High Speed Boats Human Challenges

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High-Speed Boat Impacts Cause Severe and Permanent Injuries

Hull-slamming impacts can exceed 20 g

This impact exposure causes

Injuries

Physical fatigue

Cognitive degradation

Reduced combat readiness

Injuries are sometimes severe, and
some injuries cause permanent disabilities.
Physical and cognitive fatigue reduce combat value.

Injuries increase in Number and Severity

Impact-induced musculoskeletal injuries
are a well-known problem

New research shows that:

Impact exposure also can injure the brain

Acute – Cognitive effects and Concussions

Chronic – mTBI ”minimal Traumatic Brain Injury”


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Why is the problem not solved?

The actual **human impact exposure** onboard is still **unknown** (!)

Current Regulations and Standards are **counter-productive** (!)

- They are based on **false assumptions** & **poor understanding**

Science has not yet established:

- What is the **actual human exposure** onboard HSB?
- What **kinds and levels** of impacts are **sustainable**?
- What **kinds and levels** of impacts are **harmfu**l?

Current standards and regulations block R&D

The **EU-directive 2002/44**

regulates allowable exposure

- only to VIBRATION – not to IMPACT

Mean values of vibration have NO correlation to the impact-induced forces, causing acute injuries and cognitive impairment.

Even non-concussive impact exposure to the head causes cognitive impairment

Current standards and regulations block R&D

The EU directive is NOT relevant

The EU directive 2001/44 defines exposure limits defined as VDV - mean values of VIBRATION.

It is based on **ISO standard 2631**, created 30 years ago to regulate human exposure to vibration in land vehicles

Neither VDV, Nor Sed(8) have any correlation to the impact induced forces causing acute injuries

The EU directive is also impossible to comply with,
unless the sea is flat – or you stay on the dock.

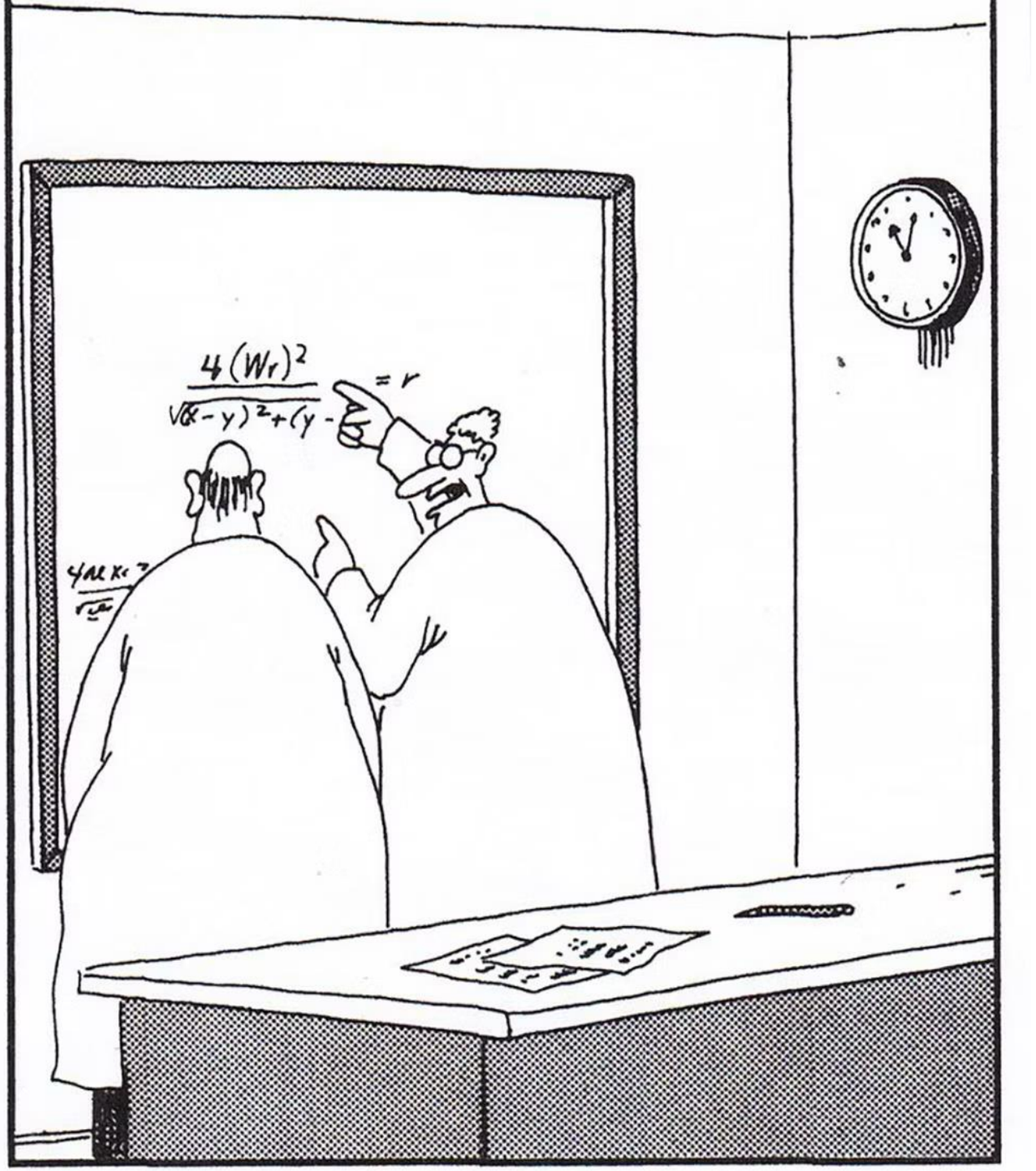
On a normal day, exposure limits are typically exceeded in < 20 minutes

