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Rotterdam, October 2012

# Impact of Shipping and Distribution on Product Reliability

*A forgotten testing parameter?*

# Introduction IPS Technology

- ***Location Eindhoven, The Netherlands***
- ***Activities***
  - Packaging & Tooling Development
  - Product & Packaging Testing
- ***Markets***
  - High-tech industrie [80%]
  - Semiprofessional & Consumer Products [15%]
  - Consultancy [5%]

# Environmental stresses during Shipping

- **Shock: Vertical & Horizontal Impact**
- **Vibration: Vehicle vibration (Random)**
- **Climate: Temperature/ Humidity Airpressure**

# Pre-shipment test procedures



Designation: D4169 – 09

## Standard Practice for Performance Testing of Shipping Containers and Systems<sup>1</sup>

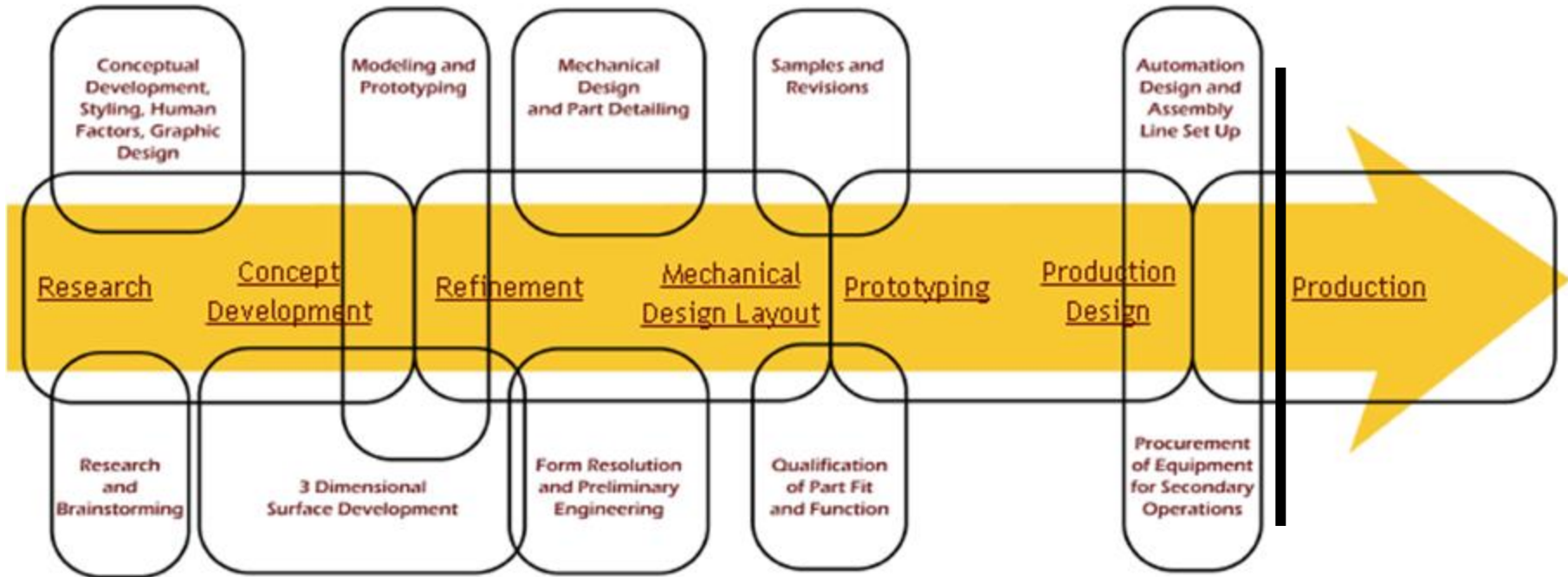
This standard is issued under the fixed designation D4169; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

