

HSBO

HighSpeed 
BoatOperations

**Human Impact Exposure
on
High Performance Boats
Science & Standards Decoded**

Johan Ullman M.D.

HSBO Pro
HighSpeed BoatOperations Professionals

HSBO Pro

HighSpeed BoatOperations Professionals

Human Impact Exposure on High Speed Boats

What you need to know
- and what you don't

People get Injured on
High-Speed Boats

People get Fatigued on
High-Speed Boats

How can we best solve the
High-Speed Boat Operator's
Problems?

To solve these problems it is essential to understand them.

What causes injuries and fatigue?

It is important to understand injury mechanics.

- Vibrations cause discomfort
- Impacts cause compression forces
- Compression forces cause structural failure

Impacts cause structural failure

Impacts cause compression forces and shear forces.

When these are large enough, structures break.

Science has come a long way

Standards have been created

Science has come a long way

We now know that:

Standing posture multiplies impact exposure.

Seats bottoming out multiplies impact exposure.

Proper suspension seats can reduce impact peak levels by 60-70%

Are Today's Standards Relevant?

What is the problem with these standards?

- They are all based on vibrations
- instead of on impacts.



WIB - wrestlingisbest

HSBO Pro
HighSpeed BoatOperations Professionals





HSBO Pro
HighSpeed BoatOperations Professionals

4GIFs
.com



Why are these standards used?

There were already standards for vibration exposure when the impact issues became recognized.



HSBO Pro
HighSpeed BoatOperations Professionals

What is the origin of these standards?

Vibration exposure limits were based on comfort ratings from truck drivers who got much more tired after 8 hrs of high vibration than 8 hrs of low.

What is the
ISO standard?
EU Directive?

How can you comply?

What is
RMS?
VDV?
Sed8 ?
Crest Factor?

IS IT POSSIBLE TO
DESCRIBE THE EXPOSURE
TO IMPACT DURING A DAY
AT SEA WITH A SINGLE
NUMBER ?