Still unknown what exposure is harmful

Lack of understanding

- NO ONE understands these algorithms
- No one can any longer explain them
- *(What does a VDV value of 1.6 m/s$^{1.75}$ feel like?)*
- The Emperor is still naked & No one dares to ask

Strong forces act to preserve the STATUS QUO



"Yes, yes, I *know* that, Sidney . . . *every*body knows *that!* . . . But look: Four wrongs *squared,* minus two wrongs to the fourth power, divided by this formula, *do* make a right."

State-of-the-Science

Boat **impacts can exceed 20** g - **Not just 4 or 10 g (!)**

Impact-generated **forces must be analysed**

Impact vectors must be analysed
- Lateral forces are more dangerous than vertical

Raw data is essential for analysing the forces
- Low pass filtering destroys essential parts the data

Rise time is crucial for injury risk - **Jerk** must be analysed!

- Vibration causes fatigue
– Impacts cause acute injuries

Human Physiologic response to impact is relevant.

Posture at impact is critical for the muscular response

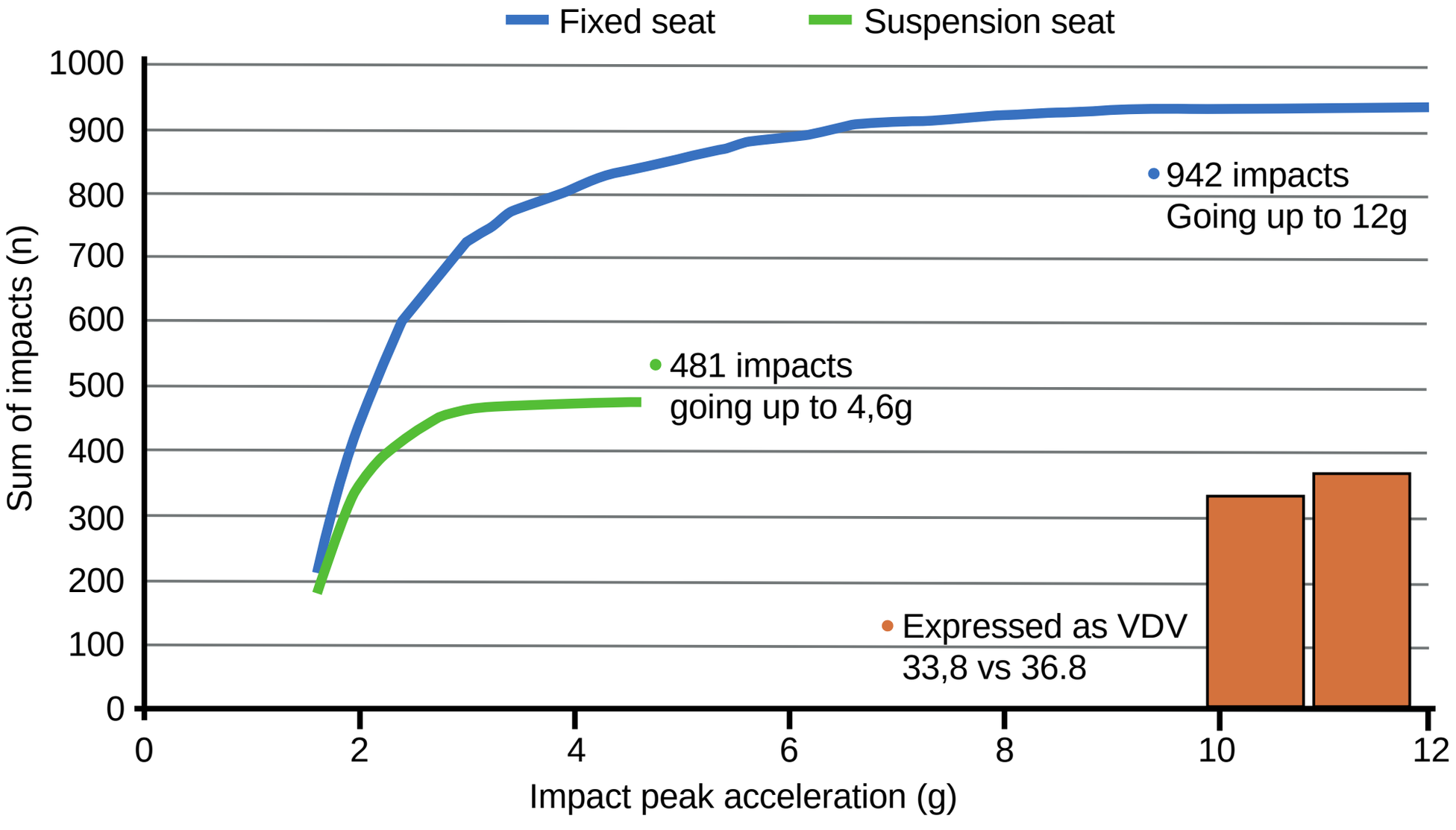
THE PROBLEMS CAN NOW BE SOLVED

Lack of relevant guidelines

To issue advice and recommendations,
it is necessary to understand:

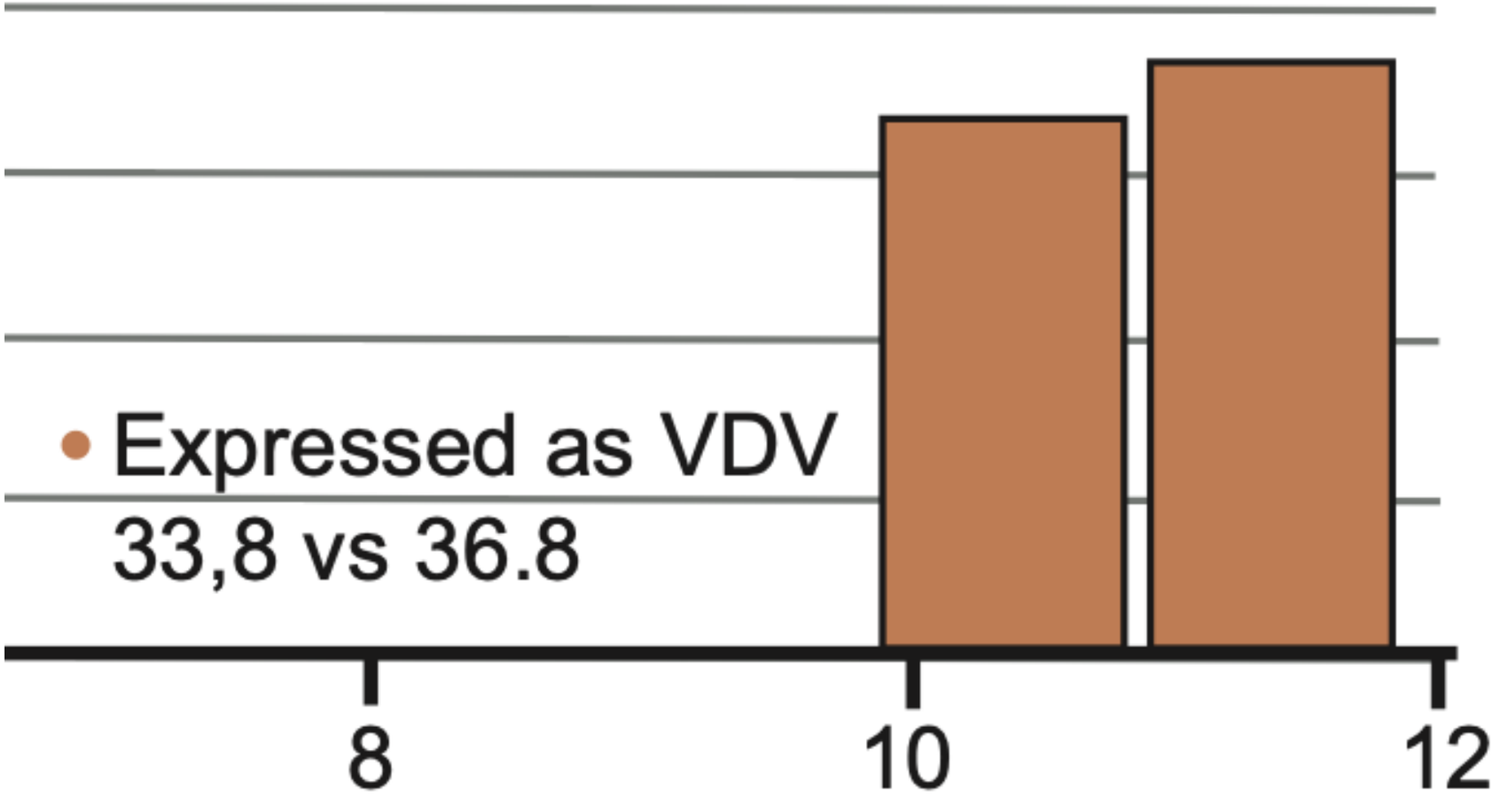
- The difference between impact and vibration
- The nature of impact exposure at sea
- The human physiologic response to impacts
- What kind of impacts cause the injuries

To specify platforms and equipment, relevant and accurate test methods and guidelines are needed.



We Must Look at REALITY

5 times higher exposure shows only a 9 % difference in VDV



VDV was never to be used for exposure > 4 g!

A few hours after this video was recorded, the boat, with 2 crew and 5 passengers turned at ≈ 20 kts.
A typical SLIP-TRIP-FLIP event occurred.
Everyone onboard, except for the driver, WAS thrown out of their seats.
The XO in the navigator seat was ejected - FAR ENOUGH NOT TO BE KILLED BY THE PROPS when the stern swung by. These seats are marketed as the “safest on the planet” based on lab testing.

High speed boats expose humans to extreme forces

To solve the problems,
significant knowledge gaps
must be filled

Only Empirical Science can do this

We must look at Reality!

What is needed to solve the problem?

1. Putting the **Human** into the equation
2. Understanding the **Nature** of the harmful impacts
3. **Scientific analysis** of **human impact exposure**
4. New relevant knowledge and **Test methods**
5. New recommendations for **Relevant Exposure limits**

What is needed to solve the problem?

