NHTSA Research on Improved Restraints in Rollovers

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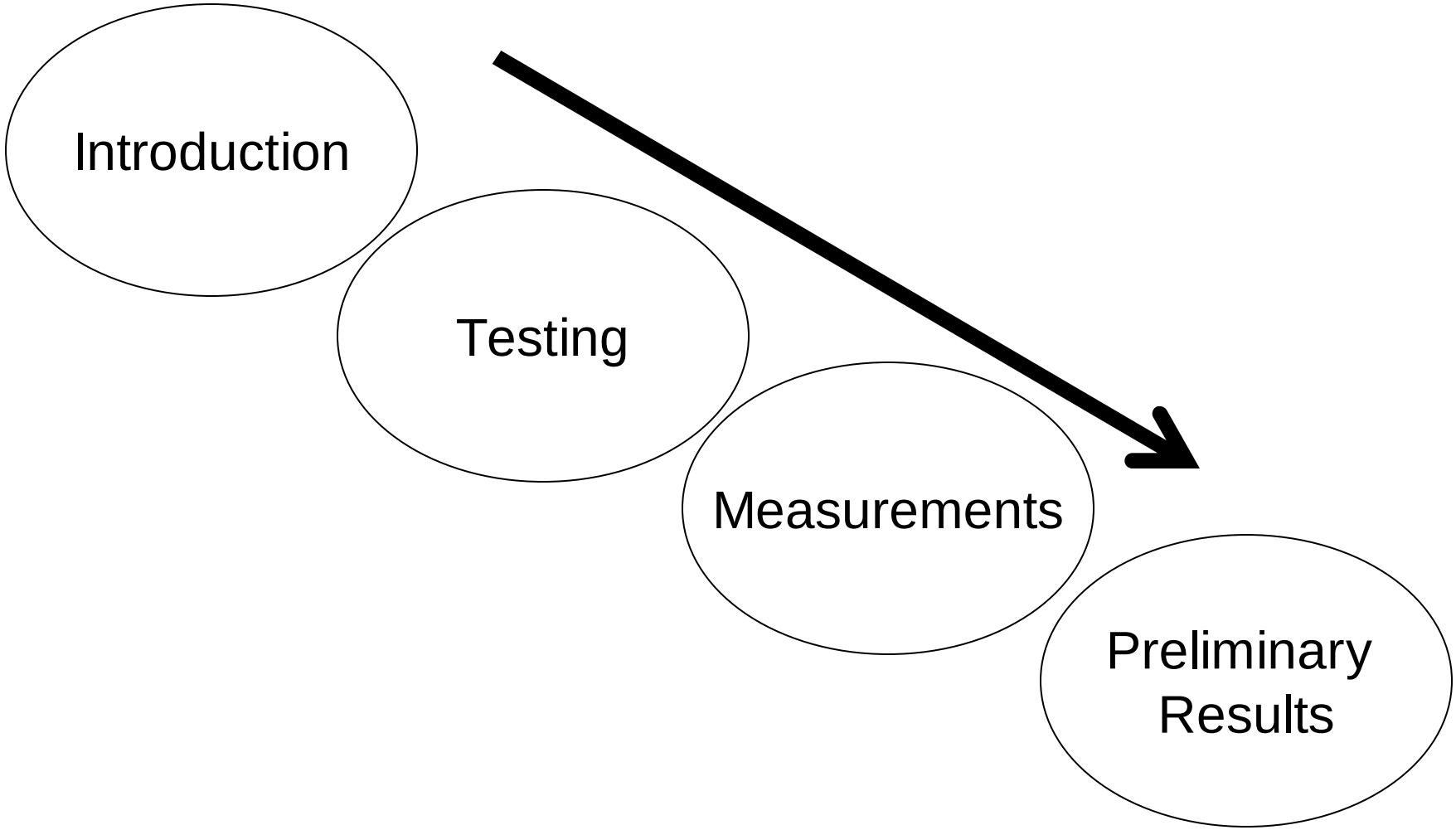
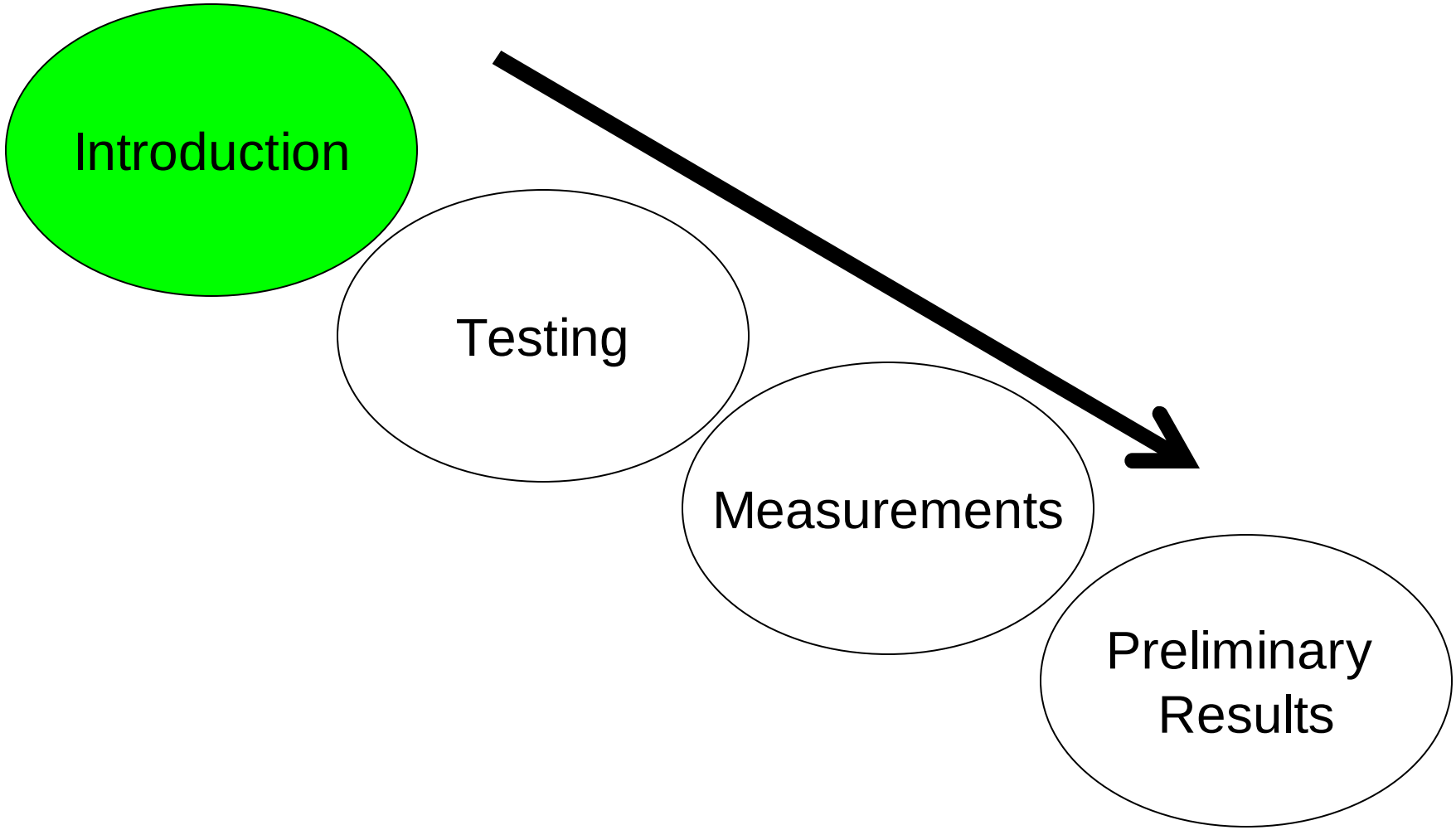
Session G3

Overview



Introduction



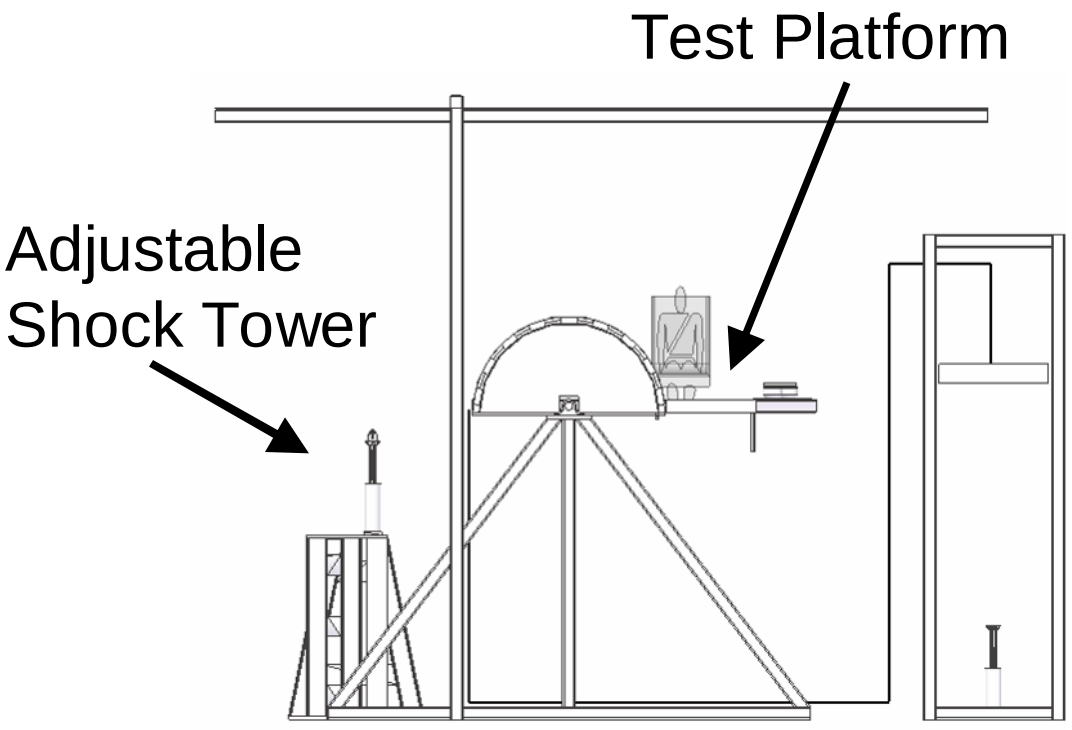
Introduction

- Reducing Roof Crush alone will not eliminate occupant contact with roof.
- Previous NHTSA (mid-1990's) research found reduced occupant excursion with improved restraint systems in rollover conditions.
- Few studies looking at improved restraint system effectiveness for rollover accident conditions exist.

