



# FedEx Procedures for Testing Packaged Products 150 lbs. or Less





As the industry leader, FedEx sets the highest standard for testing procedures to help ensure your packages reach their destination safely. FedEx package testing procedures are based on factual industry data, as well as international testing procedures and standards to provide the most reliable package test possible. Should you have any questions concerning any of the information in this brochure, contact the FedEx Packaging Design and Development department at 1.800.633.7019.



# Procedure for Testing Packaged Products 150 lbs. or Less

Package closure performance is also a test criterion. Packages will be opened and contents inspected only after completion of the entire test procedure, unless obvious damage is noted during or after an individual test component.

Product/Service	Test Sequence									
	Free-Fall Drop Test	Rotational Edge Drop Test	Full Rotational Flat Drop Test	Bridge Impact Test	Concentrated Impact Test	Compression Test	Rotary Vibration Test	Random Vibration Test – U.S.	Random Vibration Test – International	Second Free-Fall Drop Test
Electronic, Powered, and Medical Items	X					X		X		
Non -Electronic, Powered and Medical Items	X					X	X			
– Flat Packages*		X	X		X					
– Elongated Packages*		X	X	X						
International Shipments	X					X			X	X
– Flat Packages*		X	X		X					
– Elongated Packages*		X	X	X						

\* Additional Tests Required

	TEST PROCEDURE SEQUENCE	DEFINITIONS
<b>Electronic, Powered and Medical Items</b>	1) Free-Fall Drop Test Procedure 2) Compression Test 3) Random Vibration Sequence	
<b>Non-Electronic, Powered and Medical Items</b>	1) Free-Fall Drop Test Procedure 2) Compression Test 3) Rotary Vibration Sequence	
<b>Flat Packages</b>	1) Free-Fall Drop Test Procedure 2) Rotational Edge Drop 3) Full Rotational Flat Drop 4) Concentrated Impact 5) Compression Test 6) Rotary or Random Vibration, if applicable	MUST BE: Shortest dimension less than or equal to 8 inches, next shortest dimension at least four times the length of shortest dimension
<b>Elongated Packages</b>	1) Free-Fall Drop Test Procedure 2) Rotational Edge Drop 3) Full Rotational Flat Drop 4) Bridge Test 5) Compression Test 6) Rotary or Random Vibration, if applicable	MUST BE: Longest dimension at least 36 inches or greater and both other dimensions 20 percent or less of longest dimension
<b>All International Shipments</b>	1) Free-Fall Drop Test Procedure 2) If flat or elongated, follow additional drop sequences as outlined above 3) Compression Test 4) International Random Vibration Sequence 5) 2nd series Free-Fall Drop Test Procedure	

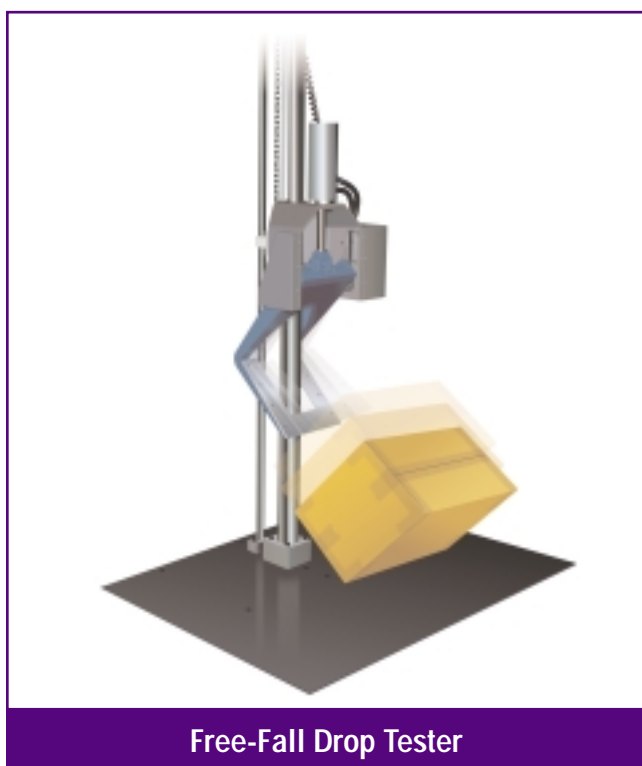
The FedEx Packaging Design and Development department reserves the right to alter test sequence or equipment used to accommodate special package characteristics, commodities and/or testing equipment limitations to provide the most representative test possible. When package and/or content conditions are uncertain or conditional on customer input, a "Post Test Inspection Notice" will be sent with the report.