1. Putting the human into the equation

Basic understanding of the:

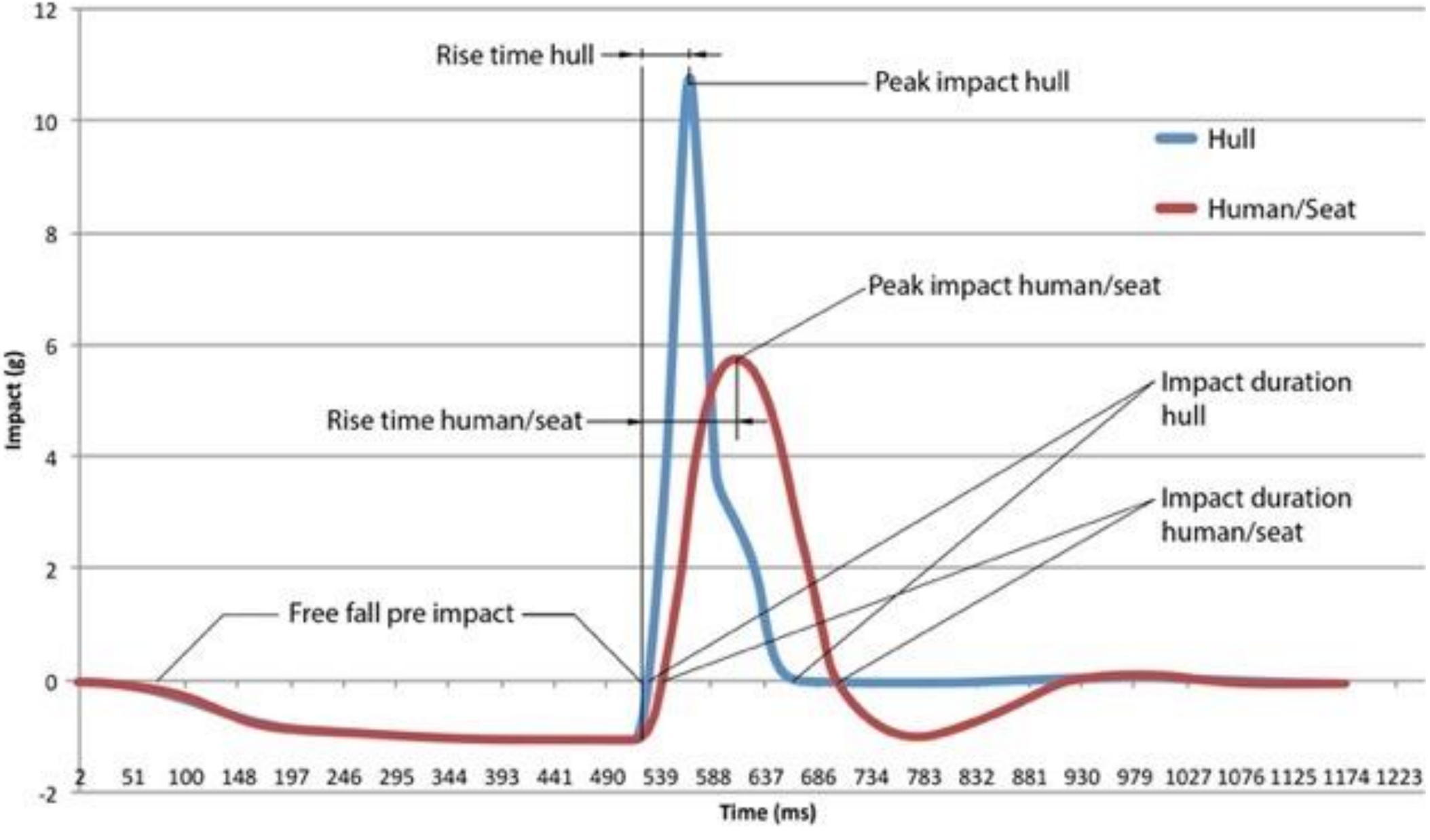
- **Human biomechanics**
- **Injury mechanisms**
- **Human physiological response to impact**
- **Importance of body posture during exposure impact**

WHAT is needed to solve the problem?