# Pre-shipment testing



# Timing Pre-Shipment Testing



# Pre-Shipment Testing

- ***Pass-or-fail: Product Damage Tolerance***

# Pass or Fail?





# Pre-Shipment Testing

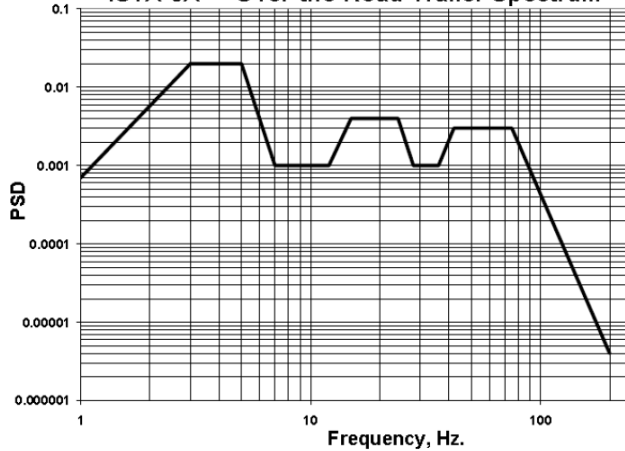
- ***Pass-or-fail: Product Damage Tolerance***
- ***Pass-or-fail: Packaging Degradation Allowence***

# Pass or Fail?

## ISTA 3A: Vibration under Dynamic Load



ISTA 3A - Over-the-Road Trailer Spectrum



Frequency (Hz)	PSD Level, g²/Hz
1	0.0007
3	0.02
5	0.02
7	0.001
12	0.001
15	0.004
24	0.004
28	0.001
36	0.001
42	0.003
75	0.003
200	0.000004

Figure: ISTA 3A- Over-the-Road Trailer Spectrum

# Pre-Shipment Testing

- ***Pass-or-fail: Product Damage Tolerance***
- ***Pass-or-fail: Packaging Degradation Allowence***
- ***Pass-or-fail: Reliability?***

# Shipment stresses



# Integration of Shipment Testing in reliability testprogrammes?

Source: [www.weibull.com/Articles/RelIntro/Reliability\\_Testing.htm](http://www.weibull.com/Articles/RelIntro/Reliability_Testing.htm)





Shipping Tests: Although shipping tests do not necessarily qualify as reliability tests per se, shipping tests or simulations designed to test the impact on the product of shipping and handling should be a prerequisite to reliability testing. This is because the effects of shipping will often have an impact on the reliability of the product as experienced by the customer. As such, it may be useful to incorporate shipping tests alongside the normal reliability testing. For example, it may be a good idea to put the units of a final design release reliability test through a non-destructive shipping test prior to the actual reliability testing in order to better simulate actual use conditions.

# Integration of Shipment Testing in reliability testprogrammes?

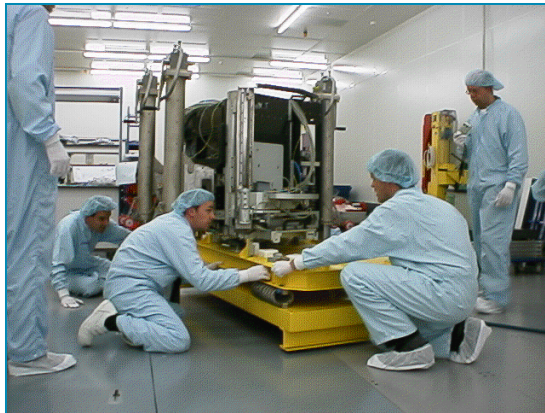
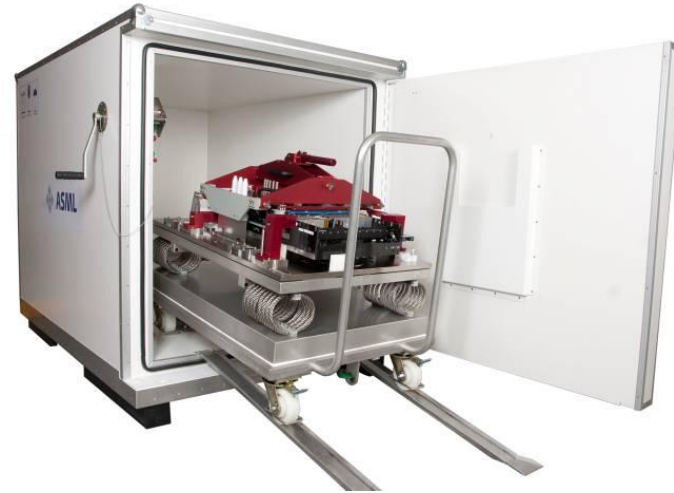
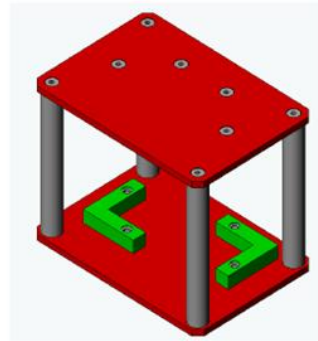
Problem: No packaging available during  
reliability test program.

