

Test Report

IPS 7898-82

ISTA 3E PERFORMANCE TEST

DRUMCLIP DC19B GREEN with PLASTIC DRUMS

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Packaging Tooling Testing

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Description : Test Report ISTA 3E Drumclip DC19B GREEN with Plastic Drums
Date : August 19. 2019
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Test Date(s) : August 16. 2019
Test Facility : IPS Technology, Eindhoven The Netherlands
ISTA Certified Testing Laboratory, Member ID: 9778 (Appendix A)

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1. Scope of test

The goal of this transport simulation test, performed according to the ISTA 3E-2017 Standard for Unitized Loads, is to validate the capability of the Drumclip system for sufficient load stability subjected to rough mechanical handling; forklift truck handling and warehousing stacking.

Four Standard Plastic Drums 200L are placed on a pallet and secured with four Drumclips and secured with three polyester lashings.

Securing of the pallets during Full Truckload (FTL) will be done with help of strapping belts and is not in scope of this test.



Figure 1. Test configuration



Details of tested configuration:

The tested configuration is built up with components listed below:

Item	Remark
Standard Plastic Drums 200L. Quantity: 4	Drums fully filled with water. Used condition.
Pallet type: CP-9	Chemie Pallet, 1140x1140x156mm, used condition.
Lashing: Signode Tenax 2040 Strapping. Quantity: 3	Polyester Strapping 16mm, thickness 0,89mm Location of the strapping shown in Figure 1.
Drumclip type: DC19B GREEN	Quantity used: 4x

Lashing is assembled with Plastic Strapping Handtool: Strapex STB75.

Pre-tension on strapping: 2100N, Weldingtime level: 4

Parameter	Value
Total mass DUT:	892 kg
Dimensions:	1170x1170x1030mm (LxWxH).
Sample Numbers to be tested:	1

Remark:

The drums are exceeding the base dimensions of the pallet.

The Tenax strapping will be applied just before the execution of the test program.



2. Product Damage Tolerance and Package Degradation Allowance

The product will be tested in the prepared configuration. Replacement of components of DUT is not allowed.

Product Damage Allowance:

During horizontal impact tests the drums will impact the ridged wall of the Horizontal Impact Tester. The drums are exceeding the dimensions of the pallet base.

It will be expected that damage to the drums cannot be avoided during the executing of this tests.

Damage to the drums caused by this impacts is within the allowance criteria.

Package Degradation Allowance:

During and after the test the integrity of the DUT must be guaranteed.

- All drums are placed on the pallet bottom during and after the execution of the test.
- The forklift truck can interface the pallet during and after the execution of the test.
- The Drumclip is not broken-heavily damaged (validation by Geba Innovations B.V.)



3. Test plan

The test plan is based on the ISTA 3E -2017 procedure.

According ISTA 3E the test sequence will be executed as stated in the table below.

Performance Test Schedule	Description	Note
1 st	Atmospheric preconditioning	Ambient level
2 nd	Shock; horizontal impact	1,2 m/s
3 rd	Shock: rotational edge drop	Drop height 150mm
4 th	Compression	Apply and release method
5 th	Vibration: random	Overall Grms= 0.54
6 th	Shock: rotational edge drop	Drop height 150mm

3.1 Atmospheric Conditioning

The sample will be conditioned to ambient laboratory level.



3.2 Shock; horizontal impact 1,2ms

The DUT will be exposed to horizontal impacts in order and under the conditions as stated in the table below.

Sequence No.	Specific Face	Impact Speed
1	Face 6	1,2 m/s
2	Face 5	1,2 m/s
3	Face 2	1,2 m/s
4	Face 4	1,2 m/s

Horizontal impact testing will be performed with the IPS Technology horizontal impact tester.

Specifications of the horizontal impact tester can be found in Appendix B.



Figure 3.DUT on horizontal impact tester.