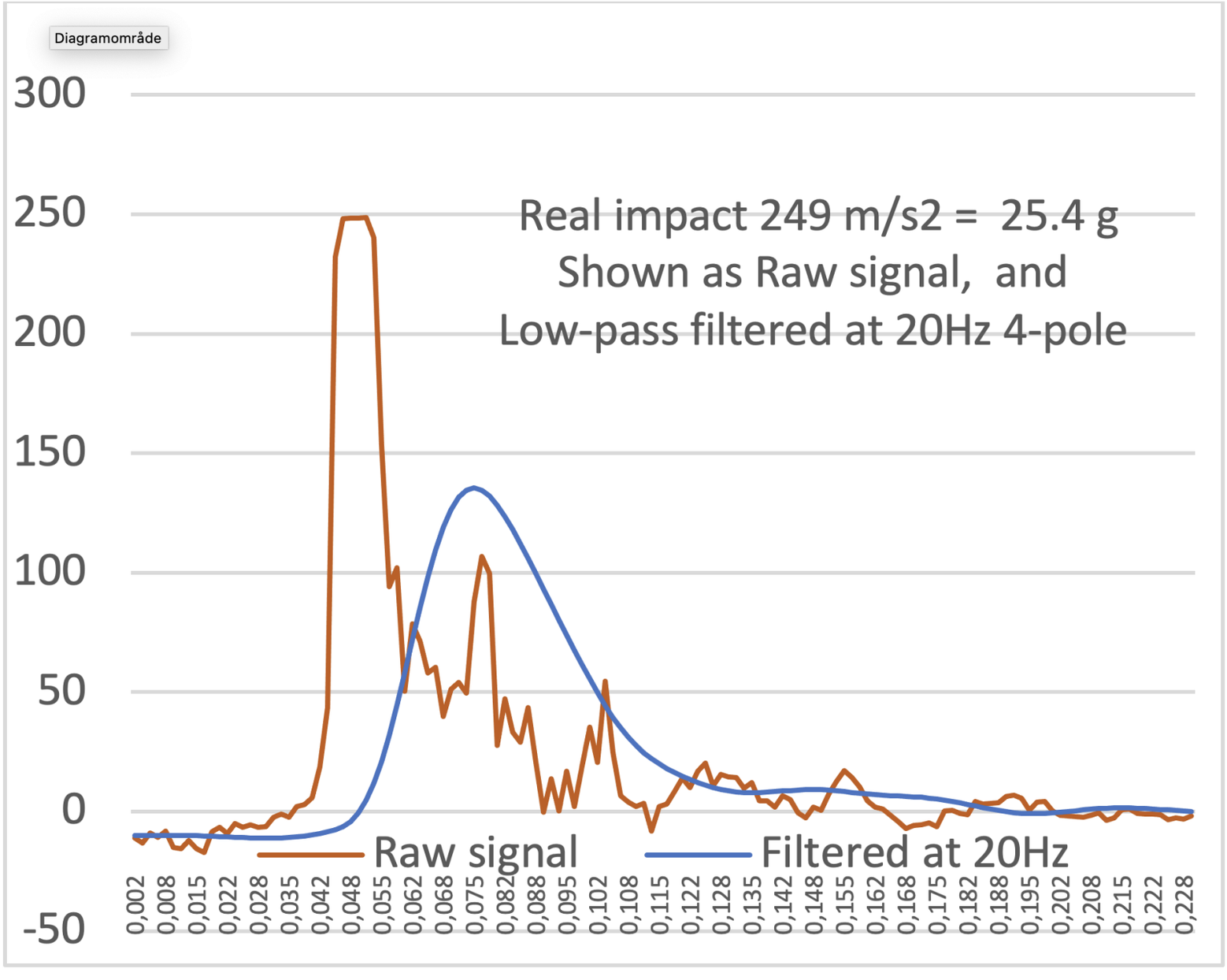
1. Putting the human into the equation
2. Understanding the Nature of the harmful impacts
3. **Scientific analysis of exposure**
    1. **Peak values**
    2. **Rise times**
    3. **Impact durations**
    4. **Force vectors – Vertical, Longitudinal and Lateral**

Example:
One impact with lateral forces and one almost purely vertical impact

Typical boat impact (recorded at 600 Hz)



Real 25 g impact & Low-pass filtered 20Hz



Both **Peak value** and **Rise time** (Jerk) severely distorted

What is needed to solve the problem?

1. Putting the human into the equation
2. Understanding the Nature of the harmful impacts
3. Scientific analysis of exposure
4. **New relevant knowledge and test methods***

   We must analyse **real impact data** to understand the forces

   We must measure exposure data on **real humans**, on **real boats**, operating at **real speeds**, in real **sea states**.

RTG-344 Human Impact Exposure onboard High-Speed Boats

Activity chair:	**Prof Stephen Myers (GBR)**
Members:	**USA, NOR, NLD, BEL, CAN, GBR, ITA, PRT, FRA, USA, DNK**
Partners:	**SWE, AUS, NZL, IRL**
Duration:	**AUG 2020 – OCT 2024**
Coordination:	**NNAG, CMRE**
Related activities:	**HFM ET-183**

Objectives:

- Protect all personnel onboard High-Speed Boats from injuries caused by exposure to whole body impacts
- Strengthen physical combat capacity
- Establish which levels and what kinds of impacts cause acute injuries and which reduce physical combat capacity
- Define recommendations for new relevant exposure limits
- Specify smart signalling solutions of expected high impact related to current weather and sea conditions

Topics covered:

- Epidemiology of occup. hazards onboard high-speed boats
- Safe ride standards for high speed boats

Exploitation and impact:

- Establish limits for exposure to discrete and cumulative impacts
- Define a relevant unit for measuring and quantifying whole body impact exposure.
- Define, for each boat type, recommended hull-exposure limits to keep personnel safe and fit for mission
- Specify and calibrate dashboard displays, indicating in real-time, Safe - Risky - Dangerous levels of exposure.

Status:

- Approved

The NATO HFM 344 study shall answer these questions:

What are the actual kinds and levels of impacts at sea?

What exposure to impacts is sustainable vs harmful?

