

PLOT Showcase

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Vibration testing / bulky vs compact products

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About Barco : **B**elgian **A**merican **R**adio **C**ooperation



1934:

assembly of
radios with parts
from the US

1981:

Barco split into two separate companies, Barco Electronic (consumer electronics) and Barco Industries (high tech electronics for visualization and process control).



1968:

studio monitors,
customers from
all over the world

Barcoviev



Barco Projection



NYSE Euronext

International company
Headquartered in Belgium
Stocklisted (BAR) on
NYSE Euronext Brussels

90+

Presence in more
than 90 countries

3,980

Employees

1.156

Billion euro
sales in 2012

You will find us where images are critical to professionals

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Geographical breakdown of sales 2012

NORTH-AMERICA



34%

EMEALA



42%

APAC



24%

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Aerospace



ATC displays

Market leader
Air traffic Control



Cockpit displays

Control display units
Mission displays
Flight critical displays
Modular software platform

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Defense



**Rugged
displays**

Consoles
Computers
Workstations

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Healthcare



Mammography

High-resolution (>5MP)
grayscale displays



Diagnostic

Nio and Coronis
display families
for image creation
and interpretation



Clinical review

Reviewing diagnostic
images and clinical
information



Point-of-care

Smart bedside terminals
and mobile tablets to
enhance patient comfort
and clinical efficiency



Digital OR

high-accuracy surgical
displays

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Why vibration testing

- Look for mechanical resonances

Vibration Swept Sine (S):

- Weak mechanical points
- Root cause analysis of vibration damage

- Simulation real environment:

Vibration Swept Sine (S):

- Propeller and turbojet Aircrafts
- Helicopters
- Mechanical cracks

Specific vibration profiles

- Helicopters rotor + gun vibration
- Wheeled ⇔ tracked

Why vibration testing

Vibration Random (R)

- Vibration is not related to a driving stimulus frequency
- Motor noise
- Vibration due to Transportation
(wheels over a road)

Shock

- accidental abuse
- normal operational environments of ground vehicles, aircraft
- handling of equipment (Medical)

Vibration test equipment at product validation

- (Electrodynamic) shaker (LDS V895-440) / ground plane: 50 x 50 cm
- Slip table
- Amplifier
- 8 input controller (datagraphics)
- measurement Accelerometers
- Fixture (R&D responsibility)

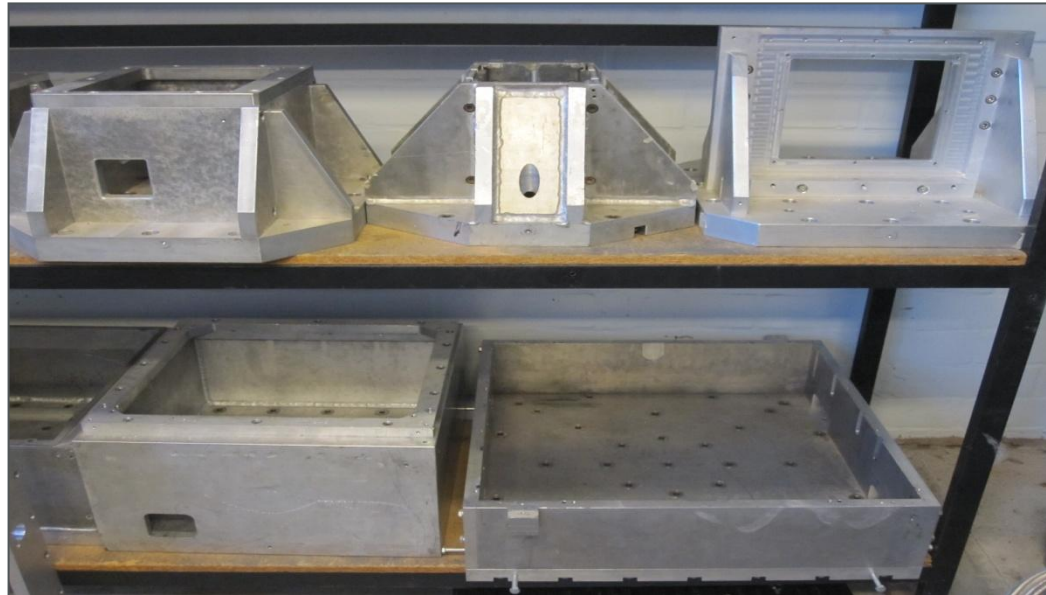
⇒ **Stiff** ⇒ “No or limited” resonances in frequency range of interest



