Mapping of transport stresses

SEES, April 2022
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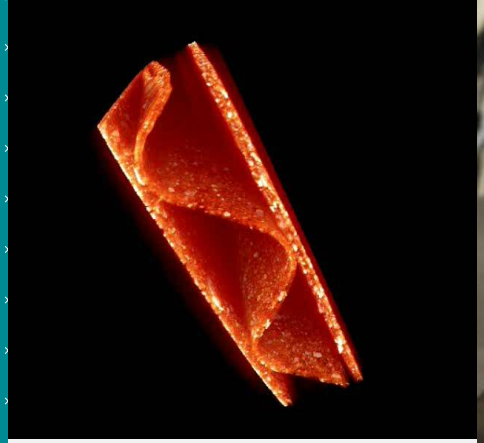

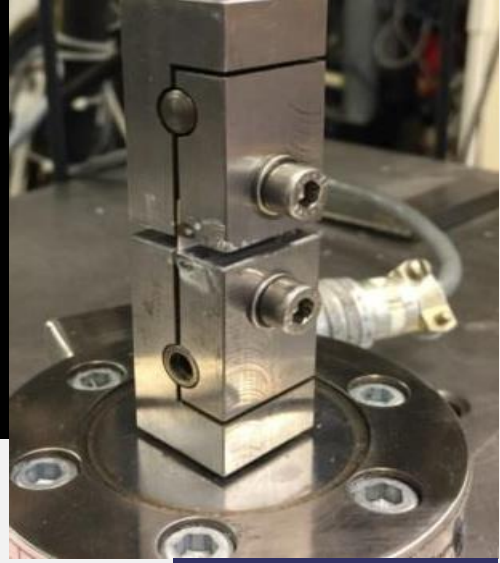

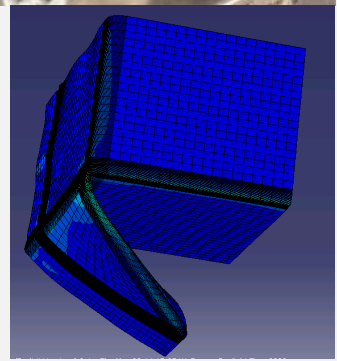

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Transport stresses - Introduction

/Rouillard; Weng; 21st IAPRI World Conference on Packaging, 2018/

Some history

RI.
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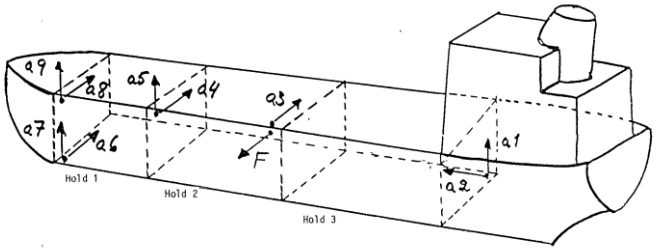
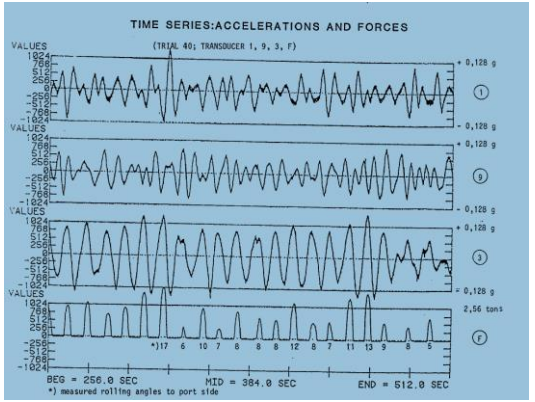
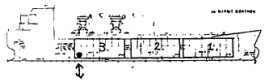
Older cases – Sea transport