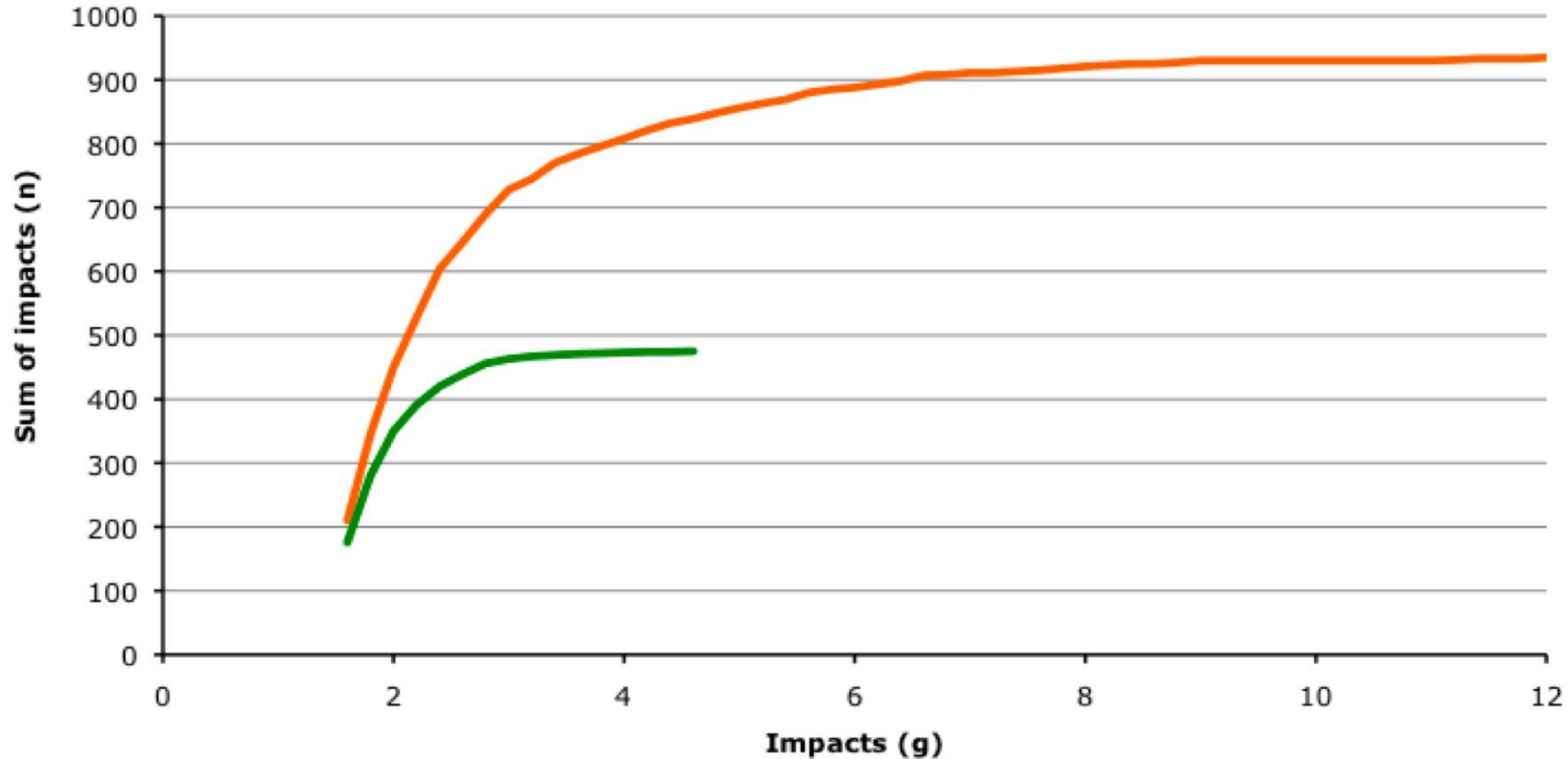
IMPACT COUNT INDEX FOR HIGH SPEED CRAFT MOTION ASSESSMENT

Dr. Trevor Dobbins
STResearch

Dean Schleicher
Donald L. Blount and Associates, Inc.