Product Range of Defense, Aerospace & Healthcare

Visualisation solutions which are:

- Mostly **display like**
- Not heavier than **40 kg**
- Ground surface **not wider than 50 cm**
- Each product has it's **own test fixture** to secure the EUT



2008: product validation Barcoveiw & Projection merge, Business areas & markets to be covered



Projection



Healthcare



Advanced Visualization



Defense &
Aerospace



Cinema



Venues &
Hospitality



Healthcare



OEM
Siemens
GE, ...



Utilities, Security
& Surveillance



Corporate AV

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Digital Cinema



DC Projection

2K and 4K resolution
3D



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Events, venues & hospitality



Lighting

Digital lights
Automated luminaires
Lighting controllers



LED

Full range of LED
tiles and creative
LED
for rental and
fixed applications



Projection

Rental and staging

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Utilities, Security & Surveillance



Rear-projected video walls

LED-based
Lamp-based



LCD video walls

Near-seamless LCD
LCD displays

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Simulation / training



SIM Projection

Steady & motion based



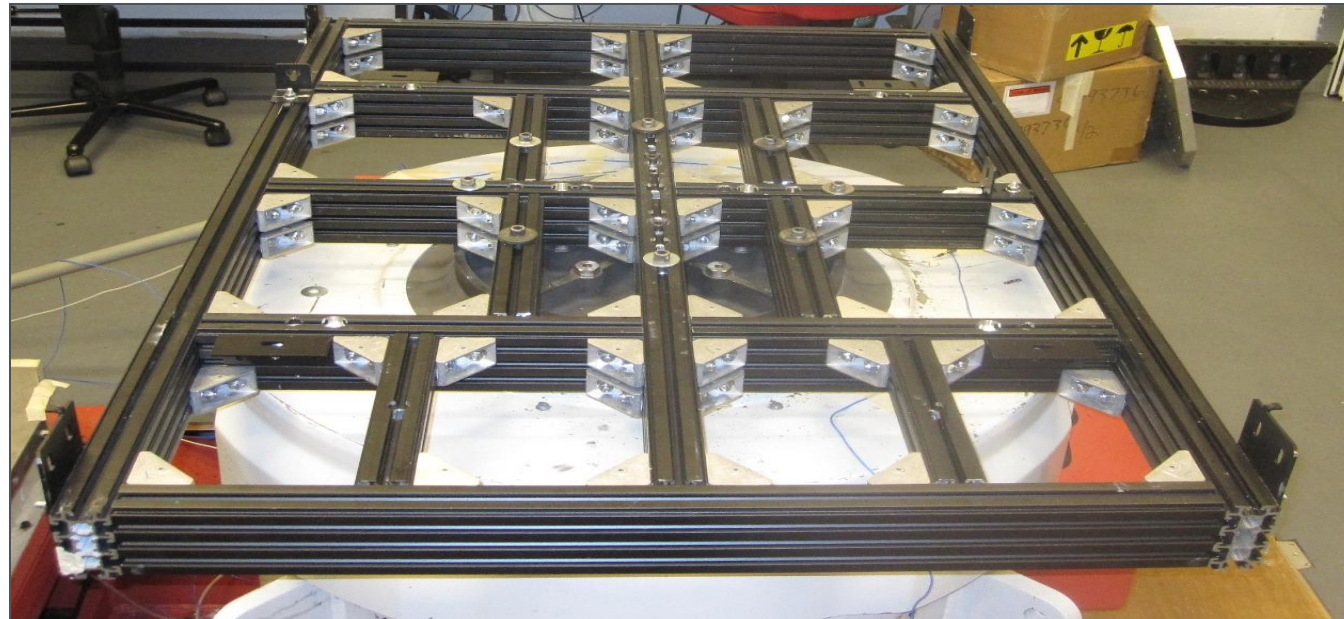
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Combined Product Range of Barco