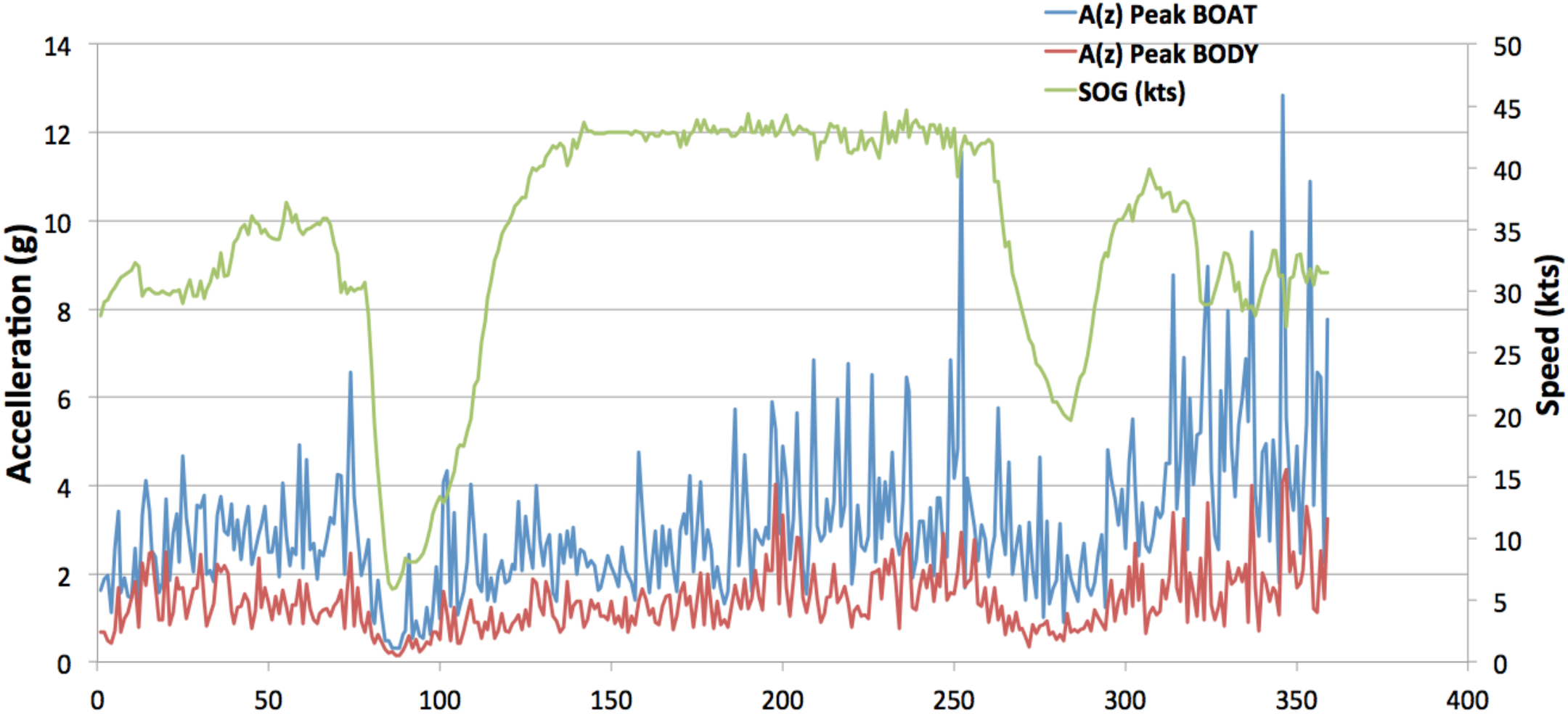
How shall impact exposure be measured and quantified?

How hard can each type of boat be driven and slammed before people onboard risk injuries?

What exposure limits will keep people safe & sound?

When we know this, onboard instruments can tell the coxswain, in real-time, when exposure levels get risky.

- Multi Agency Study - Human Impact Exposure



TAKE HOME MESSAGE

The problems can be solved

Harmful impact exposure gives

NO positive training effect

on the human body

- only injury risks!

Training can be done better with

safer levels of impact exposure.


Questions?