# Development of engineered packaging

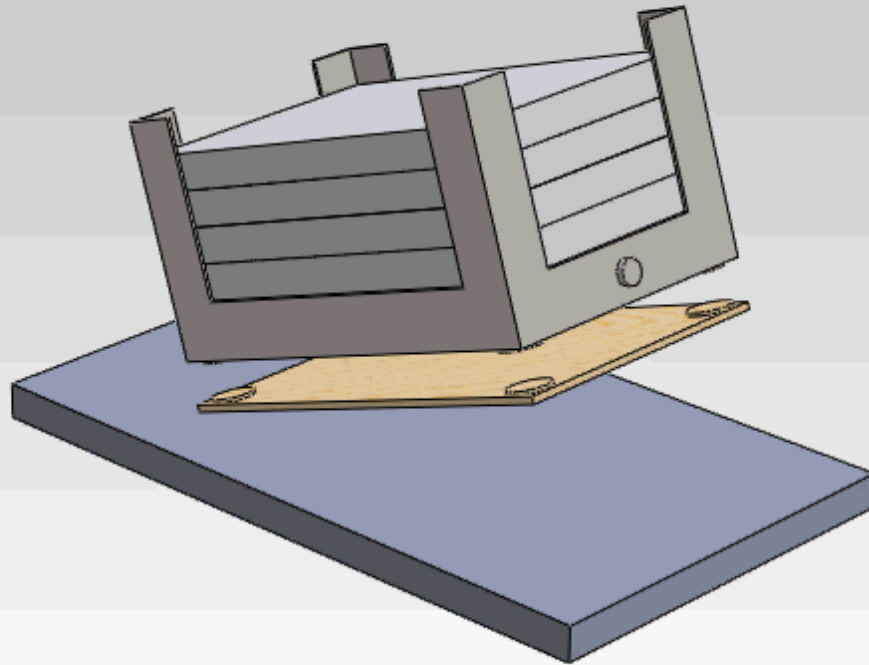
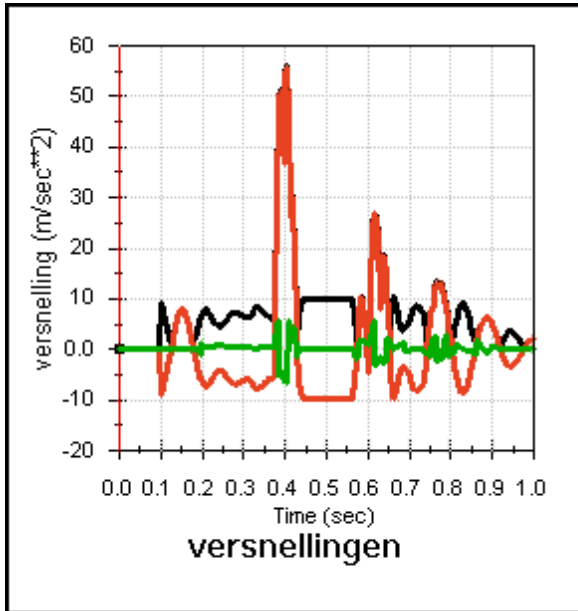
Purpose of Packaging: Reducing the environmental shipping stresses on product level.