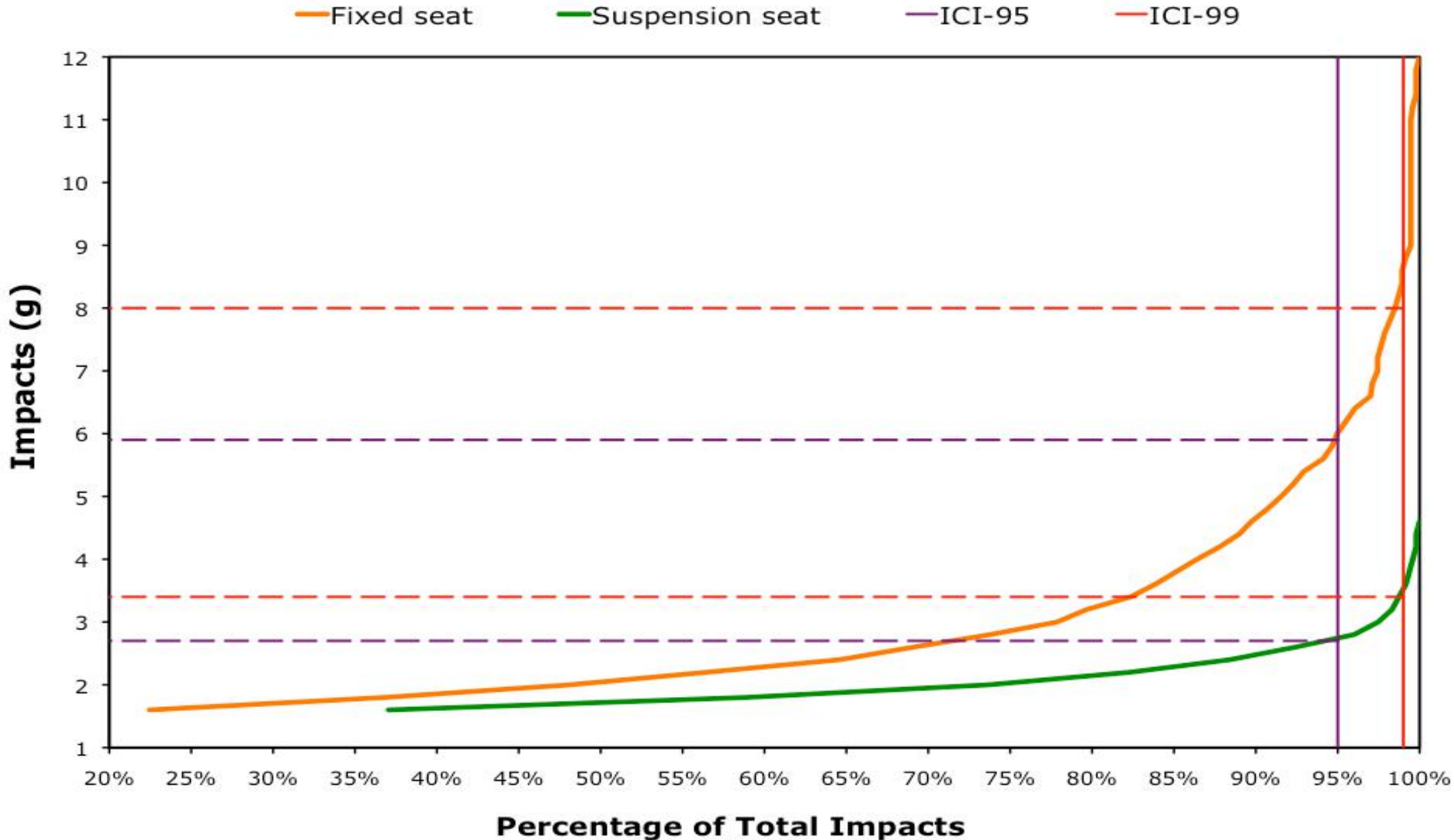
CUMULATIVE IMPACT COUNT (IC)

Fixed seat Susp seat



Dobbins and Schleicher

ICI – Impact Count Index



Is there a correlation between
the vibration standards and
injury risks?

Is it possible to measure
the risk of injury ?

Is it possible to measure the risk of injury ?

Pain is correlated to injury.

Pain can be

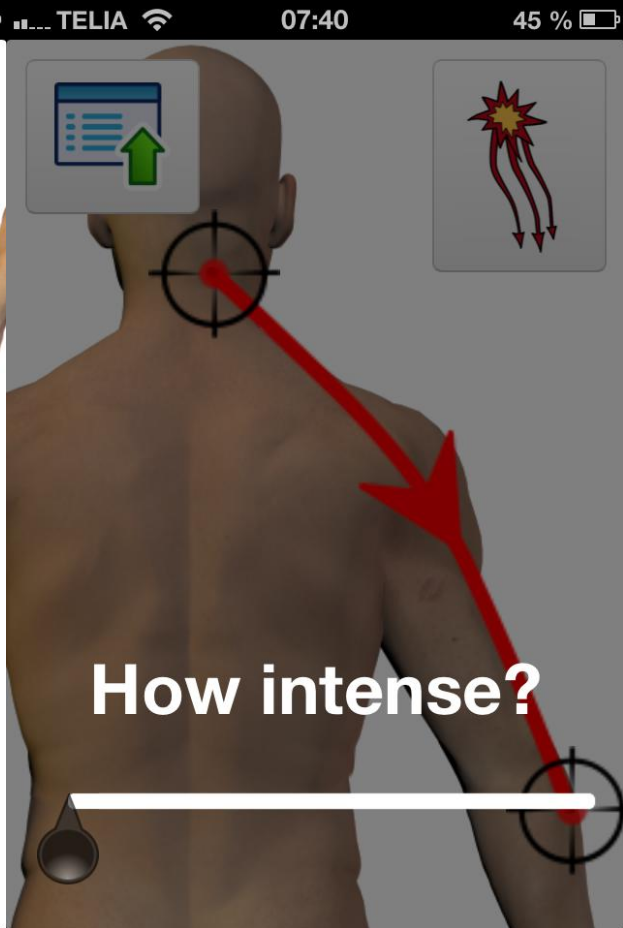
Measured, Recorded and Quantified

How?

