

ISTA 3 Series  
General  
Simulation  
Performance  
Test  
PROJECT\*

VERSION DATE  
February 2010  
Initial Release

Last  
EDITORIAL  
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May 2010

For complete  
listing of  
Procedure  
Changes and  
Version Dates  
go to  
[www.ista.org](http://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)
Force	pounds force (lbf)	newtons (N)
Distance	feet (ft) or inches (in)	meters (m) or millimeters (mm)
Velocity	inches per second (in/sec)	meters per second (m/sec) or millimeters per second (mm/sec)
Volume	cubic inches (in <sup>3</sup> )	cubic centimeters (cm <sup>3</sup> )
Density	pounds per cubic inch (lb/in <sup>3</sup> )	kilograms per cubic meter (kg/m <sup>3</sup> )
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.**

\* Notes Regarding ISTA "Projects" and "Procedures"

- ISTA 3J is currently an ISTA "Project", first released in February 2010. New ISTA test protocols are given the designation "Project" during their implementation phase. After a minimum one-year period and required evaluation, a "Project" will either be adopted as an established "Procedure", revised and kept as a "Project" for another period of time, or be dropped. Therefore, a "Project" is potentially subject to greater and more frequent revision than a "Procedure".
- ISTA members may use either Procedures or Projects for package certification.
- Comments regarding this Project and its use are encouraged and welcome. Please contact [ista@ista.org](mailto:ista@ista.org).

Project 3J is a general simulation test for packaged-products shipped through a club store distribution system to final destinations in the U.S. It was developed from an extensive survey, observation, and field measurement program of an actual such system. The program involved personal visits to various Distribution Centers, overseas suppliers and ports, and U.S. club stores. Ocean containers, trucks, and fork lifts were instrumented for acceleration and other data. Industry experts translated this information, observation, and data into the Project 3J laboratory tests specified here.

Users should be aware of other packaging requirements (configurations, materials, weight and height limits, etc.) for the particular club store distribution system of interest.

Project 3J is appropriate for three different types of packaged-products commonly shipped through a club store distribution system to U.S. destinations. For non-perishable products which are initially shipped as palletized loads, there are two sub-types based on the club (store) quantity. See Definitions below for an explanation of club (store) quantity.

#### Packaged-Product Types

- Non-Perishable, initially shipped palletized (on standard or custom pallet)
  - Club (store) quantity is the unchanged palletized load
  - Club (store) quantity is *other* than the unchanged palletized load, including elongated and flat package-products
- Non-Perishable, initially shipped floor-loaded, including elongated and flat packaged-products
- Perishable, initially shipped palletized

#### Definitions

- Perishable. Typically products such as foods, beverages, fresh flowers, etc. which may be susceptible to deterioration or spoilage if not maintained at prescribed temperature, humidity, or other conditions.
- Non-Perishable. Typically products which are not harmed by extremes of temperature, humidity, etc.
- Club (Store) Quantity
  - The club or store quantity is the number of packaged-products typically shipped at any one time to an individual club or store to replenish its stock.
  - A group of packaged-products may be shipped from the manufacturer or producer in a unitized load, but the load may subsequently be disassembled into smaller groups or individual packaged-products for shipment to the clubs or stores to meet their replenishment requirements.
- International Shipment, where the initial point of origin is outside the U.S.
- Domestic Shipment, where the initial point of origin is within the U.S.
- Standard and Custom Pallet. A standard pallet is a design which is in wide industry use, with published specifications, quality, and applications, used within those specifications and in a typical application. Information on standard pallets can be found on the internet. A custom pallet is one designed for a specific product or narrow range of products, and with its design and performance characteristics completely or largely unknown.
- Elongated Packaged-Product
  - A packaged-product where the longest dimension is 36 in (910 mm) or greater and
  - both of the other dimensions are each 20 percent or less of the longest dimension
- Flat Packaged-Product
  - A packaged-product 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<sup>3</sup> (13,000 cm<sup>3</sup>) or greater

**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 club store distribution system.
- Tests and levels are generally based on the survey, observation, and measurement program described above.
- 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.

## Scope

Project 3J covers the testing of packaged-products prepared for shipment via a club store distribution system to U.S. destinations. In such a system, packaged-products are typically shipped from the manufacturer or producer through one or more Distribution Centers (DCs), and then to the clubs or stores. Various types of handling may occur in the DCs, including manual, fork lift, clamp truck, etc. The original shipment configuration may be altered at a DC to fit the needs of the system and the requirements of the stores. Final shipment to the club or store is typically on a pallet.

Product Damage  
Tolerance and  
Package  
Degradation  
Allowance

The shipper, manufacturer, club store buyer, and/or other stakeholders 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*.