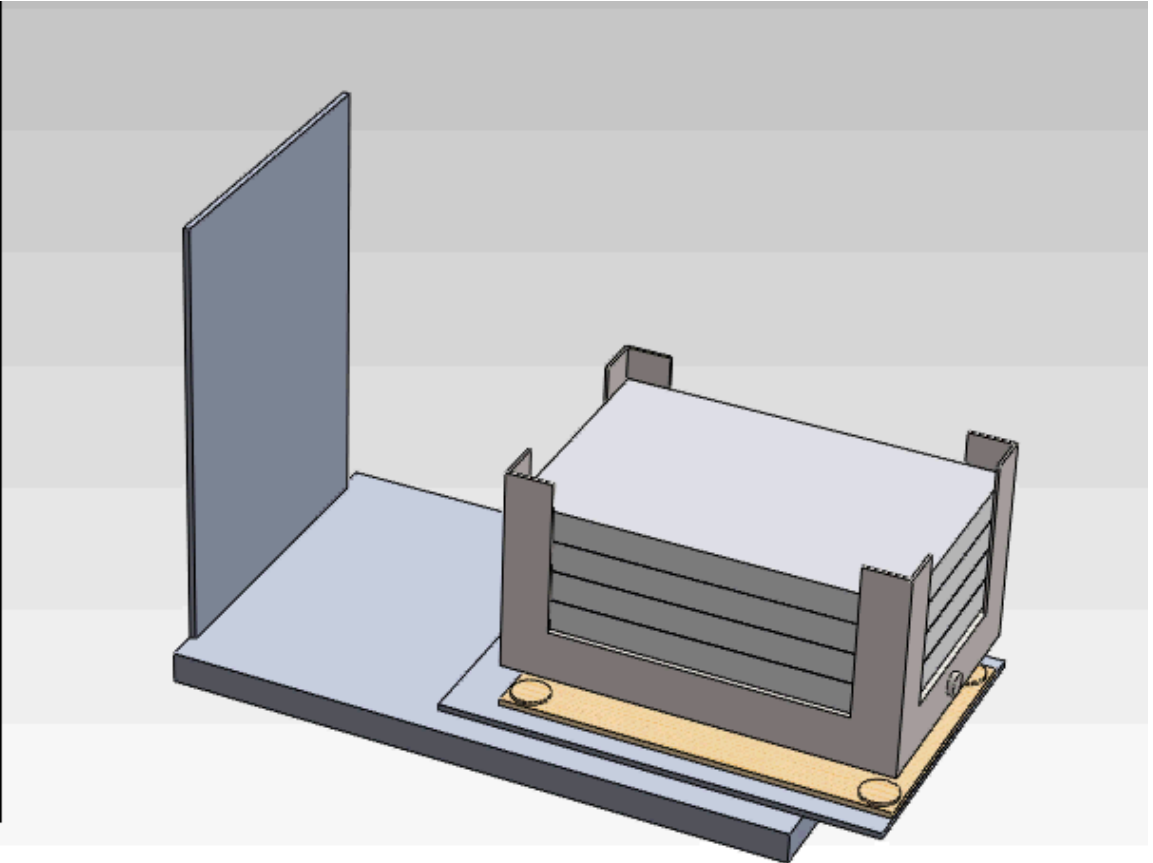
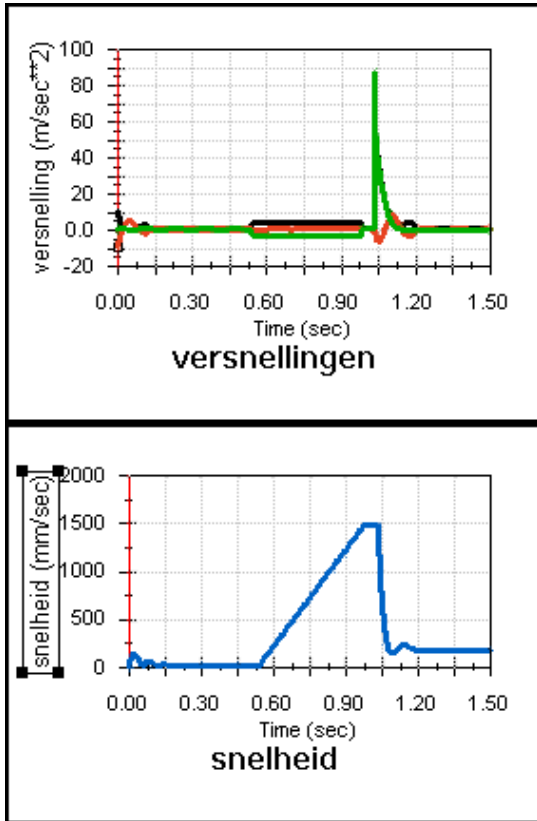
# Vibration and shock protection packaging



