



# APBA Safety Seminar

2020 APBA Annual Meeting

January 25, 2020

8-9:00 am

# Seminar Take Away Points

**Importance of education**

## Restrained Drivers

**How capable is your cockpit?**

**Cockpit failures continue to occur from water and/or collision**

**The critical importance of analysis and test methods used in combination for cockpit construction**

**The importance of a registration process to review cockpit design**

**The analyses starts with the impact loads defined by water pressure, rise time, and/or collision and then applied to the structure**

**Much of our understanding comes from the data recorder analysis done to determine crash phenomena and g loads from instrumenting high-speed tunnel boats in a UIM research project**

**Window and mounting flange bend tests at University of Messina (Italy) help define window joint geometry**

**Crash boxes and deformable pickles help reduce cockpit penetration and absorb energy in tunnel boats**

Note: The following topical points were discussed using the following charts for illustration during the seminar. Most of the topics are available as longer and more in-depth subjects for those who may be interested.

Presenters: Bob Wartinger  
Tom Stanley

# Seminar Take Away Points, (Con't).

Relative comparison of strength of the body to react impact loadings

The more comfortable and protected is the body, the better the lap times, i.e. form fitting seat (foam), vision lines, correct helmet fit, 7-point harness, correct belt install angles, belts not twisted or cocked, use of an FHR, air system

Polyester belts necessary, much less stretch than nylon

## Unrestrained Drivers

Protect the body by correct helmet fit, cut resistant clothing, tested life jacket

Helmet bucketing is an issue, possible antidotes are head and neck restraints sold by manufacturer's and the solution used by Bob Koschka to fill the gap under the full-face helmet.

Hit-Air device still being evaluated

## All Drivers

Boat stability is critical, the influence pyramid

## **Seminar Take Away Points, (Con't).**

**Concussions are relatively common in boat racing accidents, family and team members may be most aware of symptoms**

**Addition of "Return to Competition Protocol" to General Safety Rules**

**Elaboration on key performance tips for drivers**

**The WADA anti-doping code**

**UIM education seminars at driver's meetings and races worldwide on the subject of anti-doping**

**Every decision you make is governed by the space you think, believe, or feel you have.**

- **Brain processing, eyesight and nervous system**
- **Eyesight and nervous system**

**We pay so much attention to data recording of the boat performance, pay the same amount of attention to driver performance, the driver's logbook**

**We started boat racing for fun, remember that and use it as a guide in your racing career**

# Safety Seminar/Part 2

January 25, 2020

## APBA Annual Meeting



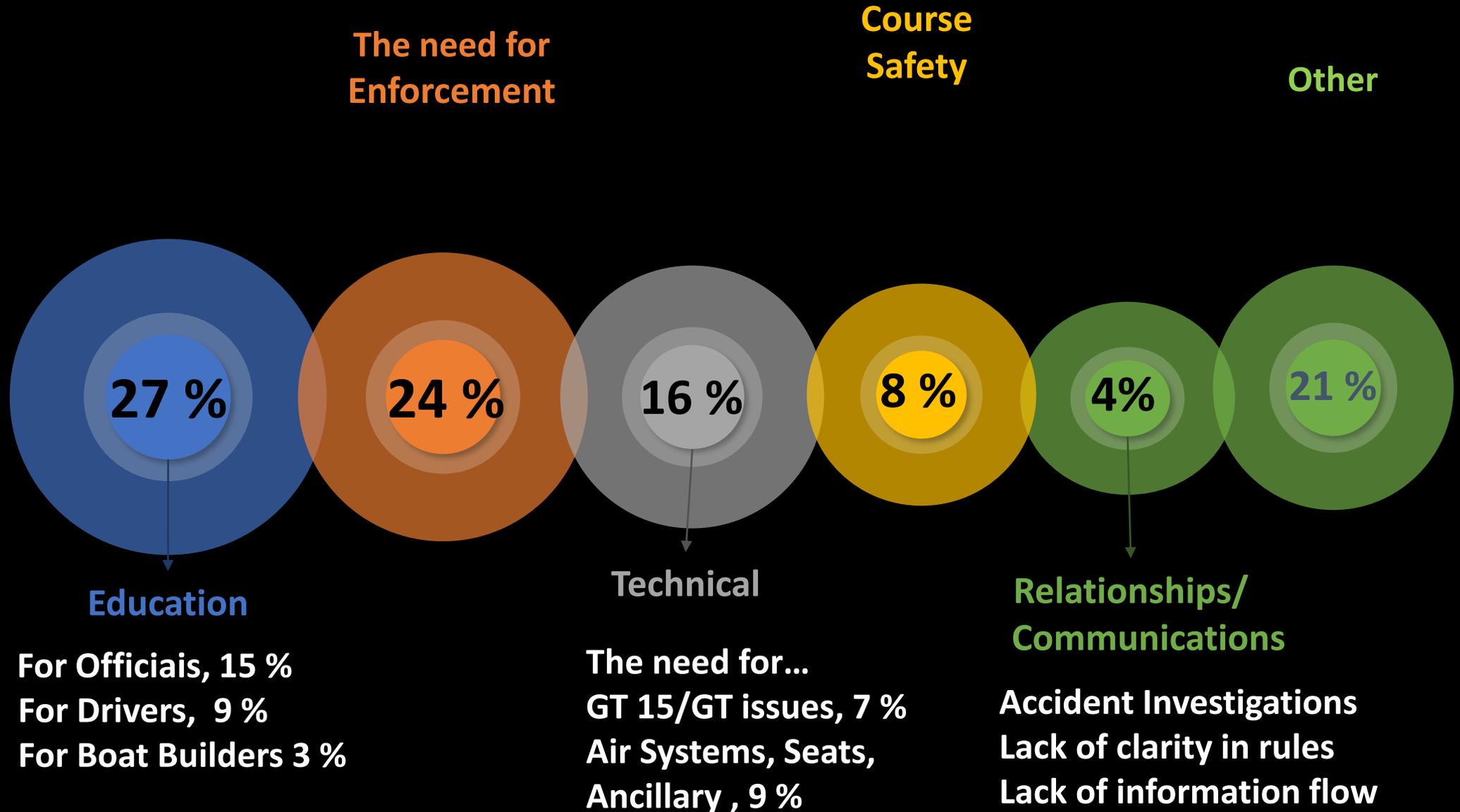
**“If You Think Education Is Expensive,  
Try Ignorance”**

**-Derek Bok**



# Safety Concerns

Cominsafe Meeting Survey Results



“..... Race boats don't have accidents, drivers do .....”

**How Capable is Your Cockpit?**

**How do you know?**

**How capable is your internal cockpit system ?**

# How Strong Is Your Cockpit ?





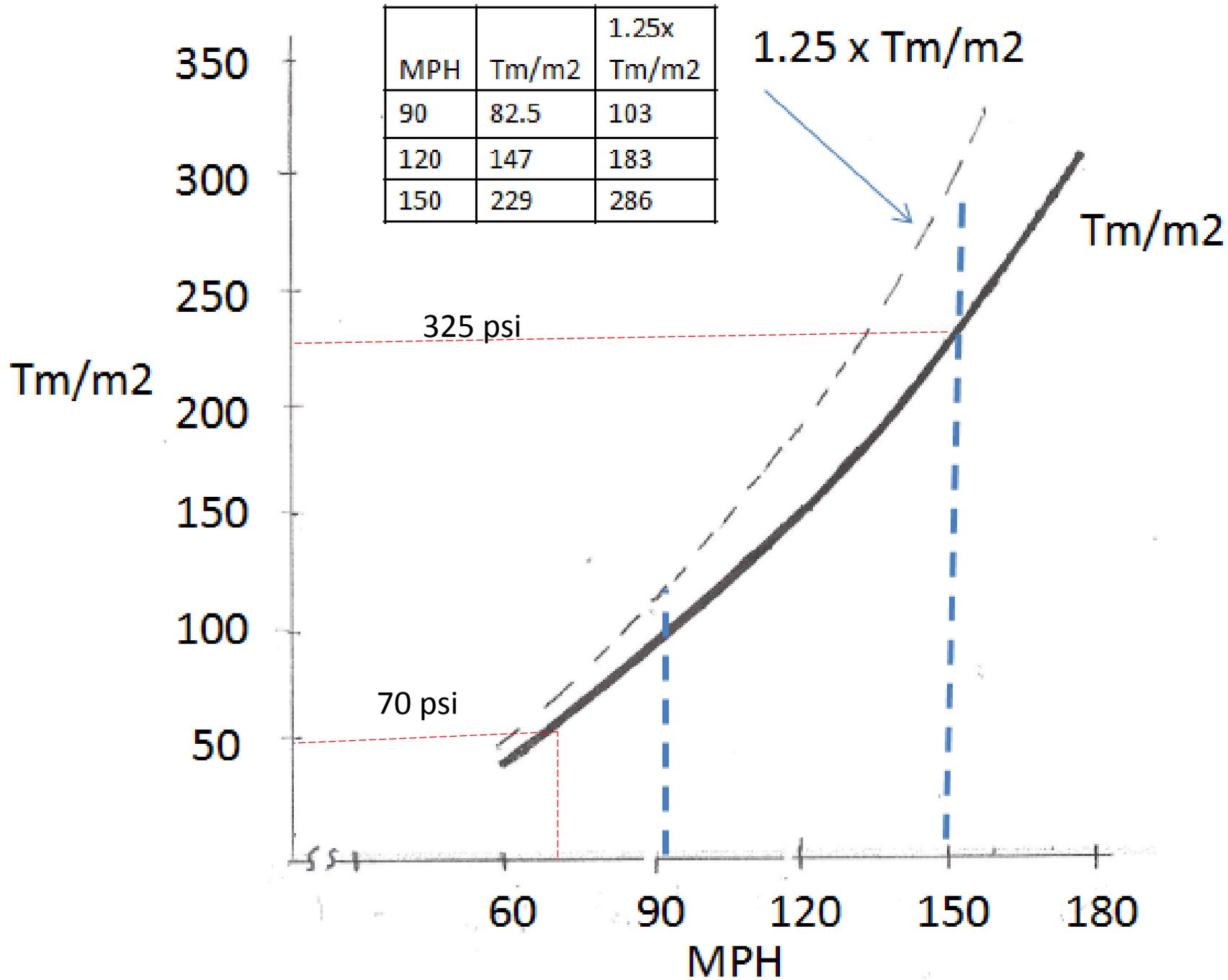


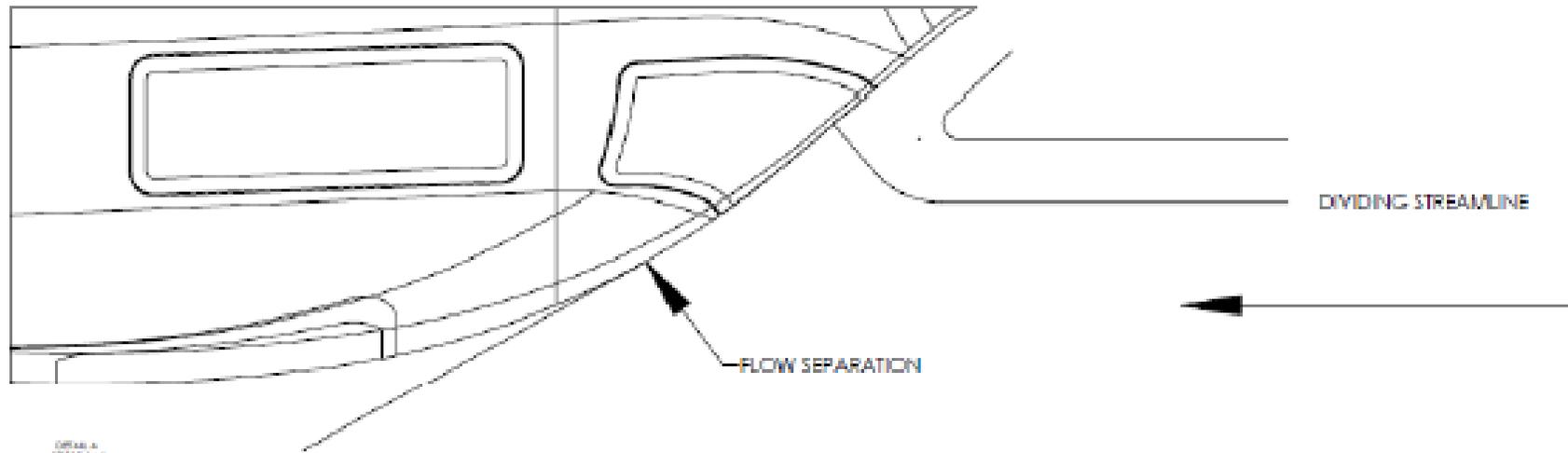


Driver was Eric Langevin. He was run over in Long Sault.

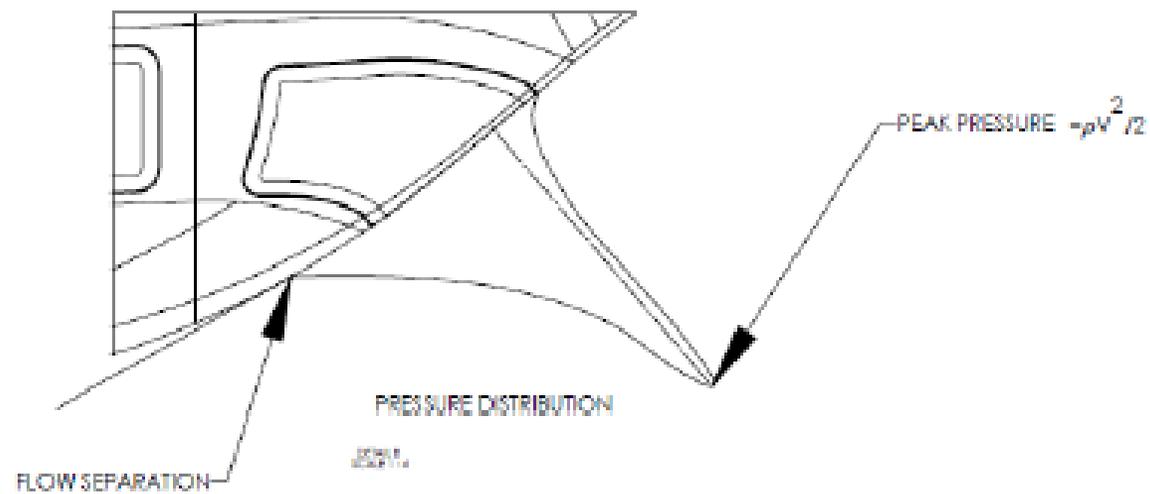
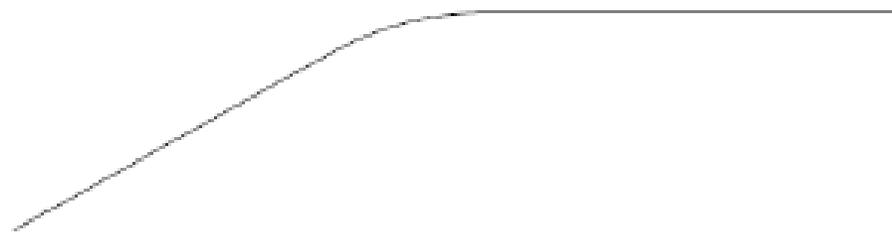


MPH	Tm/m2	1.25x Tm/m2
90	82.5	103
120	147	183
150	229	286





© 2014 AIAA



© 2014

**Loading.....105 mph, .....160 psi.....112 ton/m<sup>2</sup>**  
**150 mph,.....325 psi.... 229 ton/m<sup>2</sup>**  
**70 mph, .....70 psi..... 49 ton/m<sup>2</sup>**

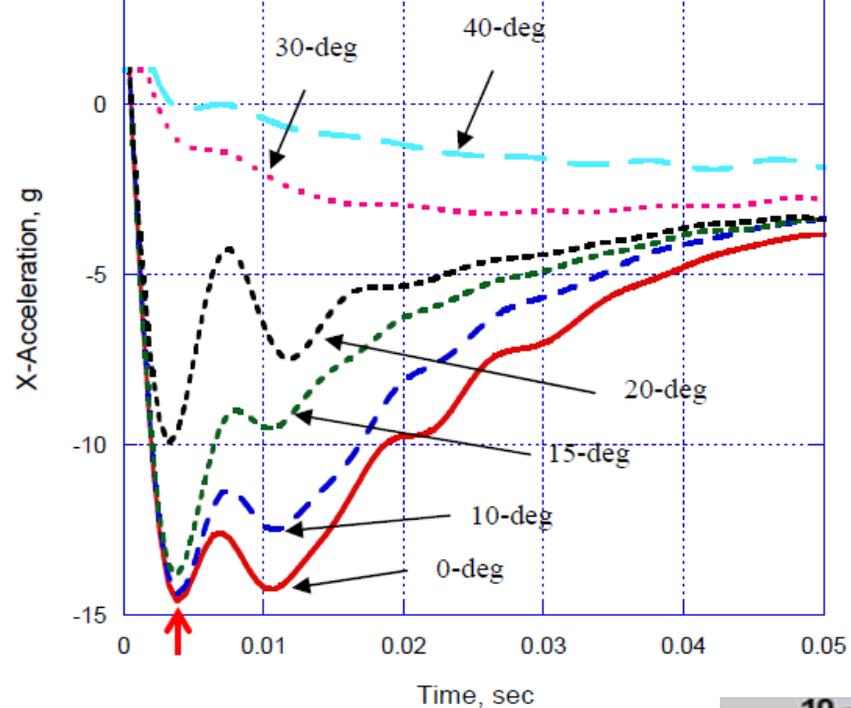
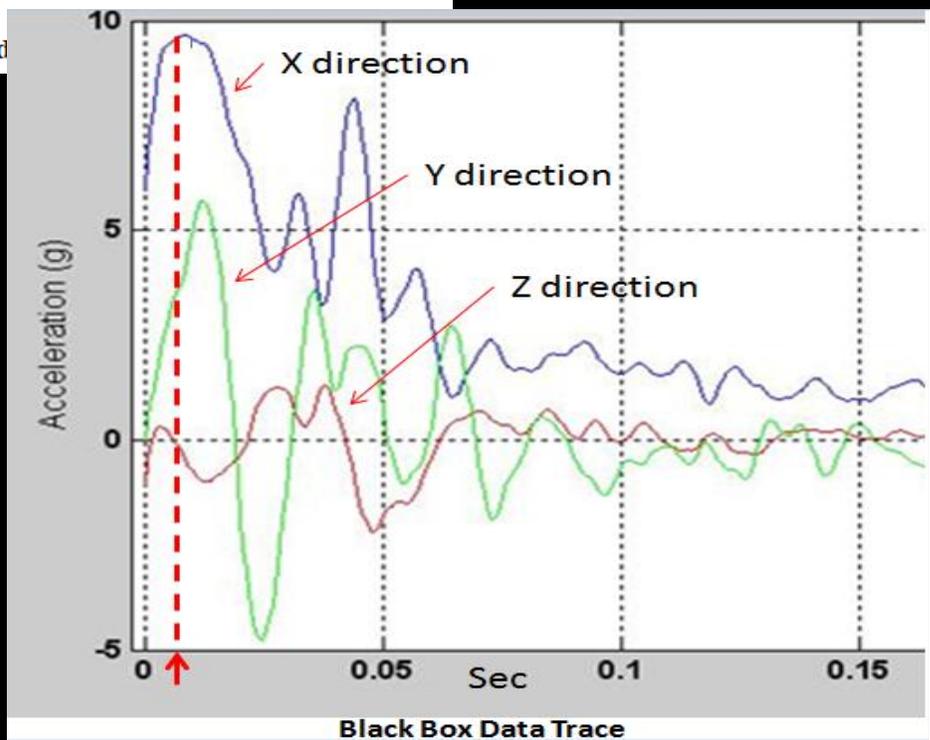