## DROP TEST

Weight of Package in Pounds	Drop Height, Inches	Number of Drops Per Sequence
Less than 75	30	10
Greater than 75 but less than 100	24	10
Greater than 100 but less than 150	18	10

### Free-Fall Drop Test Procedures for Regular Packages



**Free-Fall Drop Test:** Performed on a free-fall drop tester.\*\* Package is dropped onto a flat, firm, nonyielding steel base. The drop height varies with package weight as shown in the chart above.

A total of 10 drops are conducted in the following orientations:

1. Most fragile corner
2. Shortest edge radiating from drop corner
3. Medium edge radiating from drop corner
4. Longest edge radiating from drop corner
5. Flat on one of the smallest faces
6. Flat on the opposite small face
7. Flat on one of the medium faces
8. Flat on the opposite medium face
9. Flat on one of the largest faces
10. Flat on the opposite large face

(See page 7 for detailed diagrams of the Free-Fall Drop Test Package Orientations.)

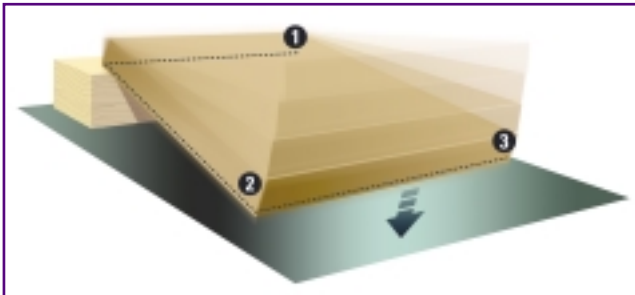
NOTE: For international products, a second sequence of free-fall drop tests will be performed following the vibration test.

\*\* Computer-aided data acquisition and analysis are available when requested.



**Note: Irregular-shaped items are subject to consideration for Special Drop Orientation.**

## Drop Procedures for Flat Packages:

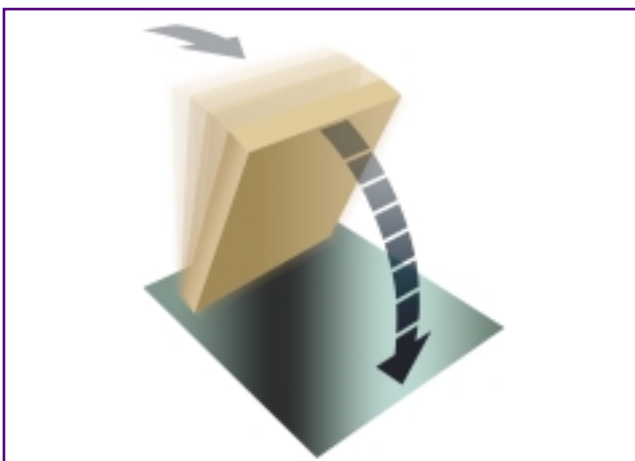


**Rotational Edge Drop for Flat Packages**

**Rotational Edge Drop:** Performed with one test package edge supported by a 4-inch-high block. Raise the nonsupported package end so that the edge to be dropped is elevated to 8 inches above a flat, firm, nonyielding steel or concrete surface. Release the raised package end so that it freely falls onto the impact surface. A total of three rotational edge drops are performed according to the procedure as follows:

See illustration above for package support edges labeled 1, 2 and 3.

1. Place the longest package edge (Number 1) on the support block. Raise the nonsupported package end and perform drop as indicated.
2. Place next longest edge (Number 2), radiating 90 degrees from previous edge, on the support block. Raise the nonsupported package end and perform drop as indicated.
3. Rotate the package 180 degrees so that the opposite package end (Number 3) is positioned on the support block. Raise the nonsupported package end and perform drop as indicated.