Visualisation solutions also:

- Mostly bulky projectors for cinema, simulators & rear projection
- Heavier than 100 kg
- Ground surface wider than 50 cm
- Adjustable test fixture to secure various projector sizes made of an assembly of extrusions bolted together



Try to test this!



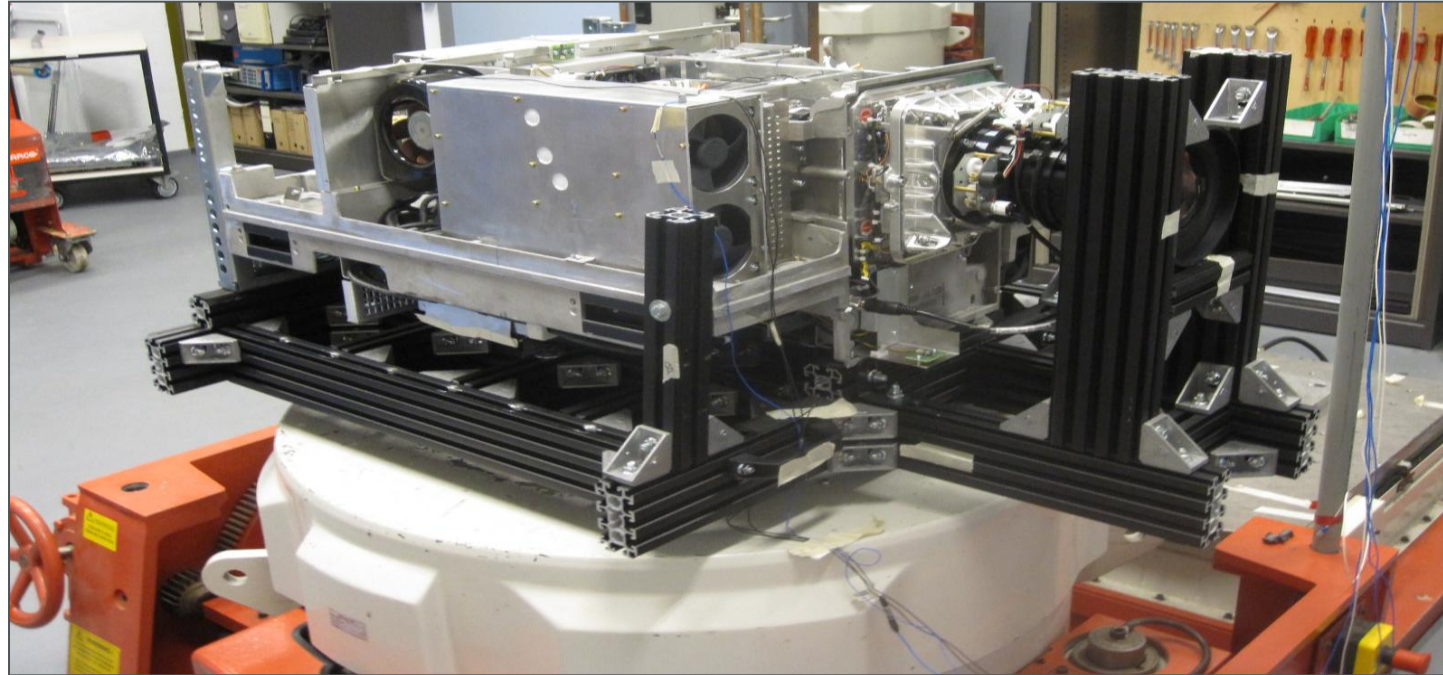
Ground plane & center of gravity

- **armature out of balance**
 - ⇒ Damaging the vibration table