Fig. 11 Filtered X-acceleration histories for the water landing of the rigid

Essentially “Instantaneous” Impact Loading



Black Box Data Trace



**Pull anodized handle up  
Then slightly rock it as you  
bring the upper end of  
the box down into the  
bracket... after putting  
the lower end in first**

**Status Lights**

**Put lower end in first**



# Black Box Placement



Black  
Box

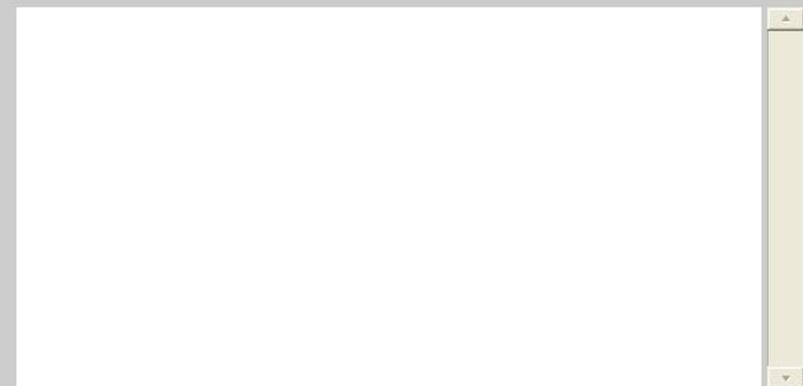
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- Box: WN000180, 03-May-2008 12:56:12(UCT), "#41" [90,90,180]
- Box: WN000180, 03-May-2008 12:56:53(UCT), "#42" [90,90,180]
- Box: WN000180, 03-May-2008 12:56:57(UCT), "#43" [90,90,180]
- Box: WN000180, 03-May-2008 12:57:05(UCT), "#44" [90,90,180]
- Box: WN000180, 03-May-2008 12:57:08(UCT), "#45" [90,90,180]
- Box: WN000180, 03-May-2008 12:57:20(UCT), "#46" [90,90,180]

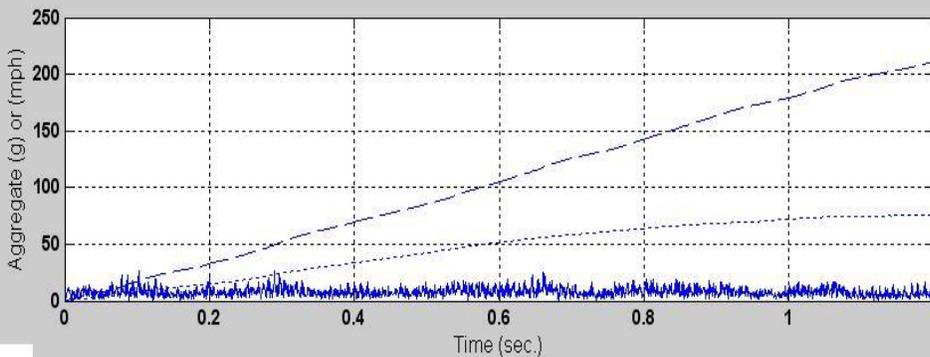
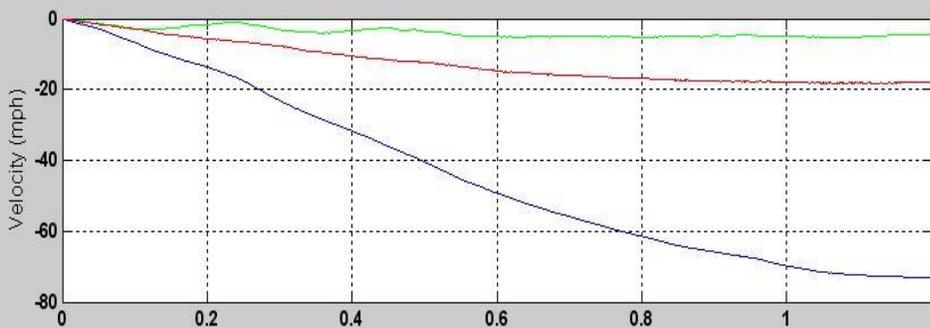
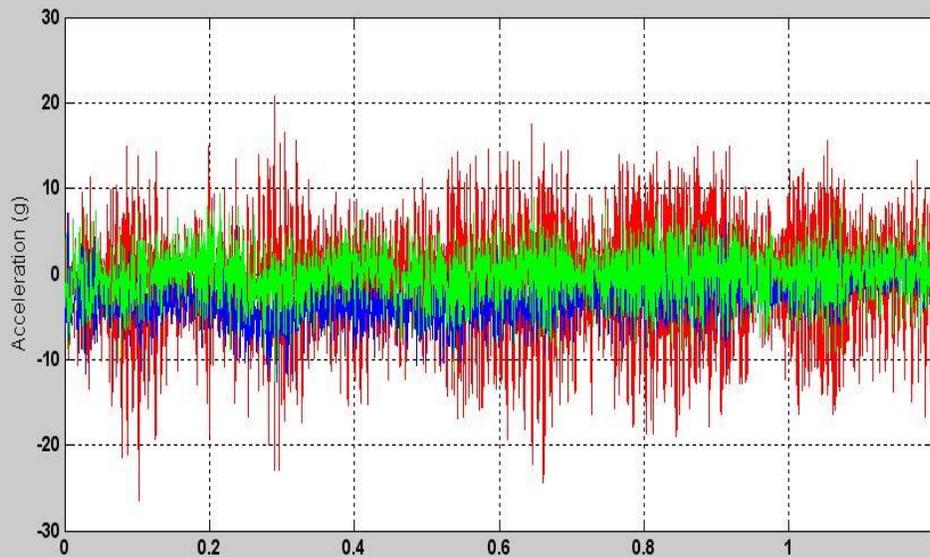
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- Channel Filter = Raw
- Channel Filter = 20
- Channel Filter = 60
- Channel Filter = 180
- Channel Filter = 120

- X Axis
- Y Axis
- Z Axis
- Aggregate Velocity
- Velocity Magnitude
- Acceleration Magnitude



BLUE = Occupant Travel  
 RED = Acceleration  
 GREEN = P.D.O.F



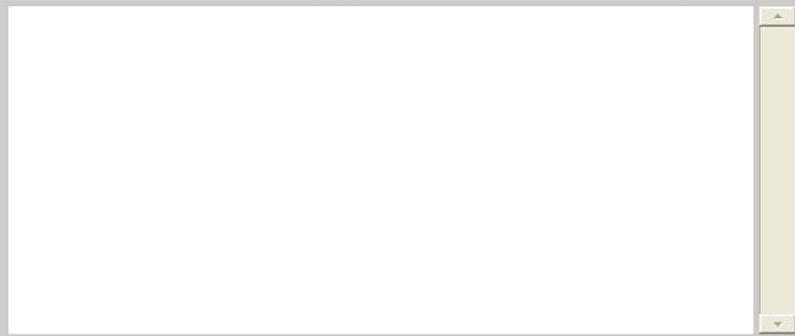
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- Box: WN000180, 03-May-2008 12:56:53(UCT), "#42" [90,90,180]
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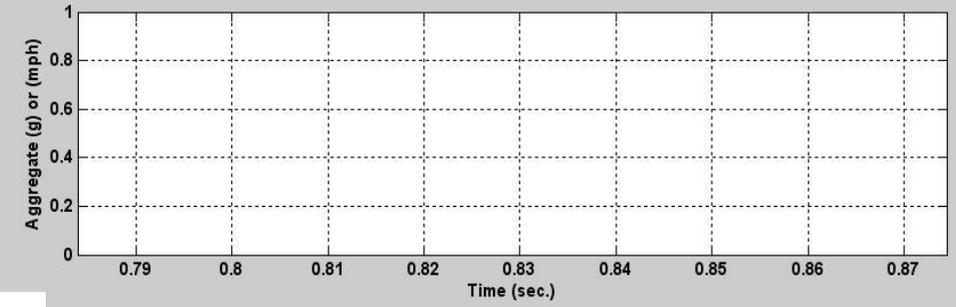
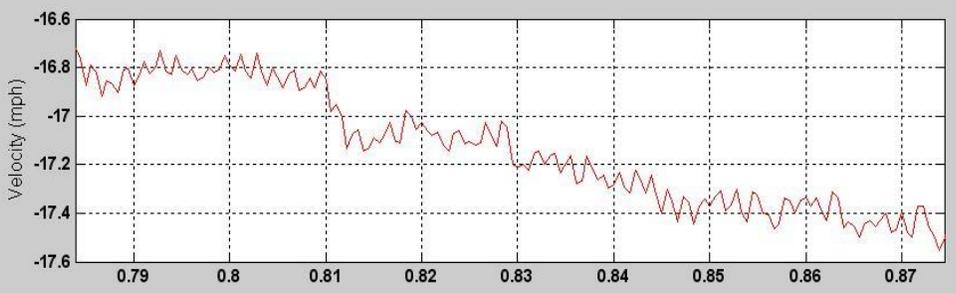
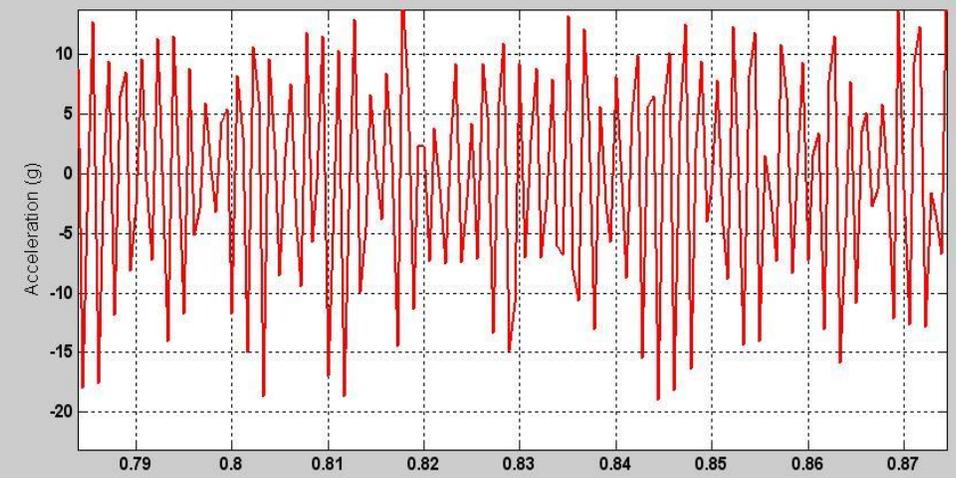
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- Velocity Magnitude
- Acceleration Magnitude



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RED = Acceleration  
GREEN = P.D.O.F



Longitudinal (X) Acceleration: Potential for individual prop blade analysis

Event Selection:

- Box: WN000446, 9/21/2002 9:50:20 AM (WEDT), "#01" [0,0,180]
- Box: WN000399, 05/10/2002 06:00:40 (RDT), "U1V2W3" [0,0,180]

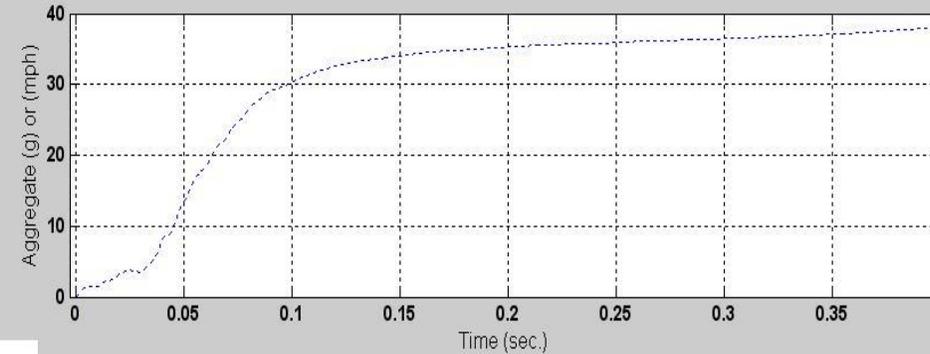
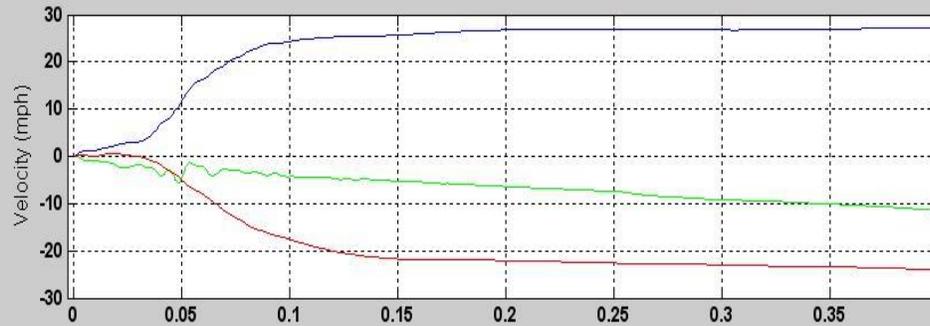
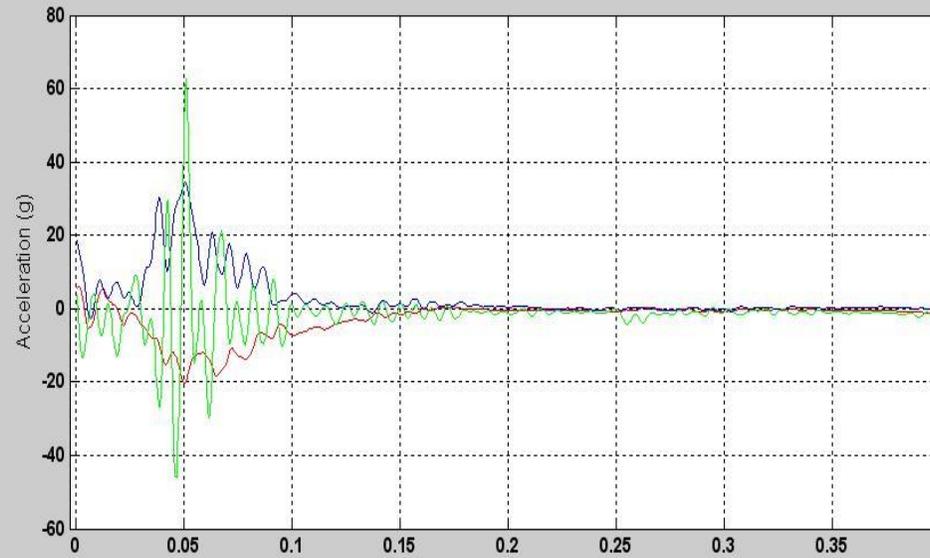
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- Y Axis
- Z Axis
- Aggregate Velocity
- Velocity Magnitude
- Acceleration Magnitude



