ista | OVERVIEW

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Packaged-Products for Less-Than-Truckload (LTL) Shipment

3B 2017

ISTA 3 Series General Simulation Performance Test PROCEDURE

VERSION DATE
Last TECHNICAL Change: MARCH 2017

Last EDITORIAL Change: MARCH 2017

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.

OVERVIEW OF PROCEDURE 3B

Procedure 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). Procedure 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 in^3 (13,000 cm^3) 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.

OVERVIEW OF PROCEDURE 3B

Scope

Procedure 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.

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

Samples

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. If the nominal basis weights change, even if the board is rated for the same performance, a retest is appropriate.

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

OVERVIEW OF PROCEDURE 3B

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 < ½ the height; **or** for packages ≥ 30 in. (760 mm) tall **and** with a center of gravity vertical location > ½ the package height
4	Shock TEST BLOCK 3	Free-Fall Drop	6 drops - height varies with packaged-product weight	Required
Δ 5	Vertical Vibration TEST BLOCK 7	Random With Top Load	Overall G_{rms} level of 0.54	Required
6	Shock TEST BLOCK 10	Concentrated Impact	Impact mass free-fall drop, guided drop, 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

OVERVIEW OF PROCEDURE 3B

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 < ½ the height; **or** for packages ≥ 30 in. (760 mm) tall **and** with a center of gravity vertical location > ½ 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
Δ 6	Vertical Vibration TEST BLOCK 7	Random With Top Load	Overall G_{rms} level of 0.54	Required
7	Shock TEST BLOCK 10	Concentrated Impact	Impact mass free-fall drop, guided drop, 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

OVERVIEW OF PROCEDURE 3B

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 Δ	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

OVERVIEW OF PROCEDURE 3B

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
Δ 6	Vertical Vibration TEST BLOCK 9	Random With Top Load	Overall G_{rms} level of 0.54	Required
7	Shock TEST BLOCK 10	Concentrated Impact	Impact mass free-fall drop, guided drop, 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	Load 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 PROCEDURE 3B

Equipment Required Atmospheric Conditioning

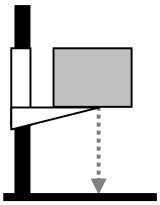
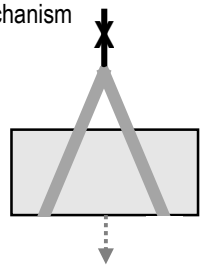
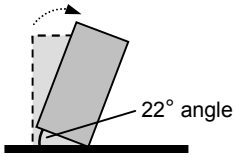
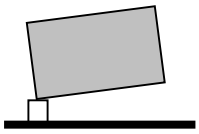
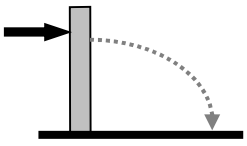
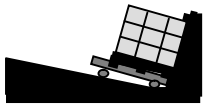
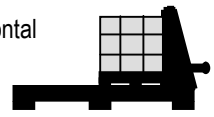
Atmospheric Conditioning:

- 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.

Equipment Required Shock

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 FOR PROCEDURE 3B

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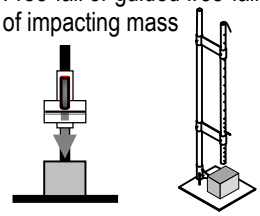
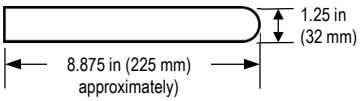
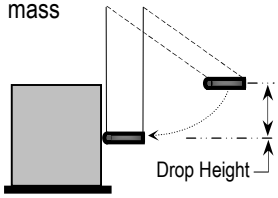
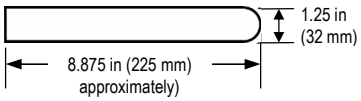
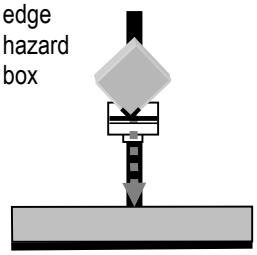
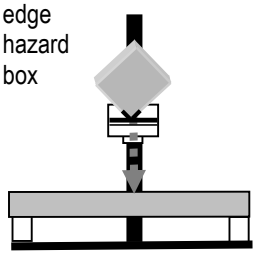
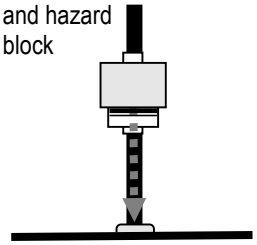
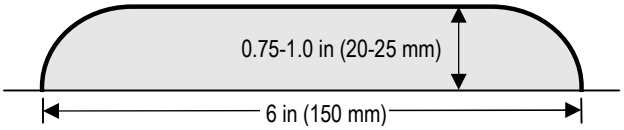
Equipment Required Shock (continued)

