Hold –Dead Weight	300 lb	135 kg
	Formula values, force	3	530
	Formula values, load	3	54
L	Overall container length	Inches	Meters
W	Overall container width	Inches	Meters
	Compensating Factor for time of compression	1.4	1.4
	Metric conversion factor	NA	9.8

Determine the Maximum Top-Load weight with the following Table

Step	Action	
1	Is the package height over 60 in (1.5 m)? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, then use the appropriate minimum values only from the table above as the test force or load.</li> <li>• If <b>No</b>, then continue with the next step.</li> </ul>	
2	Determine the maximum test force or load to be used by performing the appropriate action as indicated below:	
	<b>IF the calculated test load from above is ...</b>	<b>Then use...</b>
	Equal to or less than 300 lbf (1300 Newtons) or 300 lb (135 kg)	300 lbf (1300 Newtons) or 300 lb (135 kg) as the test force or load in the Compression Test Block.
	More than 300 lbf (1300 Newtons) or 300 lb (135 kg) but Less than 750 lbf (3300 Newtons) or 750 lb (340 kg)	the appropriate calculated test force or load in the Compression Test Block.
	Equal to or greater than 750 lbf (3300 Newtons) or 750 lb (340 kg)	750 lbf (3300 Newtons) or 750 lb (340 kg) as the test force or load in the Compression Test Block.

## BEFORE YOU BEGIN PROCEDURE 1C

**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:

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

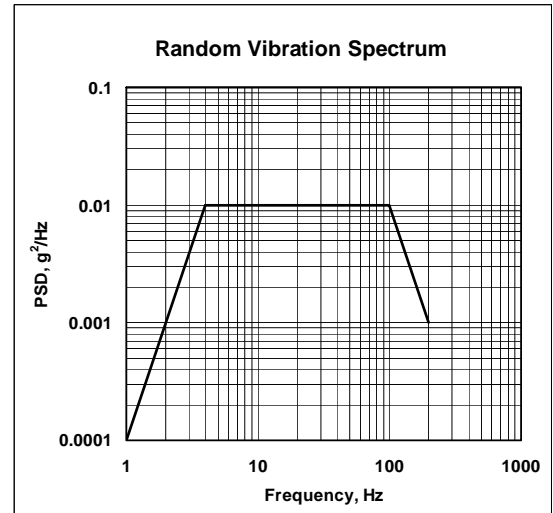
The chart below shows example Test Duration's calculated for several frequencies:

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

**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

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



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 1C

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

TEMPERATURE AND HUMIDITY	
Step	Action
1	Record the temperature and humidity when testing starts.
2	Continue to record temperature and humidity at one-hour intervals while the test is being conducted.
3	At the end of testing record temperature and humidity.

COMPRESSION		
Step	Action	
1	Testing is to be conducted using the test load from the Before You Begin Test Block and by performing the appropriate action as indicated in the table below:	
	<b>IF the testing equipment to be used is a ...</b> <b>THEN...</b>	
	Compression Test System	Step 2.
	Weight and load spreader	Step 7.
2	Center the packaged-product with face-3 resting on the lower platen of the compression tester.	
3	Start the test machine and bring the platens together at the rate of one-half (0.5) in (13 mm) per minute.	
4	Perform the appropriate action as indicated in the table below:	
	<b>IF the compression test is a ...</b> <b>THEN...</b>	
	Apply and Release Test	Increase the force until it reaches the AR Test Force value determined in the Before You Begin Compression Testing block. Then go to Step 5.
	Apply and Hold Test	Increase the force until it reaches the AH Test Force value determined in the Before You Begin Compression Testing block. Then go to Step 6.
5	Release the force. Compression Conditioning is complete. Go to the Vibration Test Block.	
6	Maintain the force for one (1) hour, and then release the force. Go to the Vibration Test Block.	
7	Place the packaged-product with face-3 resting on a smooth, flat, rigid surface.	
8	Place a rigid load spreader that is larger than the top face of the test specimen on the packaged-product.	
9	Apply the necessary weight to bring the total of the load spreader and weights up to the DW-AH Test Load determined in the Before You Begin Compression Testing block and maintain for one (1) hour.	
10	Remove the weight and load spreader.	
11	Compression Conditioning is complete. Go to the Vibration Test Block.	