BLUE = Occupant Travel  
RED = Acceleration  
GREEN = P.D.O.F



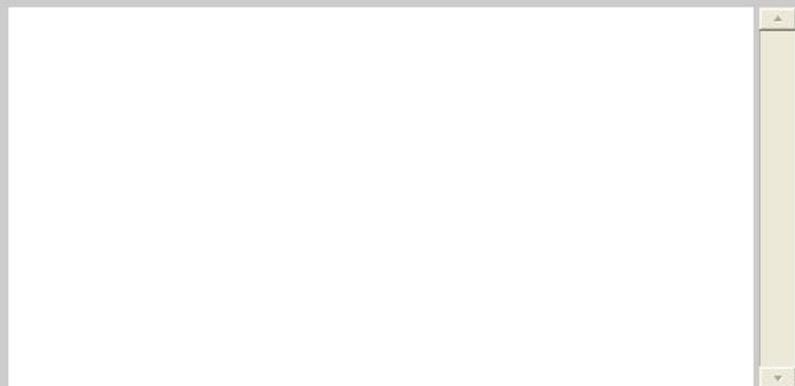
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- Box: WN000180, 03-May-2008 12:57:20(UCT), "#46" [90,90,180]
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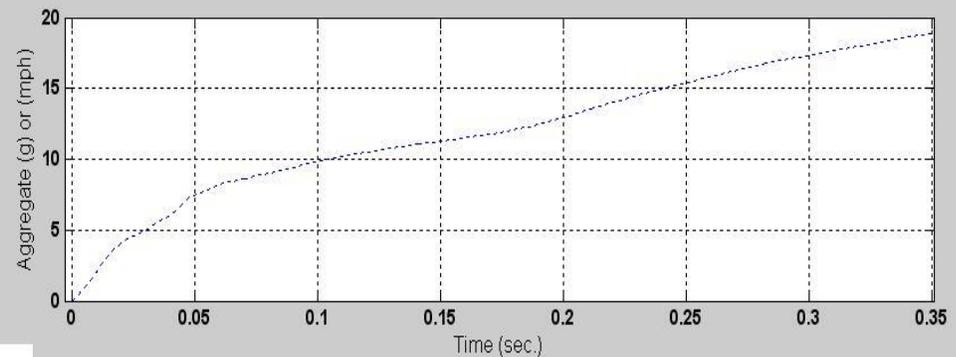
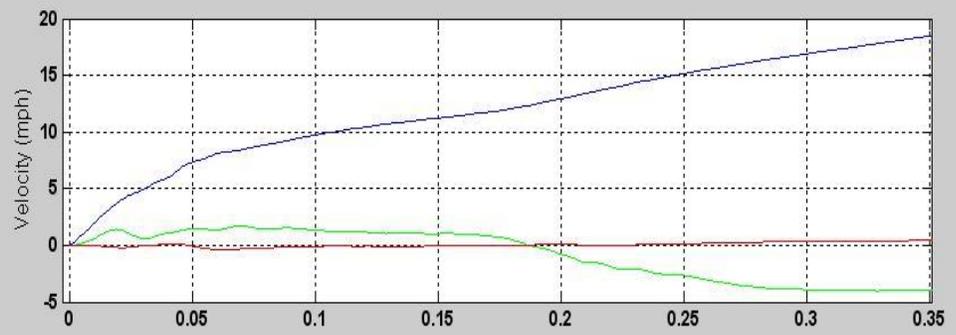
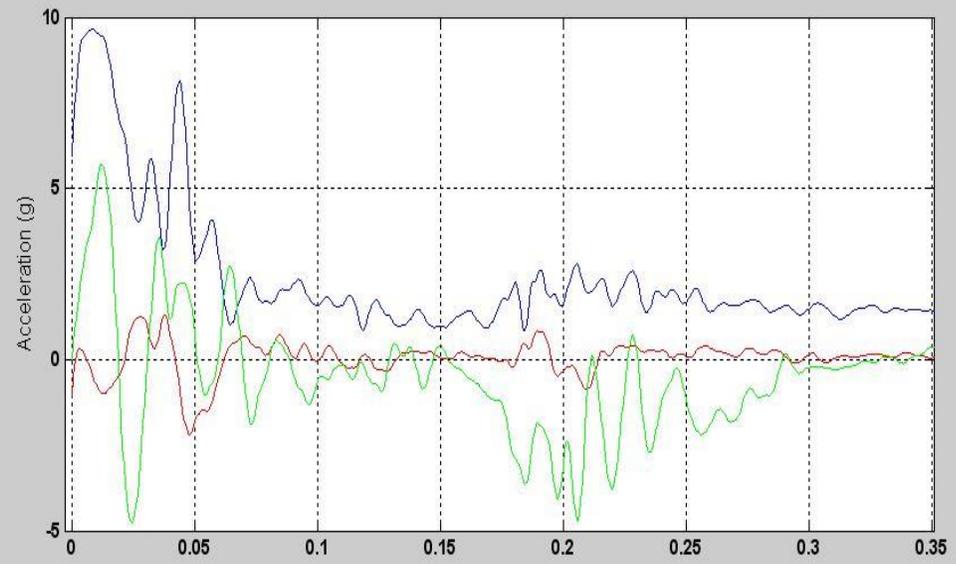
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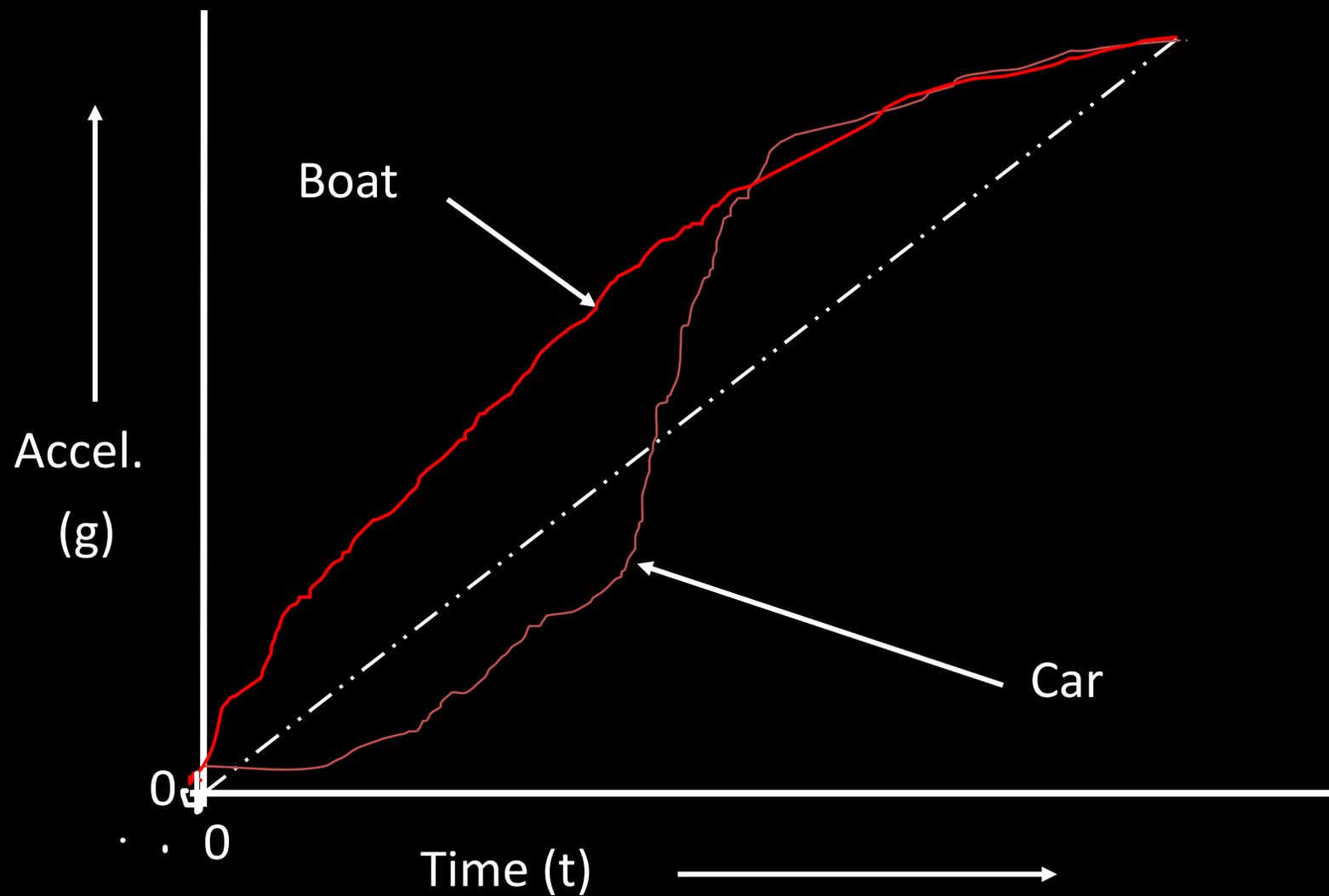
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- Y Axis
- Z Axis
- Aggregate Velocity
- Velocity Magnitude
- Acceleration Magnitude



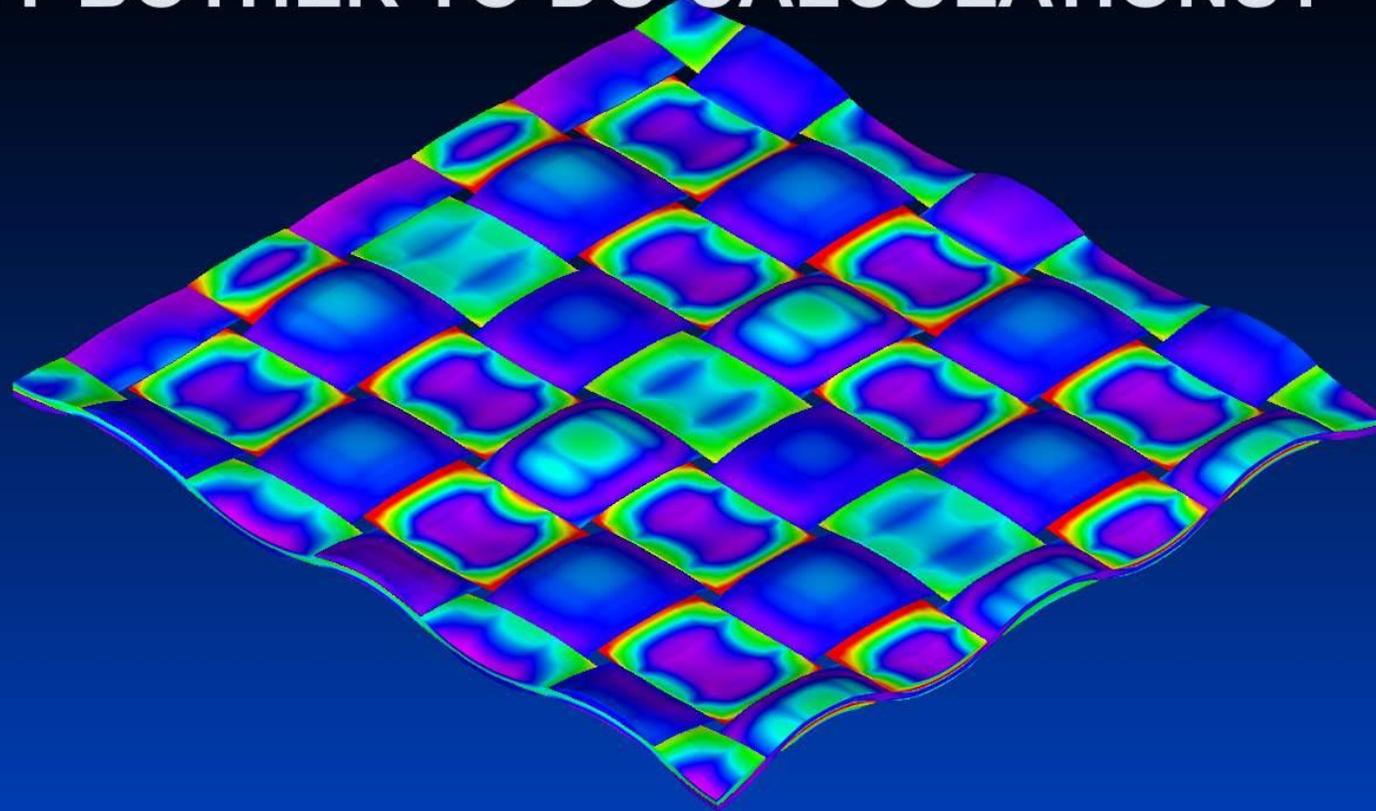
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 GREEN = P.D.O.F



# Initial Slope-Acceleration vs. Time

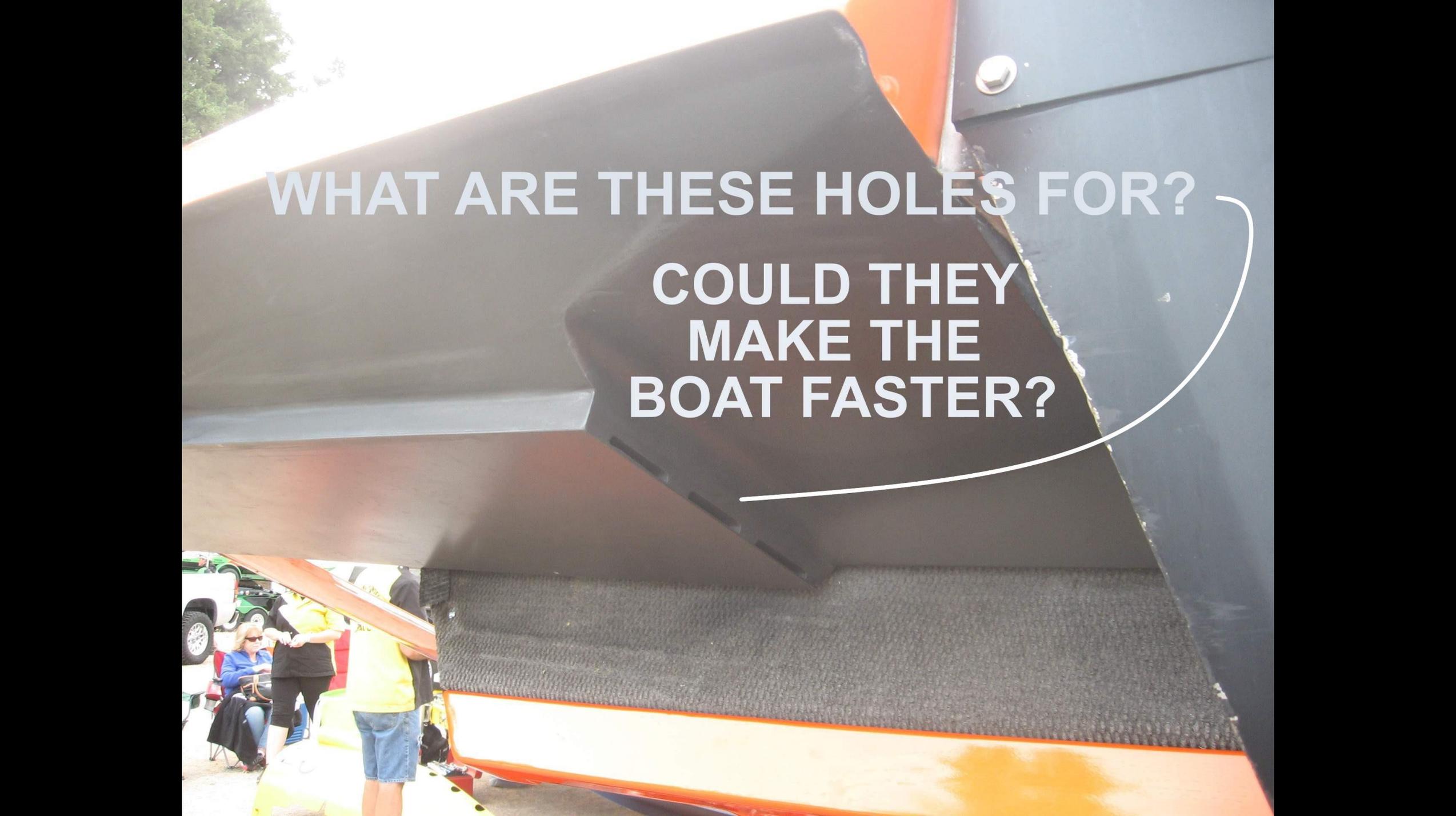


**WHY BOTHER TO DO CALCULATIONS?**



**SAFETY, APBA – 2020  
VALUE OF ANALYSIS**

**ONE BENEFIT MIGHT BE TO GO  
FASTER**



**WHAT ARE THESE HOLES FOR?**

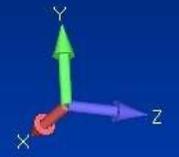
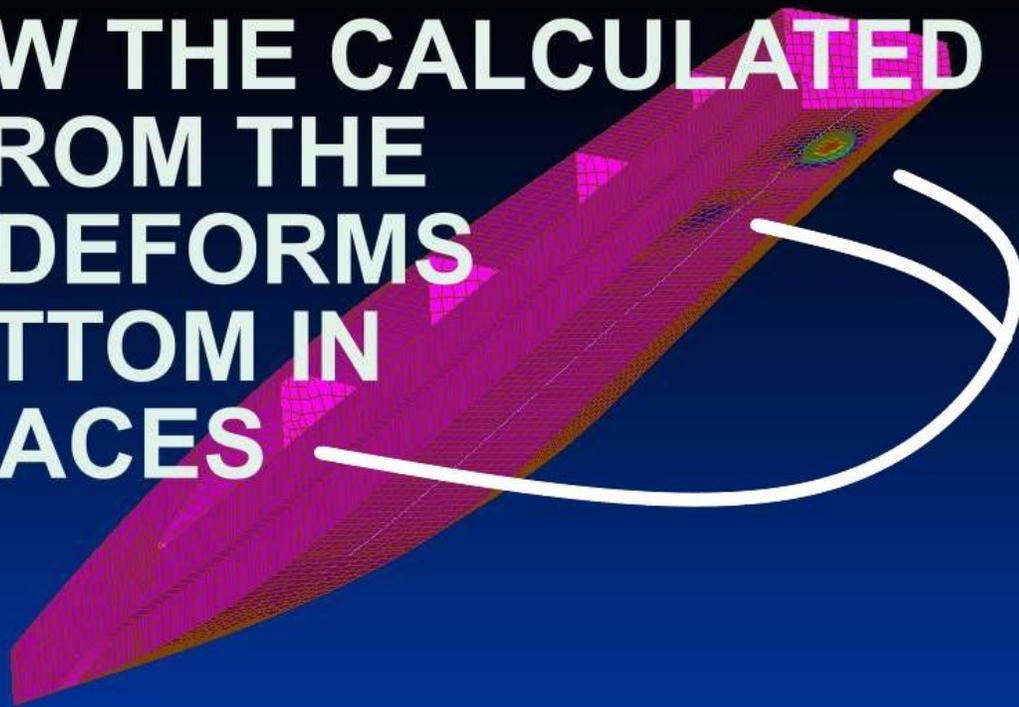
**COULD THEY  
MAKE THE  
BOAT FASTER?**