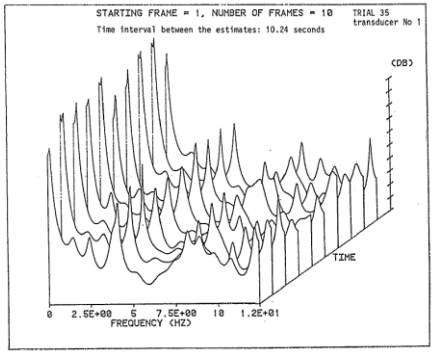
a = accelerometer

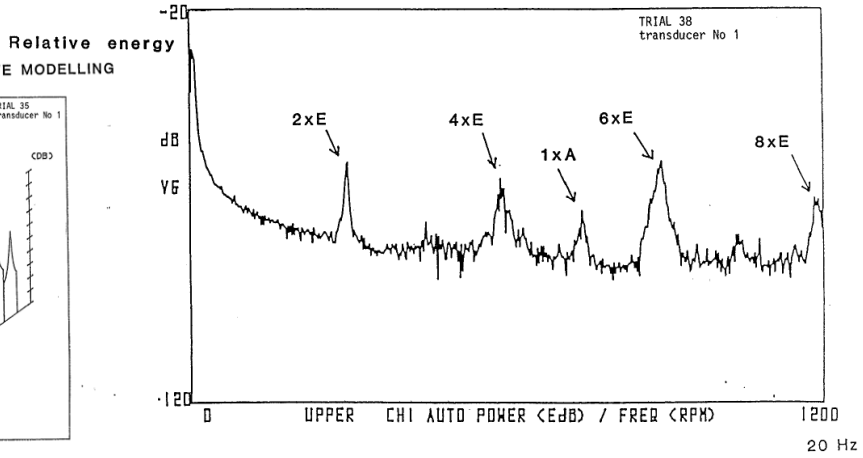
F = force transducer





SPECTRAL ESTIMATION BY AUTOREGRESSIVE MODELLING





/Trost, Thomas; Mechanical stresses during sea transport. IMEKO Xth World Congress, Prague, 1985-04-22 – 26/

Older cases
- Air transport (1)

PACKAGING TECHNOLOGY AND SCIENCE VOL 1 137–155 (1988)

Mechanical Stresses on Products During Air Cargo Transportation

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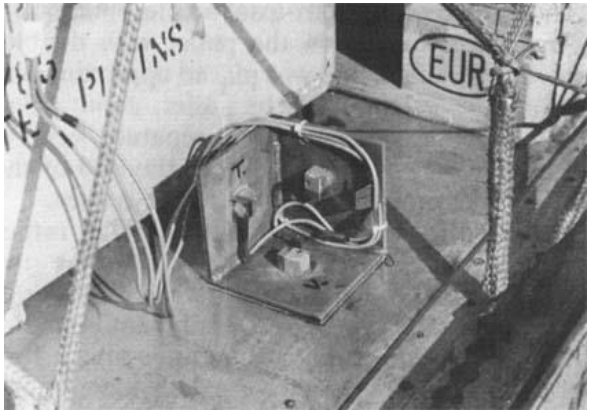
A field study was conducted on board a Boeing 747 Combi (freight and passenger) aircraft on the route Stockholm (Arlanda) via Oslo (Gardermoen) to New York (John F. Kennedy Airport) and return to Stockholm (Arlanda). Shock and vibration, acting on the cargo, during air transportation were measured and analysed.

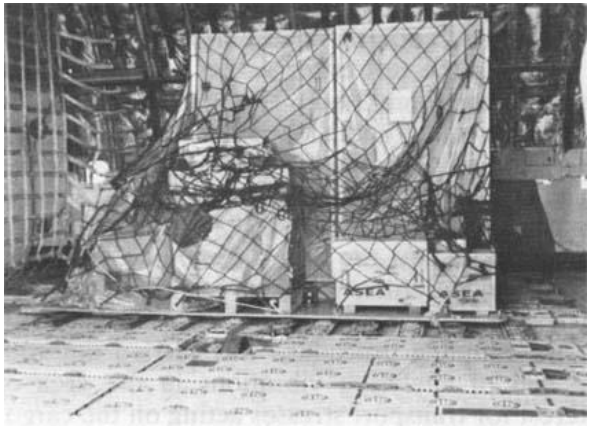
The study encompassed all phases of the flight, including taxiing, climb, cruise during both calm and turbulent conditions, descent and approach, landing including touchdown and taxiing to apron.