PainDrawing

PainDrawing





Scientific study during Lisbon Atlantic Endurance Challenge

Hulls and Humans monitored for Impacts

Humans monitored for Pain

980 Nm – Lorient to Lisbon

6 legs \approx 25 subjects \approx 12 boats




HSBO Pro
HighSpeed BoatOperations Professionals

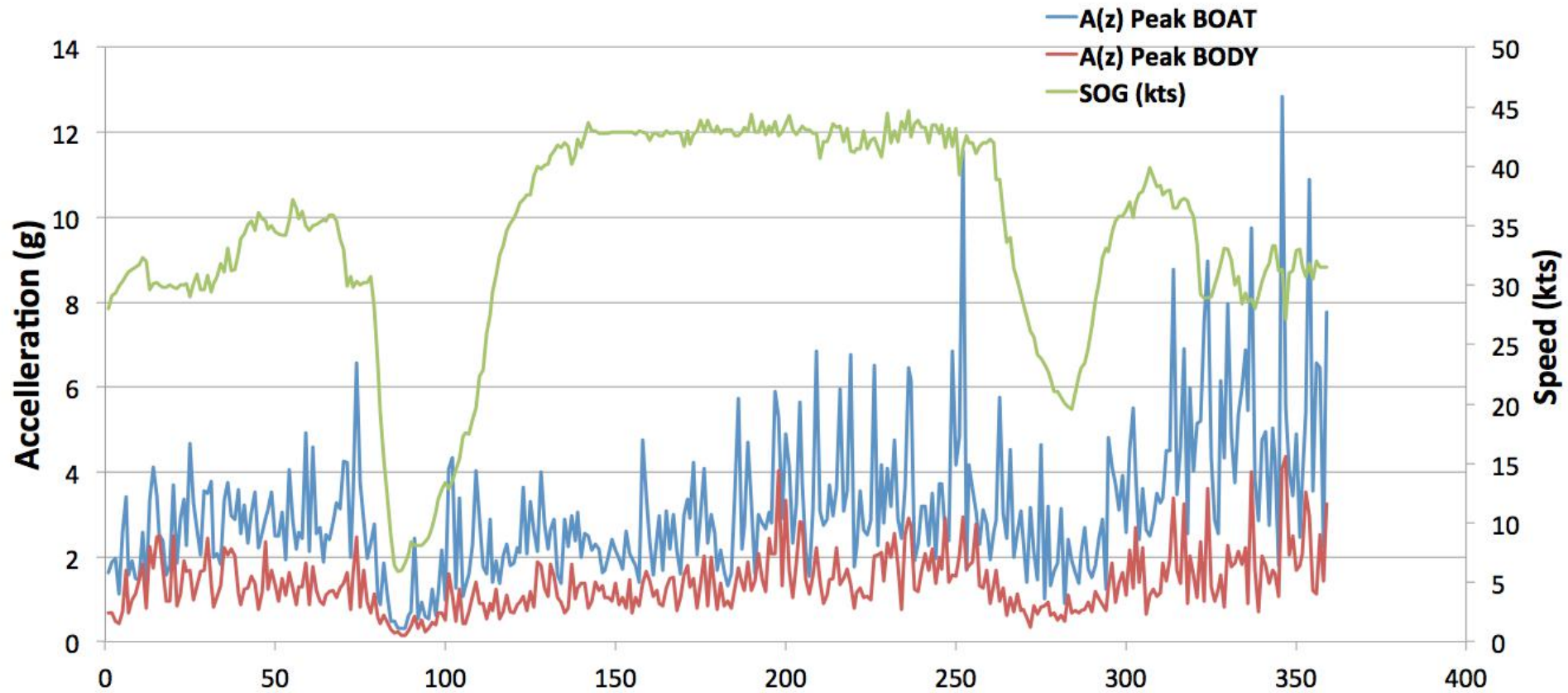
Study supported by 3 Universities and 3 Navies