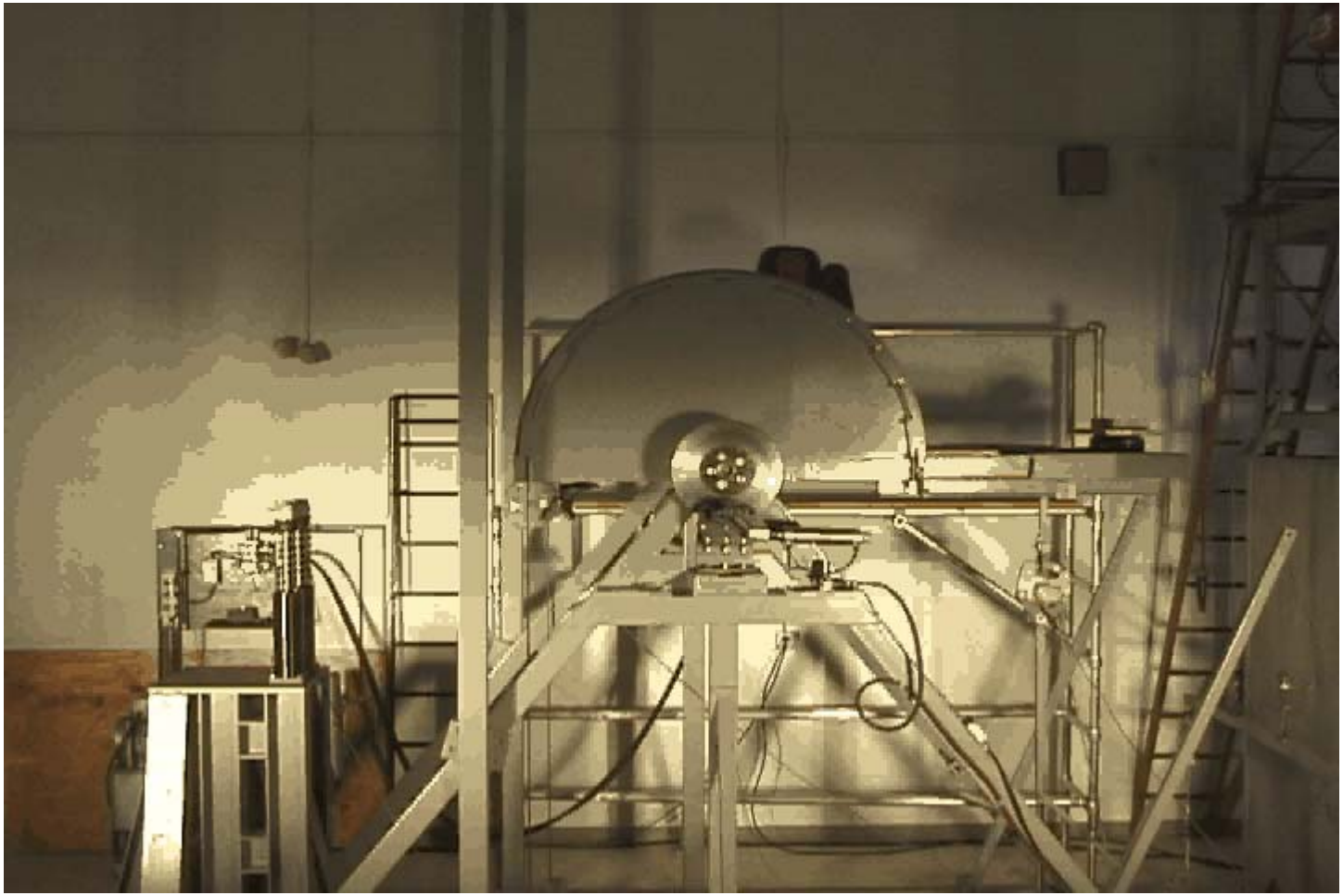
Objective

- Evaluate the current state-of-the-art of restraint systems in a rollover condition.
- Examine *Occupant Head Excursion* of various restraint configurations.
- Build research data for aiding in the potential test procedure development for assessing restraint effectiveness.

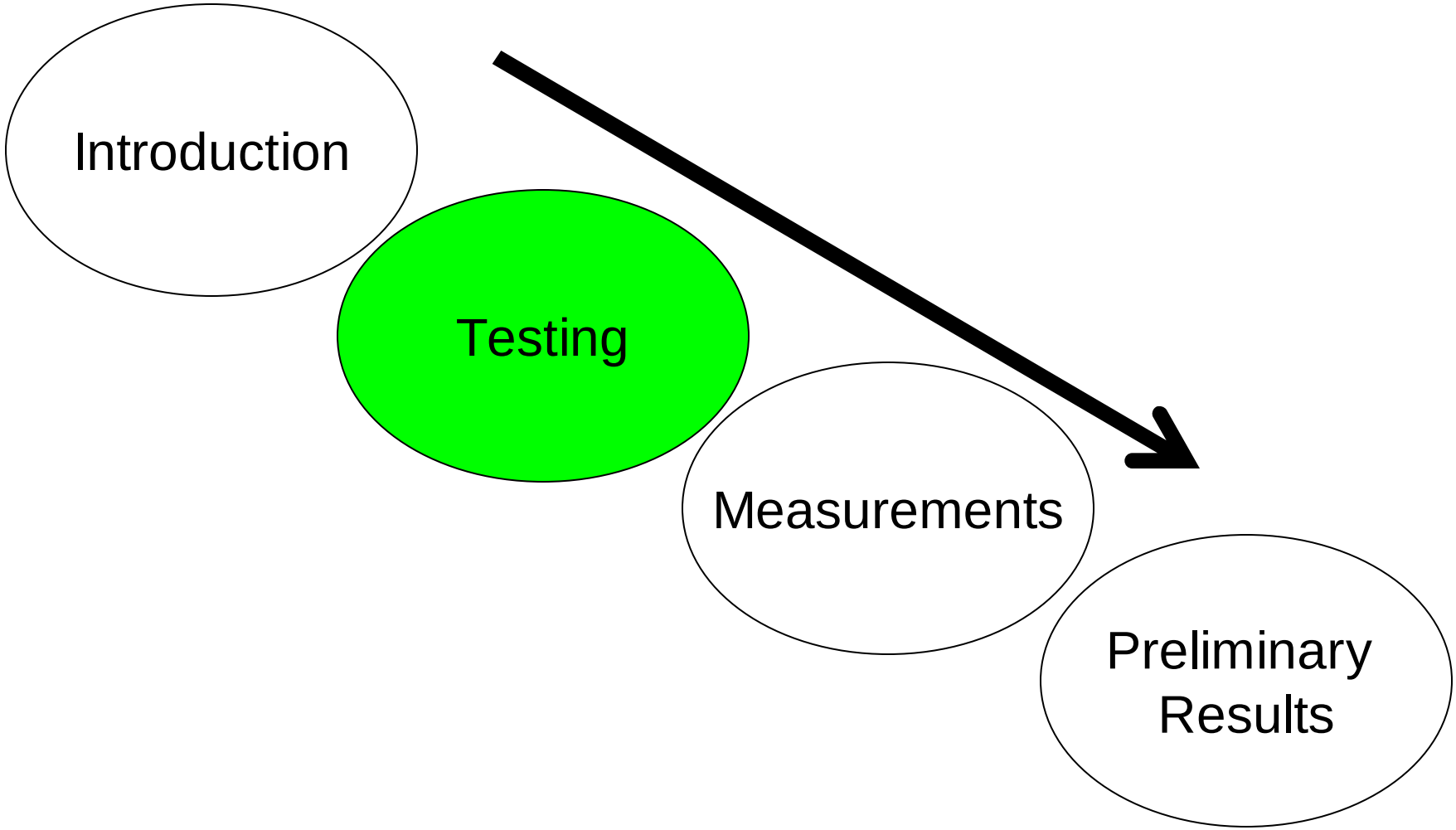
RRT Test Fixture



RRT Overview Video



Testing



Test Protocol

- Evaluate Restraint Performance in a Rollover Scenario
- Phase I uses 50th male Hybrid III (instrumented head, neck and chest)
- Each Configuration repeated 3 times
- Use video analysis to evaluate occupant head excursion

Phase I Test Matrix

Integrated 3-Point:

No Pretensioner **A**

SWAP No Pretensioner **B**

Other:

4-Point with two lower anchor Pretensioners **J**

Non-Integrated 3-point:

Lower D-Ring (No Pretension) **C**

Upper D- Ring (No Pretension) **D**

Retractor Pretensioner **E**

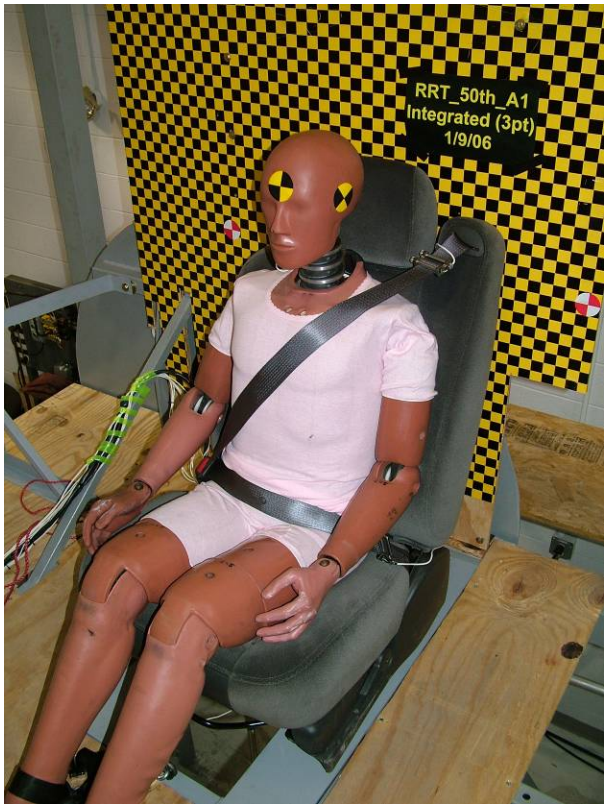
Buckle Pretensioner **F**

Retractor & Buckle Pretensioner **G**

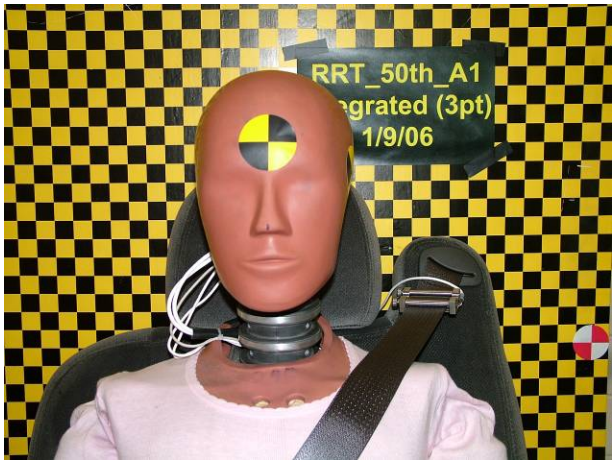
Motorized Pretensioner **H**

Motorized & Buckle Pretensioner **I**

Configuration A
Integrated 3 pt. Seat

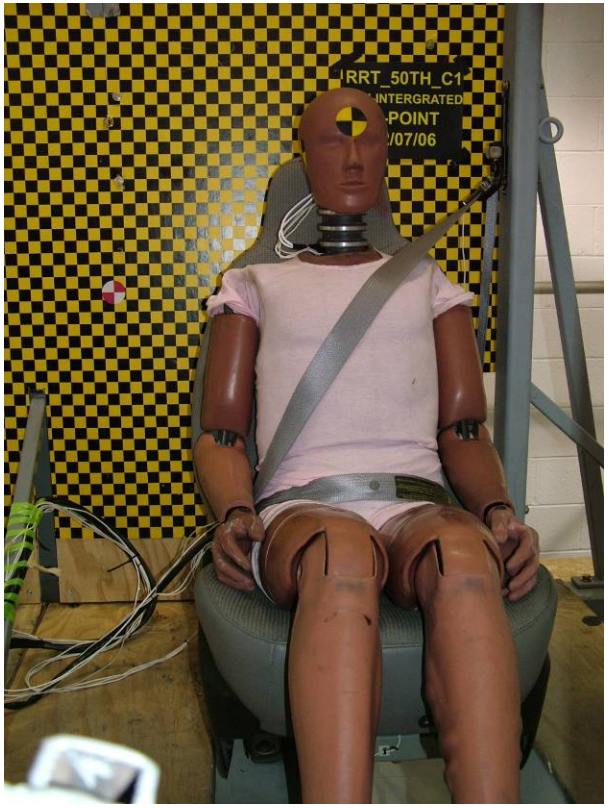


PRE

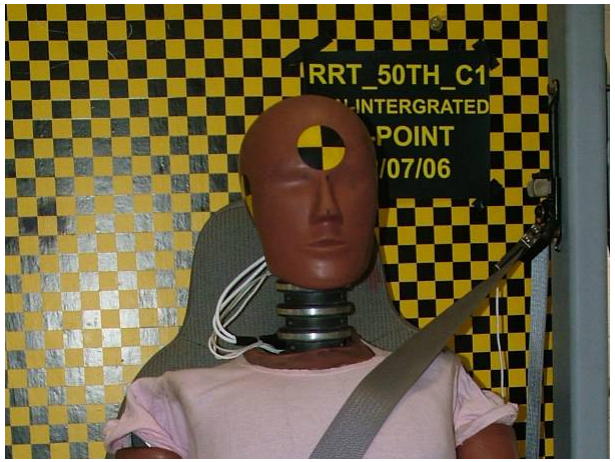


POST

Configuration C
Non Integrated 3 pt. Seat



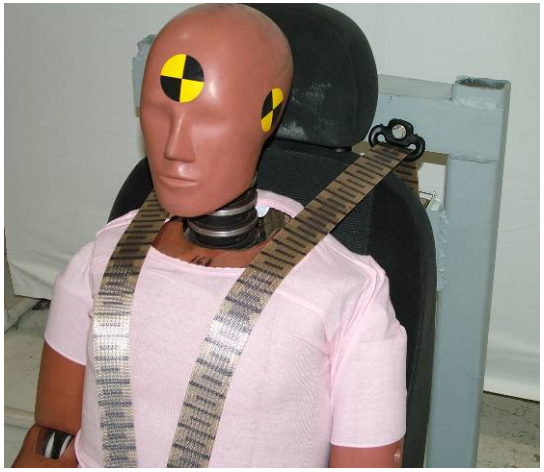
PRE



POST

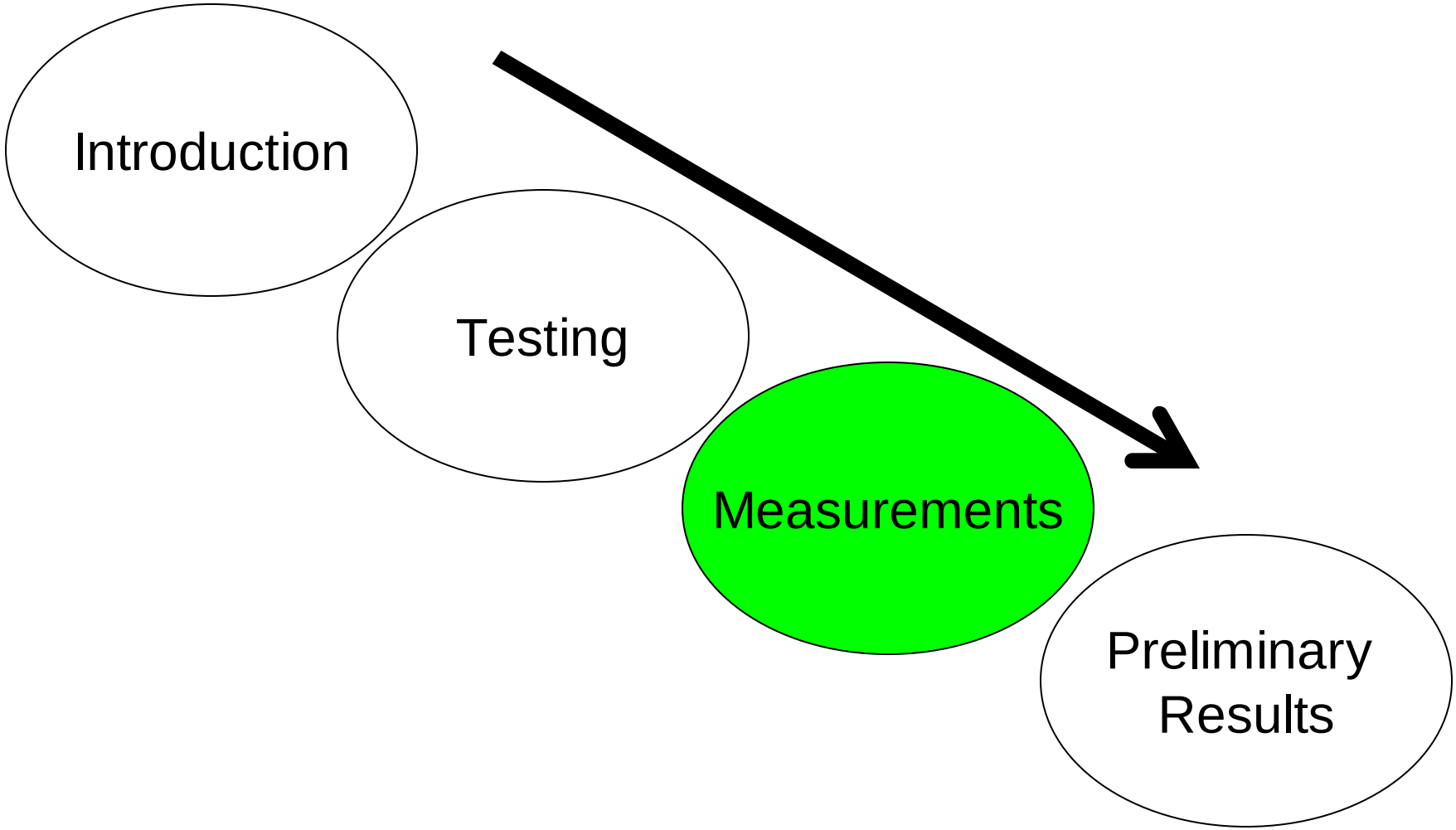
Configuration J
4 Point Belt

PRE



POST

Measurements



Fixture Dynamics

- Roll Rate **(Goal: 315 deg/s at impact)**
- Impact Force**(~100000 N)**
- Shock Deflection **(up to 25 cm)**
- Acceleration Under Seat **(~50 g)**
- Lap Belt Force
- Shoulder Belt Force