Additional  
Information

The shipper, manufacturer, club store buyer and/or other stakeholders shall also provide information regarding the club (store) quantity, pallet type, initial shipment configuration, and other necessary details of shipment within the system as required to determine proper clamping (see especially *Before You Begin Horizontal Compression Testing* and TEST BLOCK 11), stacked vibration, shock, and other test requirements.

## 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 if the sample is a palletized or unitized load. As appropriate, it may be required to select individual samples from that load for further testing.

Three test samples are required when the initial shipment is floor-loaded into the transport vehicle or ocean container.

When multiple identical specimens are tested, all specimens must pass all tests.

To permit an adequate determination of representative performance of the packaged-product, ISTA:

- *Requires* the test procedure, with the required number of samples, to be performed one time, but
- *Recommends* performing the entire test procedure five or more times using new samples 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. It has been determined that basis weights are better indicators of box equivalence than ECT or Burst ratings.

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

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

### 3J – Non-Perishable, Initially Shipped on Standard or Custom Pallet

Test Sequence  
Non-Perishable,  
Initially Shipped  
on Standard or  
Custom  
Pallet

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Lab ambient, 12 hours	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and humidity chosen from chart	Optional
3	Shock TEST BLOCK 2	Inclined or Horizontal Impact	42 in/sec (3.5 ft/sec) (1.1 m/sec) impact velocity or velocity change	Required Impact all 4 vertical faces of pallet load
4	Shock TEST BLOCK 3	Rotational FLAT Drop	6 in (150 mm) (domestic) 8 in (200 mm) (international)	Required Test entire pallet load
5	Vertical Compression TEST BLOCK 4	Top-to-Bottom Standard pallet on top	Calculated from formula Maintain force for 1 hour	Required Test entire pallet load Machine, or weights and load spreader
6	Vertical Vibration TEST BLOCK 8	Random	Overall Gms level of 0.46 3 hours	Required Test entire pallet load
7	Shock TEST BLOCK 9	Rotational EDGE Drop	4 in (100 mm) (domestic) 6 in (150 mm) (international)	Required Test entire pallet load
8	Flat Push TEST BLOCK 12	Push Pallet Load with Fork Blade Tip	Push 40 in (1 m) in 2-3 sec	Required only for loads on custom pallets
Stop here if "Club Quantity" is the unchanged pallet load. Continue if the "Club Quantity" is <i>not</i> the unchanged pallet load				
Select three specimens from the load, one each from top, middle, and bottom layers (if possible) for further tests below. All specimens must pass all tests.				
9	Horizontal Compression TEST BLOCK 11	Clamping Simulation	Calculated from formula Clamp one specimen in each orientation	Required only for certain distribution situations
10	Shock TEST BLOCK 5	Free-Fall Drop	15 in (380 mm) (domestic) 18 in (460 mm) (international)	Required 3 drops each specimen
11	Vertical Vibration TEST BLOCK 13	Random All 3 Specimens Stacked Vertically	Overall Gms level of 0.55 1 hour	Required only for certain distribution situations
12	Shock TEST BLOCK 14	Concentrated Edge Impact	Hazard box dropped 12 in (300 mm) (domestic) 15 in (380 mm) (international)	Required only for flat packages
13	Shock TEST BLOCK 15	Bridged Impact	Hazard box dropped 12 in (300 mm) (domestic) 15 in (380 mm) (international)	Required only for elongated packages

### 3J – Non-Perishable, Initially Shipped Floor-Loaded into a Transport Vehicle or Ocean Container, Club Quantity is Case or Unit

Note: If the test item is *unitized* and shipped floor-loaded or slipsheeted initially, but is ultimately placed on a pallet for shipment as a unit to the club or store, place it on a pallet prior to starting the test and use the protocol above (*Non-Perishable, Initially Shipped on Standard or Custom Pallet*). Properly secure to the pallet with several layers of stretch wrap, with strapping, or with other appropriate means.