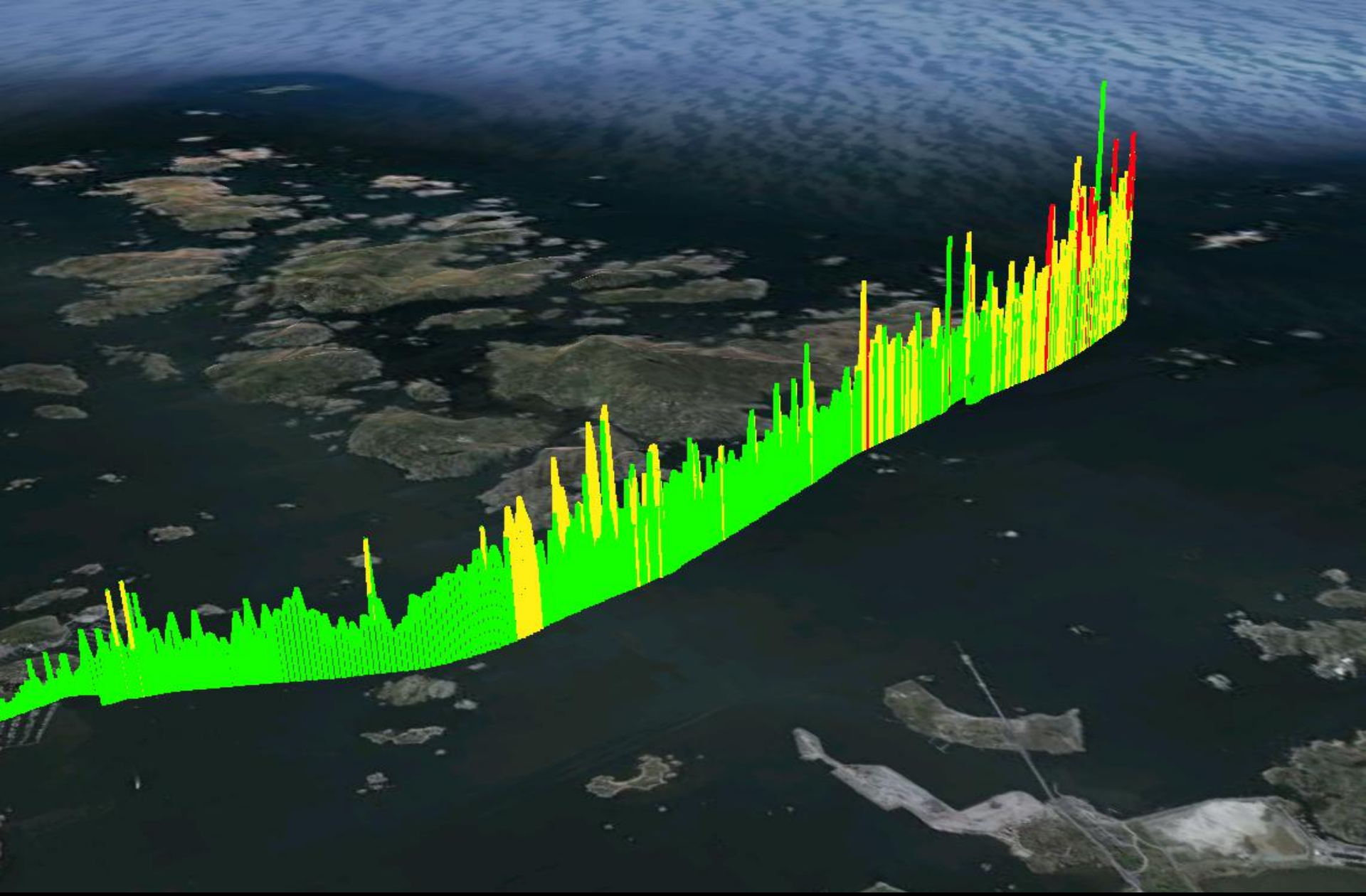
Expected Results

Hull performance compared.
How much impact will people
expose themselves to?

