

ISTA 4 Series
Enhanced
Simulation
Performance
Test Project

January 2009
Program
Version:
1.0.5

Initial Release:
October 2006

This web-based
Application is
subject to
frequent
revision.
For the
current
version,
go to the
4AB webpage
at
www.ista.org

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NOTE:

ISTA Project 4AB is a web-based software application that generates Enhanced Simulation Test Plans. Released in October of 2006 as version 1.0.0, it is available free to ISTA Members via a link on the "Member Center" page of the ISTA website at www.ista.org. Non-members may contact ISTA members to have them demonstrate the program and/or produce a 4AB Test Plan.

Preface

Enhanced Simulation is defined as an extension of General Simulation, covering all typical distribution hazards in a realistic way, and in addition incorporating one or more elements of Focused Simulation. Project 4AB closely ties the tests and sequence to a user-defined pattern of distribution, and includes a broad range of current and quantitative information on distribution environment hazards.

Scope

Project 4AB covers testing of 12 different package types, 4 handling types, and 7 types of load-carrying materials or combinations; any hazard (test) element may be assigned one of three intensities. Program inputs and test plans may be in English or metric units.

Product Damage Tolerance and Package Degradation Allowance

The shipper shall determine the following prior to testing:

- what constitutes damage to the product **and**
- what damage tolerance level is allowable, if any, **and**
- the correct methodology to determine product condition at the conclusion of the test **and**
- the acceptable package condition at the conclusion of the test.

For additional information on this determination process refer to *Guidelines for Selecting and Using ISTA Projects and Procedures*.

Samples

Samples should be the untested actual package and product, but if one or both are not available, the substitutes shall be as identical as possible to actual items.

Number of samples required:

One sample is required for the tests in this procedure.

Replicate Testing Recommended:

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

- Requires the procedure to be performed one time, **but**
- Recommends performing the procedure five or more times using new samples with each test.
- When multiple tests are conducted all specimens must pass.

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 test sequence is tailored to individual situations with usage of up-to-date and specific hazard profiles and parameters. Unlike Focused Simulation, 4AB does not require the user to make quantitative field measurements and translate those into laboratory tests. Measurement-derived test protocols are included as part of the simulation. Once the item to be shipped and the distribution system, means, and configurations are defined, a test plan is generated without further input.

The tests shall be performed on each test sample in the sequence indicated in the 4AB Test Plan generated. The following table provides a general idea of the variables for each hazard type:

Test Category	Test Type	Test Level	For ISTA Certification
Atmospheric Conditioning	Controlled Temperature and Humidity	Temperature and Humidity Table	If Required
Shock	Handling	More than 50 handling tables	Required
Vibration	Random Vibration with and/or without a Top Load	17 vibration spectra with more being added Vibration test time is related to user-specified transit time Vibration tests are accelerated (time-compressed)	Required
Compression	Machine Apply and Release Force Apply and 12-Hour Hold	Calculated Test Force Compression test compensation for time, temperature, humidity and stacking pattern is calculated from data-based formulas Compression tests can accommodate load-sharing packages	If Required

Equipment Required

Enhanced Simulation and Project 4AB test plans may require relatively sophisticated laboratory testing equipment. As a maximum, the required equipment may include several types of appropriate drop test apparatus, a random vibration test system, an inclined impact tester, compression test apparatus (fixed-platen), conditioning chambers, a lift truck, and – if rail transport is involved – a horizontal impact test machine.

OVERVIEW OF PROJECT 4AB PROGRAM

Project 4AB Sponsorship Program

The creation of Project 4AB and the Data Depot (see below) involved considerable effort and the commitment of significant resources. A Sponsorship program was created to support this important work; ISTA gratefully acknowledges below the organizations that generously provided both economic and technical assistance. Special thanks to Lansmont Corporation, which provided the expertise of Dale Root, their Software Development Manager, for programming and technical collaboration.

Founding Sponsors**Charter Sponsors****Supporting Sponsors****The "Data Depot"**

Part of Project 4AB is the commitment to a continuing effort of data collection. If the 4AB distribution hazard parameters are to be kept current and meaningful, latest information must be continuously available. For some time, technology has supported the accurate and appropriate measurement of distribution shock, vibration, compression, and atmospheric data. Efforts are continuously underway to obtain as much of that information as possible, analyze and compile it appropriately, and use it within 4AB. These efforts are called ISTA's "Data Depot". Individual records will be leveraged by combination with similar data to increase statistical significance and confidence. Persons and organizations willing to contribute distribution environment information to the Data Depot are encouraged to contact ISTA Headquarters.

OVERVIEW OF PROJECT 4AB PROGRAM

Briefly, program operation involves description of the product and package, and then creation of a user-defined "Distribution Sequence", characterizing the modes, means, and details of how the test item is distributed. Once the sequence is complete, a corresponding laboratory test plan is generated.