**NOTE: NO HOLES**



V:1  
L:1  
C:1

**SEE HOW THE CALCULATED  
LOAD FROM THE  
WATER DEFORMS  
THE BOTTOM IN  
TWO PLACES**

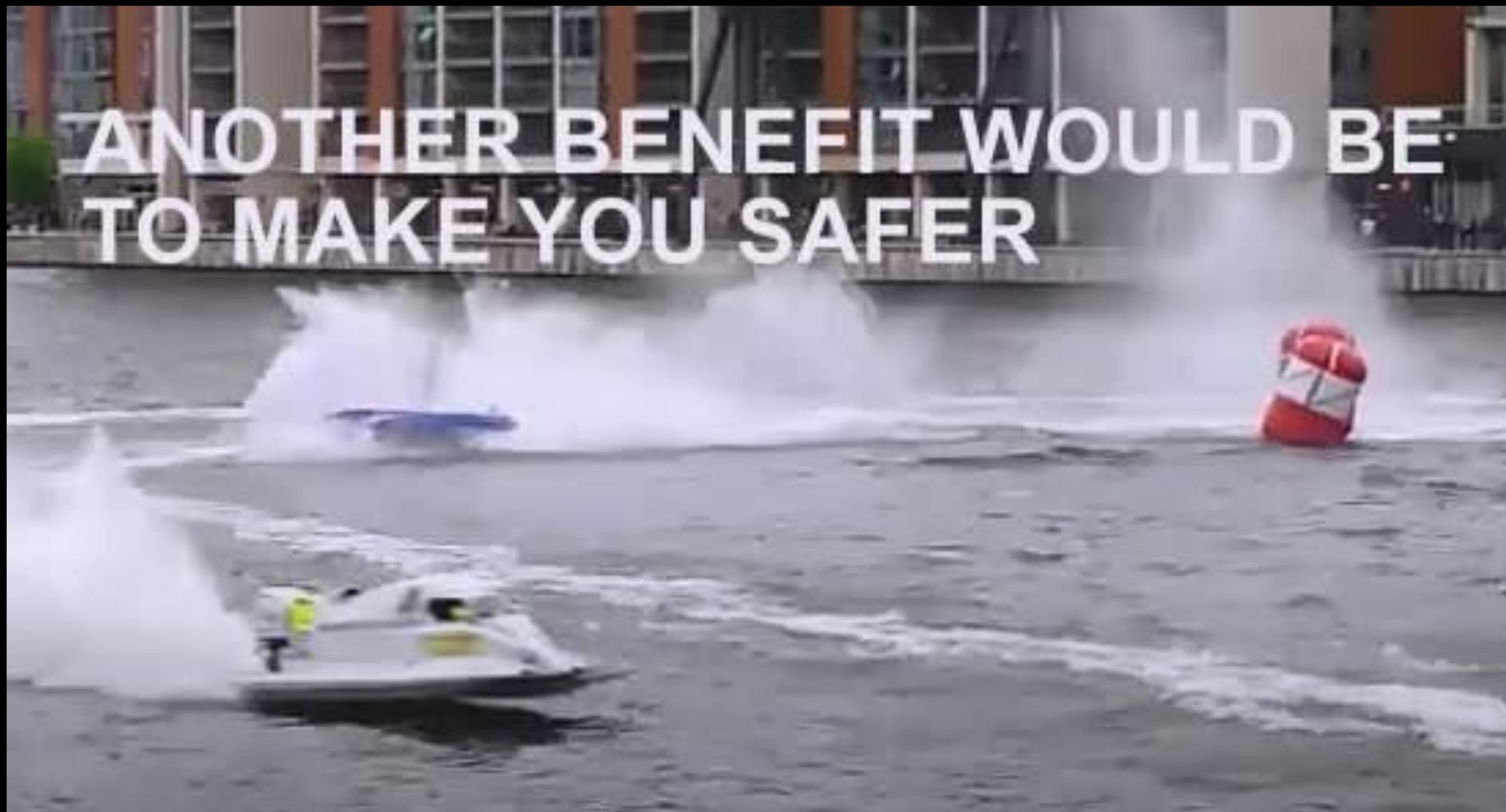


Output Set: AT SPEED - SPONSON CONNEC  
Deformed(2.3635): TOTAL TRANSLATION  
Nodal Contour: COMP MAX STAB FAIL INDX



**RON JONES Sr. & Jr.**

**ANOTHER BENEFIT WOULD BE  
TO MAKE YOU SAFER**



**DAC AND BABA DECIDED TO USE LAMINATED GLASS WITH LAYERS ON THE INSIDE TO HOLD THE GLASS TOGETHER IN AN ACCIDENT TO PROTECT THE DRIVER. THEY BOTH HAD SAMPLES PHYSICALLY TESTED.**

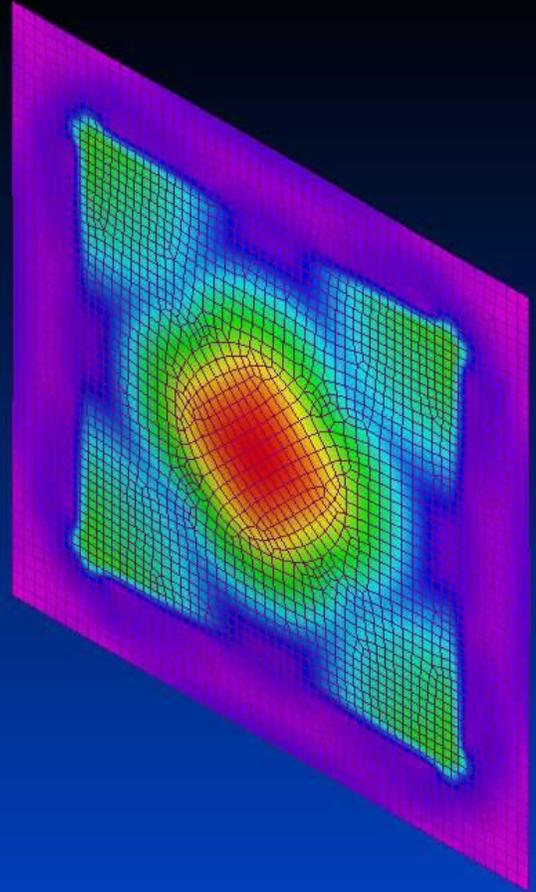
**TO DO CALCULATIONS FIRST THE PHYSICAL TESTS WERE CALCULATED:**

T.R.STANLEY ENGINEERING  
YCOM LAMINATED GLASS TEST  
JUNE 2018

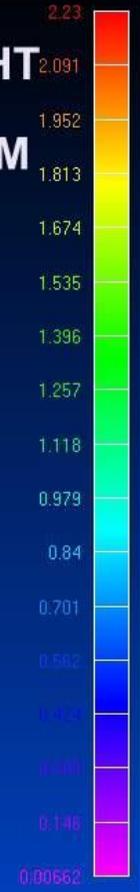
**HERE IS THE SIMULATION  
OF THE PHYSICAL TEST  
OF THE LAMINATED GLASS**



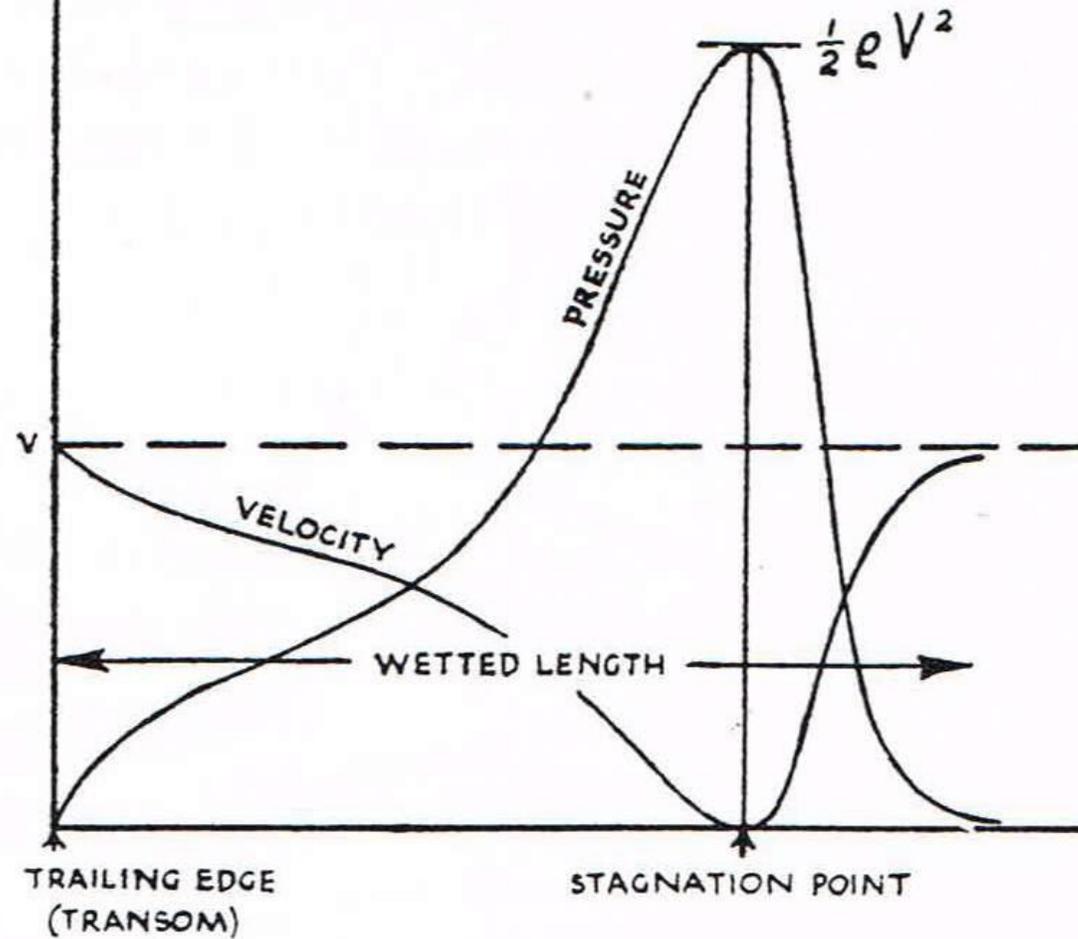
Output Set: NX NASTRAN Case 1  
Deformed(0.1778): Total Translation  
Elemental Contour: Laminate Max Failure Index



**THE SCALE ON THE RIGHT  
SHOWS THE FAILURE  
INDEX FOR THE MAXIMUM  
LOAD THE SAMPLE WAS  
ABLE TO WITHSTAND.**

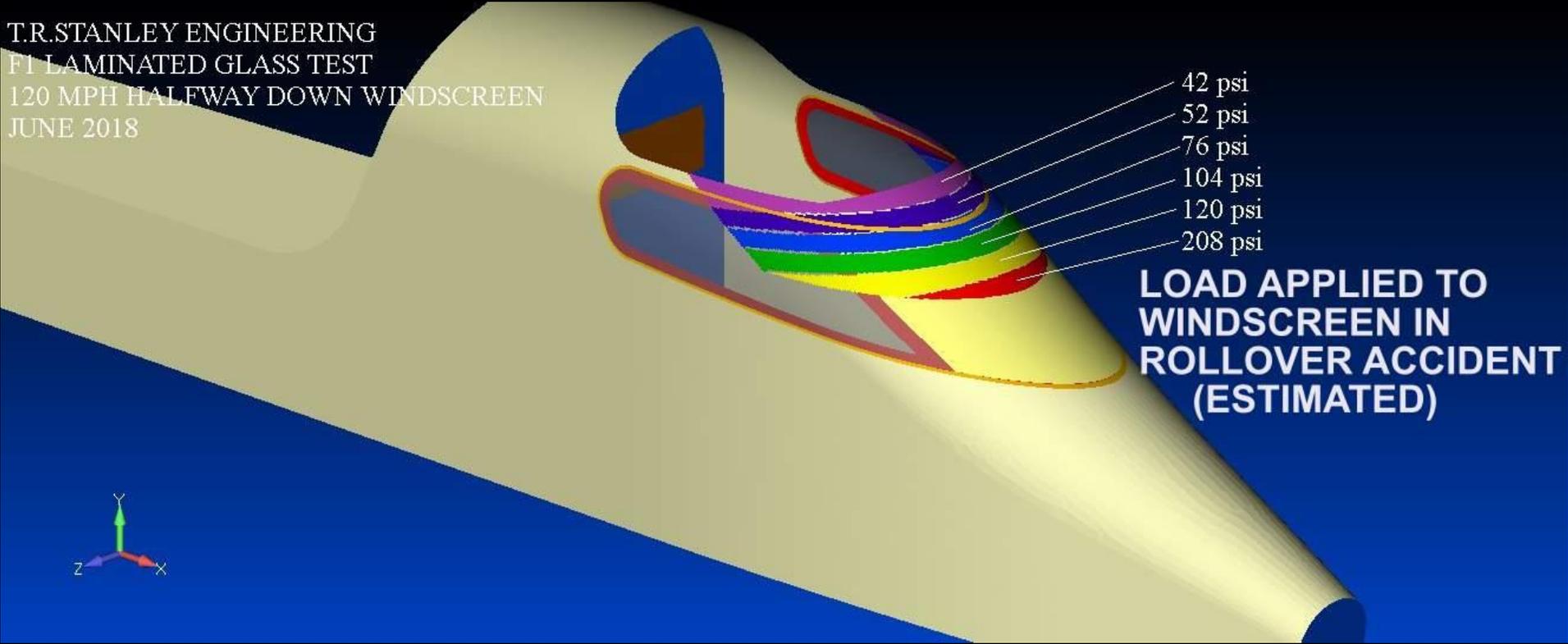


# STANDARD PRESSURE FORMULA



*Fig. 59:—Relation of pressure to velocity through length of planing surface*  
Du Cane-"High Speed Small Craft" page 114

T.R.STANLEY ENGINEERING  
F1 LAMINATED GLASS TEST  
120 MPH HALFWAY DOWN WINDSCREEN  
JUNE 2018

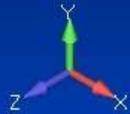


- 42 psi
- 52 psi
- 76 psi
- 104 psi
- 120 psi
- 208 psi

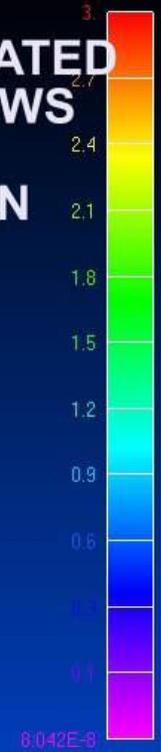
**LOAD APPLIED TO  
WINDSCREEN IN  
ROLLOVER ACCIDENT  
(ESTIMATED)**

T.R.STANLEY ENGINEERING  
F1 LAMINATED GLASS TEST  
120 MPH HALFWAY DOWN WINDSCREEN  
JUNE 2018

**FAILURE INDEX FOR LAMINATED  
GLASS WINDSCREEN - SHOWS  
FAILURE AT 120 MPH - SEE  
PHYSICAL TEST SIMULATION**

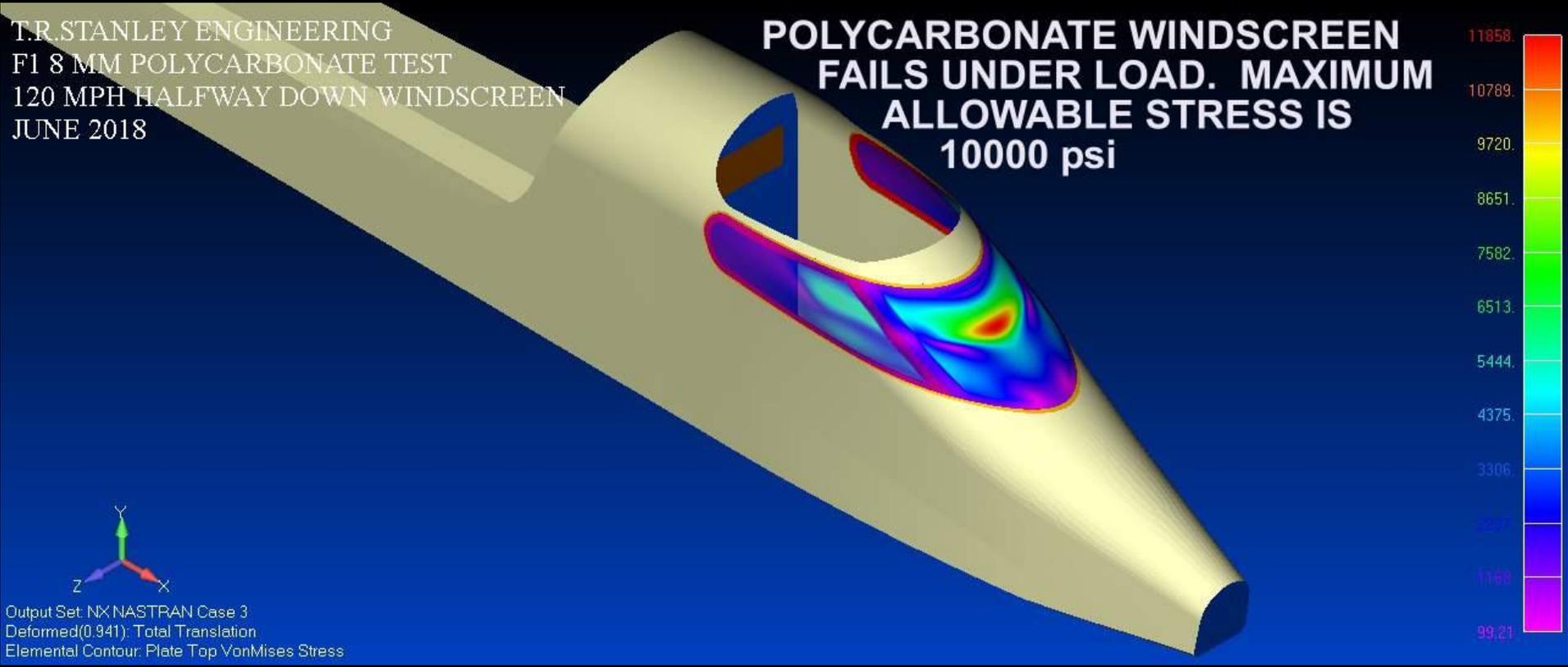


Output Set: NX NASTRAN Case 3  
Deformed(0.297): Total Translation  
Elemental Contour: Laminate Max Failure Index



T.R. STANLEY ENGINEERING  
F1 8 MM POLYCARBONATE TEST  
120 MPH HALFWAY DOWN WINDSCREEN  
JUNE 2018

**POLYCARBONATE WINDSCREEN  
FAILS UNDER LOAD. MAXIMUM  
ALLOWABLE STRESS IS  
10000 psi**

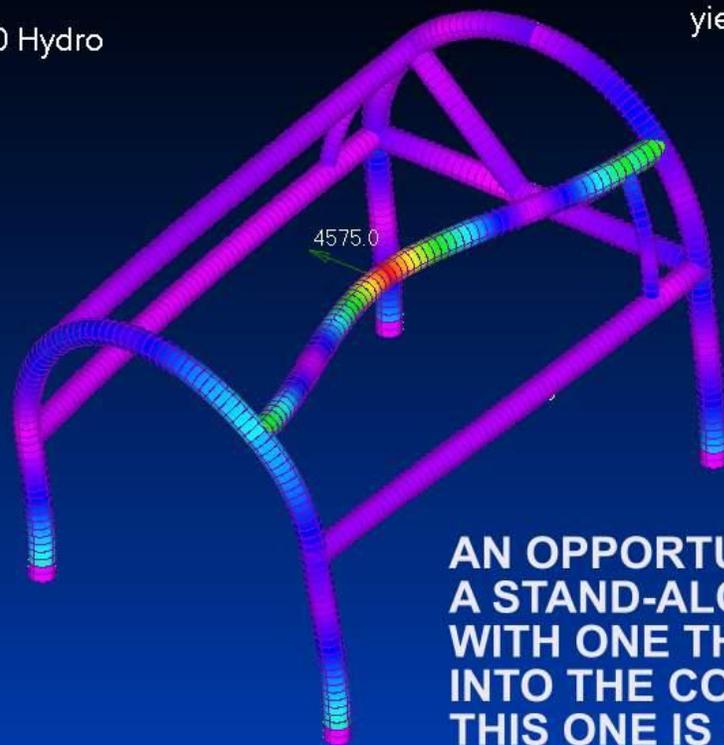


**WHAT OTHER OPPORTUNITIES  
ARE THERE FOR SOLVING OUR  
PROBLEMS BY DOING CALCULATIONS?**

**ROLL BARS? SEATS?**

T.R. Stanley Engineering  
P0297, Femap version 2020.1  
Rough model of roll cage for E350 Hydro  
January 9, 2020