The field data were analysed by conventional frequency analysis and modelling techniques. In order to generalize the results, flight recorder data from the field trial and from other flights are included.

Guide-lines for the development of realistic, simulation test programs for product and package design are included.

Keywords: Air transport, Cargo stresses, Test programmes, Product and package design, Transportation stresses, Air cargo vibration





Older cases - Air transport (2)

PACKAGING TECHNOLOGY AND SCIENCE VOL 2 85–108 (1989)

Mechanical Stresses on Cargo during Ground Operations in Air Transport

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Mechanical stresses from the shocks and vibrations to which air cargo is exposed during transport and handling at airports have been investigated. Field trials were carried out at Arlanda Airport, Stockholm, and John F. Kennedy Airport, New York.

It was found that when products are transported in the airport area, they are exposed to much higher stresses than during actual flight. Especially severe conditions were registered during transport at John F. Kennedy Airport.

Measured stresses are related to the ground and mode of driving within the airport area, as well as to location on the pallet wagon.

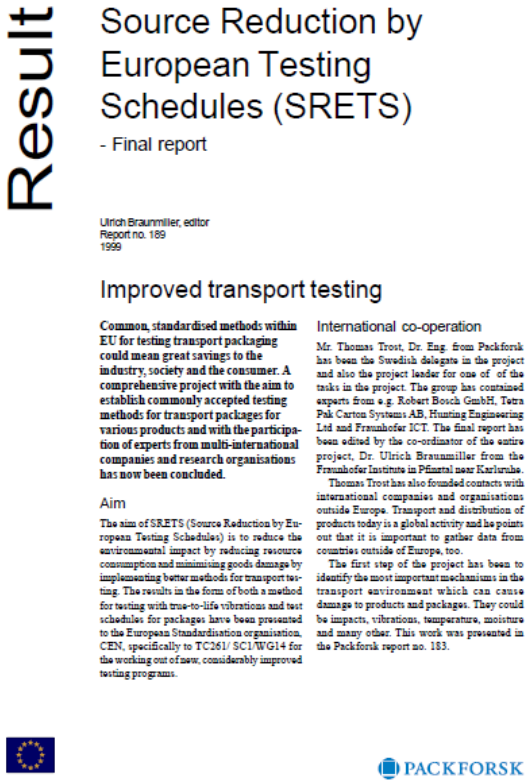
Guidelines as regards design of realistic, simulating test programs for product and package design are reported.

Future development possibilities and suggestions for further research within the area are discussed.

Keywords: Air cargo; transport stresses; ground operations; vibration; power spectral density; test programs; product and package design

SRETS 1999

Result



Source Reduction by European Testing Schedules (SRETS)

- Final report

Ulrich Braunmiller, editor
Report no. 189
1999

Improved transport testing

Common, standardised methods within EU for testing transport packaging could mean great savings to the industry, society and the consumer. A comprehensive project with the aim to establish commonly accepted testing methods for transport packages for various products and with the participation of experts from multi-international companies and research organisations has now been concluded.

Aim

The aim of SRETS (Source Reduction by European Testing Schedules) is to reduce the environmental impact by reducing resource consumption and minimising goods damage by implementing better methods for transport testing. The results in the form of both a method for testing with true-to-life vibrations and test schedules for packages have been presented to the European Standardisation organisation, CEN, specifically to TC261/ SC1/WG14 for the working out of new, considerably improved testing programs.

