

PACKAGING LABORATORY





WHAT DOES THE OPTIMAL PACKAGING SYSTEM LOOK LIKE?

The packaging logisticians at Fraunhofer IML have made it their mission to design packaging systems that can withstand the stresses that occur during storage, handling, and transportation within a distribution chain in an undamaged and secure state. Project partners have been benefitting from the very successful research and development work of the packaging laboratory since 1986. A total of more than 1 500 projects have been carried out with partners from industrial, trade, and service companies in this time period. That's why it was time for something new...

Dynamic stresses – Thanks to HITS so close to reality like never before

The packaging laboratory celebrated a reopening in June 2012. The design department of FH Dortmund created the artistic spatial concept for the redesign of the 400 square metre laboratory. Something suitable for the occasion that is unique worldwide was brought into the laboratory. The new highlight was a testing machine manufactured especially for Fraunhofer IML by the Lansmont Corporation in California: the Horizontal Impact Test System (HITS). This testing machine simulates horizontal accelerations and decelerations such as those that occur when trucks are cornering or braking. Two pallets weighing up to 1500 kg can be placed at the same time on the test track of the 17 metre long system and put in motion and then slowed down. The testing machine simulates trucks fully braking with decelerations of 0.8 g and also the impact of track switching on trains with a deceleration of 4 g – and this is done with the real duration of these processes.

In addition to horizontal stresses, the vertical jolts and vibrations that occur in transport processes are also simulated in the packaging laboratory. Two systems are used for this. The small

vibration table is used for simulating vibrations and oscillations on individual products and packages. The larger "brother" is both a vibration table and a climatic chamber. This vibration table is used to test the vertical stresses that are caused by road surface irregularities and truck shock absorber springs. This system can be used to run different tests on unit loads weighing up to 1.2 tonnes to examine the vibration behaviour under different environmental conditions.

The system also has an external surface for handling tests with forklift trucks. The optimal set-up of products, loading equipment, and unit load securing can be determined reliably under realistic conditions.

Packaging used in parcel shipment in particular is also exposed to other stresses: Logistic service providers expect a package to be "dropped" about ten times on route from sender to customer. Drop testers and release hooks are used to test the stresses on packaging. These tests can be used to validate the cushioning effect of the packaging before the first time they are shipped and to avoid damages in transit.



Static stresses – Will the pallets in the high racks hold up?

Durability tests are some of the types of tests that can be conducted to test static stresses. A compression testing machine is used to test the durability of pallets, corrugated boxes, and plastic transport containers. This machine can apply a pressure of 20 tonnes – a weight of more than 15 VW Golfs. The test objects can be stacked to a height of 1.5 metres. The compression testing machine is used to calculate the load bearing capacity of packaging, transport containers, and pallets. This is important for shelf stacking or the block stacking of large types of loading equipment on the floor. In accordance with national and international testing standards, the containers and pallets are pre-climatized according to the requirements.

Environmental stresses – All everyone talks about is the weather...

Packaging and transport containers have to be able to withstand extreme environmental conditions: From up to +50 °C in the high rack or the truck to -25 °C during transportation in winter.

Plastic containers and pallets experience a load bearing capacity loss of up to 40 percent at high temperatures. At very low temperatures packaging materials made out of plastic can become very brittle and splinter. In humid climates cardboard absorbs water from the air and loses rigidity. Packaged medication and fresh food in particular need to be kept in a specific temperature window. Exact humidity and temperature requirements can be simulated in one of the four climatic chambers or rooms. The temperatures range from -50 °C to 140 °C. The relative humidity can be regulated between 10 and 95 percent. This makes it possible to realistically emulate all transportation chains – based on customer requirements and using climatic profile data captured with data loggers before the simulations are conducted.

Technical Equipment

Simulation of static stresses

- Gravity endurance test bench
- Compression testing machine (up to 200 kN (20 t))

Simulation of dynamic stresses

- HITS – Horizontal Impact Test System up to a total weight of 1500 kg
- Roller conveyor section
- Fatigue testing machine #1 for test samples up to 500 kg and fatigue testing machine #2 with a climatic chamber for test samples up to 1200 kg
- Forklift truck and outdoor test track
- Precision shock table (test samples of up to 56 kg) and drop heights of up to 1500 mm
- Release hooks (test samples of up to 1300 kg) and drop heights of up to 4000 mm
- Vertical shock tests (test samples of up to 227 kg)

Simulation of environmental conditions

Four air-conditioned rooms of different sizes: temperatures ranging from -50 °C to 140 °C; humidity controllable from 10 to 95 % of relative humidity

Optimizations for securing unit loads

- Stretch film rewinder (semiautomatic)
- Handheld device for strapping with plastic straps

Data capture in the distribution chain and during laboratory tests

- Digital high speed camera
- Mobile test system for friction coefficient measurements (test samples of up to 5000 kg)
- State of the art measuring and recording devices for acceleration/vibration/shock/temperature/humidity and monitoring dynamic driving tests

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