Type of Shock Test	Type of Equipment	In compliance with the apparatus sections of…	Additional Required Equipment
Concentrated Impact Tests	Free-fall or guided free-fall of impacting mass 	ASTM D 6344, except the impacting mass must be approximately 8.875 in (225 mm) long, with a diameter of 1.25 in (32 mm), and weigh a total of 3 lb (1.4 kg).	**Impacting Mass Details** Total weight: 3 lb (1.4 kg). See ASTM D 6344 for other information. 
Concentrated Impact Tests (Alternate)	Pendulum with impacting mass 	ASTM D 6344, except the impacting mass must be approximately 8.875 in (225 mm) long, with a diameter of 1.25 in (32 mm), and weigh a total of 3 lb (1.4 kg).	**Impacting Mass Details** Total weight: 3 lb (1.4 kg). See ASTM D 6344 for other information. 
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.

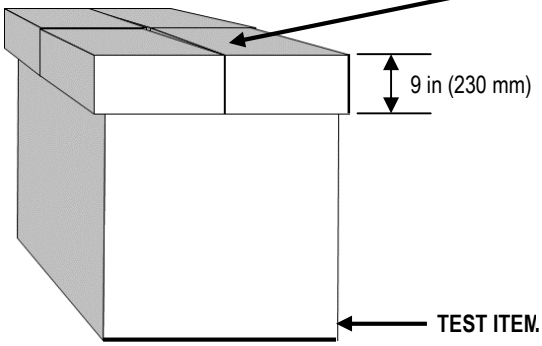
Cross section of Hazard Block



EQUIPMENT REQUIRED FOR PROCEDURE 3B

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 sturdy fiberboard box or similar container with a height of 9 in (230 mm), and 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 separate equal portions if *one* of the top face dimensions of the test item exceeds 18 in (460 mm), and into 4 separate equal portions if *both* of the top face dimensions of the test item exceed 18 in (460 mm).



- **Use an undivided apparatus if both top face dimensions of the test item are 18 in (460 mm) or less.**
- **Divide the apparatus into two separate equal portions if one top face dimension of the test item exceeds 18 in (460 mm). Divide the apparatus perpendicular to the longest dimension.**
- **Divide the apparatus into four separate equal portions if both top face dimensions of the test item exceed 18 in (460 mm).**

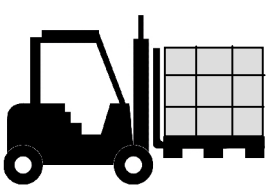
The Top Load is to simulate the effects of 6 lb/ft^3 (0.0035 lb/in^3) (96 kg/m^3) of assorted freight on top of a floor loaded packaged-product in an LTL trailer with an inside height of 108 in (2.7 m). This load density has been determined by empirical testing which resulted in correlation between damage 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

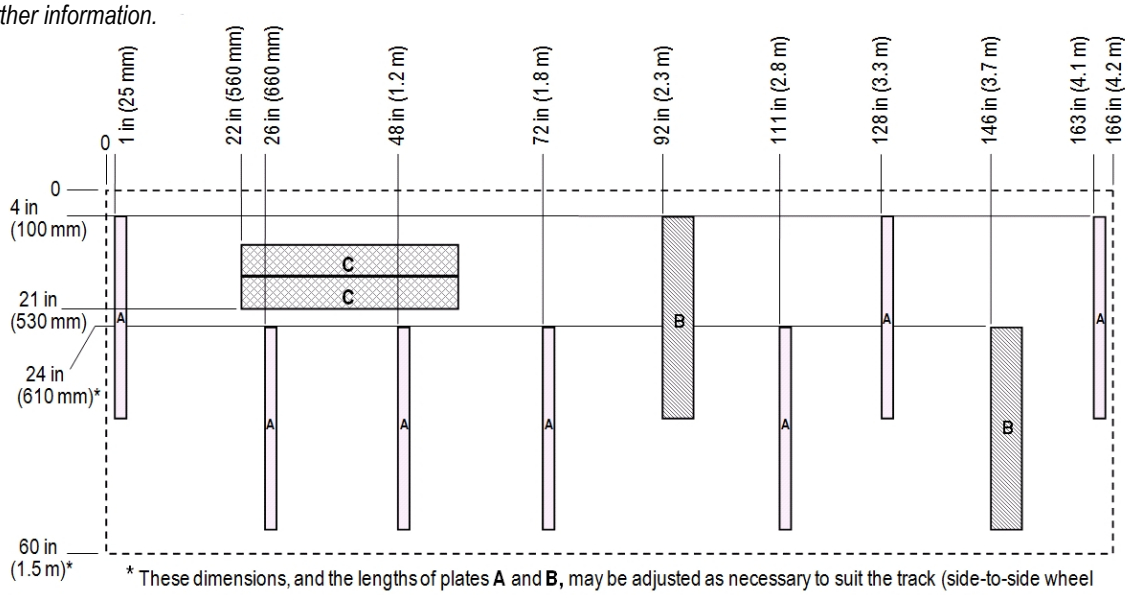
- A fork lift truck of sufficient capacity to handle the test specimens and complying with the requirements below.
- A fork lift handling course as shown on the following page.