International co-operation

Mr. Thomas Trost, Dr. Eng. from Packforsk has been the Swedish delegate in the project and also the project leader for one of of the tasks in the project. The group has contained experts from e.g. Robert Bosch GmbH, Tetra Pak Carton Systems AB, Hunting Engineering Ltd and Fraunhofer ICT. The final report has been edited by the co-ordinator of the entire project, Dr. Ulrich Braunmiller from the Fraunhofer Institute in Pfinztal near Karlsruhe.

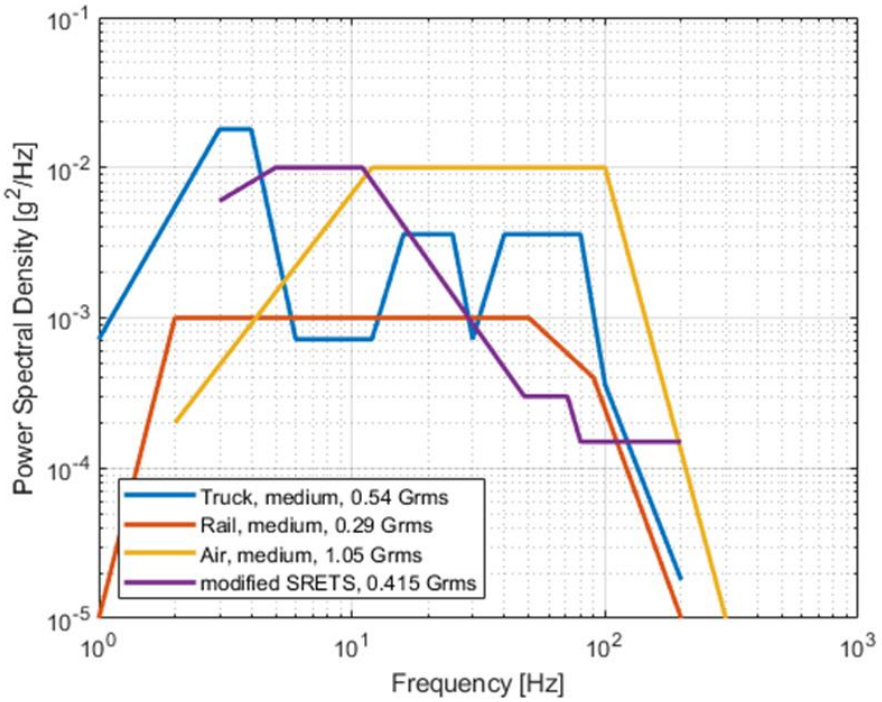
Thomas Trost has also founded contacts with international companies and organisations outside Europe. Transport and distribution of products today is a global activity and he points out that it is important to gather data from countries outside of Europe, too.

The first step of the project has been to identify the most important mechanisms in the transport environment which can cause damage to products and packages. They could be impacts, vibrations, temperature, moisture and many other. This work was presented in the Packforsk report no. 183.