3.3 Shock; 1st Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	Specific edge	Drop height
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm



Figure 4. Set-up Rotational Edge Drop Test



3.4 Compression Test; Machine Apply and Release

The DUT will be exposed to a 'Machine Apply and Release' compression test according to the ISTA 3E test protocol. For the calculation for compression (Apply and Release method) the formula $AR = \{[Wt \times (S-1) + (Wt/L) \times (L-1)] \times F - (Wt / L) (L-1)\} \times 1,4 \times 9,8$ is applicable.

Wt	Total weight of packaged product (Kilograms)	921 Kg	
S	Total number of <u>potential</u> unitized loads in a warehouse stack or a vehicle stack	3	Including the bottom unitized load
L	Total number of layers in the unitized load	1	
F	Compensating factor	3	Typical compensating factor
9,8	Metric conversion factor	9,8	
1,4	Factor to account for time of compression	1,4	
AR	Result of calculation: Test Load for Apply and Release (Newton)	25.339N	= 2.583 Kg

The test will be performed with an additional (empty) pallet on top of the DUT. This will be done in order to simulate the reality of stacking load.



Figure 5. Set-up compression test



3.5 Vibration; ISTA Steel Spring Truck Random Vibration

The DUT will be exposed to a vibration test without compressive load, to simulate transport vibrations. The test is performed under 'loose load' conditions. For the test setup see Figure . The during of 60minutes will be equivalent to a transport of 480km.

Orientation	Vibration Profile acc.	Duration
Face 3 down (bottom face)	ISTA Steel Spring Truck	60 minutes

Specifications of the vibration test equipment can be found in Appendix C.

The Power Spectral Densities ISTA Steel Spring Truck profile is given in the figure below.

Frequency (Hz)	PSD Level, g ² /Hz
1.0	0.00072
3.0	0.018
4.0	0.018
6.0	0.00072
12.0	0.00072
16.0	0.0036
25.0	0.0036
30.0	0.00072
40.0	0.0036
80.0	0.0036
100.0	0.00036
200.0	0.000018

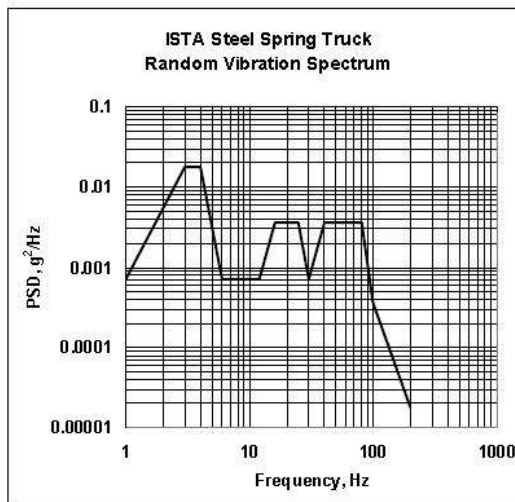


Figure 2. Power Spectral Densities – Steel Spring Truck Random Vibration





Figure 6. Test setup for vibration test



3.6 Shock; 2nd Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.

During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.

The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	Specific edge	Drop height
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm



Figure 7. Set-up Rotational Edge Drop Test



4. Test Results

The tests are executed according to test plan. In the following chapters the test results can be found per test.

4.1 Atmospheric Conditioning

The DUT has been conditioned to ambient laboratory level.



4.2 Shock; Horizontal Impact

The horizontal impact test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. The impact speed is measured at 1,2 m/s. See for the speed graph Appendix D.

4.3 Shock; 1 Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

4.4 Compression; Machine Apply and Release

The compression test is executed according test plan. At a load of approx. 1600 kg wooden bars parts of the top part of the pallet base cracked.

A screenshot of the compression test and the crack is shown in a graph in Appendix E.



4.5 Vibration; ISTA Steel Spring Truck Random Vibration

The vibration test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. A screenshot of the PSD during the test is shown in Appendix F.

4.6 Shock; 2nd Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan.

During execution of the test bending of the pallet bottom could be seen.



Figure 8. Bended pallet bottom



5. Inspection after test

After execution of the complete test cycle no remarkable – unexpected damages to the DUT and its components could be found. The expected damage to the drums was not found.