Features and functions of the program are too extensive to be fully presented here. But, as a demonstration example, consider a distribution as follows:

- Initial shipment as a unit load on a pallet
- Transport by rail to warehouse
- Storage for 30 days
- Shipment from warehouse as individual package
- Transport by truck to customer

When the program is begun, a blank Distribution Sequence "Tree" is shown at the left side of the screen, and the user is asked to enter information about the product (filled in here with some contrived information as an example):

Product Description

Product: GoodThing 1000

Description: Model GT-1000, s/n 00812, in accordance with specification GTS-1000-1.

Damage Tolerance: No cosmetic damage. Functional performance in accordance with GTFP-1000-1.

Method for Determining Damage: Cosmetic damage: Thorough visual inspection. Functional: Must meet GTFP-1000-1.

Defined By: I. M. Picky

Person who defined the Damage Criteria.

Buttons: Add Pkg, Add Handling, Add Storage, Add Transport, Remove, Shift Up, Shift Down, TestPlan, Compact.

Next the user is asked to provide information on the package. Since the initial configuration of the demonstration example is a unitized load on a pallet, the user selects that package type from the first drop-down list. This automatically sets the handling to *Mechanical*. The user then chooses the correct load-bearing material and supplies other information as shown.

Package Configuration

Description: Unitized Load on pallet

Package Type: Pallet Load of Same Product

Basic Handling: Mechanical Handling

Load Bearing Materials: Corrugated - Fiberboard

Packaged Size / Weight: Length 48 inches, Width 40 inches, Height 36 inches, 950 Lbs

Stability: ☐ Add a tip/tipover test for stability and potential damage from toppling

Dent / Chip: ☐ Add a test for potential damage from concentrated low-level impacts

Degradation Allowance: Maximum load misalignment 2 inches. No damage to pallet. Individual packages must meet package condition requirements GTPCR-1000-1.

Method for Determining Degradation: Measure misalignment. Visually inspect pallet. Compare individual package condition to GTPCR-1000-1.

Defined By: I. M. Picky

Person who defined the Damage Criteria.

Buttons: Add Pkg, Add Handling, Add Storage, Add Transport, Remove, Shift Up, Shift Down, TestPlan, Compact.

Product: GoodThing 1000

Package: Pallet Load of Same Prod

OVERVIEW OF PROJECT 4AB PROGRAM

The example distribution starts with transport by rail to a warehouse, but first a handling operation is required to place the unit load in the rail car. The user clicks *Add Handling* and specifies the details.

The screenshot shows the ISTA 4AB TEST PLANNER interface. On the left, a tree view shows the distribution sequence: Product: GoodThing 1000, Package: Pallet Load of Same Prod, Distribution: Handling. On the right, the **Handling Element** configuration panel is open. It includes fields for Handling Type (Mechanical Handling - Unit Load Over 500 lbs.), Test Intensity (Standard), and Test Method Options (Standard Conditions). A callout box points to the Handling Type field with the text "Mechanical Handling of the unit load pallet". Another callout box points to the Add Handling, Add Storage, and Add Transport buttons with the text "The 'Add Handling', 'Add Storage', and 'Add Transport' buttons are clicked in any order and as many times as necessary to describe the user's distribution situation".

When *Add Transport* is clicked, the user is asked for information regarding the transportation method, the vehicle used, the load configuration, and other details. Rail transport and other example information are shown here.

The screenshot shows the ISTA 4AB TEST PLANNER interface with the **Transportation Element** configuration panel open. The tree view on the left now includes Distribution: Transportation. The Transportation Element panel includes fields for Transport Method (U.S. - Rail Boxcar), Test Intensity (Standard), Vehicle Stacking (Number of Shipping Units Stacked: 3), and Rail Shipment Details (Cushioned Draft Gear, Load may Shift slightly during normal Railcar Impacts, Railcar Loading Orientation is unknown or uncontrolled). A callout box points to the Transportation Element panel with the text "Transportation Element". Another callout box points to the tree view with the text "The 'tree' above begins to build the sequence".

Another handling element is added to simulate removal from the railcar, then *Add Storage* is clicked and details of the warehouse time and conditions are specified.

The screenshot shows the ISTA 4AB TEST PLANNER interface with the **Storage Element** configuration panel open. The tree view on the left now includes Distribution: Storage. The Storage Element panel includes fields for Stack Height / Storage Time / Storage Conditions (Number of Shipping Units Stacked: 5, for 30 Days, Standard), Stacking Pattern Type (Full Pallet Loads), Loading Carrying Conditions (% of Load Carried by Plastic: 0), and Test Method Options (Test at Standard Conditions, Constant Load - 12 hours). A callout box points to the Storage Element panel with the text "Storage Element". Another callout box points to the tree view with the text "Elements can be Removed or shifted Up or Down".

OVERVIEW OF PROJECT 4AB PROGRAM

At this point in the example, movement of the unit load from origin to warehouse has been described, and the “Tree” at the left side of the screen above summarizes the hazard elements involved. Now the package changes from unit load to individual package, so the user clicks *Add Package* and specifies the new configuration.

Next, user selects “Add Pkg” because the pallet load has been broken down into individual corrugated containers. The User needs to describe the packaged-product in this new configuration.