PACKFORSK

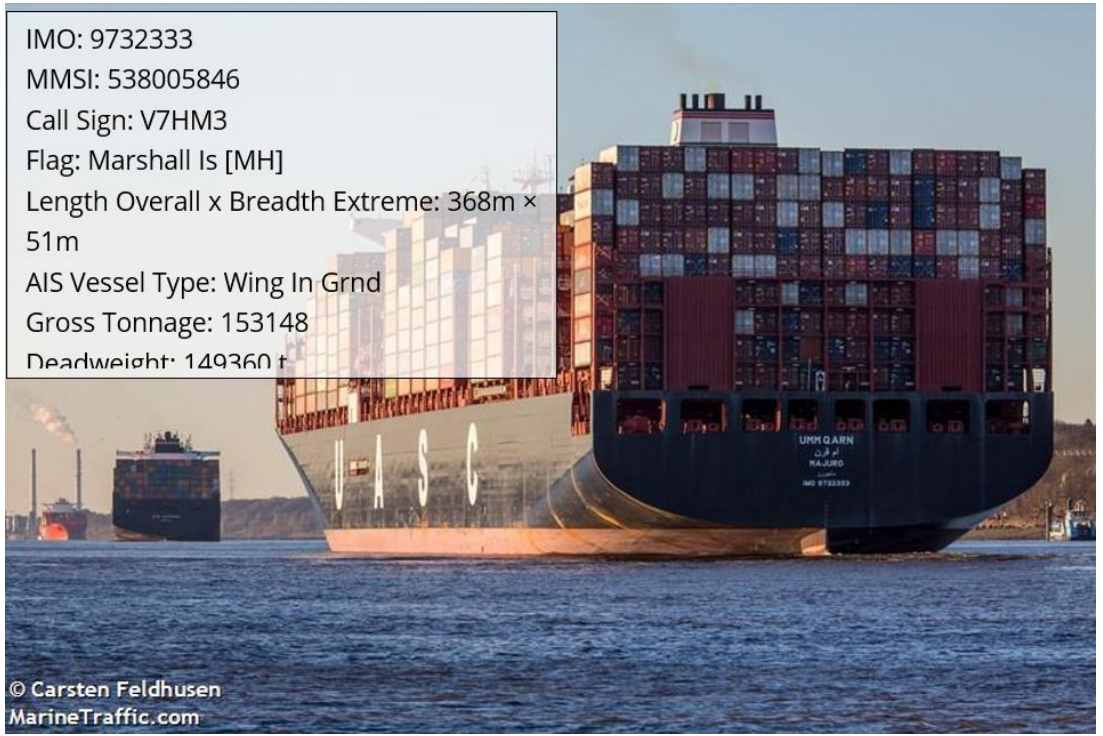
/Braunmiller, Ulrich (editor); Source Reduction by European Testing Schedules (SRETS) – Final Report, Packforsk Report No. 189, 1999/

Some generic random test spectra according to ASTM D4169 and SRETS



Recent study from 2019

- UMM Quarn
- From Antwerp, Belgium to Busan, South Korea
- 14500 TEU



Some International Studies on mapping of transport stresses

- Ostrem F E, Godshall W D (1979)
  An assessment of the common carrier shipping environment
  U.S. Department of Agriculture, Madison, Wisconsin. General Tech. Report FPL, 1979; 22: 1-54
- Singh, S. Paul; Antle, John R.; Burgess, Gary G. (1992); *Comparison between lateral, longitudinal and vertical vibration levels in commercial truck shipments;* Packaging Technology and Science 1992; 5(2): 71–75. DOI: 10.1002/pts.2770050205
- Böröcz P, Singh S P (2015)
  Physical and climatic measurement and analysis of intercontinental multi-mode shipping environment between Central Europe and South Africa
  27th IAPRI Symposium on Packaging 2015, Valencia, Spain, June 8-11
- Singh S P, Singh J, Saha K (2015)
  Measurement and analysis of physical and climatic distribution environment for air package shipment
  Packag. Technol. Sci. 2015; 28: 719–731
- Péter Böröcz, S. Paul Singh (2017) Measurement and analysis of delivery van vibration levels to simulate package testing for parcel delivery in Hungary Packag. Technol. Sci. 2017;
- V. Rouillard, M. Lamb and M. Sek (2007); Determining Fatigue Progression in Corrugated Paperboard Containers Subjected to Dynamic Compression

Some transport mapping questions for the future

- **Analysis:**
- rms values, time blocks, statistical analysis, kurtosis and other skewness, probability distributions, filters and frequency content, product and packaging ”comfort” indexes, damage and fatigue classifications, heave, pitch and roll characteristics
- **Time accelerated tests:**
- 1 or 3 axis testing, time compression factors, replication of shock events, ”finger prints” of level increased Grms levels, monitoring of damages, test for ”normal extremes” or ”extreme normals”, safety factors
- **Relation to material and product properties:**
- fatigue, abrasion, wear, transmittance of vibration energy, resonance frequencies on different levels, interaction, contact pressure between and within packages etc

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