NOTE: Maximum allowable  
yield stress 60200 psi

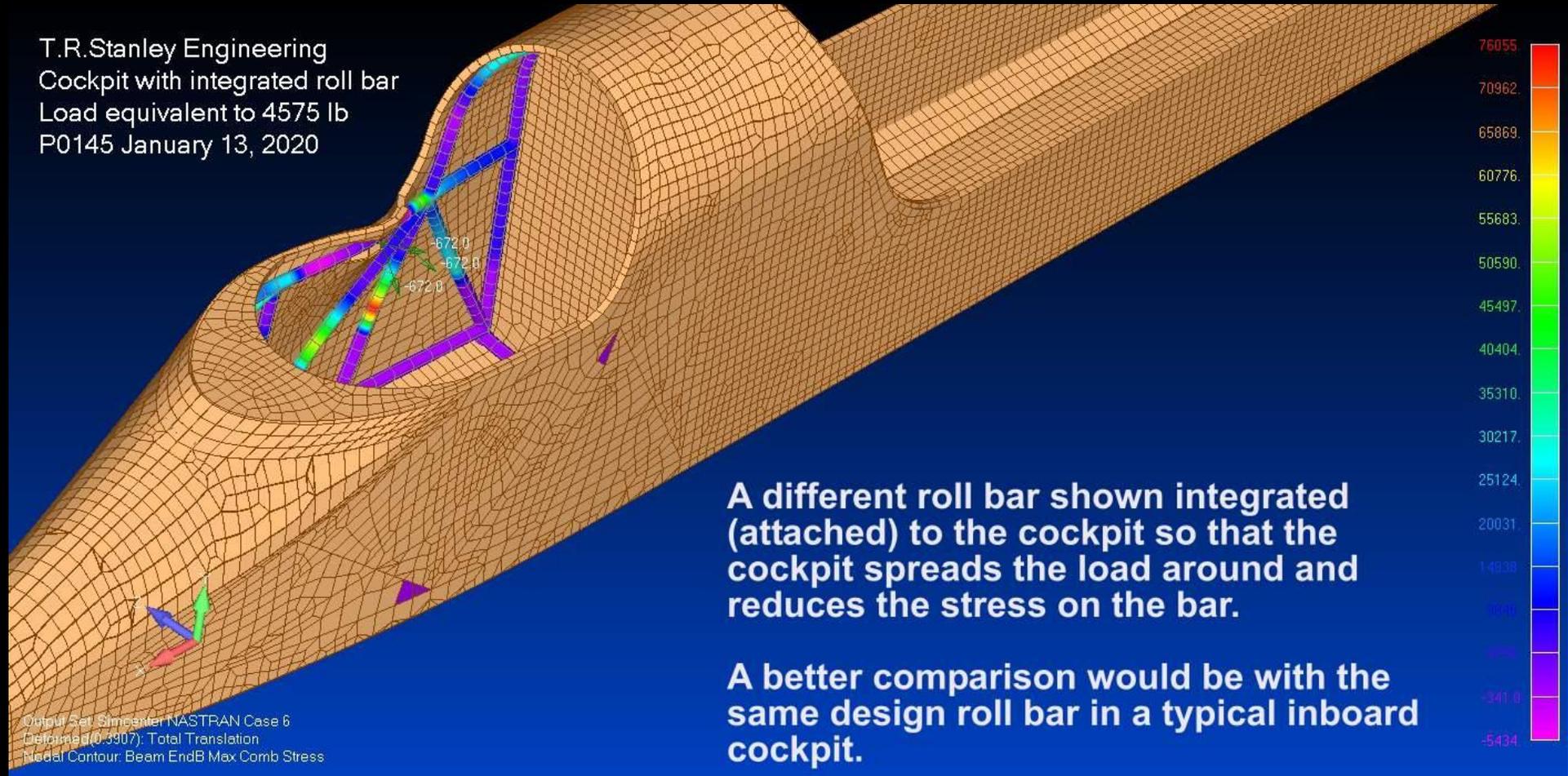


**AN OPPORTUNITY TO COMPARE  
A STAND-ALONE ROLL BAR  
WITH ONE THAT IS INTEGRATED  
INTO THE COCKPIT.  
THIS ONE IS STAND-ALONE WITH  
A POINT FORCE ABOVE THE  
WINDSCREEN**



Output Set: Simcenter NASTRAN Case 3  
Deformed(0.8372): Total Translation  
Elemental Contour: Beam EndA Max Comb Stress / Beam EndB Max Comb Stress

T.R.Stanley Engineering  
Cockpit with integrated roll bar  
Load equivalent to 4575 lb  
P0145 January 13, 2020



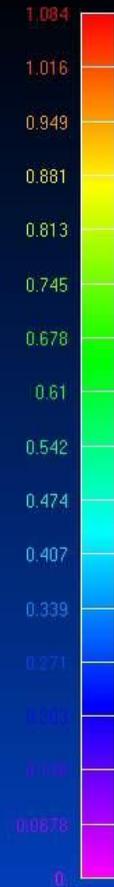
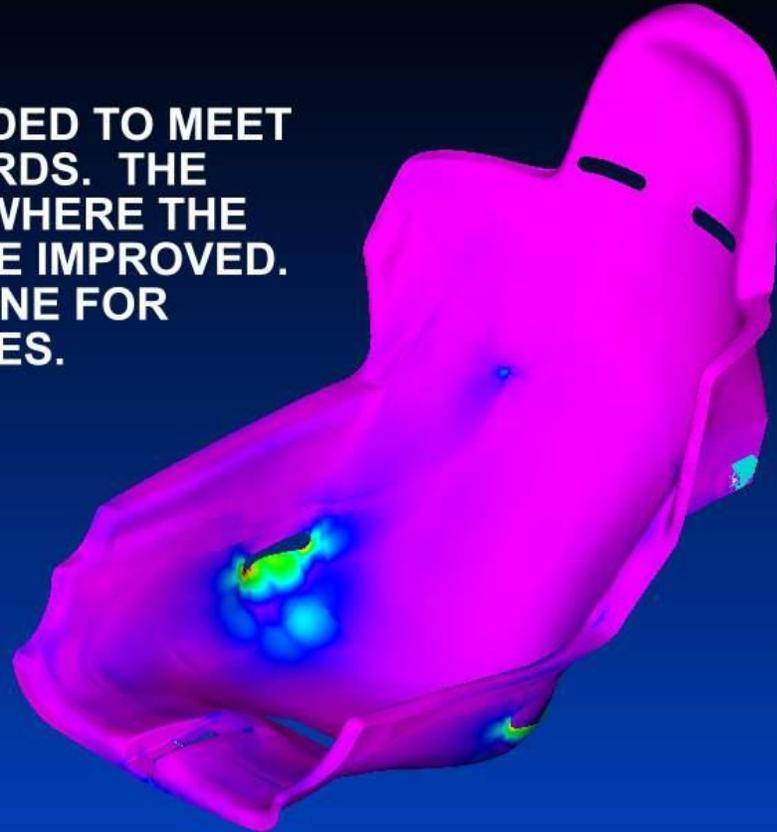
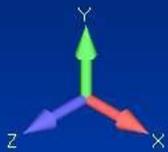
**A different roll bar shown integrated (attached) to the cockpit so that the cockpit spreads the load around and reduces the stress on the bar.**

**A better comparison would be with the same design roll bar in a typical inboard cockpit.**



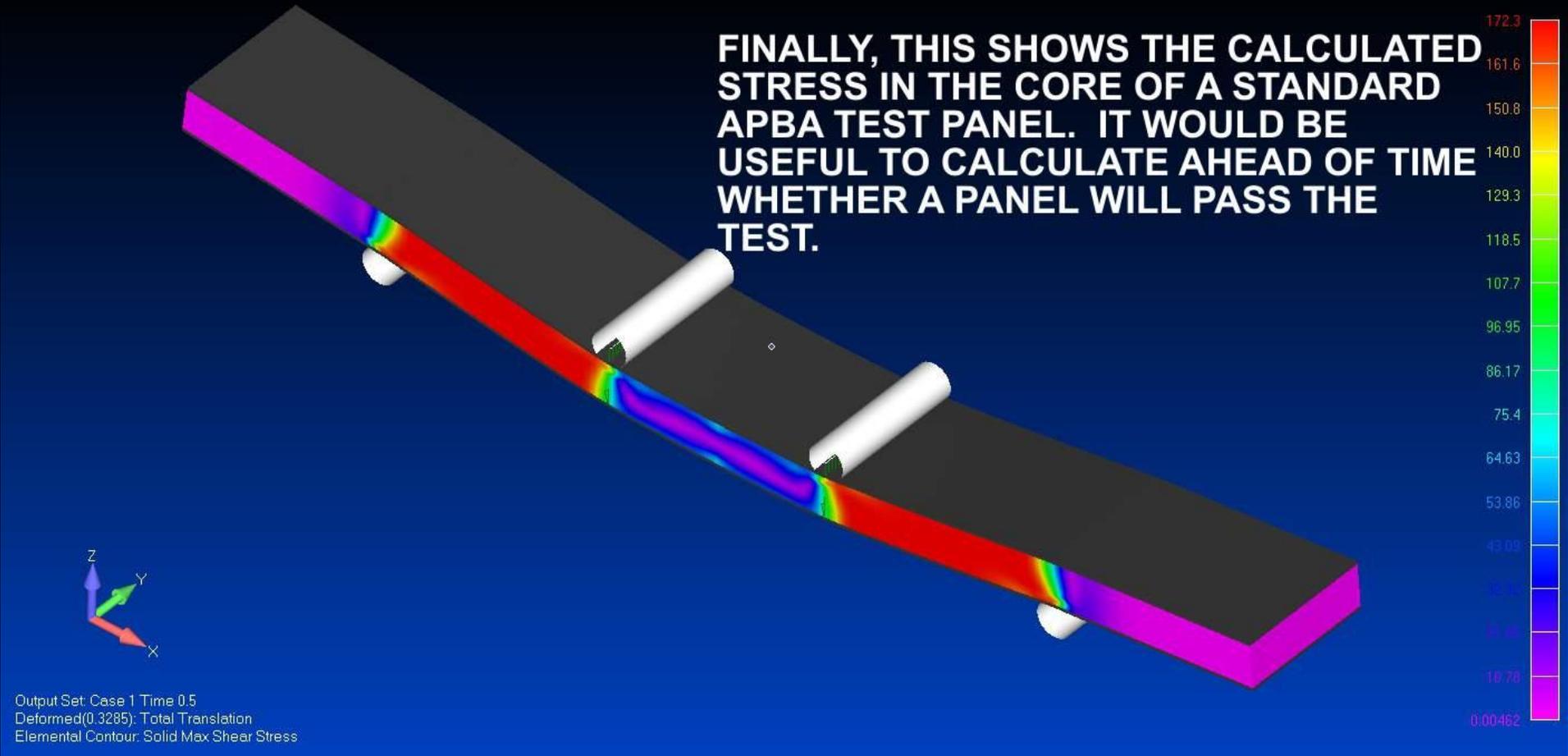
T.R.Stanley Engineering  
Improved Layups

**HERE IS A SEAT LOADED TO MEET  
SFI AND FIA STANDARDS. THE  
ANALYSIS SHOWED WHERE THE  
LAYUP NEEDED TO BE IMPROVED.  
THIS MODEL WAS DONE FOR  
STACKED COMPOSITES.**

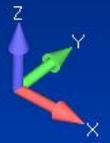
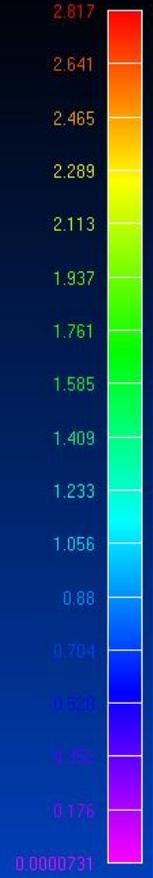
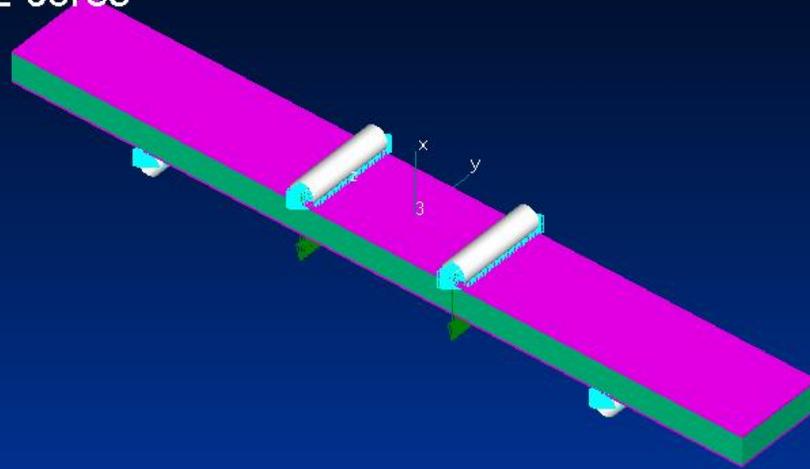


Output Set: NX NASTRAN Case 1  
Deformed(0.2219): Total Translation  
Elemental Contour: Laminate Max Failure Index

**FINALLY, THIS SHOWS THE CALCULATED STRESS IN THE CORE OF A STANDARD APBA TEST PANEL. IT WOULD BE USEFUL TO CALCULATE AHEAD OF TIME WHETHER A PANEL WILL PASS THE TEST.**



T.R.Stanley Engineering  
Heslop Xcat UIM test (Ecoseas)  
Non-Linear  
bond shear allowance 8000  
drive C for solution, set to 12 cores  
NL test with version 2020.1  
Jan 1, 2020



Output Set: Case 1 Time 0.65  
Animate(5.7923): Total Translation  
Elemental Contour: Laminate Max Failure Index