Package Configuration

Description: Individual Package

Package Type: Corrugated Box

Basic Handling: Manual Handling

Load Bearing Materials: Corrugated - Fiberboard

Packaged Size / Weight: Length 24 inches, Width 18 inches, Height 12 inches, 25 Lbs

Stability: ☐ Add a tip/tipover test for stability and potential damage from toppling

Dent / Chip: ☐ Add a test for potential damage from concentrated low-level impacts

Degradation Allowance: Individual packages must meet package condition requirements GTPCR-1000-1.

Method for Determining Degradation: Compare individual package condition to GTPCR-1000-1.

Defined By: I. M. Picky

The example process continues with a handling operation to load the truck, transport by truck to the customer, and unloading at the customer location. The example Distribution Sequence is now complete, and is summarized by the “Tree” on the screen below. The Sequence can be edited or re-ordered at any time by highlighting and using the appropriate buttons.

Handling Element

Handling Type: Manual Handling - 40 lbs. or Less

Test Intensity: Standard

Test Method Options: Standard Conditions

Standard Conditions: -70°F (-51°C) to 130°F (55°C), 50% RH, 0 - 100%

User now decides to “Compact” the test or not and then selects the “TestPlan” button to generate a .PDF file printout.

Clicking the *TestPlan* button will now generate a test plan based on the “Tree”, with all details defined by the associated dialog boxes. The test plan is in .pdf format, suitable for printing and/or saving, and editable for the adding of notes and additional data. If the *Compact* checkbox is unchecked, the test plan will be an exact representation of the “Tree”, with the hazard element tests in the user-defined order. If the *Compact* checkbox is checked, the test plan will contain all the user-defined hazard element tests, but grouped into a sequence of *Handling, Transportation, Storage, Transportation, Handling*. This could streamline laboratory testing operations, but might not be the most accurate simulation.

OVERVIEW OF PROJECT 4AB PROGRAM

Following are some excerpts from the demonstration example test plan.

Handling test, there are two handlings in the unit load configuration and two in the individual package configuration):

Testplan Details

Handling

Handling Test: Mechanical Handling - Unit Loads - Over 500 lbs.
Test Intensity: Standard

Atmospheric Test Conditions: Standard Conditions 73.0 °F / 50 %RH

It is desirable to perform the test in the conditioned atmosphere. If this is not possible, the test should be performed as soon as possible after removing the packaged-product from the conditioning environment.

Actual Conditions: **Actual Temperature:**
Actual RH:

Test Sequence

Level	Side Down	Method
6 inches	Edge 3-6	Rotational Edge Drop
6 inches	Edge 3-5	Rotational Edge Drop
48 in/sec	Face 6	Incline Impact Test
48 in/sec	Face 5	Incline Impact Test
5 Laps	-	Lift Truck Handling Test

Vibration test from the "individual package" configuration:

Transportation

Random Vibration Test: U.S. - Truck - Steel Spring

Simulated Trip Length: 150 miles
Test Intensity: Standard

Test Level: .542 Grms
Total Test Duration: 30 minutes

Atmospheric Test Conditions: Standard Conditions 73.0 °F / 50 %RH

It is desirable to perform the test in the conditioned atmosphere. If this is not possible, the test should be performed as soon as possible after removing the packaged-product from the conditioning environment.

Test Sequence:

Side Down: Face 3 for 10.0 minutes with a topload of 288.0 Lbs

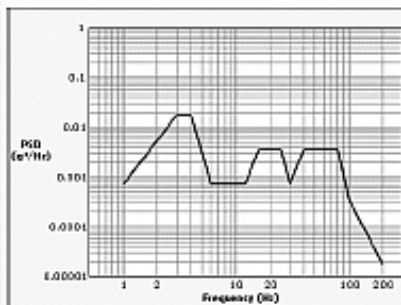
Side Down: Face 2 for 10.0 minutes with a topload of 180.0 Lbs

Side Down: Face 5 for 10.0 minutes with a topload of 126.0 Lbs

It is highly recommended that the test be performed with units stacked in the actual shipping configuration. If this is not possible, a simulated top load may be used to approximate stacked loading conditions.

Use the following breakpoints to program profile in the vibration controller.

Frequency (Hz)	PSD (g ² /Hz)
1	0.00072
3	0.018
4	0.018
6	0.00072
12	0.00072
16	0.0036
25	0.0036
30	0.00072
40	0.0036
60	0.0036
100	0.00036
200	0.000018



OVERVIEW OF PROJECT 4AB PROGRAM

Compression test to simulate warehouse storage:

Warehouse Storage

Compression Test: Storage Duration: 30 days
Storage Conditions: 80.0 °F / 80 %RH
Stacking Pattern: Full Pallet Loads
Stacking Pattern Factor: 1
Stack Height: 5 units

Percentage of Load Carried by Plastic: 0%
Vertical Unitizing Forces: 0 Lbs

Test Intensity: Standard

Test Type: Constant Load - 12 hours
Test Conditions: Test at Standard Conditions

Test Sequence
Side Down: Face 3 with a topline of 9307 Lbs

Further Information

For further information about Project 4AB, contact ISTA Headquarters.

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