Thank you for listening

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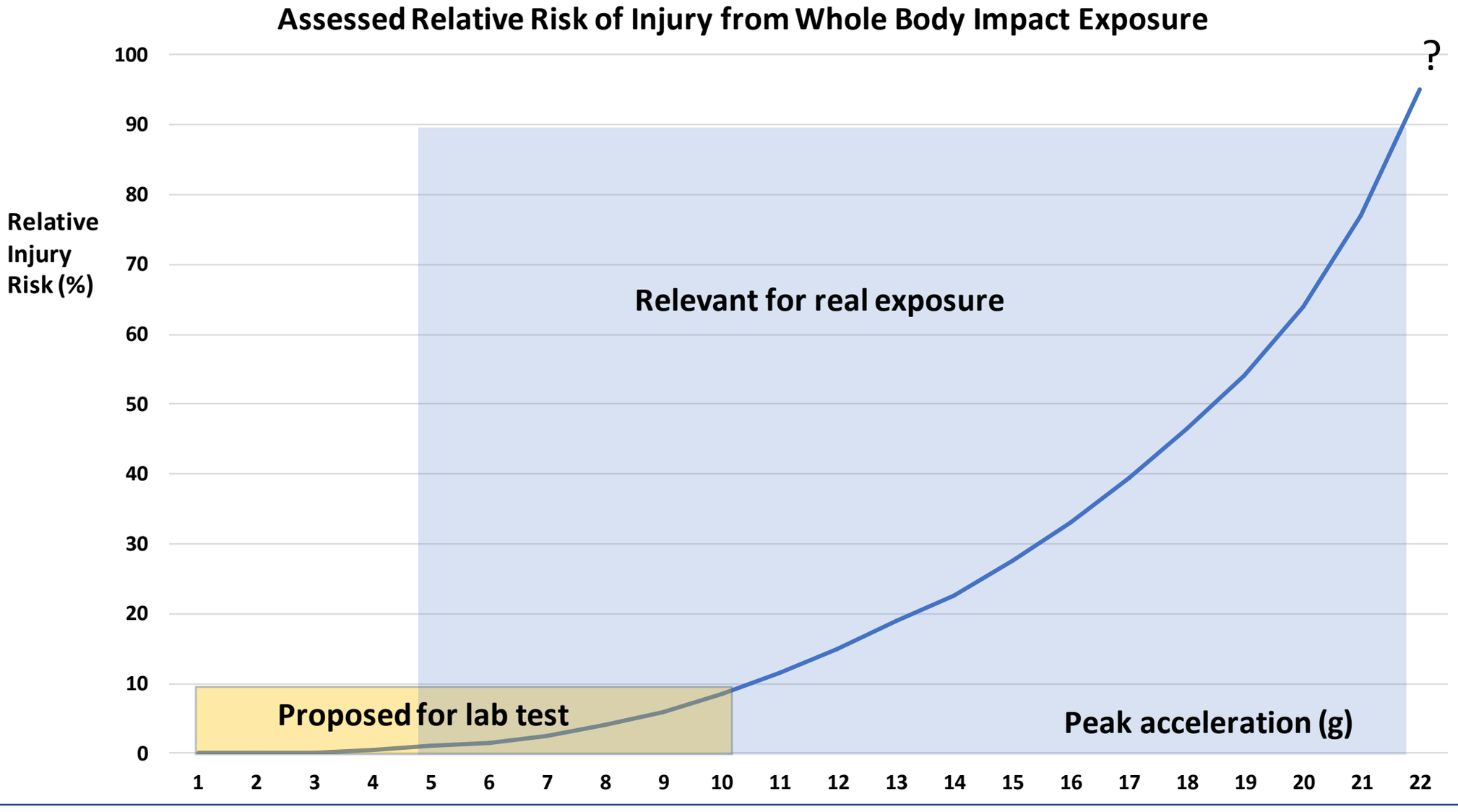
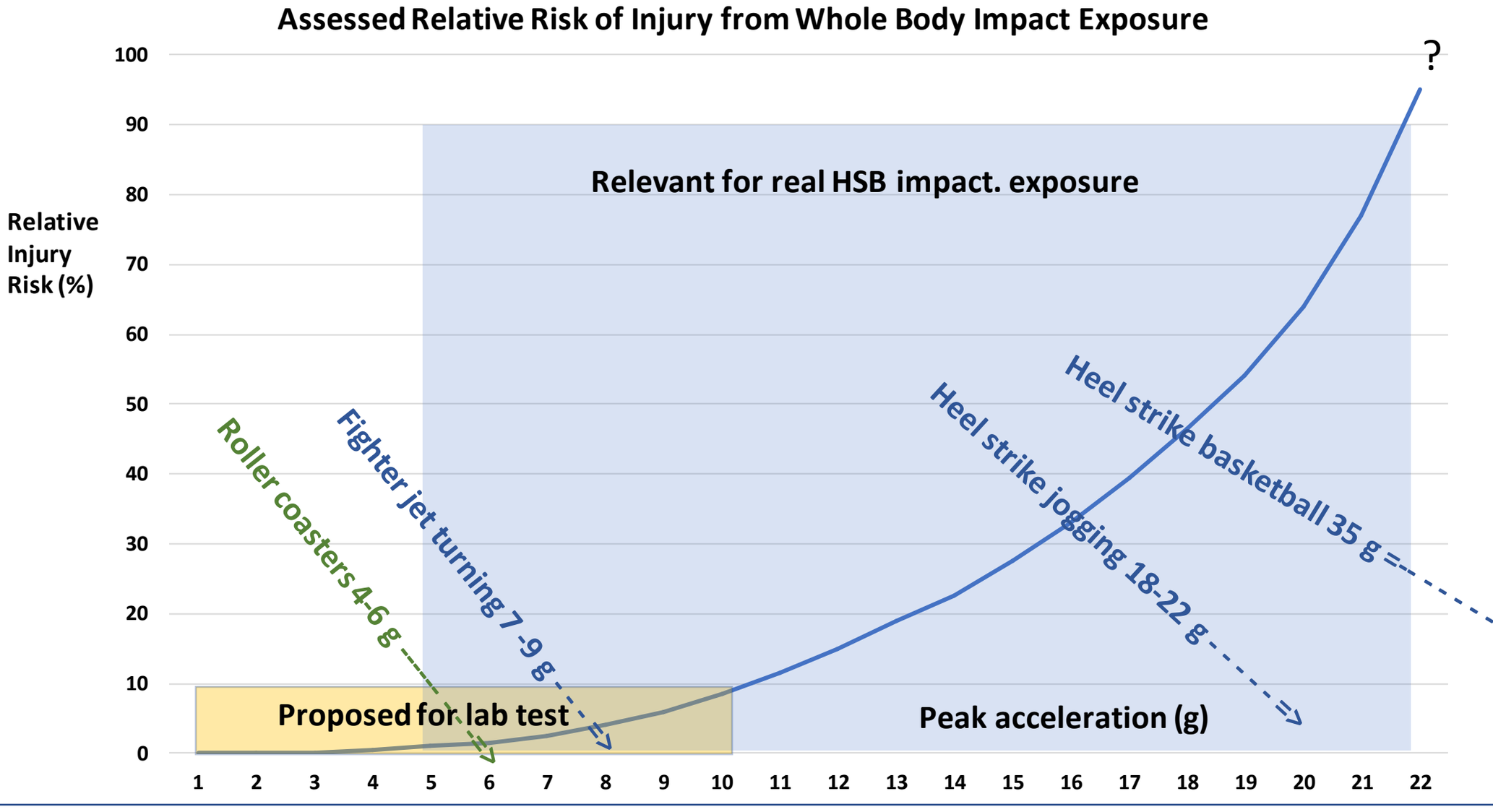
Why did ISO kill the drop test method?