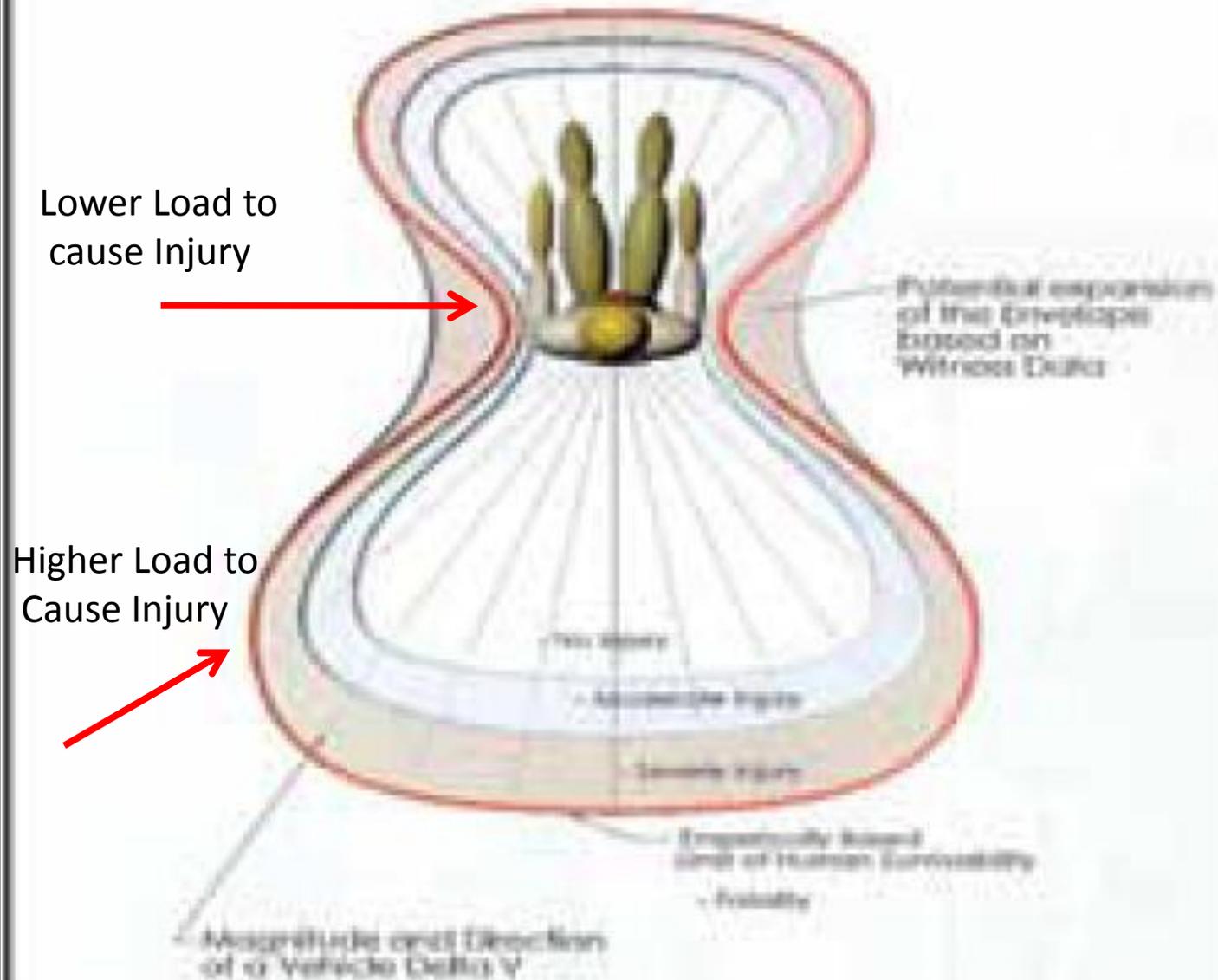


**Crash Box**



# Vehicle Occupant Injury Envelope

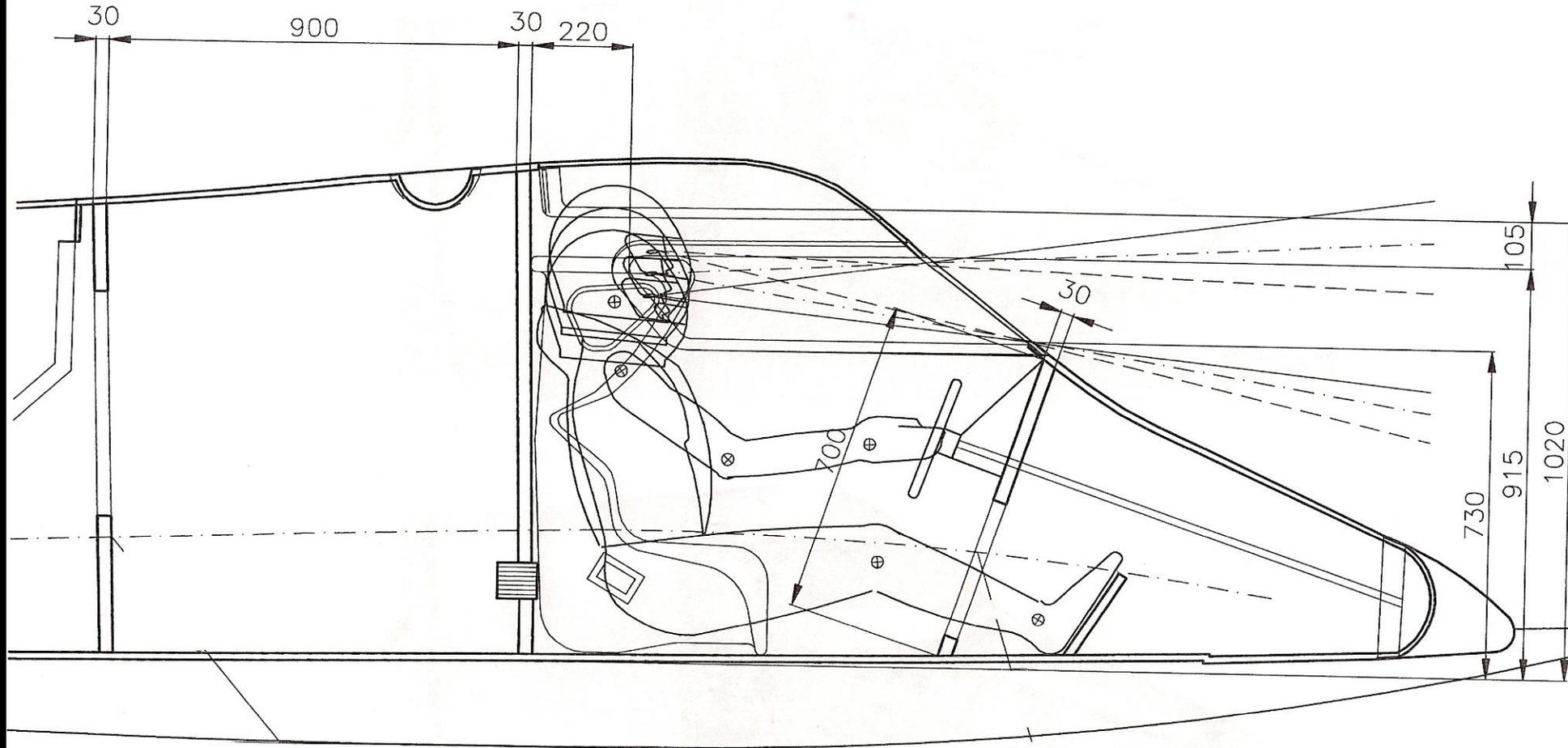
(Demonstrative Diagram)



**Do You Want Quicker**

**Lap Times?**

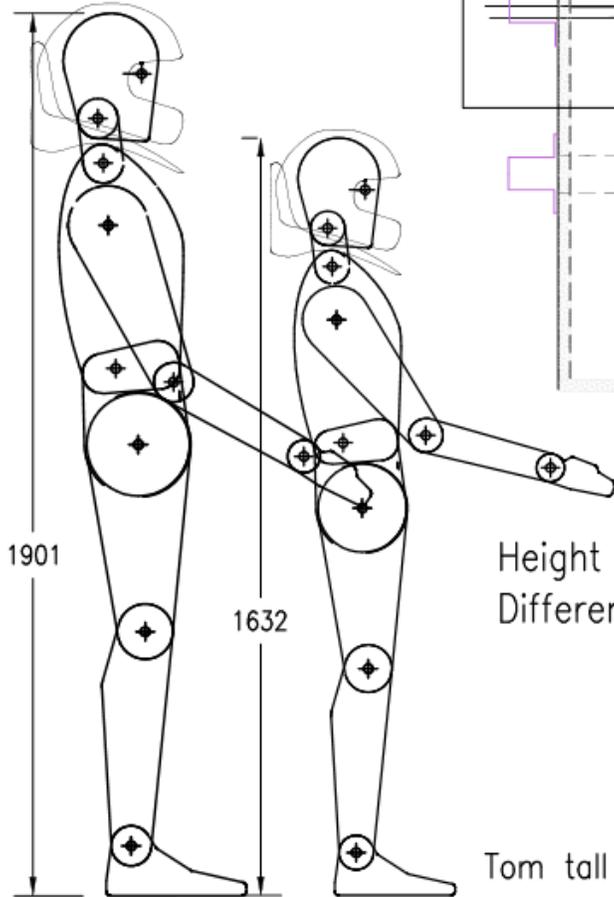
# Driver/Cockpit Fit



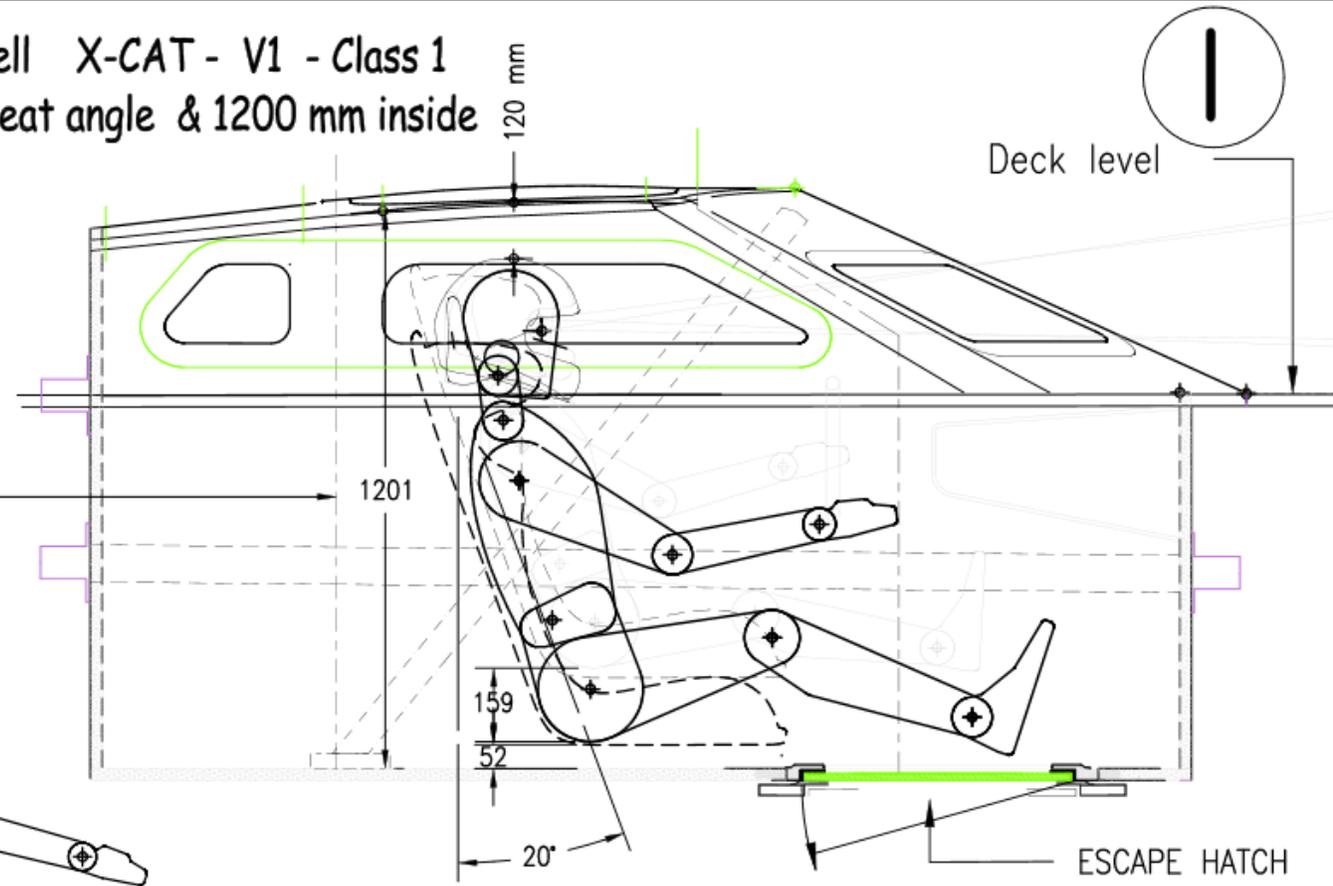
**"Precision" Fit...**

Mock-up GRP of safety cell X-CAT - V1 - Class 1  
 Clearance 120 mm same seat angle & 1200 mm inside

NB : actual UIM rule  
 1100 mm min !  
 Jerry big boy 1.90 m



Height difference of drivers circa 300 mm  
 Difference of level of seat ( same eye point ) 160 mm ±



**SERGIO ABRAMI & C. YACHT DESIGNERS**  
 E-mail : sergioabrami\_yd@libero.it    cell ++ 39 348 22 69 139    skype : sergioabrami\_yd  
 Safety cell offshore for Tommy Racing Roma Italy  
 Mock-up clearance hatches scala 1:10  
 01.15 dwg nr. 4283 Jan 2016

8	7	6	5	4	3	2	1
---	---	---	---	---	---	---	---

E  
 D  
 C  
 B  
 A

50 mm

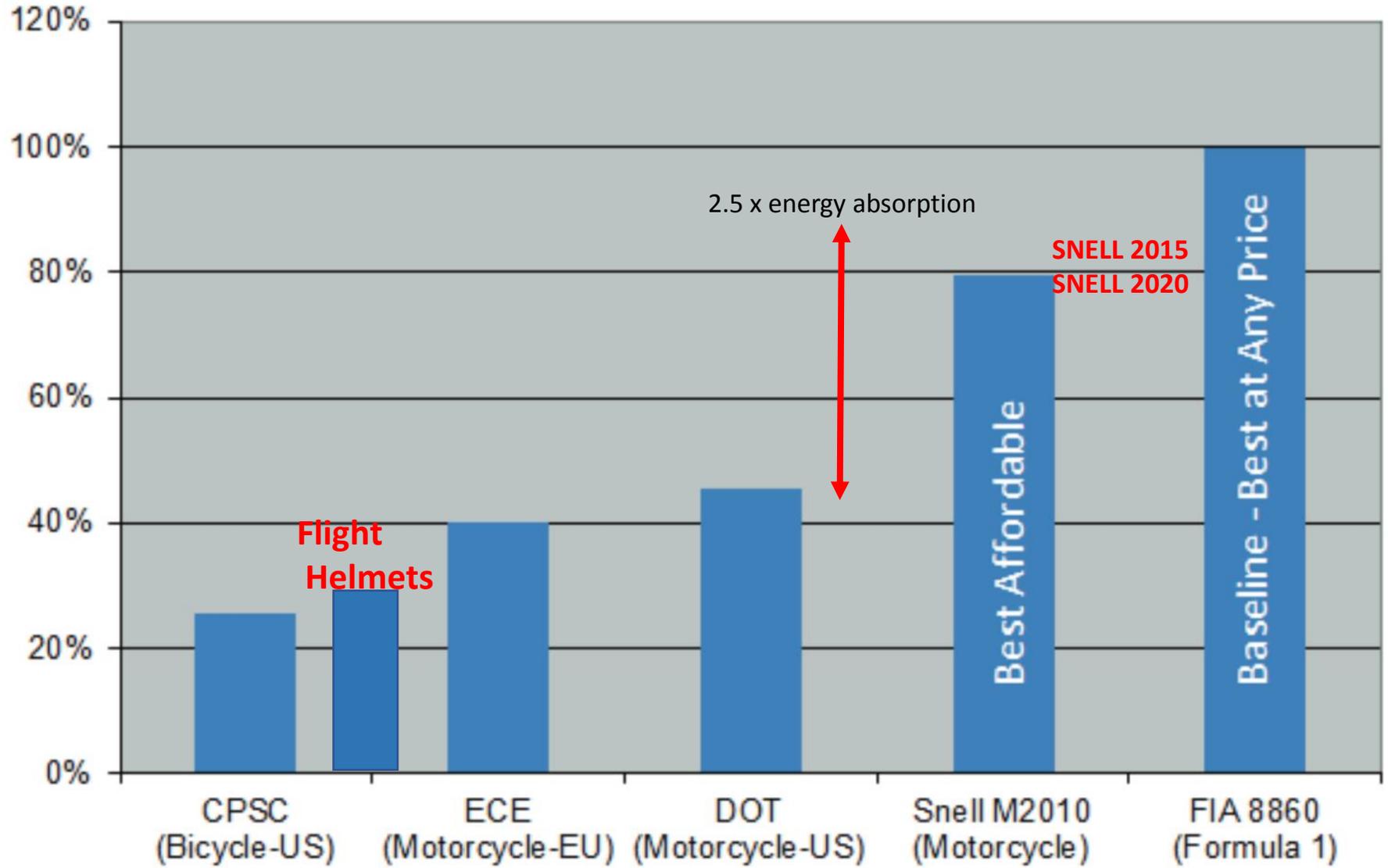
# Personal Equipment



# Personal Equipment



# Impact Energy Management - Hemi Impact - Size Medium



M2010 & DOT - Estimated Single Impact Capability based on double impact test

ECE - Estimate based on guided fall versus free fall and hemisphere versus kerbstone testing