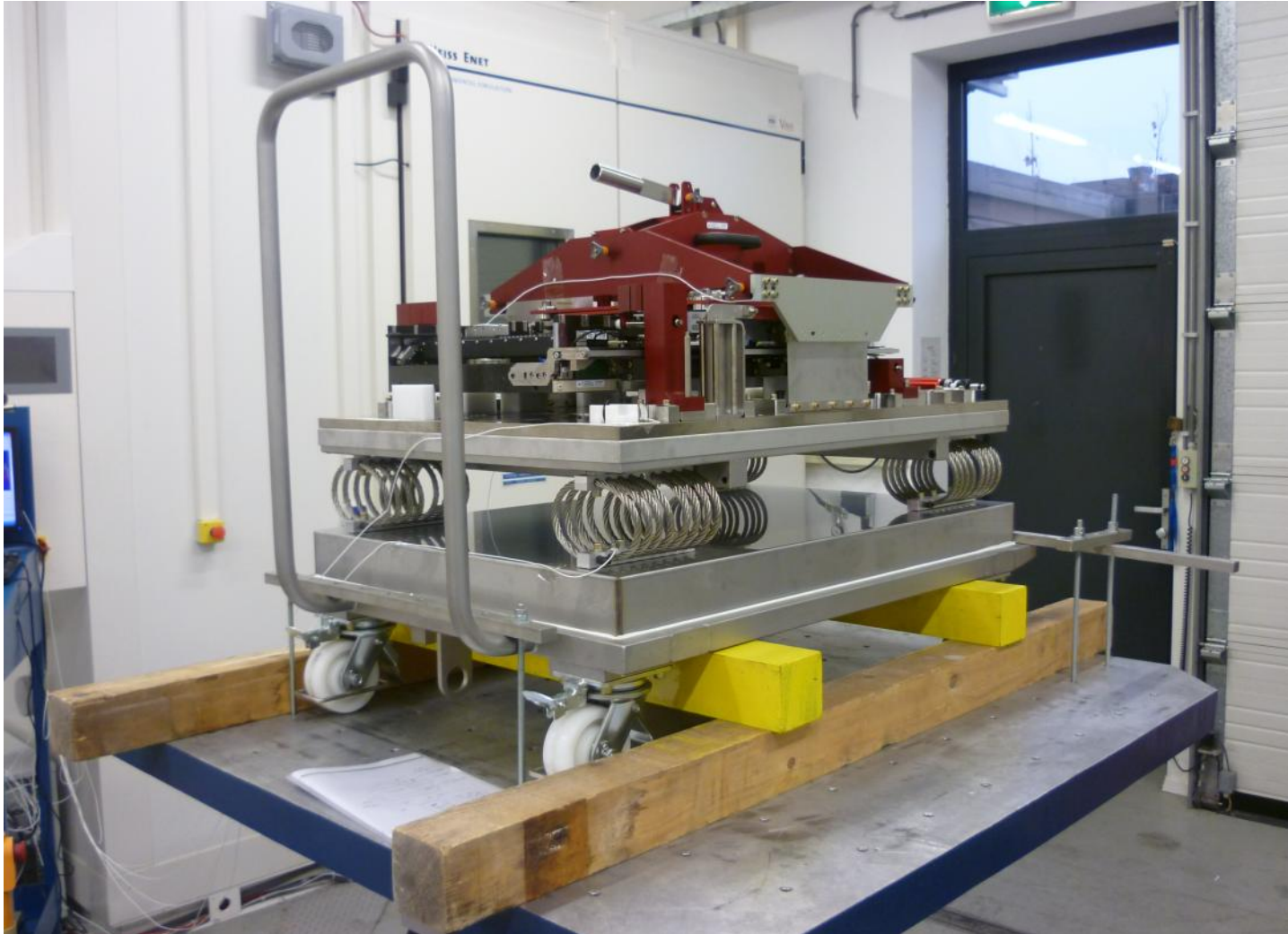
# Packaging development; engineering tools



