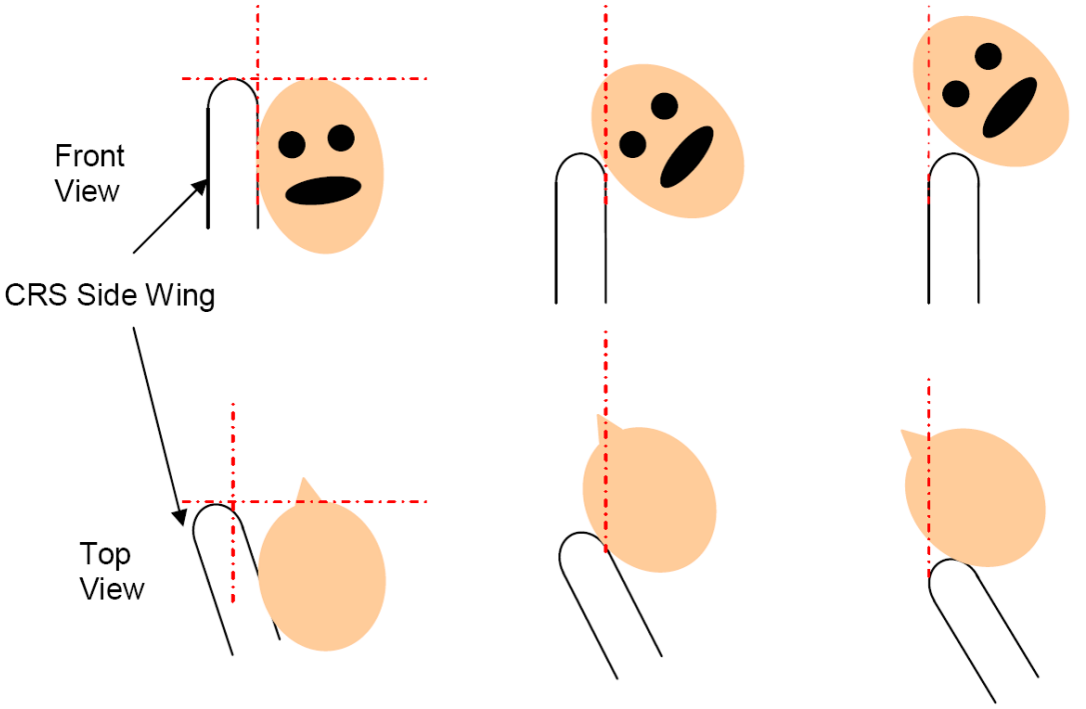
Study of GRSP side impact testing



Contained
- Head contained within inner surface of CRS side wing

Marginal
- Head passes inner surface but not outer surface of CRS side wing

Not Contained
- Head passes outer surface of CRS side wing

November 10th 2011

Takata corporation

Back ground

1 A method of CRS side impact testing has been discussed in GRSP.

2 The GRSP TP currently specifies a corridor for the velocity of the door relative to the trolley.

(This is equal to a ground velocity corridor for the test bench)