This graph is not based on experimental data. It is just an assumption to show a perspective of the relation between claimed and actual levels impact exposure.

Why did ISO kill the drop test method?



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hauck
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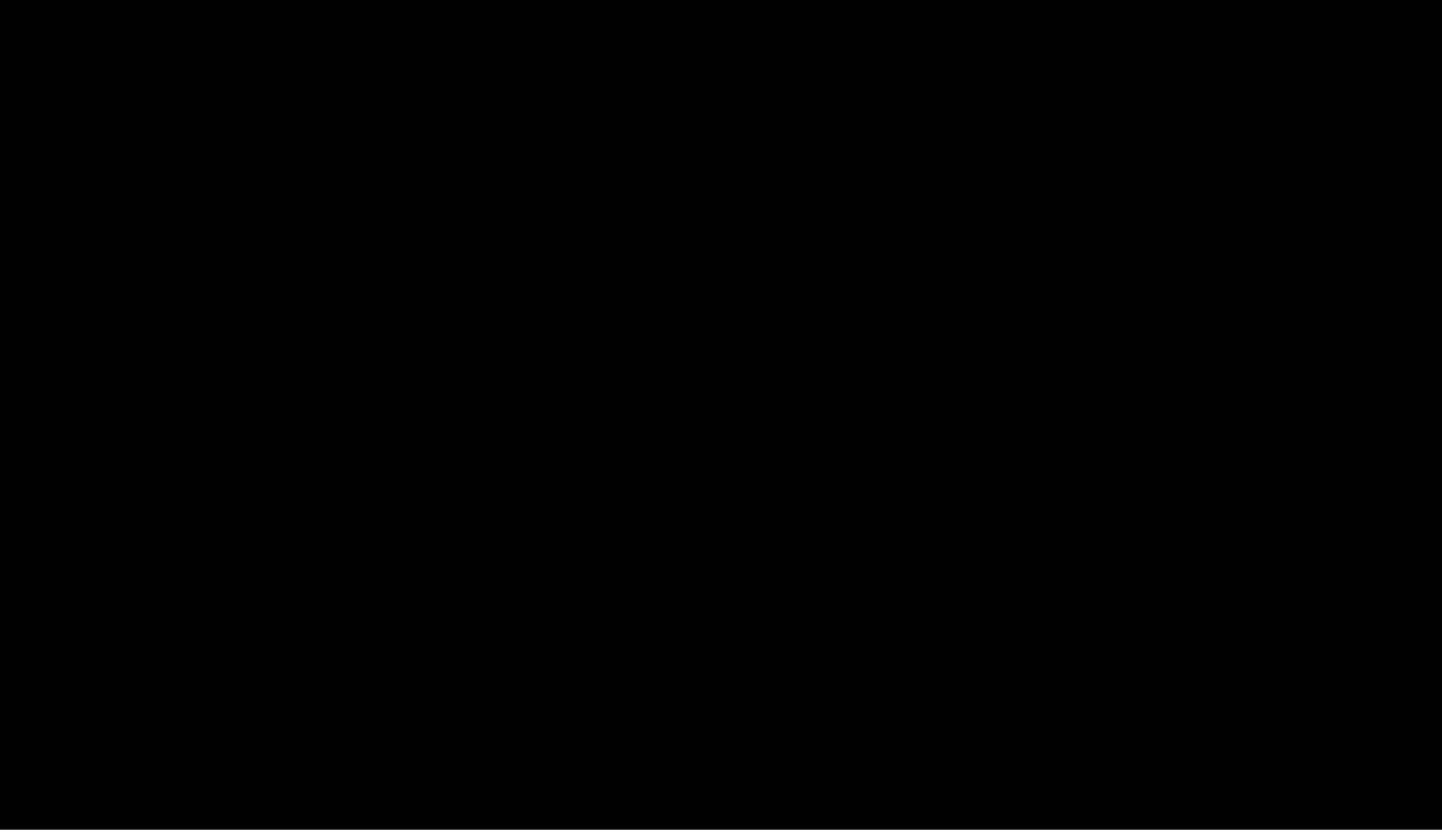
Pushchairs | Car Seats | At Home | Mix & Match | Inspirations | Design

Car Seats > Isofix > iPro Baby Set

SAFELY ON THE ROAD

"All Hauck car seats have received multiple awards and **comply with the highest safety standards**. Hauck offers car seats for newborns and children."



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