# Packaging development; engineering tools



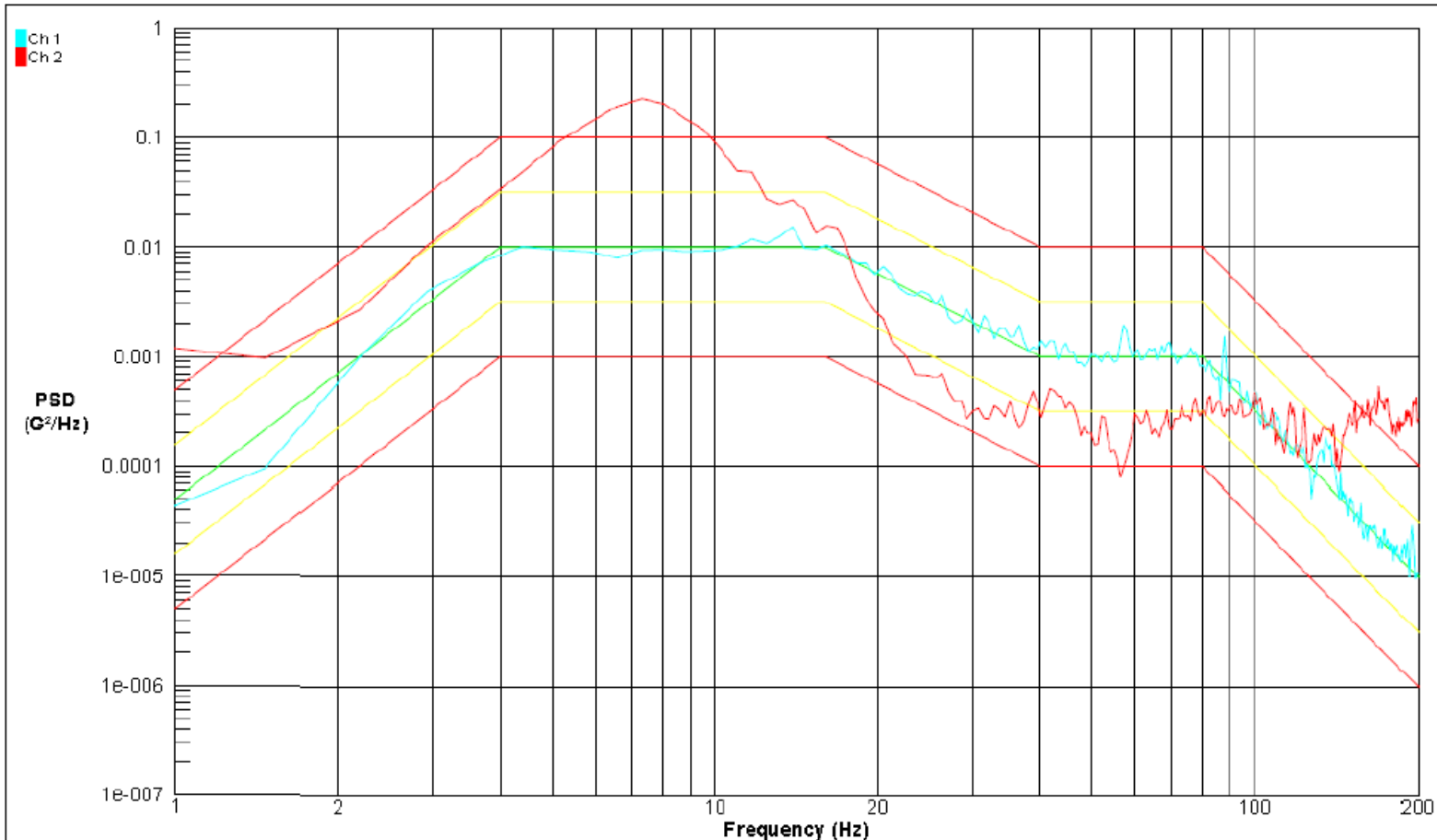
# Vibration transmission



# Vibration level on product



Test ID: OCE\_benchmark\_canon\_test    Control: 0.530 G rms    Elapsed: 2 hr 59 min 59 sec    Profile: 0 of 1  
Profile ID: ASTM D 4169 Truck Level II    Demand: 0.516 G rms - 100.0%    Remaining: 0 hr 0 min 0 sec    Total: 0 hr 0 min 0 sec

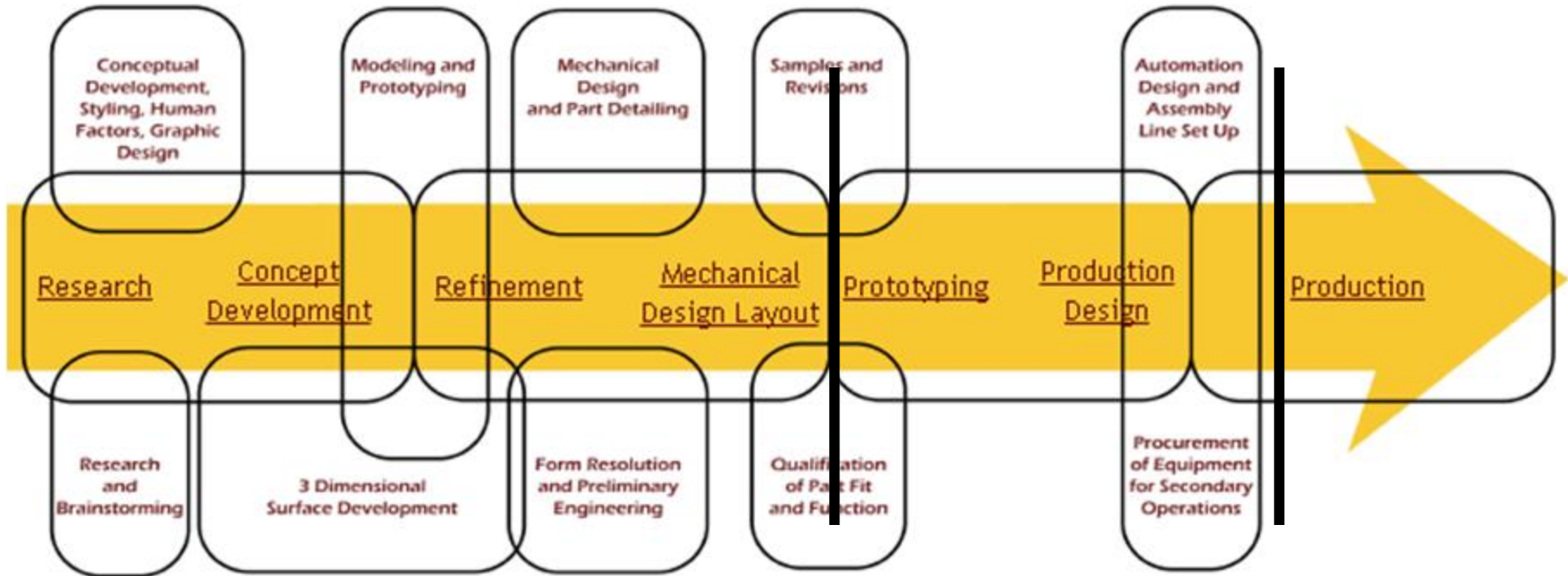


# Input for defining packaging transmission characteristic

- Product robustness for shock (G-loads).
- Product weight; manual/ mechanical handling.
- Shipment testing program.

***We can define a packaging concept with known characteristics.***

# Timing Pre-Shipment Testing



# Conclusion:

It is possible to take environmental shipping stresses into account during execution of reliability testing programmes.



# Thank you for your attention!