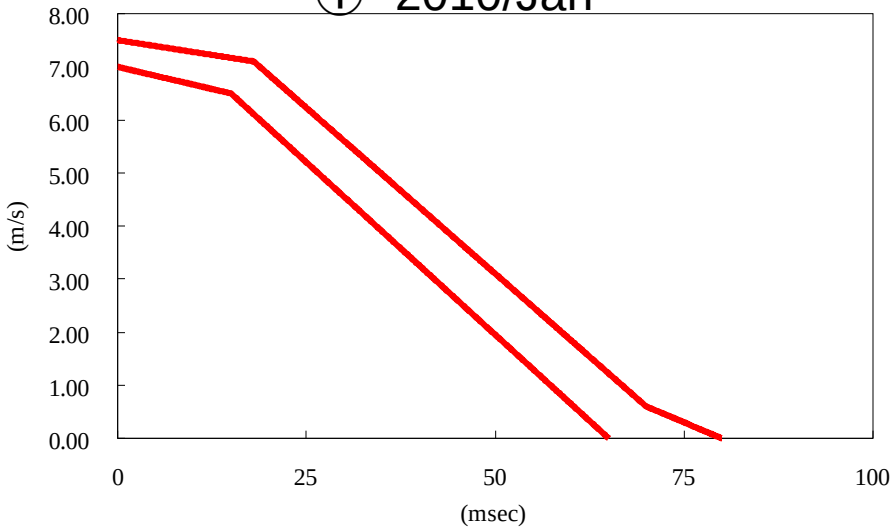
3 Our goals are to

① Make it possible to specify a impact door v-t that is compatible with an acceleration sled, and

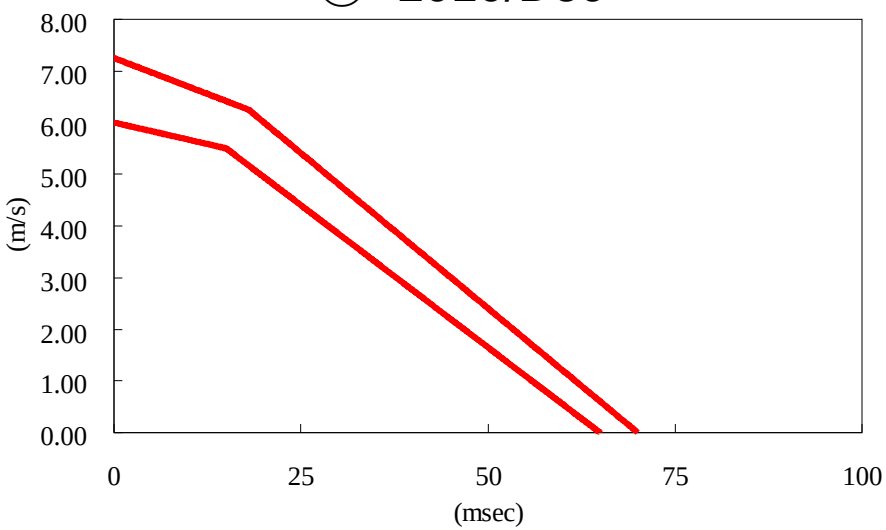
②Compare test results using different v-t corridors that meet the GRSP corridor with a v-t corridor that produces similar results but does not fall within the GRSP v-t corridor.