Excursion

Static Test

Pre and Post Test

Dynamic Test

Pre and Post Test

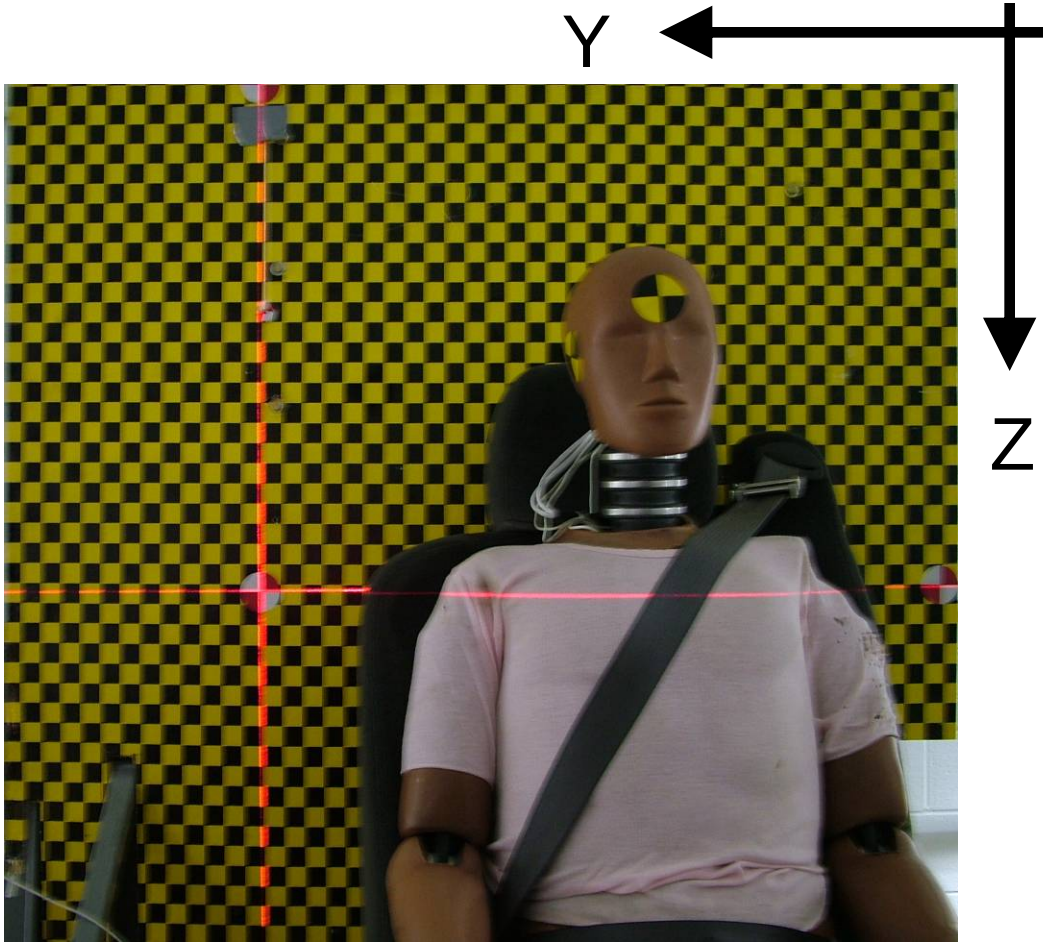
Video Analysis

Measure Dynamic Excursion

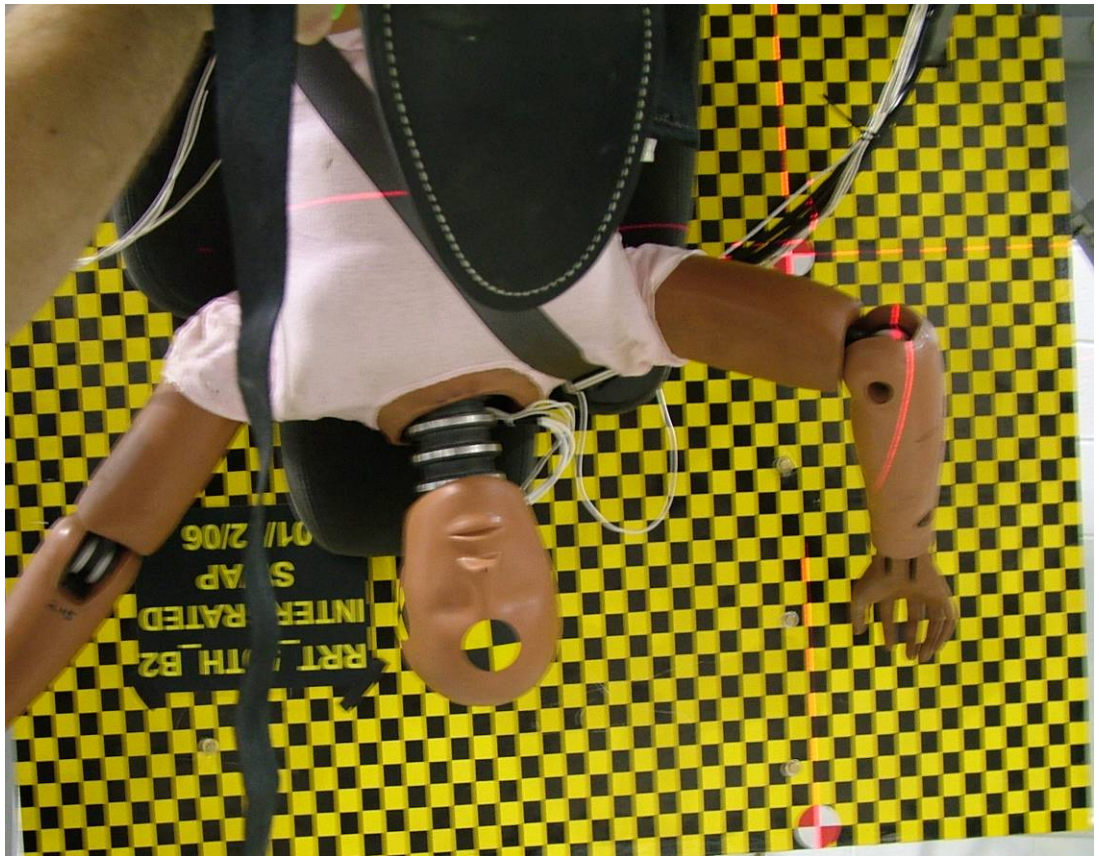
- 2 On Board Cameras (Low speed, 33 fps)
- 2 Off Board Cameras (High speed, 500 fps)