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 FOR PROCEDURE 3B

The Handling Course is comprised of ten or eleven plates (plates C may be combined into one), fabricated from steel or similar sufficiently dense, rigid, and tough material, installed in a manner that prevents movement for the duration of the testing sequence in the pattern shown here. Variations in plate fabrication and securing details are permitted, provided that plate thickness and layout is as shown below, and that the plates do not move during use. Plate width and length dimensions may be varied slightly if desired. Details of plates used in the prototype Handling Course are given below this overall layout, for use directly or as a guide.

Note: Considerable space beyond the Handling Course layout shown here is required for positioning the test item and fork truck, maneuvering, accelerating to the required velocity, clearing the course, stopping, etc. See TEST BLOCK 15, Step 4, Sequence 3 for further information.



* These dimensions, and the lengths of plates **A** and **B**, may be adjusted as necessary to suit the track (side-to-side wheel spacing) of the fork truck being used.

Plate details

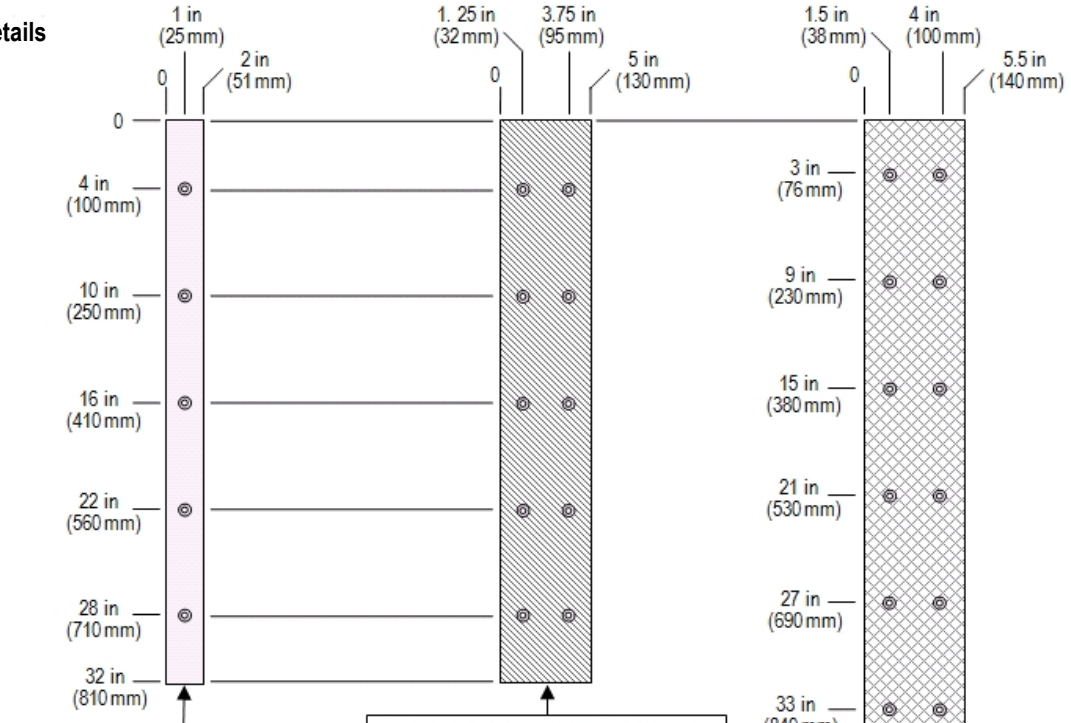


Plate A: ½ in (13 mm) thick cold rolled steel or similar sufficiently dense, rigid and tough material, bore ⅜ in (10 mm) through, countersink for up to five (5) fasteners. Round all sharp edges. **7 pieces required.**

Plate B: ½ in (13 mm) thick cold rolled steel or similar sufficiently dense, rigid, and tough material, bore ⅜ in (10 mm) through, countersink for up to ten (10) fasteners. Round all sharp edges. **2 pieces required.**

Plate C: ¾ in (19 mm) thick cold rolled steel or similar sufficiently dense, rigid, and tough material, bore ⅜ in through, countersink for up to twelve (12) fasteners. Round all sharp edges. **2 pieces required, side-by-side.**