Correlation?

Exposure  Pain





HSBO Pro
HighSpeed BoatOperations Professionals

Example of a practical application

This paper describes a simple method of measuring impact exposure.

<http://hsbo.pro/wp-content/uploads/SeatTesting-PROBOAT-142-pdf.pdf>

HSBO Pro
HighSpeed BoatOperations Professionals



Practical Impact-Exposure Testing

Taking measures required under the European Union's 2002 Vibration Directive, Boomeranger Boats, a builder of specialized high-speed RIBs in Finland, tests two models of shock-mitigating seats to determine which will best reduce whole-body impacts on boat operators.

Text by Jussi Mannerberg
Photographs and illustrations
courtesy Boomeranger Boats

Above—Built in Finland, the 31.2' (9.5m), 6,614-lb (3,000-kg) Boomeranger Special Ops C-3500 open RIB, powered by twin 300-hp Mercury Verado outboards, is designed for high-speed commercial or government service. As such, the boat is subject to the European Union's directive limiting worker exposure to impacts and vibrations. It requires adoption of the best available shock-mitigating technology to protect crews working

Editor's Note: Professional BoatBuilder has devoted significant editorial space in recent issues to exploring the efforts of naval architects and engineers to model and understand the slamming and impact accelerations that fast planing boats and their crews are exposed to. "Analyzing Accelerations" Parts 1 and 2 appeared in PBB Nos. 140 and 141, respectively. Those articles detailed what we know about the specifics of seakeeping in high-speed craft, what we should be able to model during the design phase, and what tests and data would help designers better predict vertical accelerations over a range of speeds and sea states.

The following article is a practical account of how a designer and builder

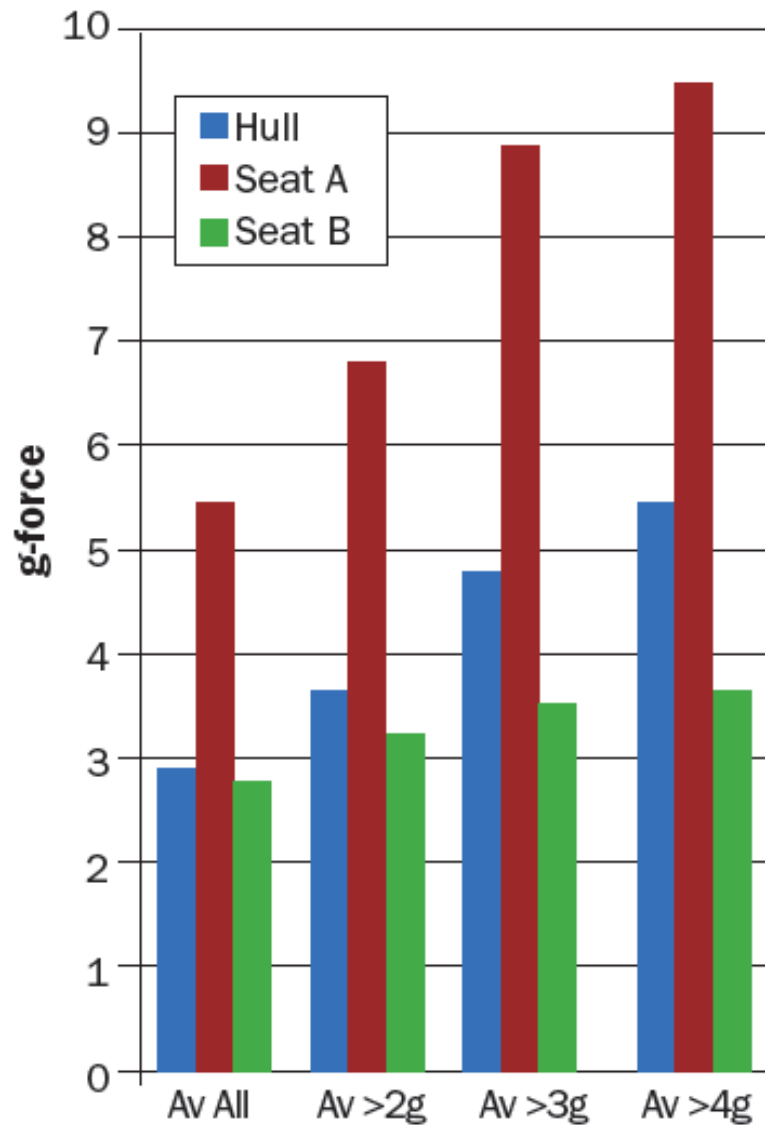
addresses vertical accelerations in its existing models. Its author, boatbuilder Jussi Mannerberg, tells how the company he manages, Boomeranger Boats (Loviisa, Finland), measures slamming loads on hulls and assesses impact exposure of professional boat crews to meet the requirements of the European Union's Vibration Directive. This article is based on a similar paper Mannerberg presented at the 2012 High Speed Boat Operations Forum in Gäddede, Sweden.