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
Three specimens are required for the following test sequence. All specimens must pass all tests.				
1	Atmospheric Preconditioning TEST BLOCK 1	Temperature and Humidity	Lab ambient, 12 hours	Required
2	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Temperature and humidity chosen from chart	Optional
3	Shock TEST BLOCK 2	Inclined or Horizontal Impact Impact all 4 vertical faces	42 in/sec (3.5 ft/sec) (1.1 m/sec) impact velocity or velocity change	Required for specimens of 75 lb (34 kg) or more, or oversized specimens requiring 2-person or mechanical handling
4	Shock TEST BLOCK 3	Rotational FLAT Drop Test one specimen in each orientation	7 in (180 mm) (domestic) 9 in (230 mm) (international)	Required for specimens of 75 lb (34 kg) or more, or oversized specimens requiring 2-person or mechanical handling
5	Shock TEST BLOCK 6	Free-Fall Drop	6 drops – 14 in (360 mm) max. (domestic) 18 in (460 mm) max. (int'l)	Required for specimens weighing less than 75 lb (34 kg)
6	Vertical Vibration TEST BLOCK 10	Random With Top Load of 0.0035 lbs/ft <sup>3</sup> (96 kg/m <sup>3</sup> )	Overall Gms level of 0.46 3 hours	Required Test one specimen in each orientation
7	Horizontal Compression TEST BLOCK 11	Clamping Simulation	Calculated from formula Clamp one specimen in each orientation	Required only for certain distribution situations
8	Shock TEST BLOCK 9	Rotational EDGE Drop Test one specimen in each orientation	5 in (130 mm) (domestic) 7 in (180 mm) (international)	Required for specimens of 75 lb (34 kg) or more, or oversized specimens requiring 2-person or mechanical handling
9	Shock TEST BLOCK 7	Free-Fall Drop	6 drops – 26 in (660 mm) max. (domestic) 32 in (810 mm) max. (int'l)	Required for specimens weighing less than 75 lb (34 kg)
10	Vertical Vibration TEST BLOCK 13	Random All 3 Specimens Stacked Vertically	Overall Gms level of 0.55 1 hour	Required only for certain distribution situations
11	Shock TEST BLOCK 14	Concentrated Edge Impact	Hazard box dropped 12 in (300 mm) (domestic) 15 in (380 mm) (internat'l)	Required only for flat packages
12	Shock TEST BLOCK 15	Bridged Impact	Hazard box dropped 12 in (300 mm) (domestic) 15 in (380 mm) (internat'l)	Required only for elongated packages

## 3J – Perishable, Initially Shipped Palletized

Test Sequence  
Perishable,  
Initially Shipped  
Palletized

Sequence Number	Test Category	Test Type	Test Level	For ISTA Certification
1	Atmospheric Conditioning TEST BLOCK 1	Controlled Temperature and Humidity	Cool, cold, or frozen as appropriate, chosen from chart	Required
2	Shock TEST BLOCK 9	Rotational EDGE Drop	4 in (100 mm) (domestic) 6 in (150 mm) (international)	Required Test entire pallet load
3	Vertical Compression TEST BLOCK 4	Top-to-Bottom Standard pallet on top	Calculated from formula Hold force for 30 seconds, release	Required Test entire pallet load Machine, or weights and load spreader
Select three specimens from the INTERIOR of the load (if possible), one each from top, middle, and bottom layers (if possible) for further tests below. All specimens must pass all tests.				
4	Shock TEST BLOCK 5	Free-Fall Drop	15 in (380 mm) (domestic) 18 in (460 mm) (international)	Required 3 drops each specimen

Note: The above is a deliberately abbreviated test sequence, intended to be completed in a minimum amount of time. This will help to ensure that the characteristics of the cool, cold, or frozen test specimen do not change appreciably during the sequence, if the tests cannot be conducted in the conditioned atmosphere.

Equipment Required Atmospheric Conditioning

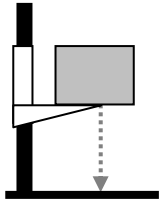
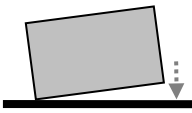
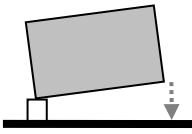

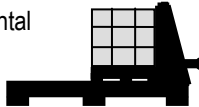
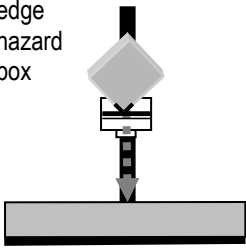
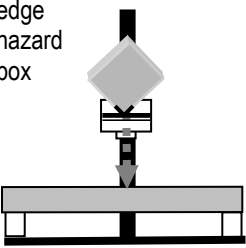
Atmospheric Pre-Conditioning and Conditioning:

- 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.

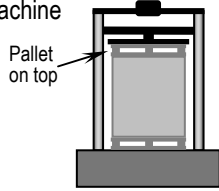
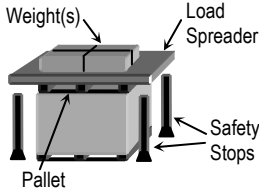
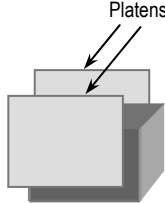
Controlled Temperature and Humidity:

- Chamber and Control apparatus complying with the apparatus section of ASTM D 4332 or ISO 2233.