# SNELL Standards



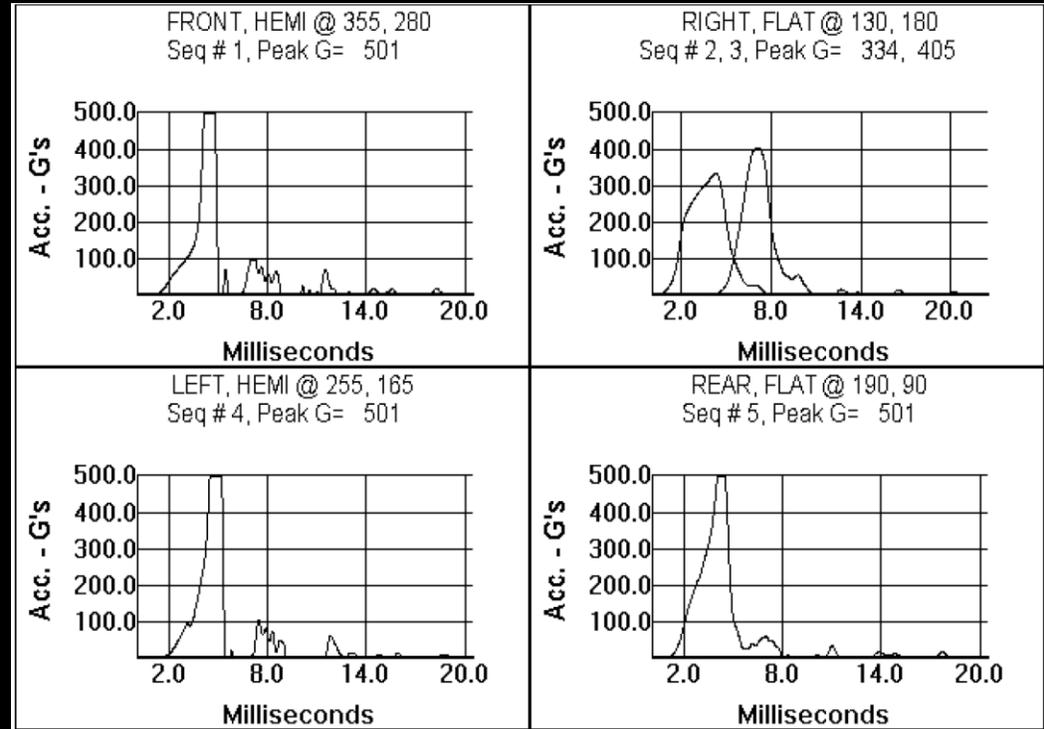
**D, R** versions

**October 1, 2020 – Snell SA2020 will take effect**

Sample# 2067(2019) SIDE VIEW



# HELMET TEST



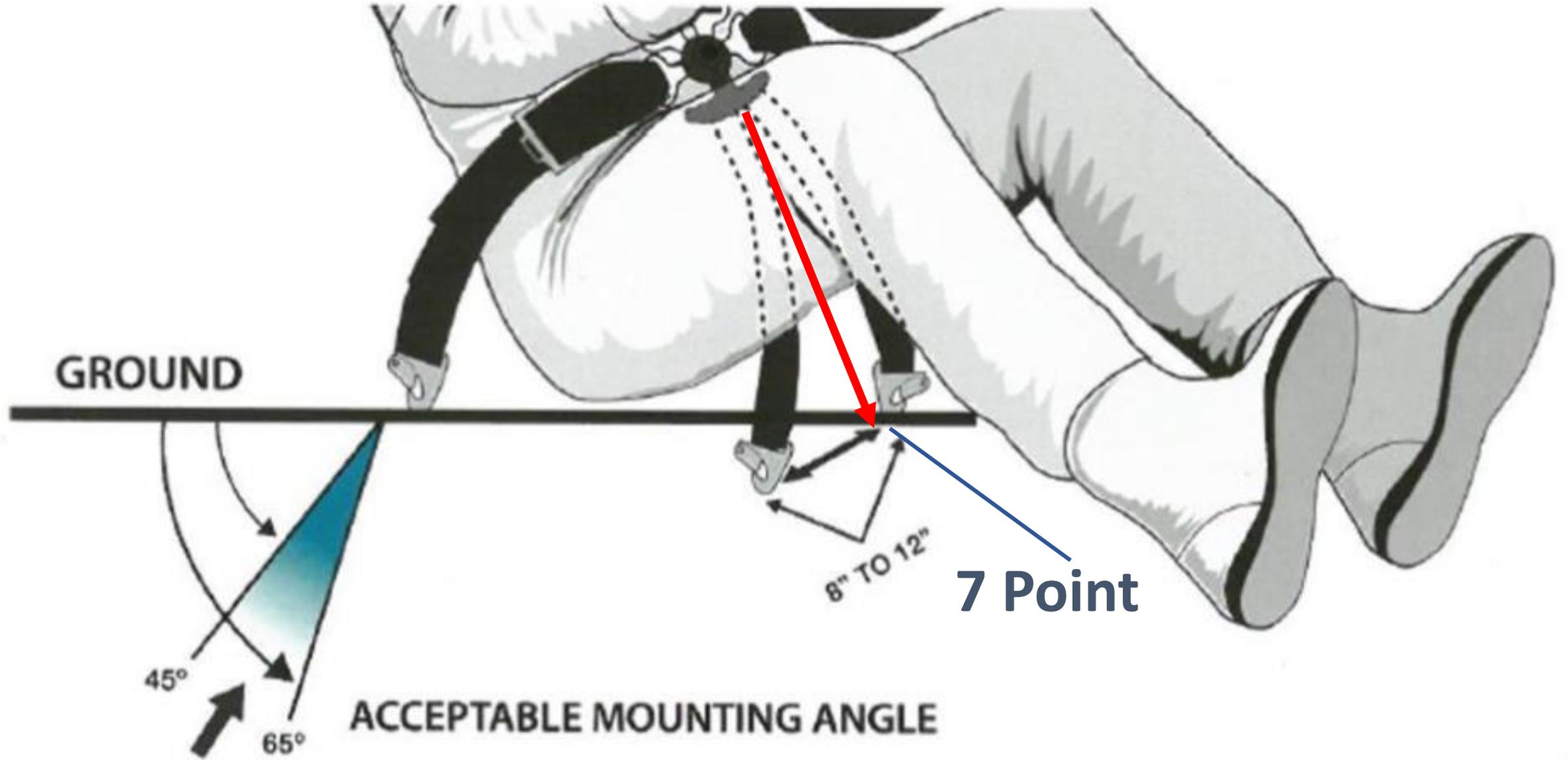
MANUFACTURER:	MSA Gallet hjelm			SNELL #:	N/A
MODEL:	Gallet hjelm			P.O. #:	N/A
SIZE:	M [57-59cm]			DATE OF MANUF:	NA
DATE ACQUIRED:	7/2/2019			CONFIGURATION:	Open Face
SAMPLE WEIGHT:	878 g				
CONSTRUCTION:	Composite				
TESTING INFORMATION					
TEST TYPE:	M2020D Prototype Test				
TEST CONDITION:	AMBIENT				
HEADFORM:	ISO J	HPI: IJ47	TEMP: 76°	HUM / PRESS:	42% / 1014 mb
VELOCITY TAB WIDTH:	20.04 mm's		DROP MASS:	4.729 kg	
SEQ #	SITE	ANVIL	TIME (ms)	PEAK G's	
1	FRONT @ 355, 280	HEMI	2.584	501	
2	RIGHT @ 130, 180	FLAT	2.599	334	
3	RIGHT @ 130, 180	FLAT	2.959	405	
4	LEFT @ 255, 165	HEMI	2.590	501	
5	REAR @ 190, 90	FLAT	2.593	501	
Site- (a,Y): a = Angle clockwise from Reference Point(degrees); Y = Distance Up to Site (mm)					
LABELING & MARKING:	Pass	VISUAL FIELD:		Pass	
RETAINING SYSTEM:	Fail	ELONGATION:		61 mm	
CHIN GUARD:	No Result	DISTORTION:		--	
PENETRATION-SHELL:	No Result	PENETRATION-SHIELD:		No Result	
POSITIONAL STABILITY:	No Result				
INSPECTION:	Pass				
SAMPLE RESULT: Fail		GROUP RESULT: Fail			

NOTES  
Prototype to M2020D per EBB.

Impact# 1: Peak acceleration (500.73 G) exceeded the limit set by the standard (275.0 G)  
 Impact# 2: Peak acceleration (333.90 G) exceeded the limit set by the standard (275.0 G)  
 Impact# 3: Peak acceleration (404.40 G) exceeded the limit set by the standard (275.0 G)  
 Impact# 4: Peak acceleration (500.73 G) exceeded the limit set by the standard (275.0 G)  
 Impact# 5: Peak acceleration (500.73 G) exceeded the limit set by the standard (275.0 G)

# 7 Point Restraint Belts





GROUND

8" TO 12"

7 Point

45°

65°

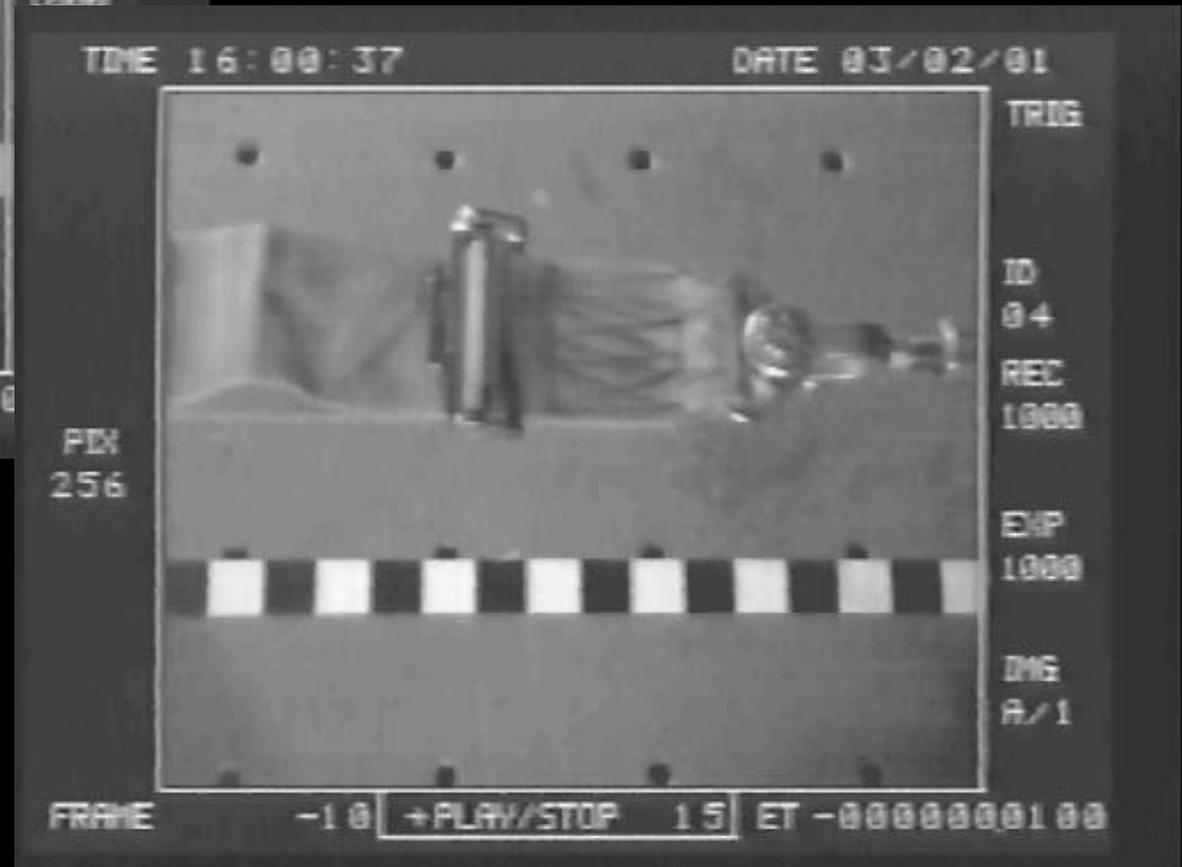
ACCEPTABLE MOUNTING ANGLE

# Low Profile FHR

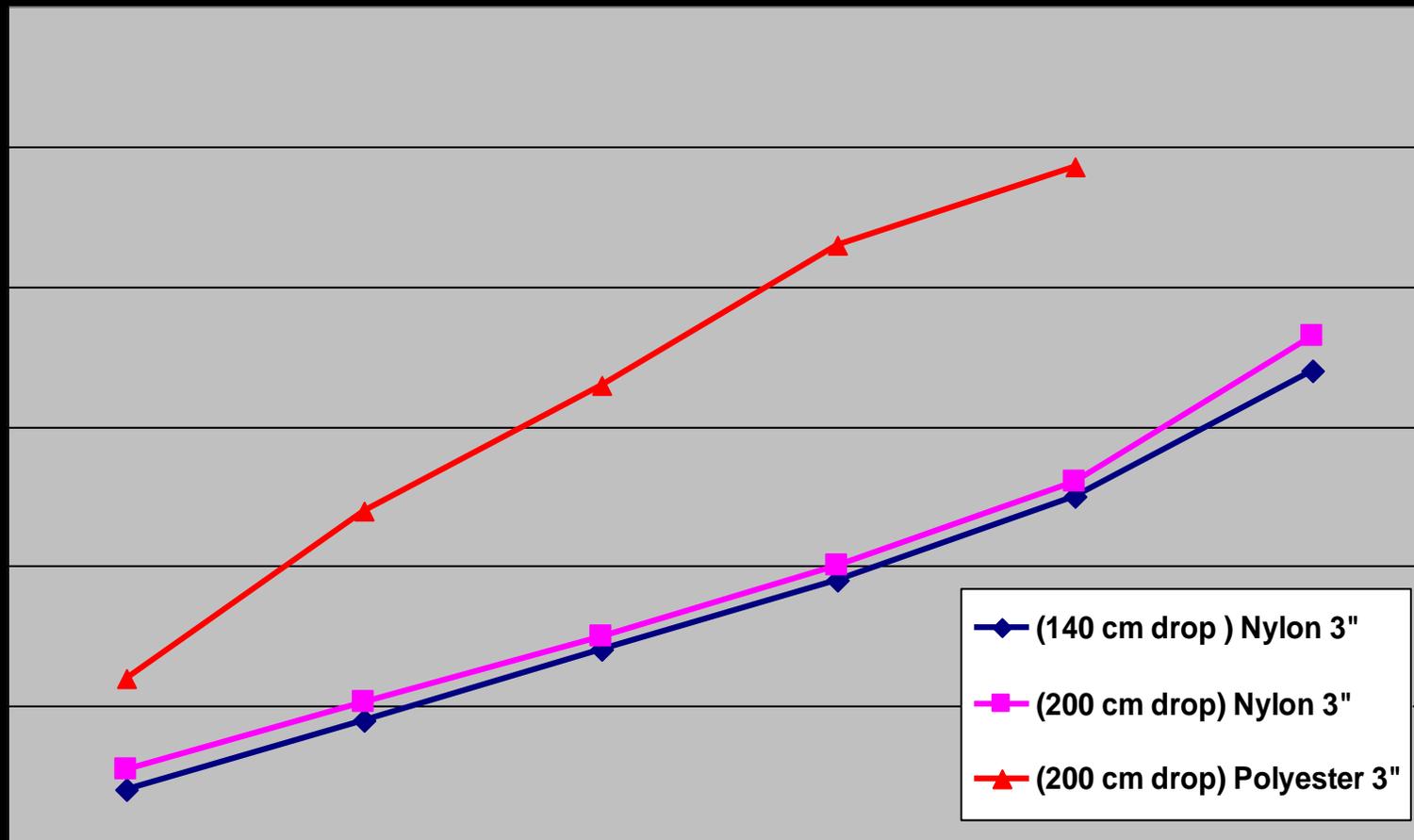


# Hardware & Material Selection

Issues with installation  
Geometry and hardware  
selection can lead to system  
failure.



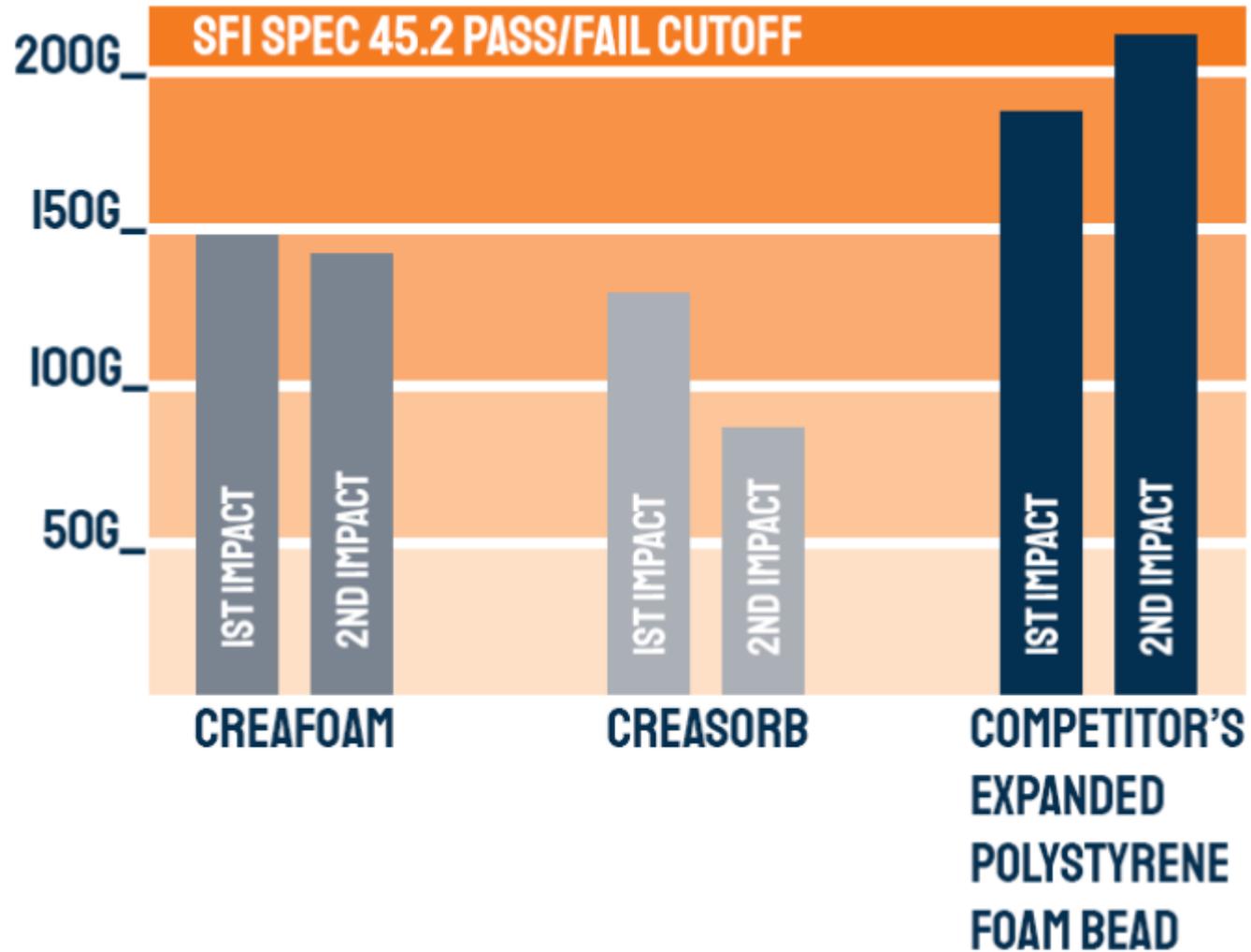
# Nylon vs Polyester Webbing - Dynamic Response Test



**What you  
do not want.**



# Foam Seat



Bald Spot Sports, Indianapolis

<https://www.baldspotsports.com/index.php>

(317)537-7328



# Recommend-Internal to cockpit

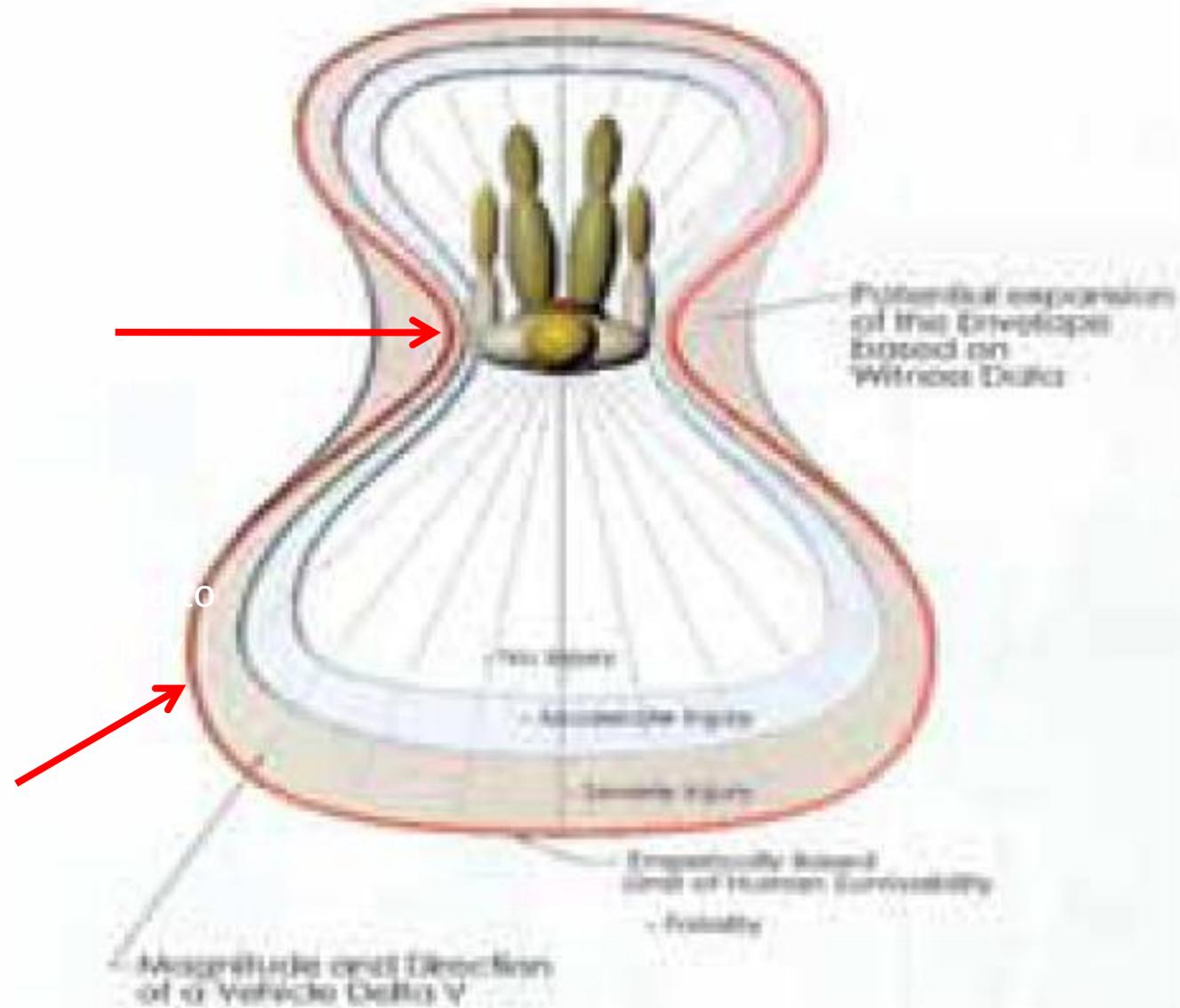
- Excellent seat, stiffness, comfort, shock attenuation
- 7 Point harness
- Forward Head Restraint
- Capable helmet/ SNELL/FIA
- Air system