Fixture

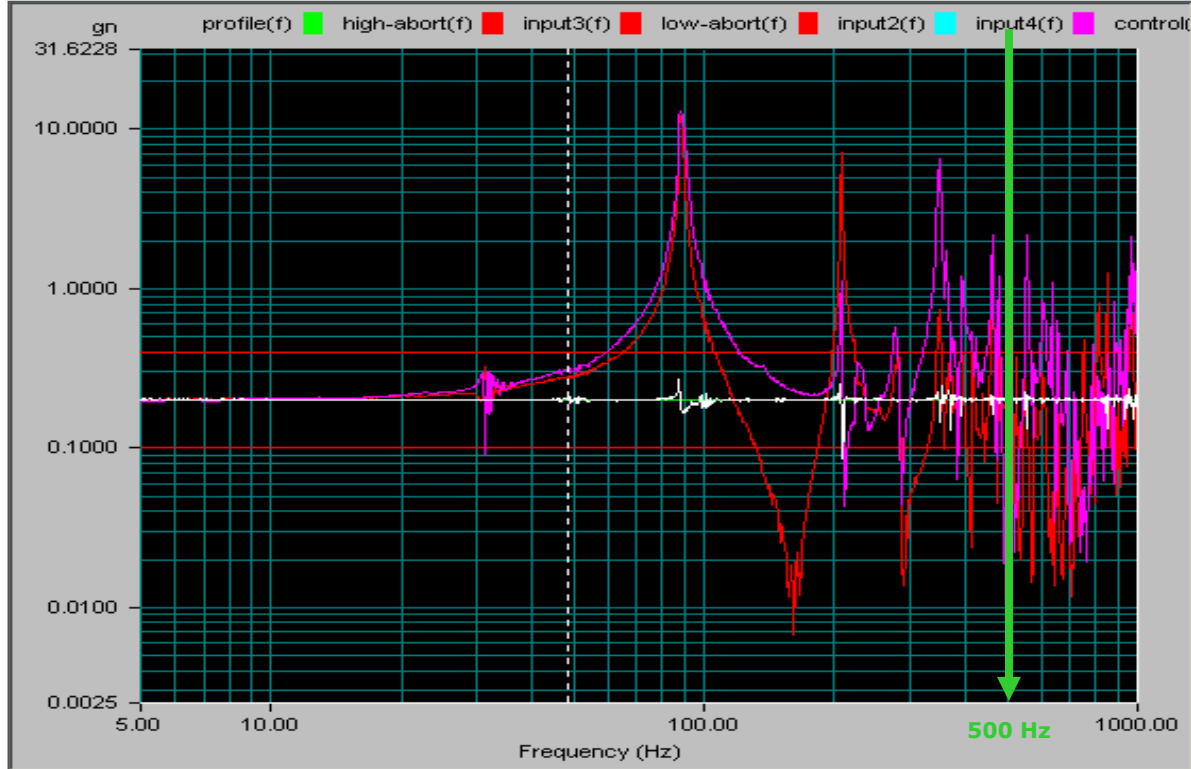
- **Inducing resonances in both EUT & vibration table**
 - ⇒ Damaging the vibration table
 - ⇒ Over testing EUT

How we started testing projectors



- Enforce test jigs
- Ensure that the center of gravity is in the center of the vibration table
- Prove to R&D that even with an improved fixture, there are still resonances induced in the frequency span of interest