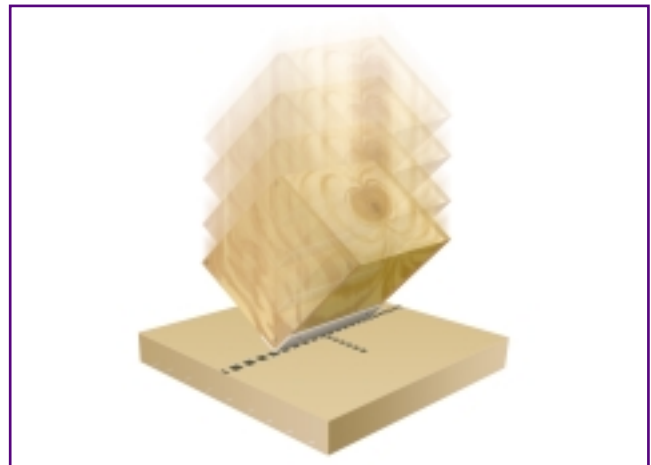
**Full Rotational Flat Drop for Flat Packages**

**Full Rotational Flat Drop:** Performed on a flat, firm, nonyielding steel or concrete surface.

Testing procedure:

1. Place the package so that it stands upright, resting on its smallest face.

2. The package shall be slowly tipped on the upper half of the package without thrust, until it falls freely, so that the largest package face impacts onto the nonyielding impact surface.
3. Place the package so that it stands upright, resting on the next largest face.
4. The package shall be slowly tipped on the upper half of the package without thrust, until it falls freely, so that the largest package face impacts onto the nonyielding impact surface.



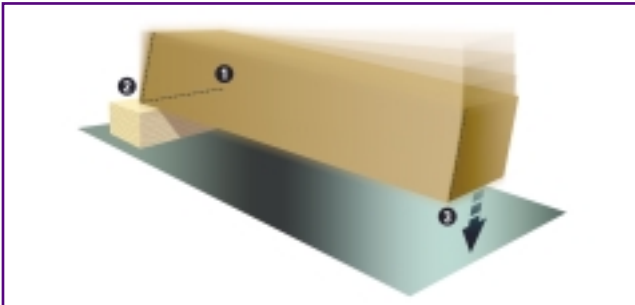
**Concentrated Impact for Flat Packages**

**Concentrated Impact:** Performed on a flat, firm, nonyielding steel or concrete base. Use a free fall-drop tester to drop a dense wooden box that measures 12" x 12" x 12" with one bottom edge covered by an angle iron, onto a test package. The box should be filled with a sandbag to achieve the weight and void fill to hold the bag in place. The wooden box should have a total weight of 12 lbs.

Testing procedure:

1. Place the package so that the largest surface rests on the nonyielding steel or concrete base.
2. Measure and mark the center of the test package in both directions. Raise the drop tester platen to exactly 16 inches above the test package surface.
3. Position the wooden box on the drop platen so that the angle iron edge is pointed toward the package and is parallel to the shortest dimension of the largest package face. Mark the wooden box impact edge midpoint and ensure it is lined up with the marked test package midpoint.
4. Allow the box to fall freely and impact the package at the marked midpoints evenly, without attempting to catch any rebound of the wooden box.

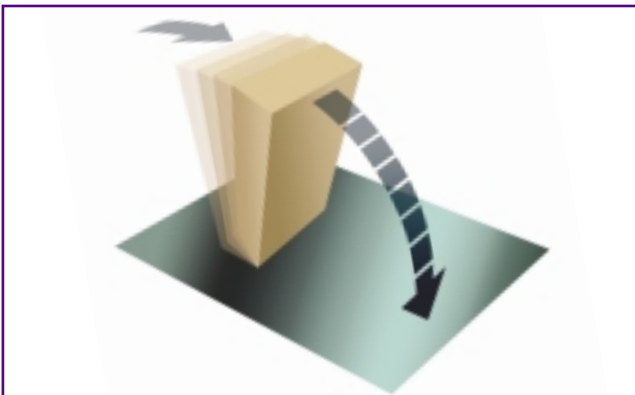
## Drop Procedures for Elongated Packages:



### Rotational Edge Drop for Elongated Packages

**Rotational Edge Drop:** Performed with one test package edge supported by a 4-inch-high block. Raise the nonsupported package end so that the edge to be dropped is elevated to 8 inches above a flat, firm, nonyielding steel or concrete surface. Release the raised package end so that it freely falls onto the impact surface. A total of three rotational edge drops are performed according to the procedure as follows:

1. Place the shortest package edge (Number 1) on the support block. Raise the nonsupported package end and perform drop as indicated.
2. Rotate the package 90 degrees so that an adjacent edge (Number 2) is positioned on the support block. Raise the nonsupported package end and perform drop as indicated.
3. Rotate the package 180 degrees so that the opposite package end (Number 3) is positioned on the support block. Raise the nonsupported package end and perform drop as indicated.



### Full Rotational Flat Drop for Elongated Packages

**Full Rotational Flat Drop:** Performed on a flat, firm, nonyielding steel or concrete surface.

Testing procedure:

1. Place the package so that it stands upright, resting on its smallest face.
2. The package shall be slowly tipped on the upper half of the package without thrust, until it falls freely, so that the largest package face impacts onto the nonyielding impact surface.

3. Place the package so that it stands upright, resting on its smallest face and position the package to drop the second largest face.
4. The package shall be slowly tipped on the upper half of the package without thrust, until it falls freely, so that the second largest package face impacts onto the nonyielding impact surface.



### Bridge Impact for Elongated Packages

**Bridge Impact:** Performed on a flat, firm, nonyielding steel or concrete base. Use a free-fall drop tester to drop a dense wooden box that measures 12" x 12" x 12" with one bottom edge covered by an angle iron, onto a test package. The box should be filled with a sandbag to achieve the weight and void fill to hold the bag in place. The wooden box should have a total weight of 12 lbs.

Testing procedure:

1. Place the test package so it is supported by two 4-inch-high blocks, which are on opposite ends of the longest package dimension, parallel to each other and the shortest package edge.
2. Measure and mark the center of the test package in both directions. Raise the drop tester platen to exactly 16 inches above the test package surface.
3. Position the wooden box on the drop platen so that the angle iron edge is pointed toward the package and is parallel to the shortest dimension of the largest package face. Mark the wooden box impact edge midpoint and ensure it is lined up with marked test package midpoint.
4. Allow the box to fall freely and impact the package at the marked midpoints evenly, without attempting to catch any rebound of the wooden box.

## COMPRESSION TEST



Compression Tester

Performed on a dynamic compression tester equipped with computerized control system.

The F-Factor is normally set to Assurance Level III

Shipping Unit Construction	F-Factors Assurance Level		
	I	II	III
Corrugated, fiberboard, or plastic container that may or may not have stress-bearing interior packaging using these materials and where the product does not support any of the load.	10.0	7.0	5.0
Corrugated, fiberboard, or plastic container that has stress-bearing interior packaging with rigid inserts such as wood.	6.0	4.5	3.0
Containers constructed of materials other than corrugated, fiberboard, or plastic that are not temperature or humidity-sensitive or when the product supports the load directly.	4.0	3.0	2.0

$$\text{Formula: Compression Load (pounds)} = 0.007 \times (108 - H) \times L \times W \times F$$

Testing procedure:

1. Calculate the compression load using the formula above:  
0.007 = Average density of freight in pounds per cubic inch (12 lbs. per cubic foot)  
108 = Maximum height (inches) of package stack in transit  
H = Height of shipping unit (inches)  
L = Length of shipping unit (inches)  
W = Width of shipping unit (inches)  
F = A factor to account for humidity, time and stacking pattern
2. Set up the compression tester.
3. Center the packaged-product on the lower platen of the compression tester.
4. Bring platens together at 0.5 inches per minute until target compression load is met or the test package fails.





## VIBRATION TEST



Random Vibration

### A) RANDOM VIBRATION:

Performed on a vertical electrohydraulic vibration machine equipped with computerized control.