# Unrestrained Driver



# Vehicle Occupant Injury Envelope

(Demonstrative Display)









AllTheTorque  
Photography

*Driver: Summer Johnson*

Lake Boga, Australia, 1/11/20

# Helmet Bucketing

Lake Hoptacong, New York  
September, 2019, Jersey Speed Skiff,  
shot of water to closed face HJC helmet, strap slid,  
all rubber padding and visor gone

Black Lake, Olympia, Washington, July, 2019  
Outboard Hydro Blowover, Dale Bartley,  
Helmet torn off, strap intact and closed.  
Severe concussion and still in recovery



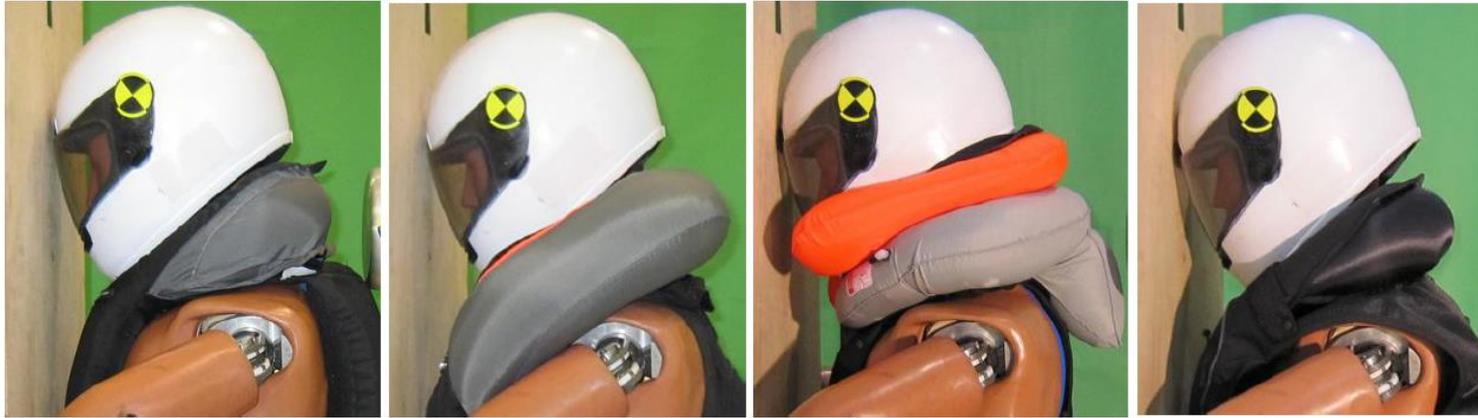
# Hit-Air System

(a) H Model

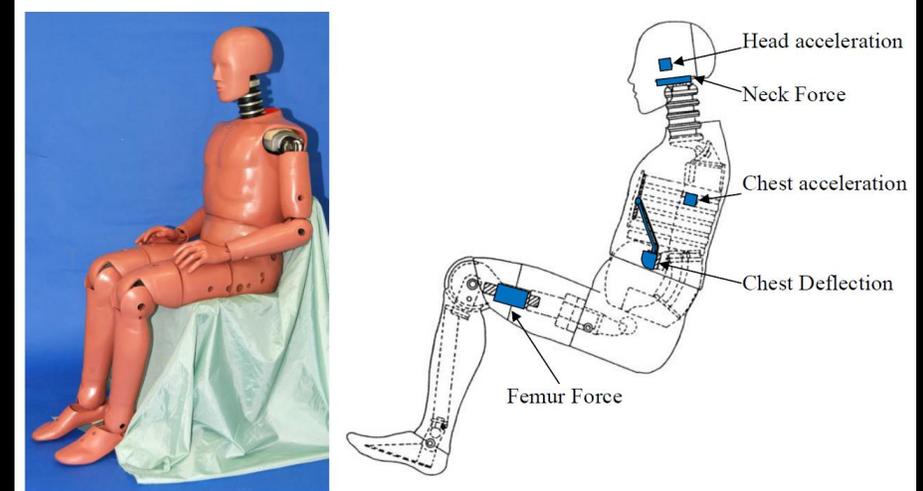
(b) R Model

(c) NW Model

(d) MC Model



**Fig.1** Some of the airbag jackets used in neck impact test



**Fig.3** Hybrid-III dummy

# Collar Test Video



# Hit-Air System

- **Designed for motorcycle riders and equestrian riders**
- **For racing considered the neck airbag system only (not chest)**
- **Lanyard pull force between 25 and 32 kg.**
- **Inflation time (for neck only) Approximately 100-125 msec**
- **Laboratory testing indicates 30 to 50 % reduction in HIC (Head Injury Criteria, US FMVSS 208)**
- **325-350 USD in US, 20 USD for CO2 cartridge**
- **Airbags compulsory for Moto-GP in 2018,  
<http://www.motogp.com/en/news/2017/12/21/airbags-compulsory-from-2018/247973>**

Daniel Koshka  
Anti-Bucketing  
Device





**Trim foam insert to fit after rotating Go-Kart collar 180 degrees.**

**Fills space below chin with a full-face helmet.**

**Does not prevent head rotation**

# Unrestrained driver recommendations

- **Helmet**
- **Cut-resistant clothing**
- **Tested life jacket**
- **Consider anti-bucketing equipment**
- **Gloves**

# Performance/Stability



# RACING EQUIPMENT

## Stability Helpers

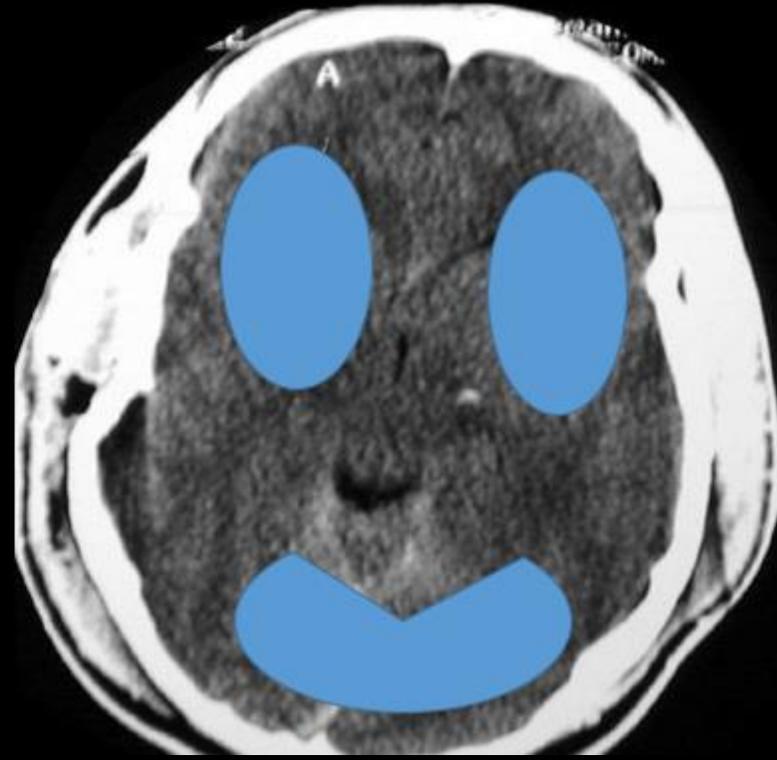
All surfaces straight and true,  
rudder/skeg/fin leading edge proper  
shape, rudder lead, boat twist?.....

Steering...

- Limits?

# THE MOST IMPORTANT THING!

TEACH YOUR TEAM, FAMILY, FRIENDS, ANYONE WHO ATTENDS  
EVENTS WITH YOU TO BE AWARE OF YOU



## **28. Return to competition**

**Injured drivers returning to competition must present a medical doctor's certification as to their physical and psychological fitness to race.**

**No contestant shall participate in an APBA-sponsored event with any type of splint, including, but not limited to, a cast or brace applied to his body without showing written authorization from a medical doctor and approval by the Referee at the particular event. In some cases, more than one independent doctor's release may be required.**

# Performance Tips

**Stability**

**Focus**

**Reduce survival reactions**

**Eyesight**

# Performance Tips

**Anti-doping**

**Checklist**

**Personal log**

**Seat time**

UIM



UNION INTERNATIONALE MOTONAUTIQUE

**SAY NO!**  
**TO DOPING**

In partnership with  WADA

# UIM EDUCATIONAL PROGRAMME ON THE RACE FIELD



*European Championship F125 & F700  
28-30 June 2019 - Znin, Poland*



*International Ordinary Races P750 & F4*

# UIM EDUCATIONAL PROGRAMME

## ON THE RACE FIELD



*Aquabike World Championship  
31 Mai – 2 Juin 2019 - Olbia, Italy*

# UIM EDUCATIONAL PROGRAMME

## ON THE RACE FIELD



# UIM EDUCATIONAL PROGRAMME

## ON THE RACE FIELD



*Formula 1 World Championship  
17 – 19 May 2019 – Portimao, Portugal*

# UIM EDUCATIONAL PROGRAMME

## ON THE RACE FIELD



*Formula 2 World Championship  
Kaunas, Lithuania*

# Racing Considerations

- **“Every Decision Is Governed By The Space That You Think, Feel, or Believe You Have.....”  
(Survival Reaction)**

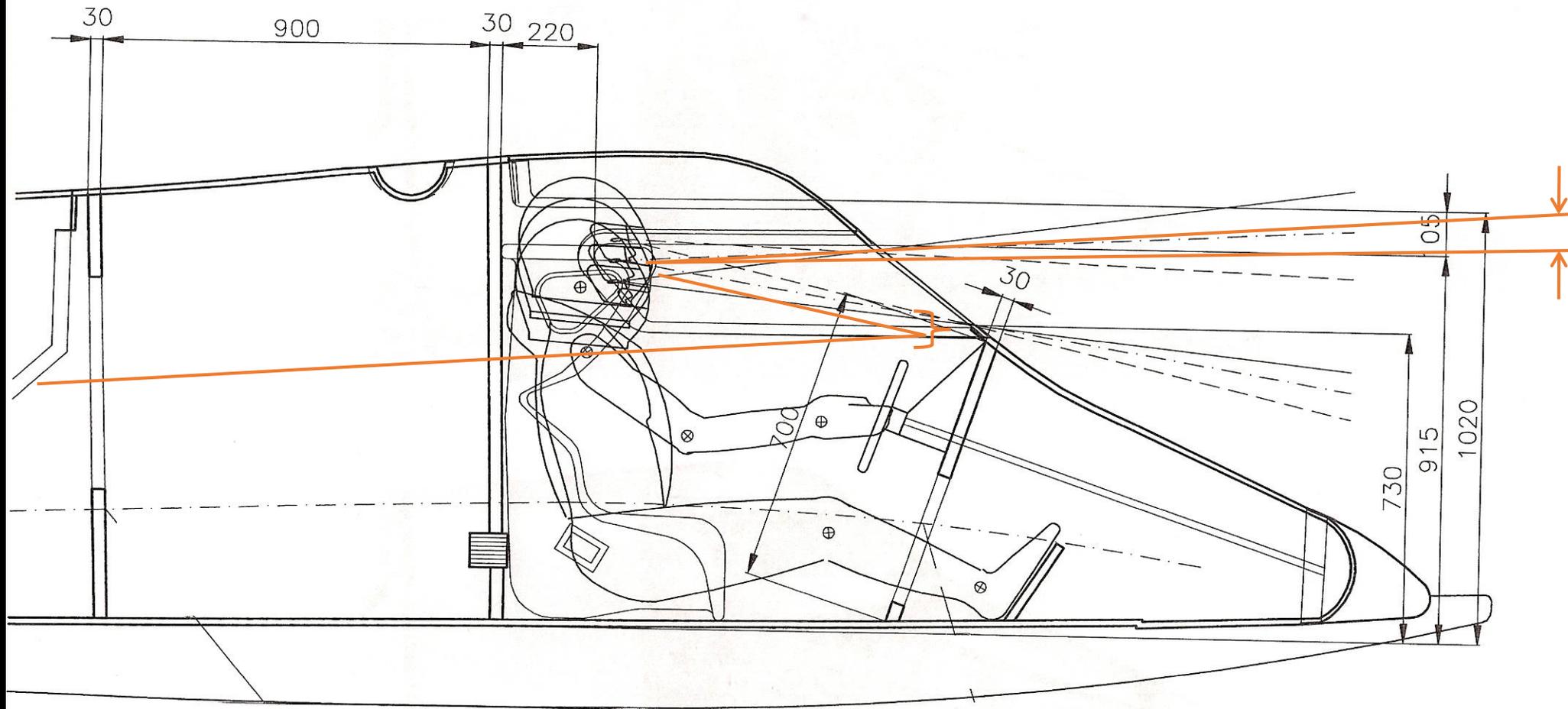


How often do you come off the throttle without “permission”?

**“Survival Reaction” (SR) vs. Personal Limit**

- \* Speed gets you closer to SR
  - \* Reducing speed gets you further from SR
- > Throttle Control is Critical

**Some SR’s: chop the throttle, tighten grip on wheel, “darting” vision, fixed attention, steering toward the object of attention, “frozen” steering or ineffective, trim errors**



# Performance Tips

**Anti-doping**

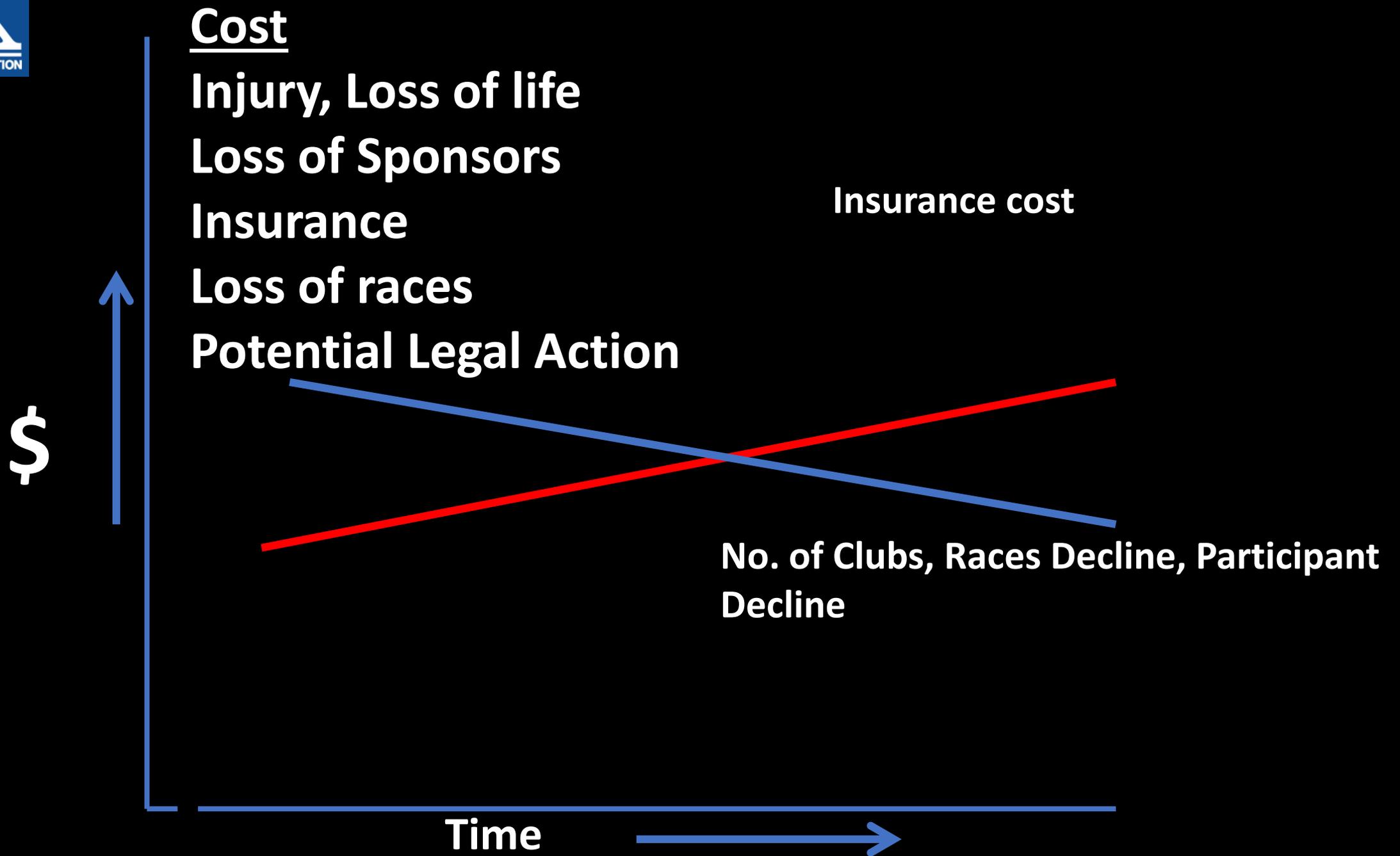
**Checklist**

**Personal log**

**Seat time**



**The cost of not taking action**



# Status of APBA Reinforced Cockpit/Capsule Builder and Cockpit Registration PROCESS



Steps	OPC	Inboard	PRO
Detailed description of process	✔ Questionnaire defined	✔ Questionnaire defined	Questionnaire ✔ ?
Submittal of test panels/laminate details	✔ LaBanco	Need to define, to whom ?	To whom ?
Test facility defined	✔ Structural Comp., Inc.	Henderson/Auld ?	
Analysis of results	✔ Stanley/LaBanco	Structural eng. ?	Structural eng. ?
Builder notified of pass/fail-registration	✔ LaBanco	Whom ?	Whom ?
Builder listed on APBA web site	In work (3 builders?)	In work	In work
Crash box construction	In work	In work- cage	TBD
UIM layup available for builders	✔		

# Cockpit Registration Process

Steps	OPC	Inboard	PRO
Registered builder ?	Yes  Required	Yes  Required	Yes  Required
Cockpit design submitted, includes design loads	 LaBanco	Additional, refined requirements/standards in work	TBD
Structural analysis	 Stanley/LaBanco	TBD 	TBD 
Cockpit registered	 Stanley/LaBanco		
Builder/cockpit reg. listed on APBA website	TBD	TBD	TBD
Cockpit tracking	TBD	In work/best effort	TBD

Notes: 1) OPC and Inboard have most complete questionnaires, OPC on APBA website (<https://www.apba.org/resource-page.php?pid=20> , Inboard from Don Melillo, PRO ?  
 2) Need cockpit tracking process, logbook?

# Fun...