Excursion

Pre Test

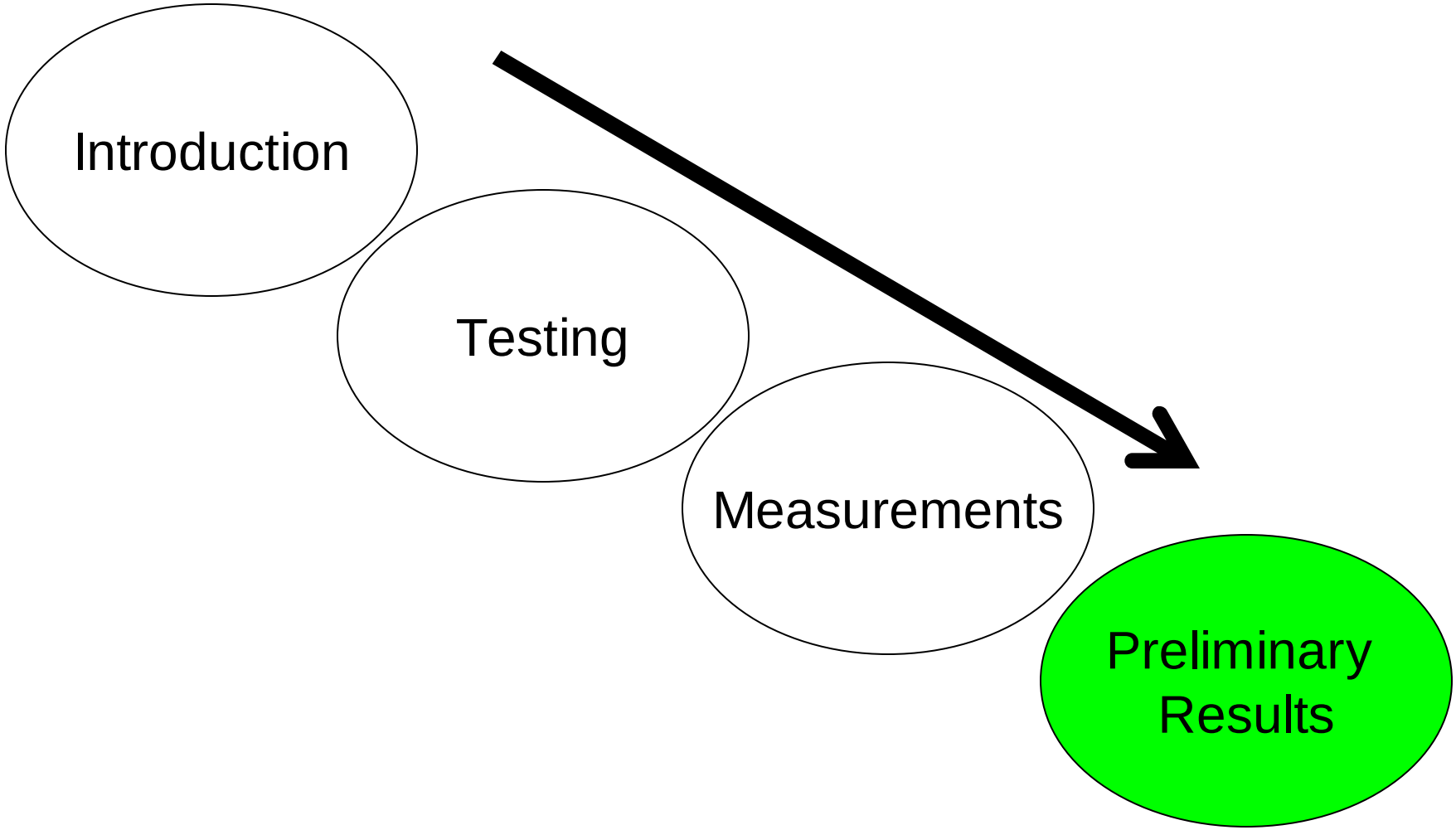


Excursion

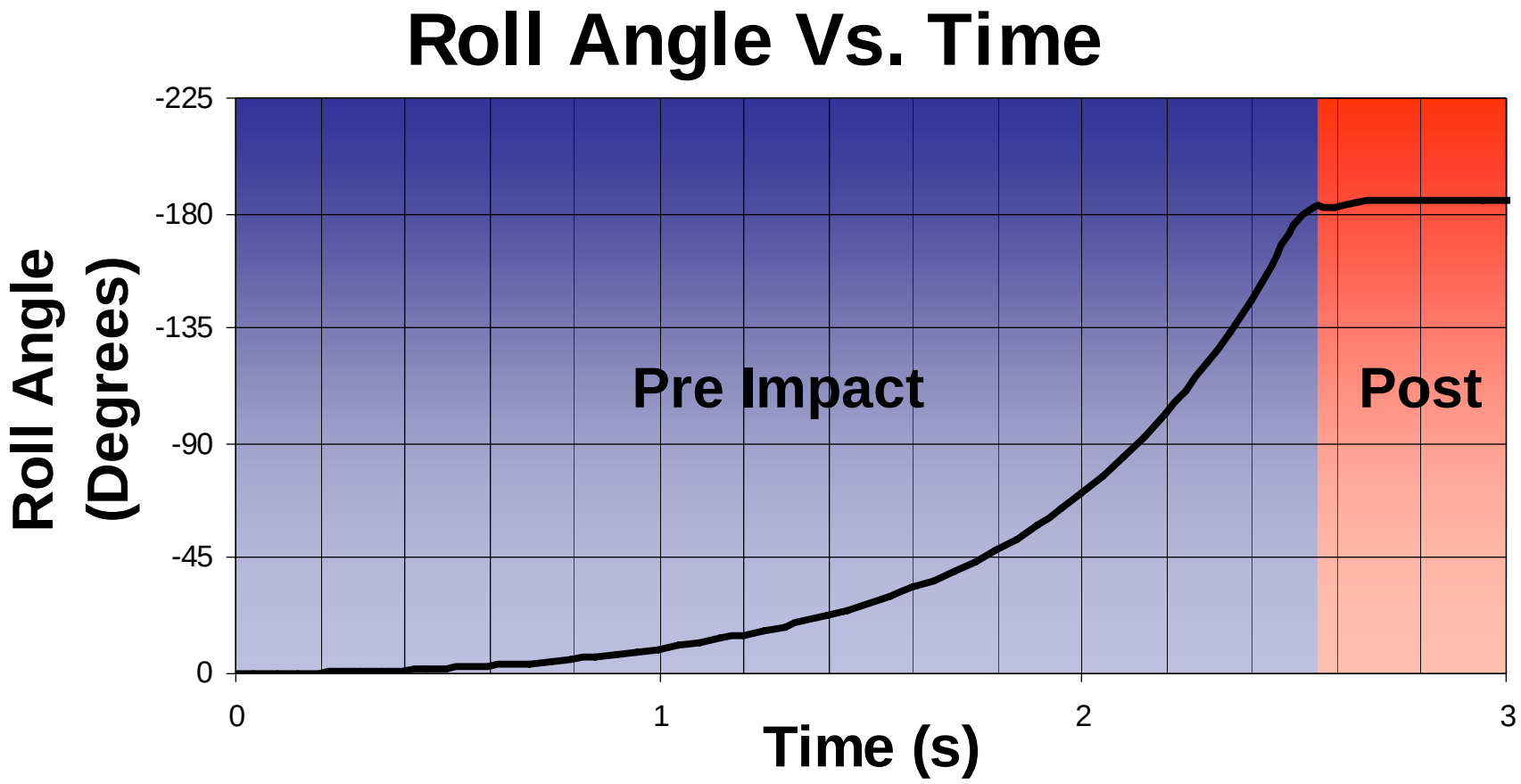


Post Test

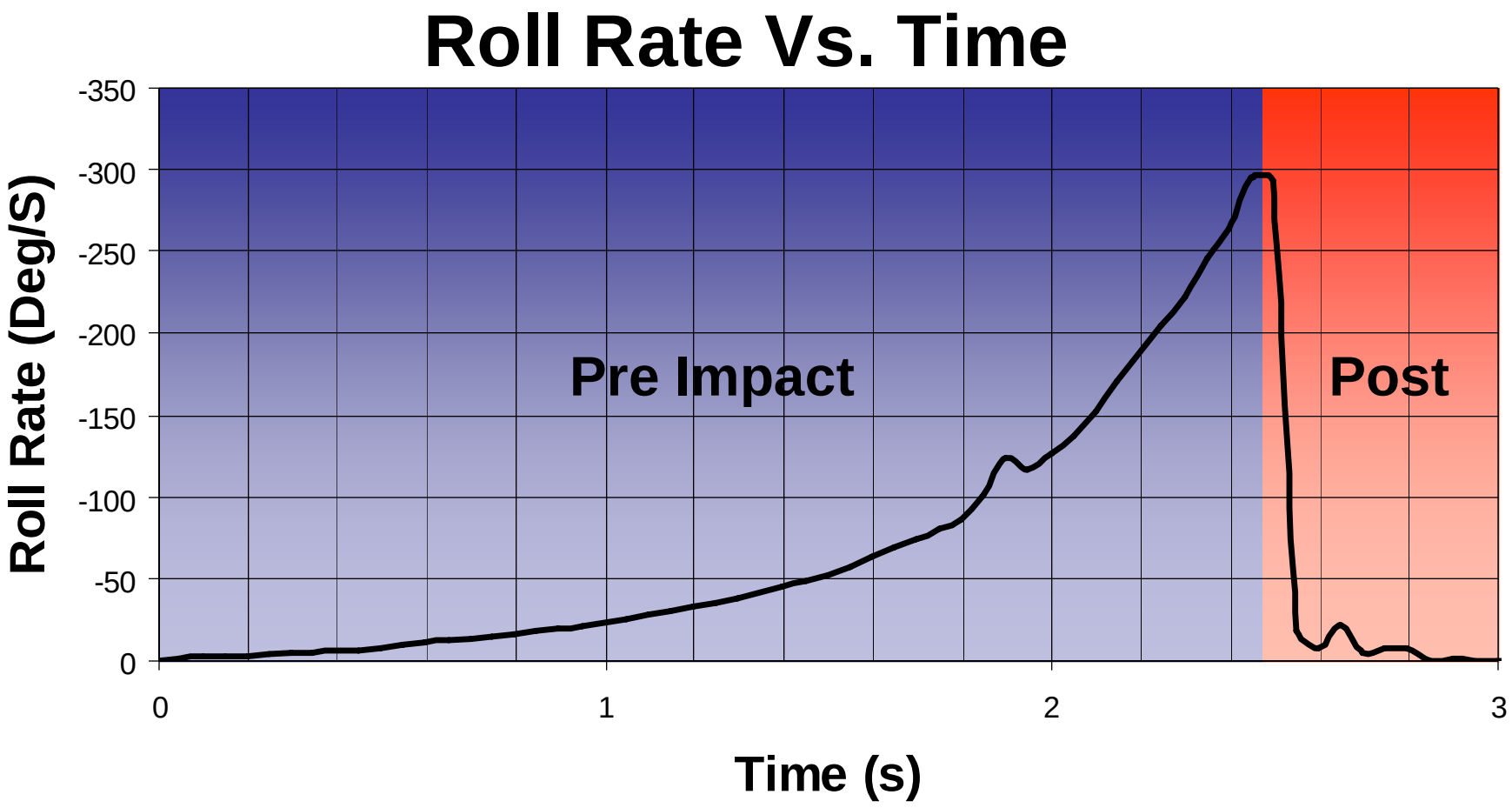
Preliminary Results



Roll Angle

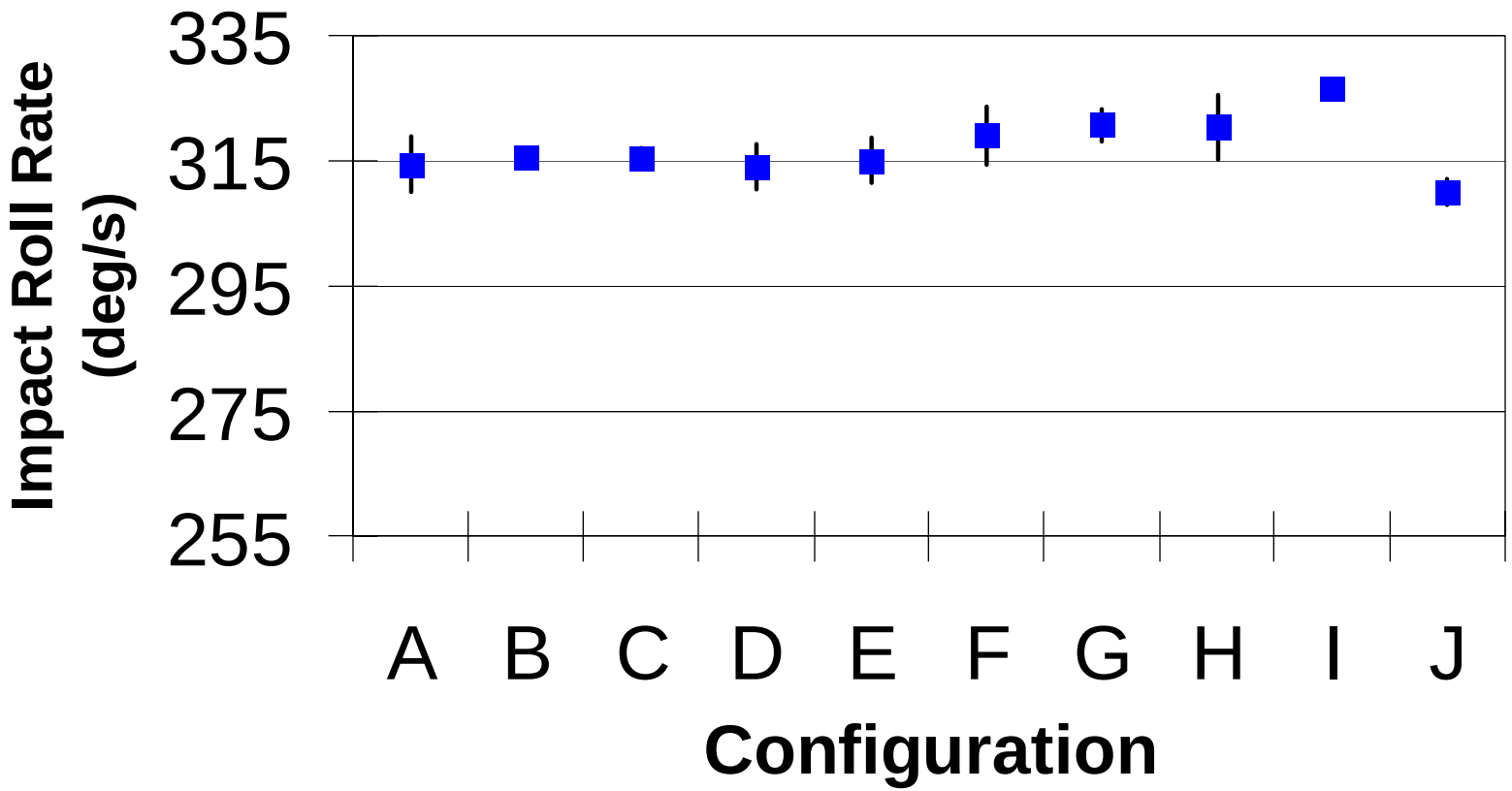

Roll Angle Vs. Time
Roll Angle (Degrees)
-225
-180
-135
-90
-45
0
Pre Impact
Post
0
1
2
3
Time (s)