The condition of the CP-9 pallet was still in useable condition. However several cracks in the wooden carriage were found. It has to be remarked that the pallet quality was poor.

During and after execution of the test the position of the Drumclip were not levelled to the top surface of the plastic drums. Also in this position the Drumclips interfaced mechanically with the edge of the plastic drums.



Figure 8. Position of drum clips during drop testing.

Examination of the condition by personnel of Geba Innovations B.V. of the Drumclips after the test showed no visible damage or wear.



6. Conclusions

The test has been executed according to the test plan.

With exception of the damage occurred during the compression test no remarkable-unexpected events and/or damage has occurred before, during or after the test to the DUT.

Despite the poor pallet quality the tested configuration maintained the position of the plastic drums on the pallet bottom.

The Drumclip system in combination with the defined lashing configuration is fully capable to ensure safe individual mechanical pallet handling and warehouse stacking.

Eindhoven, August 20, 2019

Checked and approved by:



Marten Ries
Sr. Project Engineer

Marijn Sijbers
Test Engineer



Appendix A. ISTA Certified Testing Laboratory



This recognizes that the company listed below is a **Certified Testing Laboratory** member of the International Safe Transit Association (ISTA).

Member ID: 9778

Valid through: February 1, 2020

Location: Eindhoven, Netherlands

IPS Technology

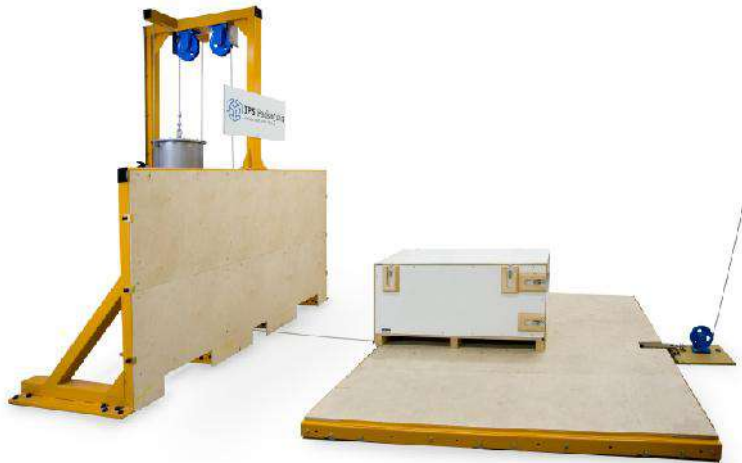

A.J. Gruber
ISTA President


Eric Hiser
ISTA Vice President - Technical

Figure 9. IPS Technology ISTA Laboratory Certification



Appendix B. Test Equipment: Impact Tester



Fabrikant
IPS Technology

Oppervlakte
245x250 cm

Max. productmassa
1300 kg

Opspanning
Horizontaal

Botssnelheden
2-10 km/h

Datalogging
Snelheidsmeetsysteem registreert de snelheid bij botsing

Optioneel
Versnellingsmetingen aan het product met een drie-assige versnellingsopnemer

Normen (o.a.):
ASTM D 5487
ISO 2244



Appendix C. Test Equipment: Shaker



- Manufacturer : Lansmont model 10000 TTV II
- Max. specimen size : 152 x 152 cm
- Max. specimen weight : 2200 kg
- Max. amplitude (peak to peak) : 6,4 cm
- Frequency-range : 3 - 300 Hz
- Frequency-rang at max. load : 3 - 200 Hz
- Acceleration range : 0 - 8 g
- Max. acceleration at max. load : 2 g
- Automatic displacement or acceleration control
- Automatic sweep generator and random vibration facilities (Lansmont TouchTest Vibration system)
- Accelerometer