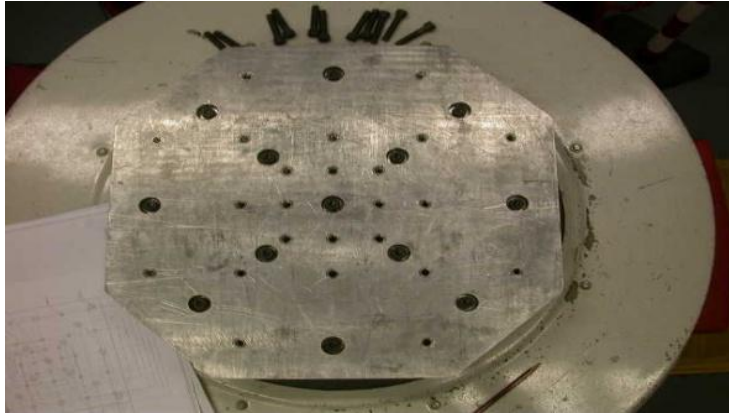
Problems with the fixture: to big & to weak



- **Input** : 0.2g sinus, 5 to 1000 Hz.(white line)
- **Control1**: On attachment point of projector (purple line)
- **Control2**: On corner of fixture (red line)
 - at 90 Hz resonance of factor 60!! (0,2 to 12g)
 - at 150 Hz damping of >10
 - at $f > 200$ Hz the fixture "sings"

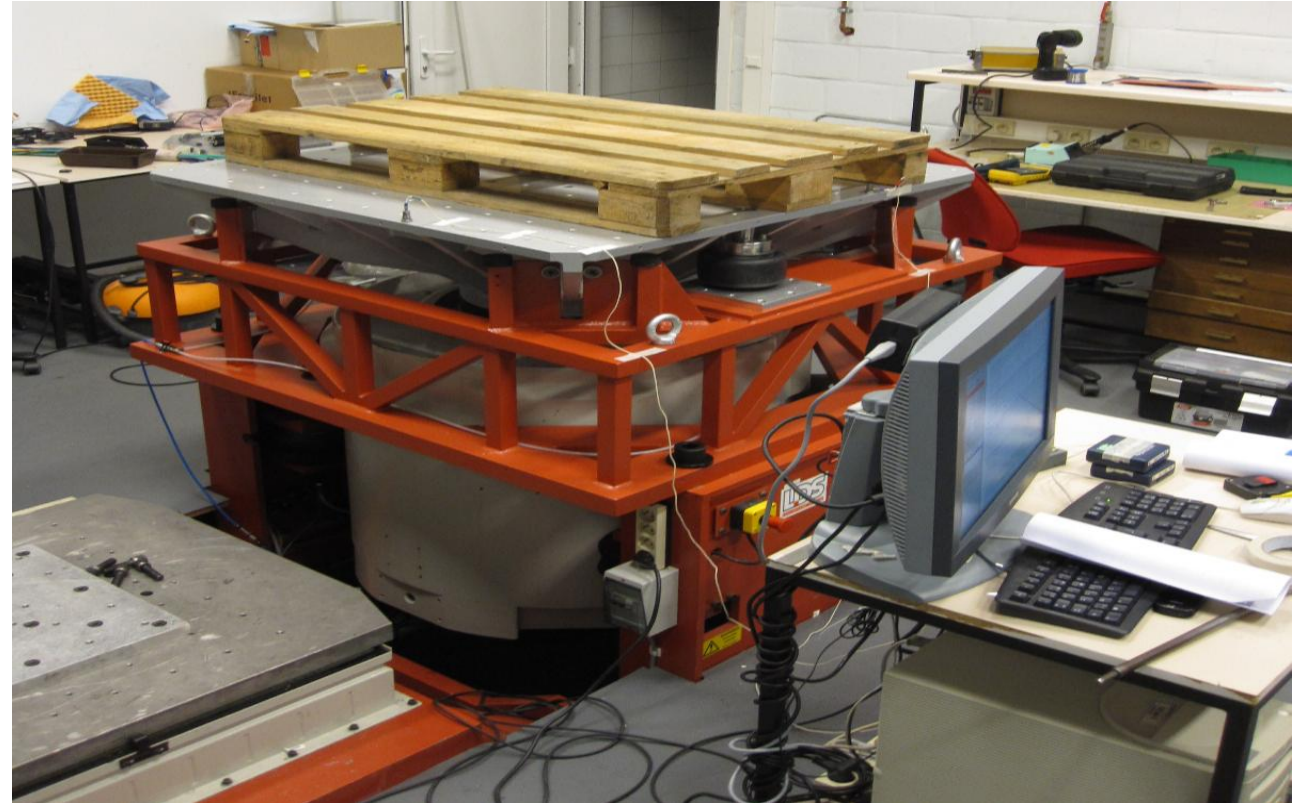
Action 1 to be taken: enlarge vibration ground plane