Testing procedure:

1. Program vibration system to reproduce three consecutive sequences of random vibration profiles (spectra) representing the FedEx® distribution environment:
  - (1) Truck Vibration at 0.52 Grms
  - (2) Air Vibration at 1.06 Grms
  - (3) Truck Vibration at 0.52 Grms
2. The duration of each sequence is 15 minutes for U.S. shipments and 30 minutes for international shipments.
3. Place package on vibration table. Fixtures or restraints may be used during testing.
4. Load appropriate automatic sequences of random vibration profiles and perform tests.



Rotary Vibration

### B) ROTARY VIBRATION:

Performed on a mechanical, rotary vibration machine. The machine will vibrate at 1.0 inches total displacement. Packages will be subjected to a total of 14,200 vibratory impacts. Fixtures or restraints may be used during testing.

Testing procedure:

1. Place the package on the machine table surface and begin the vibration cycle at a running speed of approximately 237 cycles per minute.
2. Stop the vibration test after 30 minutes (7,100 impacts). Maintain orientation and turn the package 90 degrees on its face.
3. If package size or shape does not permit 90 degree horizontal rotation, rotate the package 180 degrees horizontally.
4. Start the vibration machine for the remaining 30 minutes.

**Flat and elongated packages will be vibrated on the smallest and largest package surfaces respectively.**

## VIBRATION TEST FOR LIQUIDS

**Please note that all liquids, hazardous materials, and items with directional sensitivity (indicated by arrows) will be vibrated with arrows or bottle caps facing downward.**

**NOTE: Do not send actual hazardous materials.** Send sample package components with containers filled with nonhazardous substitute (e.g. water, sand, etc.). Weight of test package must equal weight of original package. Please write on the overbox and test samples: "NONHAZARDOUS CONTENT."

Please note that hazardous materials testing is performed for FedEx Ground® shipments only. When shipping hazardous materials, all Department of Transportation (DOT) and all other applicable regulations and requirements must be met. Refer to the current *FedEx Ground Shipping Hazardous Materials Guide* for details.

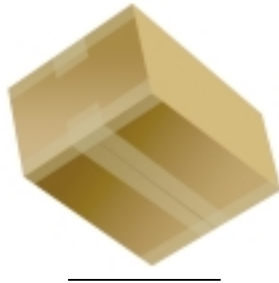




# FREE-FALL DROP TEST PACKAGE ORIENTATION\*\*\*

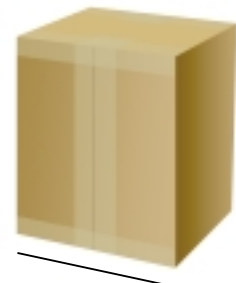
## DROP 1.

Most fragile corner.



## DROP 6.

Opposite smallest flat face.



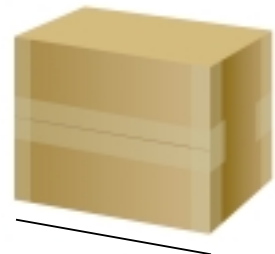
## DROP 2.

Shortest edge radiating from drop corner.



## DROP 7.

Medium flat face.



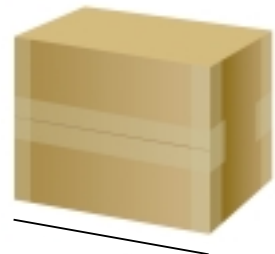
## DROP 3.

Medium edge radiating from drop corner.



## DROP 8.

Opposite medium flat face.



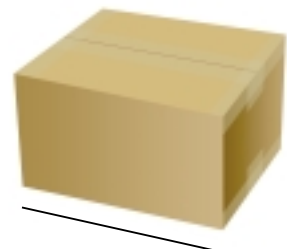
## DROP 4.

Longest edge radiating from drop corner.



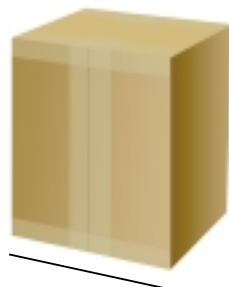
## DROP 9.

Largest flat face.



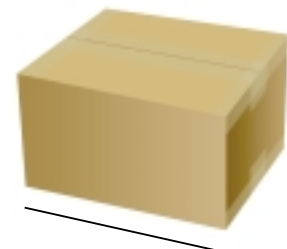
## DROP 5.