Appendix D. Impact speed

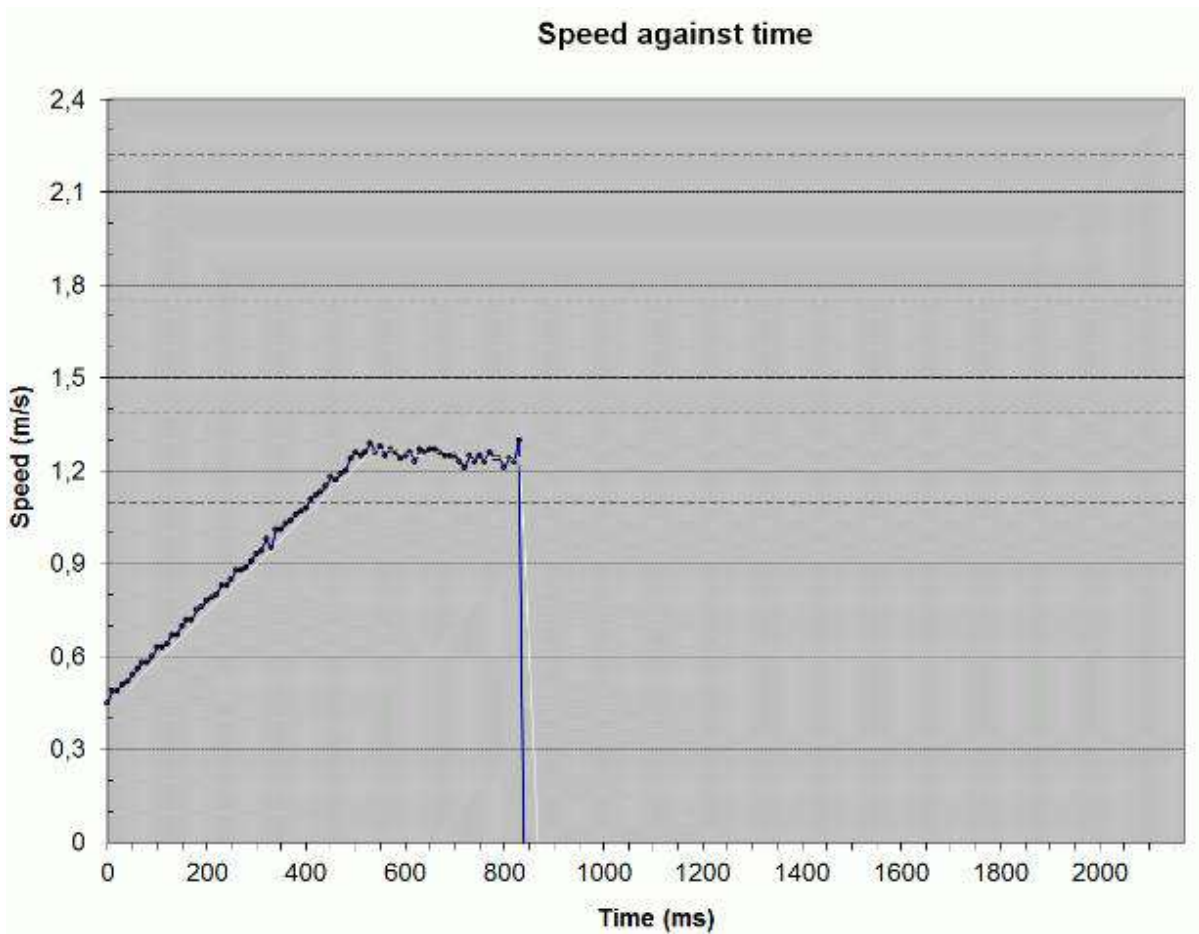


Figure 10. Impact speed >1,2m/s



Appendix E. Compression test graph



Sample ID	Peak Force (kg)	Defl @ Pk (cm)	PreLoad (kg)	Test Speed (cm/min)	Temp (deg C)	%RH	Time	Date
ISTA 3E DRUMCLIP SAMPLE DC19B PLASTIC DRUM #4	2584	2.27	22.0	1.30	21.8	54.0	03:15 PM	16-Aug-19