Buy head expander



Ground plane:

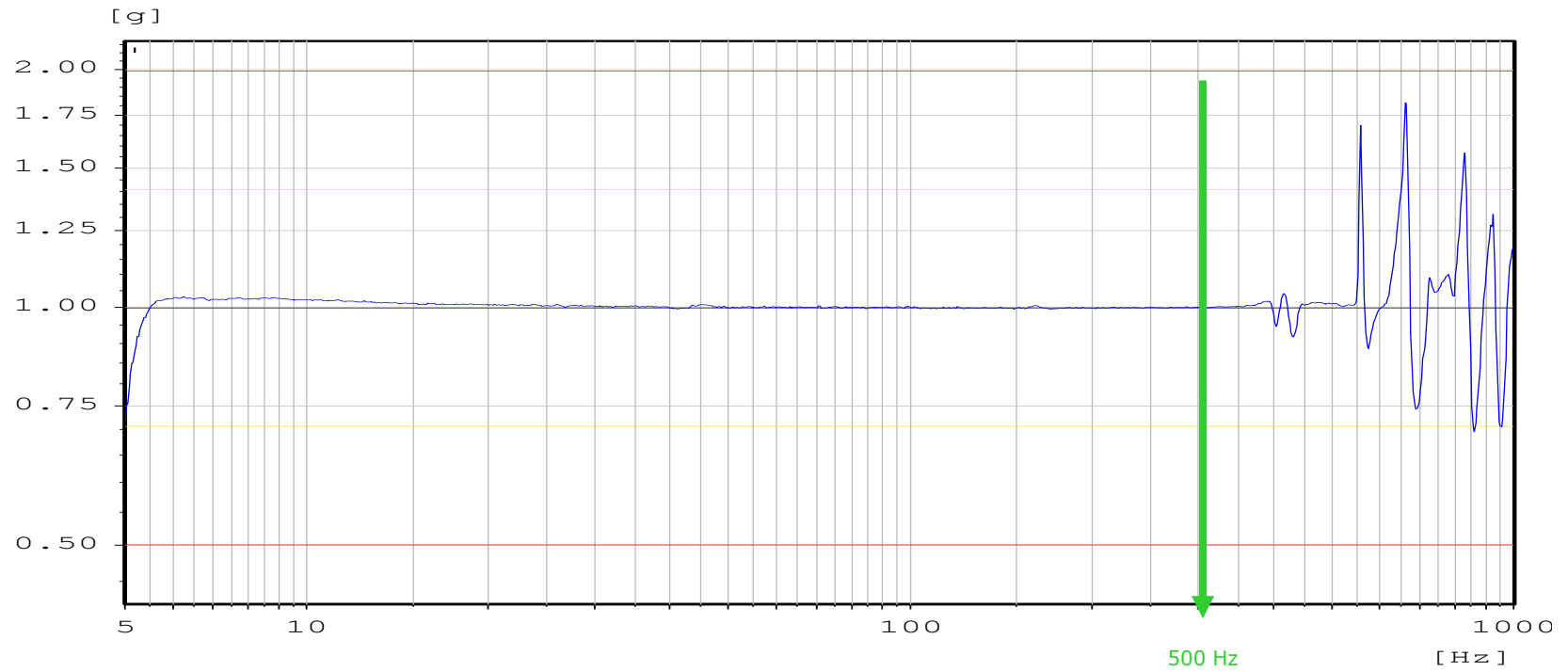
0,5 x 0,5m
↓
1,2 x 1,2 m



Resonance pattern with head expander

Sine

Control channel



Rept.:XXXX

Annex XXX

NT\Daten\m+p\bas\est headexp 1000 005.rsn

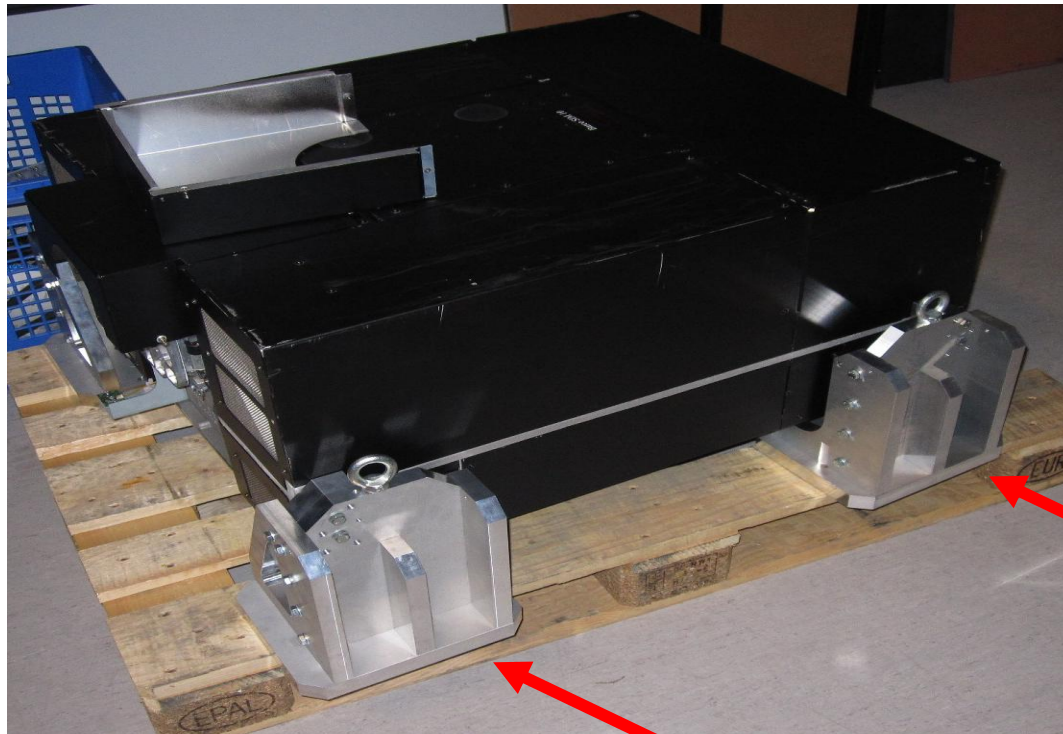
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Action 2 to be taken: change vibration fixture

It took us :

- 3 years of **arguing**
- **proof of resonances** while testing various projectors
- an internal organised **training** on the importance of rigid fixtures to convince R&D to redesign the fixtures to our specs



The go-getter wins!

PAIN

- Damaged test equipment
- Repair costs

- Overtested EUT
- Efficiency loss
- EUT loss

- Data acquisition
- Investment
- Pursuement effort

GAIN

- Test equipment in correspondence with EUT's

- Correct tested EUT
- Failures are due to design
- EUT failures do not result in loss

- Trust in PVG engineers
- Involvement from design onward
- **Cost of non quality due to mechanical field failures down to almost nil**



Questions & Answers

YouTube



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