## TEST SEQUENCE FOR PROCEDURE 1C

FIXED DISPLACEMENT		
Step	Action	
1	Determine if testing is going to be Fixed Displacement or Random Vibration.	
	<b>IF Vibration testing is going to be ...</b>	<b>THEN go to ...</b>
	Fixed Displacement	Step 2.
	Random	the Random Vibration Test Block.
2	Put the packaged-product on the vibration table so that face-3 rests on the platform.	
3	Start the vibration system to vibrate at 1 in (25 mm) total displacement at the machine's lowest frequency.	
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	Hold the vibration frequency to that determined in Step 4.	
6	Can a metal shim be intermittently moved between the bottom of the longest dimension of the packaged-product and the surface of the platform? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, hold that frequency and then continue to next step.</li> <li>• If <b>No</b>, then increase the frequency until the requirement of Step 6 is met and hold that vibration frequency.</li> </ul>	
7	Determine the test duration in minutes using the formula indicated in the Before You Begin block and the CPM or Hz frequency identified in Step 6.	
8	Begin the vibration duration.	
9	Stop the vibration test after completion of one-half ( $1/2$ ) of the total minutes of test duration. Invert the packaged-product so that face-1 rests on the platform.	
10	Start the vibration system and continue the vibration test at the frequency used in Step 8.	
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? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, then continue to next step.</li> <li>• If <b>No</b>, then adjust the frequency until the requirement of Step 11 is met.</li> </ul>	
12	Begin the vibration duration for this orientation.	
13	Stop the vibration test after completion of one-sixth ( $1/6$ ) of the total minutes of test duration. Place the packaged-product so that either face-2 or 4 rests on the platform	
14	Start the vibration system and continue the vibration test at the frequency used in Step 12.	
15	Can a metal shim be intermittently moved between the bottom of the longest dimension of the packaged-product and the surface of the platform? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, then continue to next step.</li> <li>• If <b>No</b>, then adjust the frequency until the requirement of Step 15 is met.</li> </ul>	
16	Begin the vibration duration for this orientation.	
17	Stop the vibration test after completion of one-sixth ( $1/6$ ) of the total minutes of test duration. Place the packaged-product so that either face-5 or 6 rests on the platform.	

*Continued*

## TEST SEQUENCE FOR PROCEDURE 1C

18	Start the vibration system and continue the vibration test at the frequency used in Step 16.
19	Can a metal shim be intermittently moved between the bottom of the longest dimension of the packaged-product and the surface of the platform? <ul style="list-style-type: none"> <li>• If <b>Yes</b>, then continue to next step.</li> <li>• If <b>No</b>, then adjust the frequency up or down until the requirement of Step 19 is met.</li> </ul>
20	Begin the vibration duration for this orientation.
21	Stop the vibration testing after completion of one-sixth ( $1/6$ ) of the total minutes of test duration.
22	Inspection of the packaged-product for visible damage is allowed, provided inspection does not alter, in any way, the current condition of the package or the condition or position of the product(s).
23	Vibration testing is now complete. Go to the Shock Test Block.

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 the Before You Begin Block.
3	Stop the vibration system after the completion of 30 minutes. Invert the packaged-product so that face-1 (top) rests on the platform.
4	Begin the vibration duration for this orientation.
5	Stop the vibration system after the completion of 10 minutes. Place the packaged-product so that either face-2 or 4 rests on the platform.
6	Begin the vibration duration for this orientation.
7	Stop the vibration system after the completion of 10 minutes. Place the packaged-product so that either face-5 or 6 rests on the platform.
8	Begin the vibration duration for this orientation.
9	Stop the vibration testing at the end of 10 minutes.
10	Inspection of the packaged-product for visible damage is allowed, provided inspection does not alter, in any way, the current condition of the package or the condition or position of the product(s).
11	Vibration testing is now complete. Go to the Shock Test Block.

## TEST SEQUENCE FOR PROCEDURE 1C

DROP OR IMPACT			
Step	Action		
1	Determine the method(s) of test and the required drop height or impact velocity in the Before You Begin Block.		
2	Do you have a packaged-product with only 6 faces as identified in the Face, Edge and Corner Identification Block? <ul style="list-style-type: none"> <li>If <b>Yes</b>, continue with the next Step.</li> <li>If <b>No</b>, then go to Step 6.</li> </ul>		
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	<b>Sequence #</b>	<b>Orientation</b>	<b>Specific face, edge or corner</b>
	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 Test Report Block.		
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. Go to the Test Report Block.		

## TEST REPORT FOR PROCEDURE 1C

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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