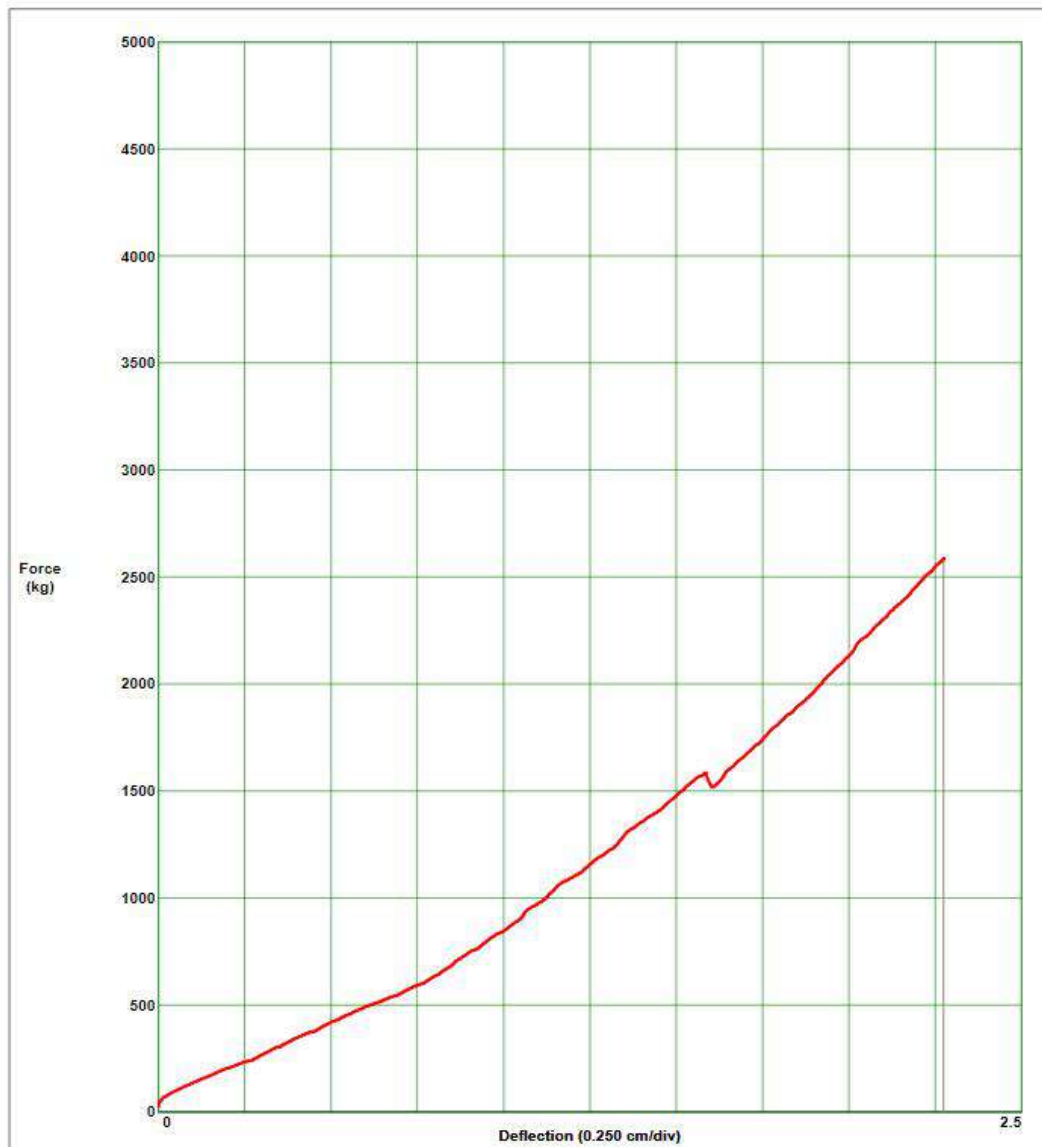


Figure 11. Compression test graph – Apply and release compression test



Appendix F. Power Spectral Densities Profile

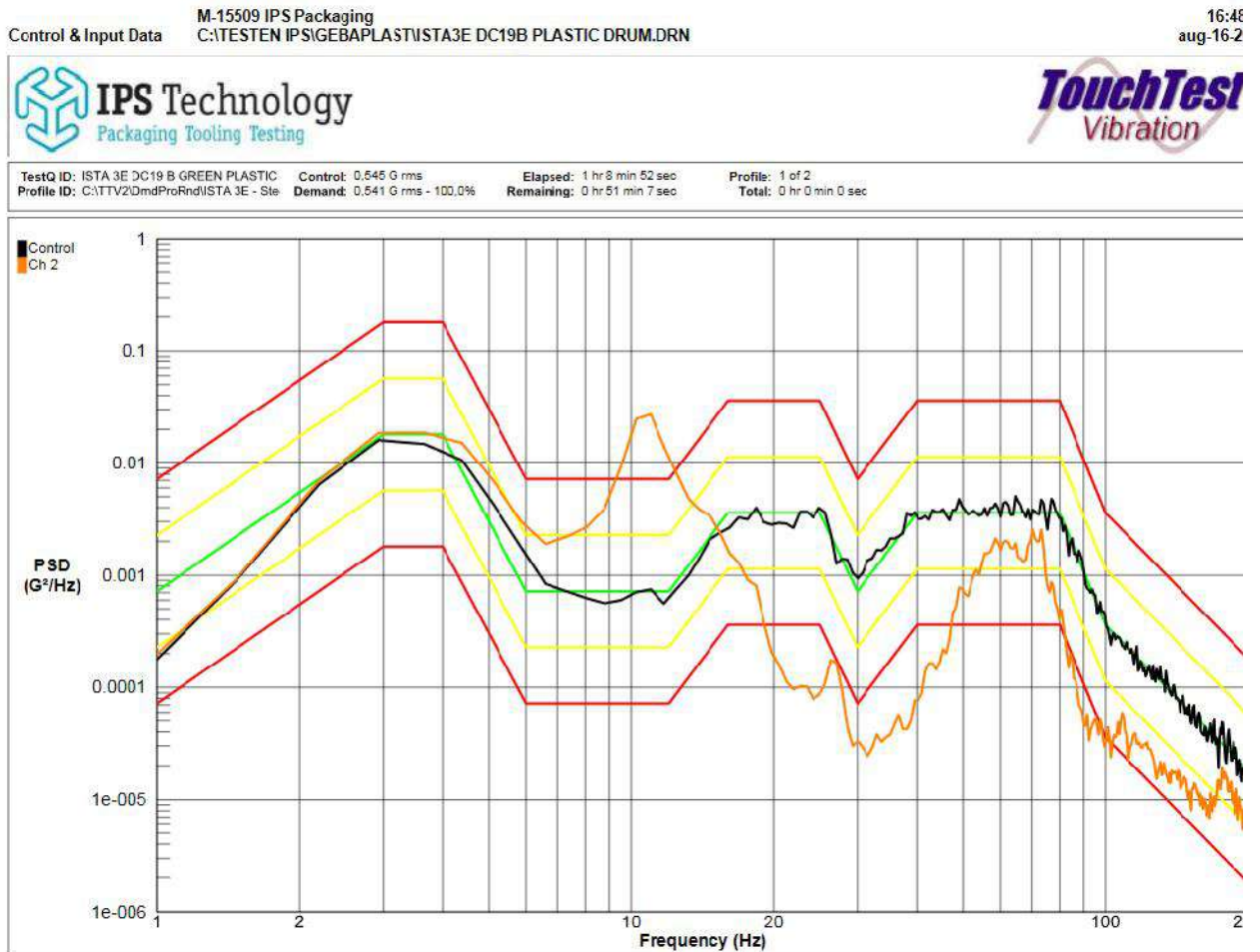


Figure 12. Power Spectral Densities - ISTA Steel Spring Truck Random Vibration; 1 hr 9min.

Remark; accelerometer Ch2 placed on top of the Drumclip for response monitoring (examination only).