Roll Rate


Roll Rate Vs. Time
Roll Rate (Deg/S)
-350
-300
-250
-200
-150
-100
-50
0
Pre Impact
Post
0
1
2
3
Time (s)

Impact Roll Rate

Average Impact Roll Rate (Deg/S) w/Std Deviation (RRT)



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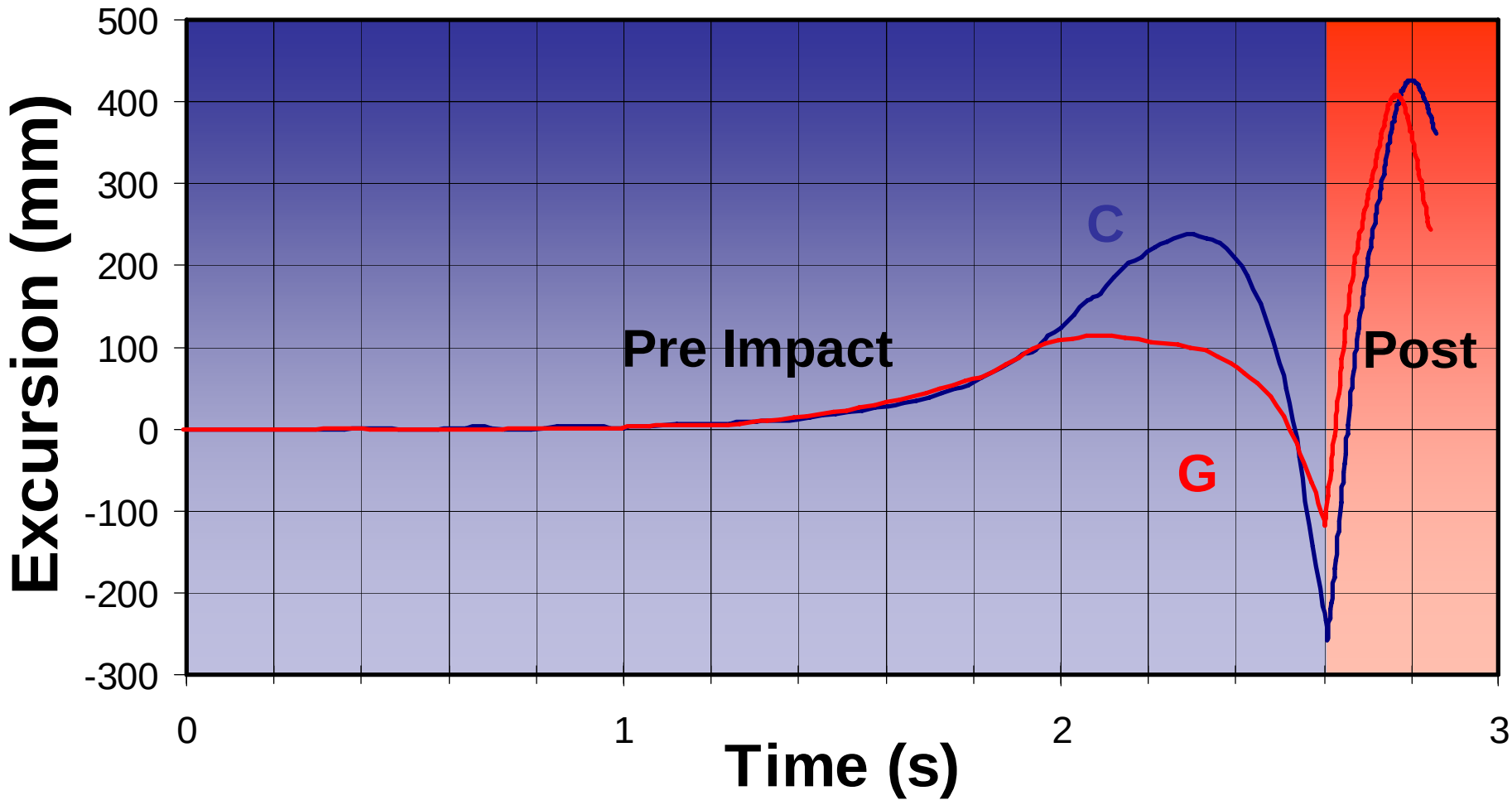
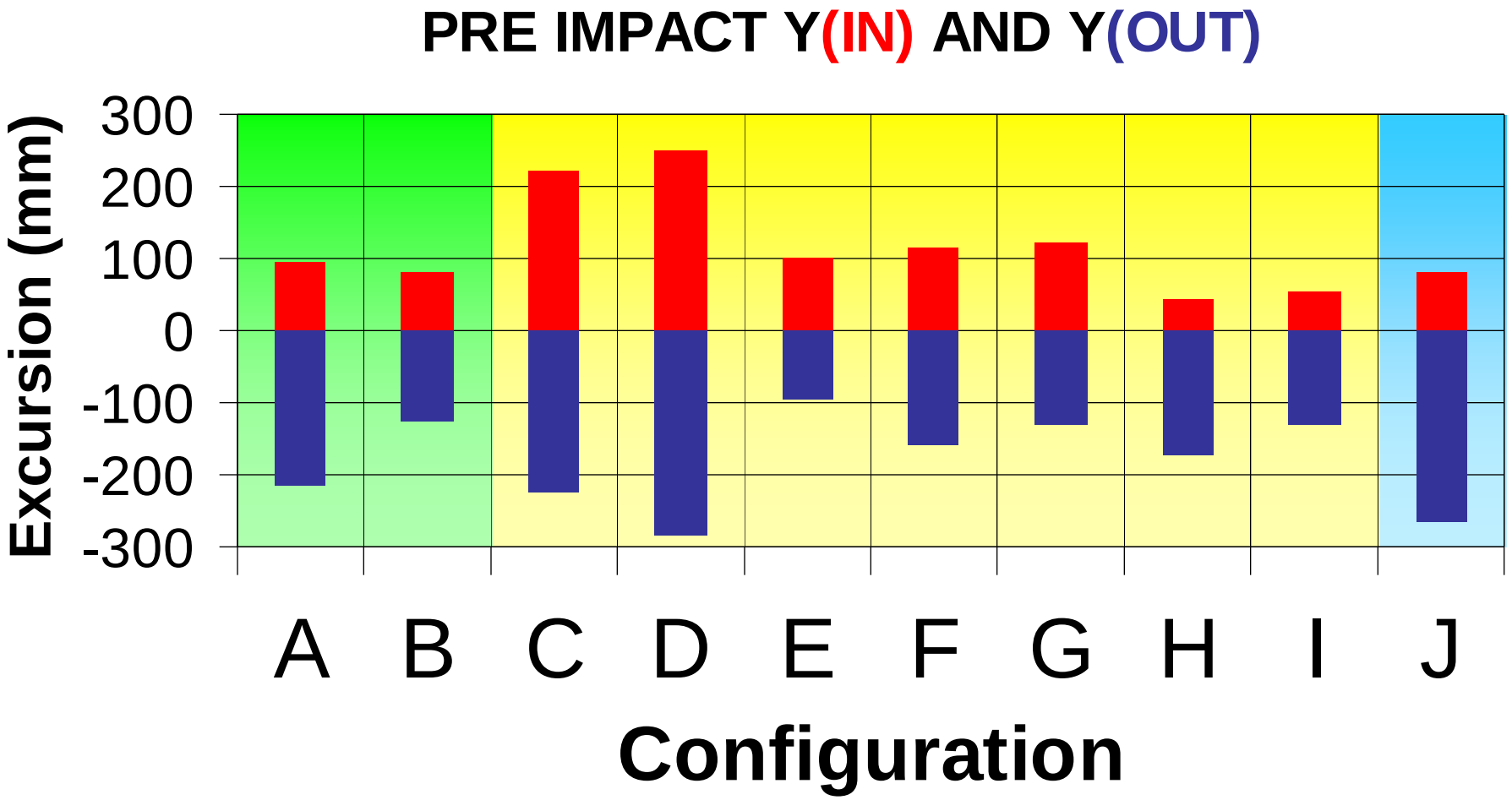
Results