—Aaron Porter

Boomeranger Boats Oy has built professional high-speed rigid inflatable boats (RIBs) since 1991. In the last two years, we've seen an increasing number of potential buyers

Comparing mean peak values for the entire data set to those for impacts greater than 2 g, 3 g, and 4 g confirms that the differences in seat performance were amplified in rougher conditions.

Figure 4. Mean Peak Values for Impacts Above 2g, 3g, and 4g



Conclusions

- We need a standard to quantify impact exposure
 - We need to correlate impact and injury
 - Pain can be an indicator of injury
 - Pain can be monitored

HSBO Pro

HighSpeed BoatOperations Professionals

To download the full article
Impact-Exposure-Standards, go to :

<http://hsbo.pro/wp-content/uploads/Impact-Exposure-Standards-ProBoat-149.pdf>

www.HSBO.pro



1310

14°

350

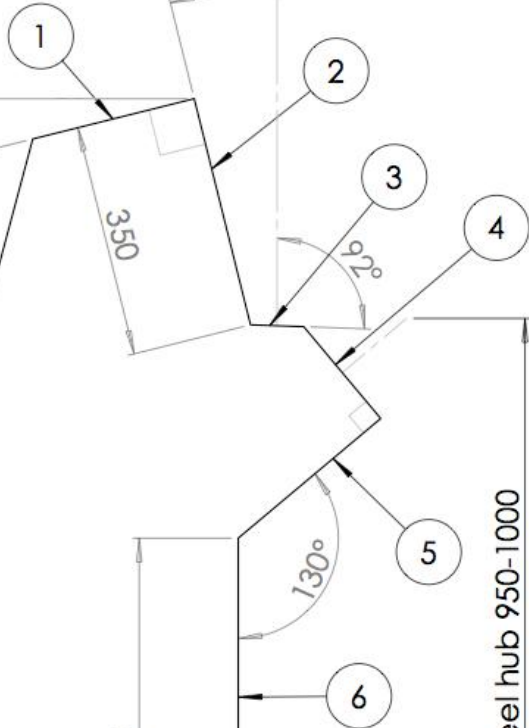
650

14°

130°

7°

Wheel hub 950-1000



Steering console side view

Steering Console measures recommendations

© High Speed Boat Operation Professionals



Cockpit Design for Speed

Paper published in ProBoat

Feb - March issue 2013

Professional Boat Builder Magazine.



“The Rubber Titanic “



Do not cut corners !!

**You
Might Sink Tomorrow**



HighSpeedBoat 2014 OperationsForum

Admission by invitation only

*Gothenburg
Sweden
May 6-8*

hsbo.org

Can Ride Control Reduce Exposure?

ACTIVE

Ares active ride control

Humphree Intersceptors

PASSIVE

Hysucat hydrofoil catamarans

How can we measure impacts?

Devices are now available which make it very easy to measure impacts.

Chine Tripping and Ejections

A number of accidents have occurred where chine tripping have caused ejections and ejections have caused casualties.

Any input about such events and issues are welcome.

Can Ride Control Reduce Exposure?



Floor Matting

What does it do ?