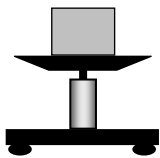
Equipment Required Shock

Type of Shock Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Free-Fall Drop Tests	Free-fall drop tester 	Compliance with the apparatus sections of ASTM D 5276 or ISO 2248.	
Rotational FLAT Drop Tests		Compliance with the apparatus sections of ASTM D 6179 or ISO 2876.	
Rotational EDGE Drop Tests	Support Block 	Compliance with the apparatus sections of ASTM D 6179 or ISO 2876.	<b>Support block</b> 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.
Inclined or Horizontal Impact Tests (Alternates)	Inclined   Horizontal 	Compliance with the apparatus sections of ASTM D 880 or ASTM D 4003 or ISO 2244.	
Concentrated Edge Impact Tests	Free-fall drop tester with edge hazard box 	Drop tester in compliance with the apparatus sections of ASTM D 5276 or ISO 2248.	<b>Concentrated Edge Hazard Box</b> 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 	Compliance with the apparatus section of ASTM D 5265, with the exception of the Hazard Box (Impactor).	<b>Concentrated Edge Hazard Box and Support Blocks</b> 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.

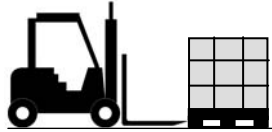
### Equipment Required Compression

Type of Compression Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Vertical Compression (Top-to-Bottom)	Compression Test Machine 	Compliance with the apparatus section of ASTM D 642 "Fixed-Platen Testing Machine".	Standard 48x40 in (1200x1000 mm) block pallet, "picture-frame", full-perimeter-base type, on top of test item. If test item is shipped on a custom pallet, use an identical custom pallet on top.
Vertical Compression (Top-to-Bottom) (Alternate)	Weight(s) & Load Spreader 	The Load spreader must be larger than the top face of the test item, and shall be sufficiently rigid to apply a uniform compression force.	See above for description of the pallet. Safety stops are recommended to support the load spreader and weight(s) to prevent damage or injury in the event of a rapid collapse of the test item.
Horizontal Compression (Clamping Simulation)	Clamp Tester 	Platens must be larger than the side dimensions of the test item, and with an opening sufficient to accommodate the test item.  The desired compression must be achieved with minimum overshoot.	Controls must permit applying the required clamping force smoothly at a rate of 0.02-0.1 in/sec (0.5-2.5 mm/sec).  Force measurement accuracy to within $\pm 5\%$ of the actual value, using accepted calibration means.

### Equipment Required Vibration

Type of Vibration Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Vertical Vibration	Random Vibration Test System 	Compliance with the apparatus section of ASTM D 4728 or ISO 13355	Means must be provided to maintain proper alignment of the test item and any top load apparatus, and to prevent the test item from moving off the vibration system's platform, without restricting vertical motion of the test item or apparatus.

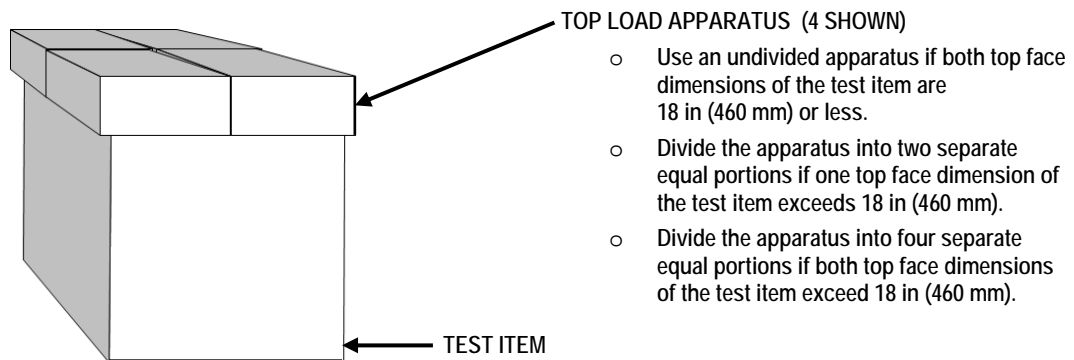
### Equipment Required Flat Push

Type of Test	Type of Equipment	Equipment Requirements	Additional Required Equipment
Flat Push with Fork Lift Truck	Fork Lift Truck 	A fork lift truck of sufficient capacity to handle the test specimens and complying with the apparatus sections of ASTM D 6055 or ISO 10531.	



Equipment  
Required  
AdditionalVibration Top  
Load Apparatus

- A Top Load Apparatus is required for the vibration testing of Non-Perishable packaged-products which are initially shipped floor-loaded into the transport vehicle or ocean container.
- The Top-Load Apparatus as described and shown below, and includes:
  - A fiberboard box or similar container 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).



The Top Load is to simulate the effects of 6 lb/ft<sup>3</sup> (0.0035 lb/in<sup>3</sup>) (96 kg/m<sup>3</sup>) of assorted freight on top of a floor loaded packaged-product in a truck-trailer or ocean container 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.