Excursion
Y-Direction



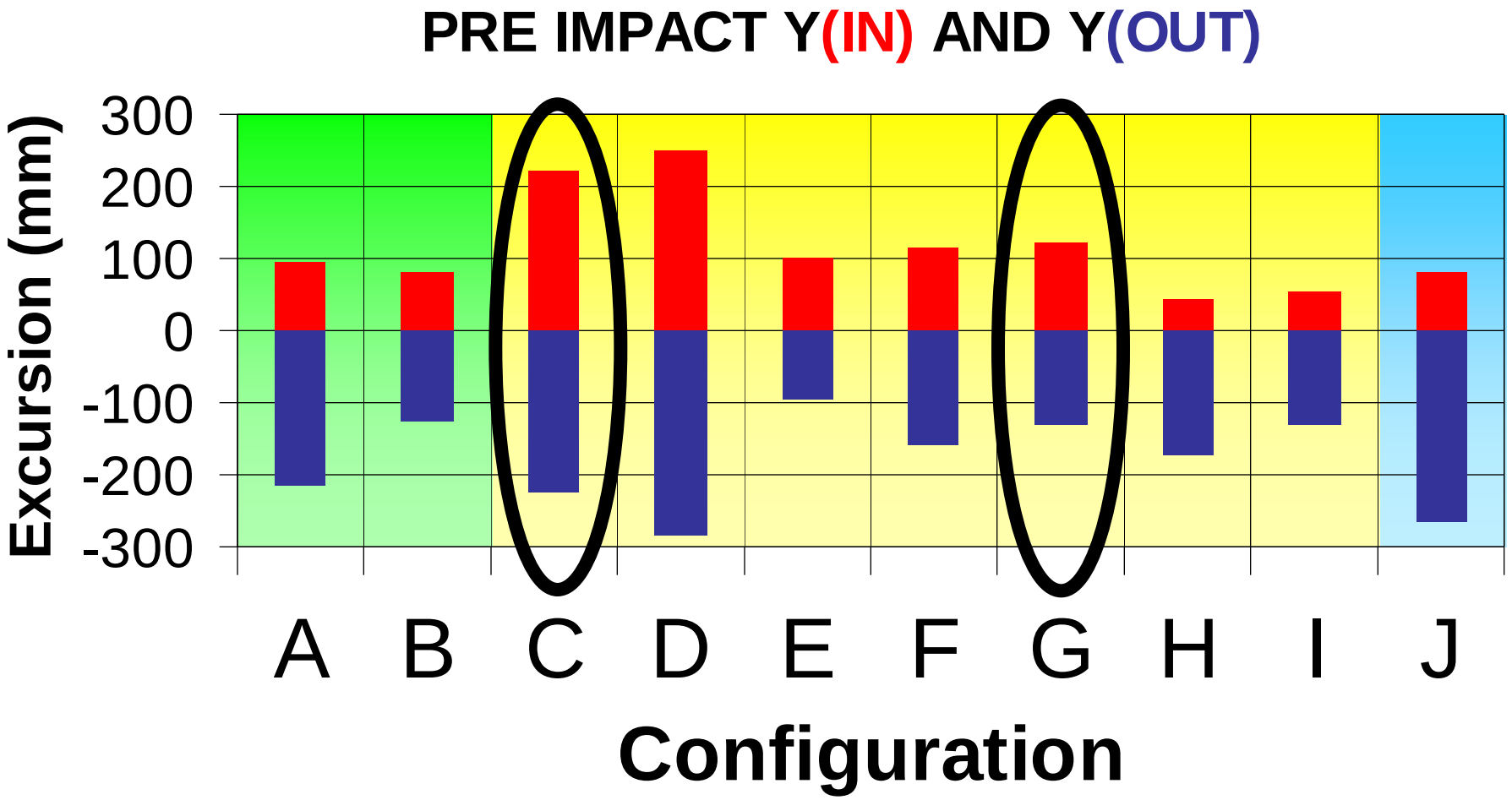
Results

Excursion
Y-Direction



Results

Excursion
Y-Direction



Video Comparison
Pre Impact

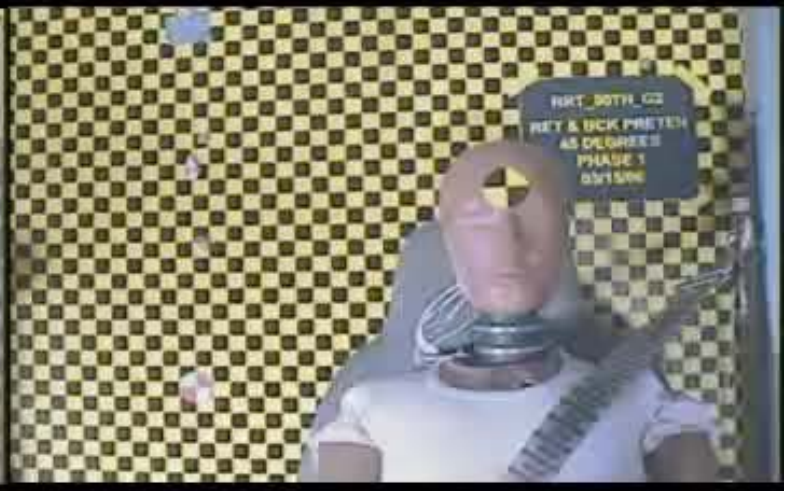
Test C

Test G

Video Comparison
Pre Impact

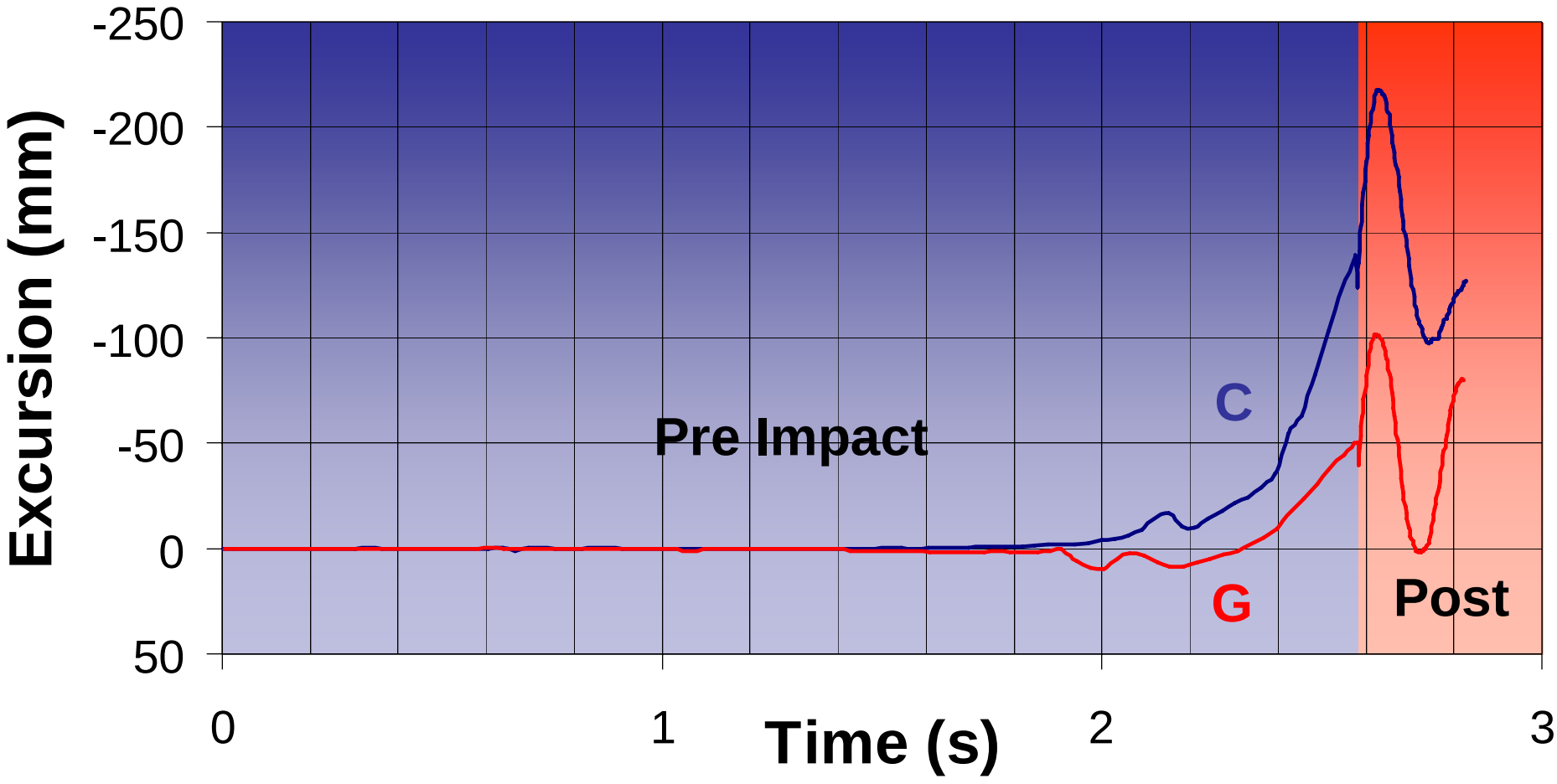
Test C

Test G



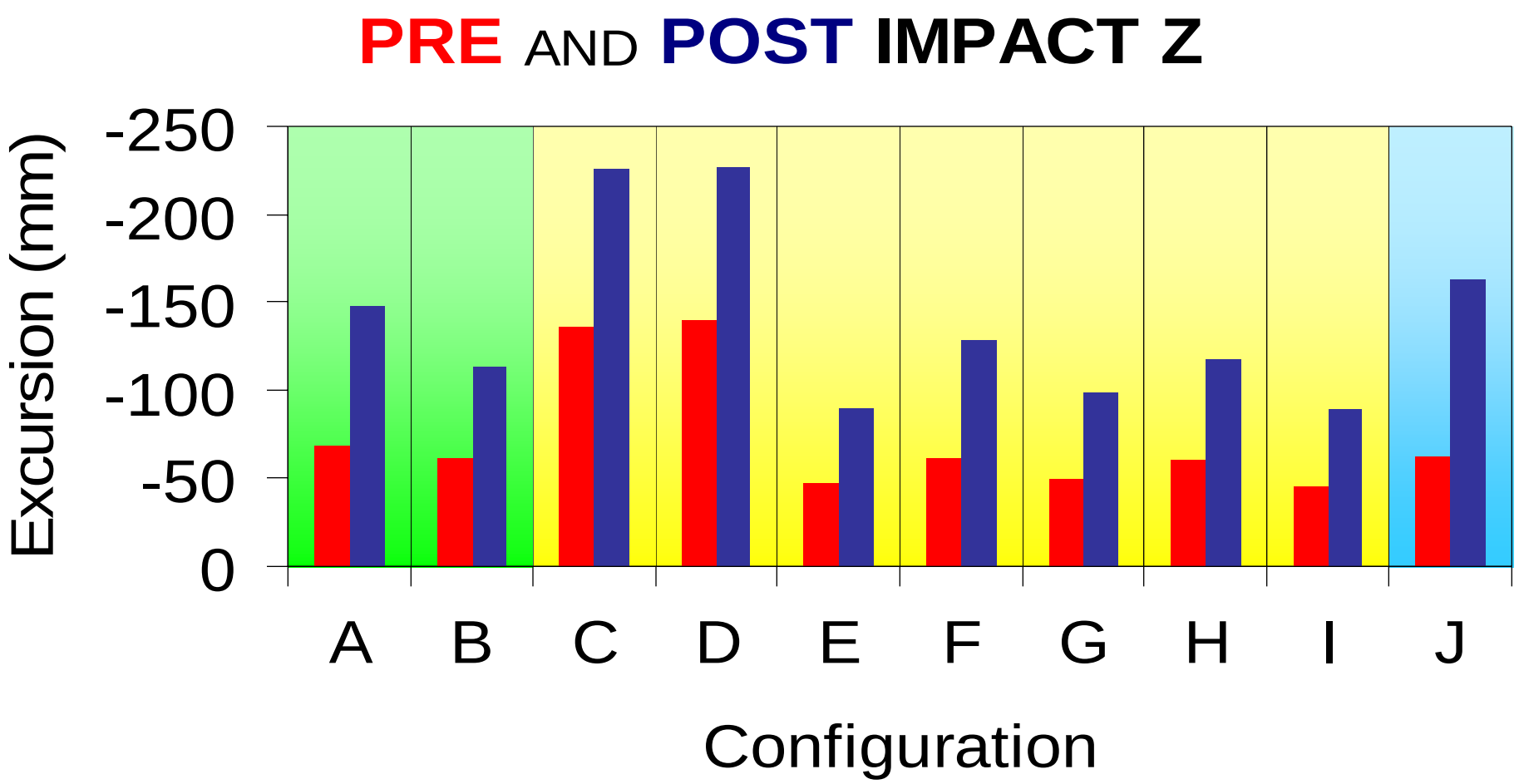
Results

Excursion
Z-Direction



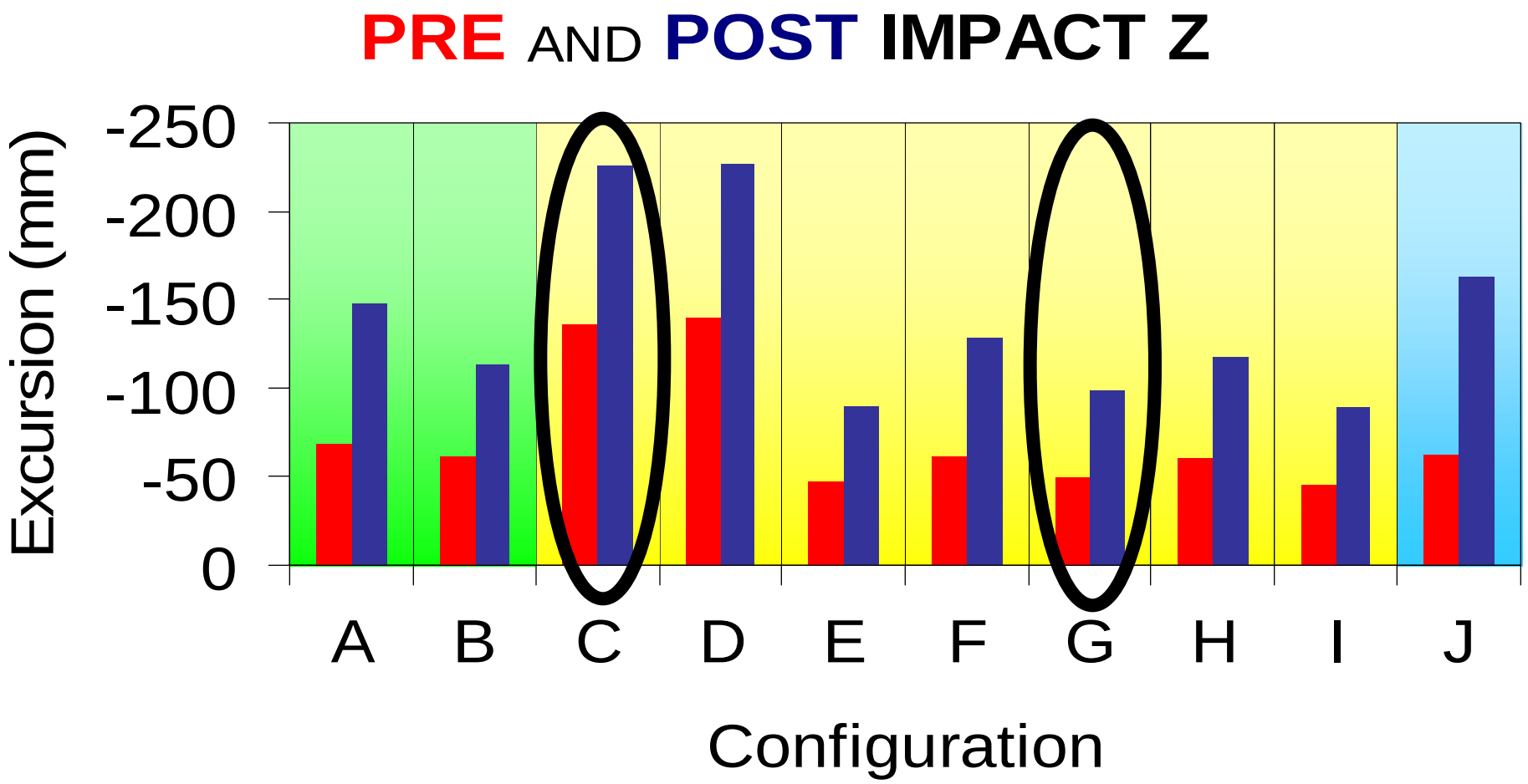
Results

Excursion
Z-Direction



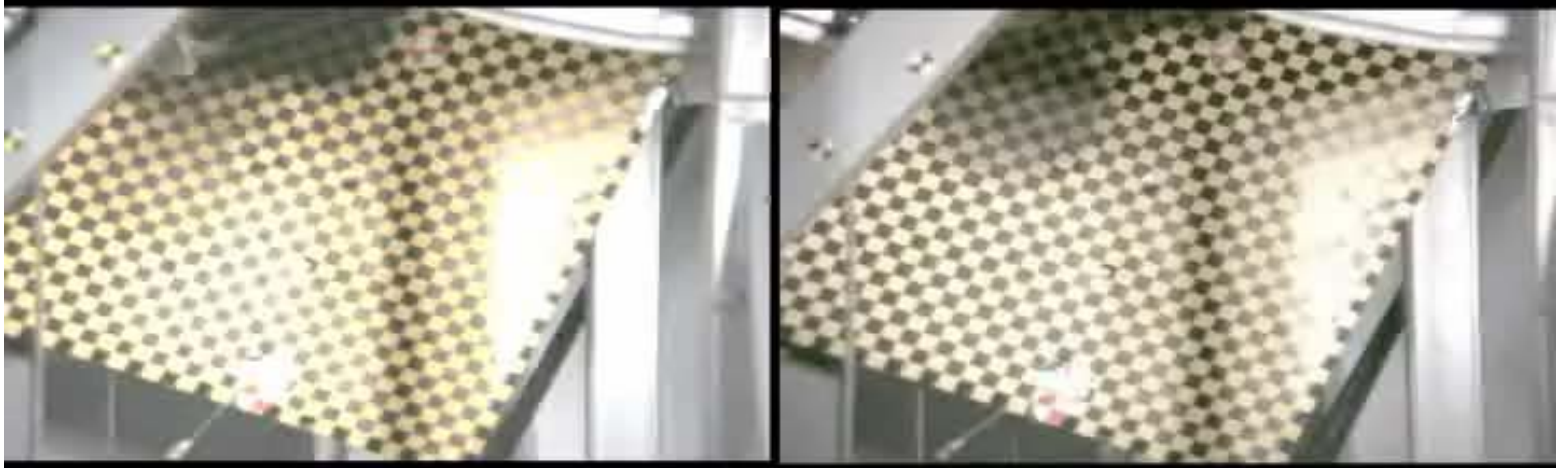
Results

Excursion
Z-Direction



Video Comparison
Post Impact

Test C **Test G**



Summary

- The RRT tester can provide repeatable dynamics.
- Pretensioning appears to reduce head excursion during the tests of the 50th male.
- Future studies will include different occupant sizes, restraint technologies and dynamic parameters.
- Explore a way to include a partial cab to utilize other restraint devices (Rollover Bags)

Thank You

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