Smallest flat face.



## DROP 10.

Opposite largest flat face.



\*\*\***NOTE:** Irregular-shaped items are subject to consideration for Special Drop Orientation. Contact the FedEx Packaging Design and Development department at 1.800.633.7019 on how to determine the orientation of any other package types for testing.

# Truck and Air Random Vibration Profiles

Figure 1. Random Vibration Profile 1 – Truck

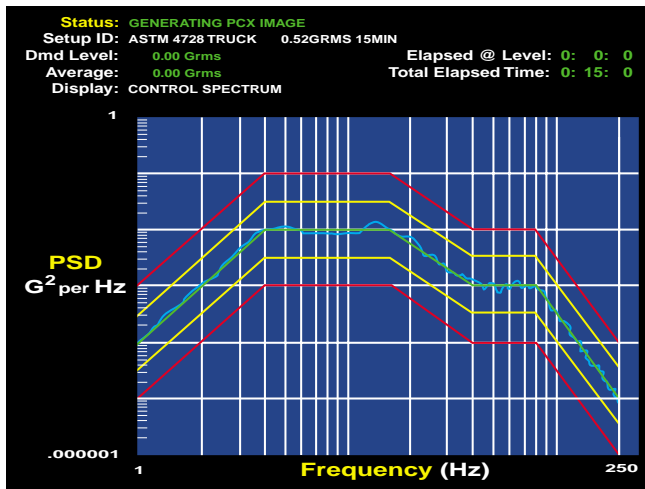
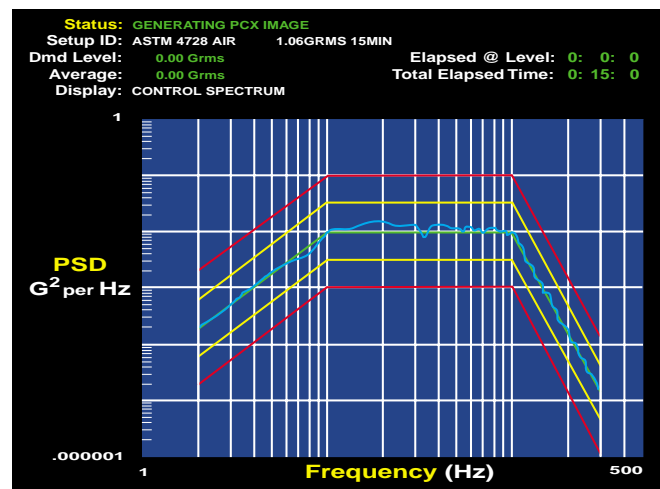


Figure 2. Random Vibration Profile 2 – Air



## Overpack Instructions for Submitting Test Samples to the FedEx Packaging Design and Development Department

Place original packaging with product inside an outer box that allows approximately 2 to 4 inches of space. Fill void areas with polystyrene peanuts or comparable dunnage.

Take completed Packaging Services Application(s) (original(s) and copies), fold in half, place in pouches and attach to the outer surface of their respective test packages and overpack shipping container.

**NOTE:** Do not send actual hazardous materials. Send sample package components with containers filled with nonhazardous substitute (e.g. water, sand, etc.). Weight of test package must equal weight of original package. Please write on the overbox and test samples: "NONHAZARDOUS CONTENT."

Please note that hazardous materials testing is performed for FedEx Ground® shipments only. When shipping hazardous materials, all Department of Transportation (DOT) and all other applicable regulations and requirements must be met. Refer to the current *FedEx Ground Shipping Hazardous Materials Guide* for details.



### NOTICE

This packaging brochure is provided free to FedEx customers to help reduce the possibility of loss or damage during transit. It is NOT intended to be a comprehensive guide for packaging items we accept for transit. We make no warranties, expressed or implied, regarding this information. Proper packaging is the sole responsibility of the shipper. For more information and comprehensive guidelines, contact the FedEx Packaging Design and Development department at 1.800.633.7019. Refer to the current FedEx Service Guide for terms, conditions and limitations applicable to FedEx® delivery services. © 2004 FedEx.