Relative Velocity Corridor between Trolley and Door Panel

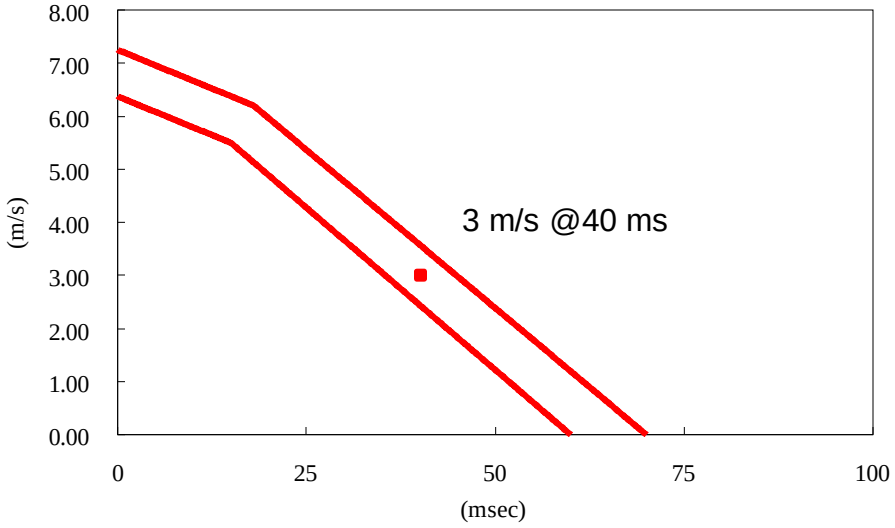
① 2010/Jan



② 2010/Dec



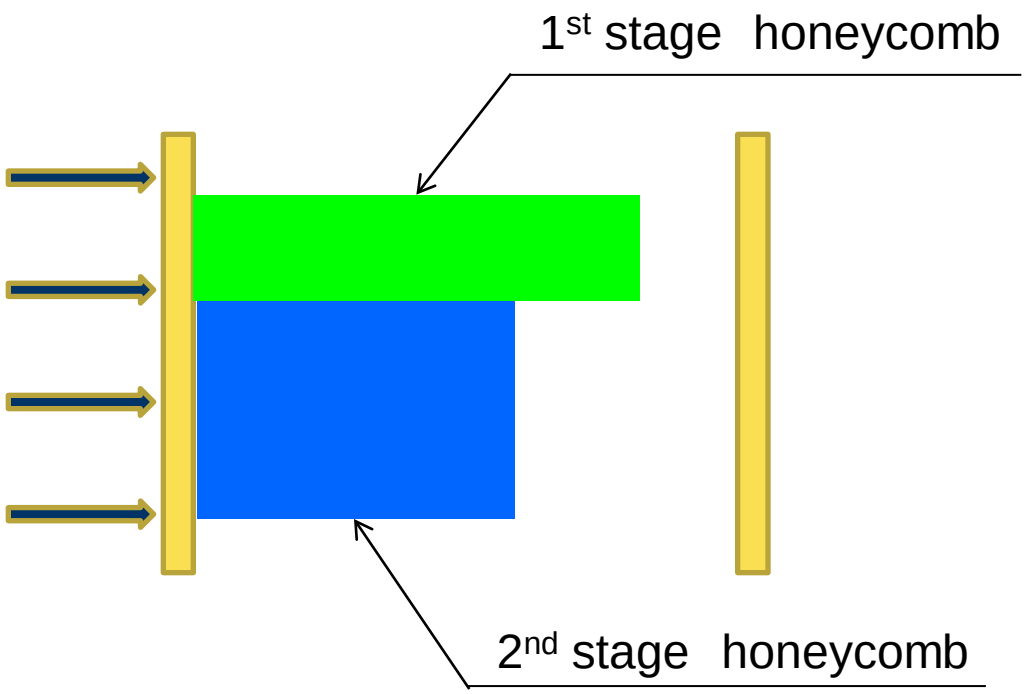
③ 2011/Sep

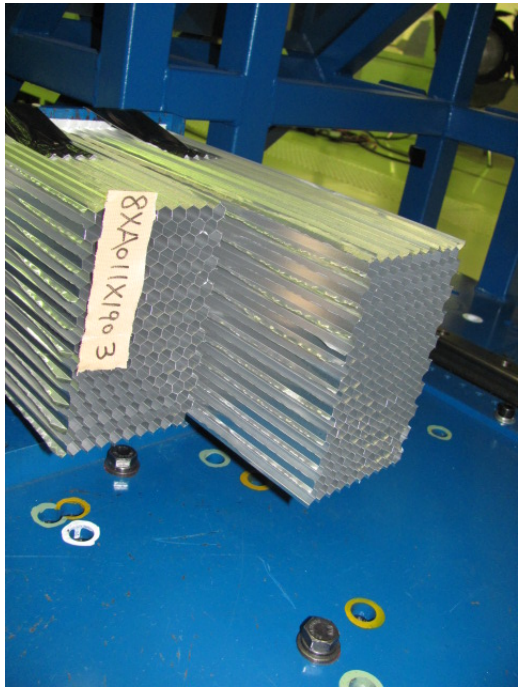


④ ？？？

Can a v-t Curve which is inside of Corridor ③ be created with HYGE SLED System?

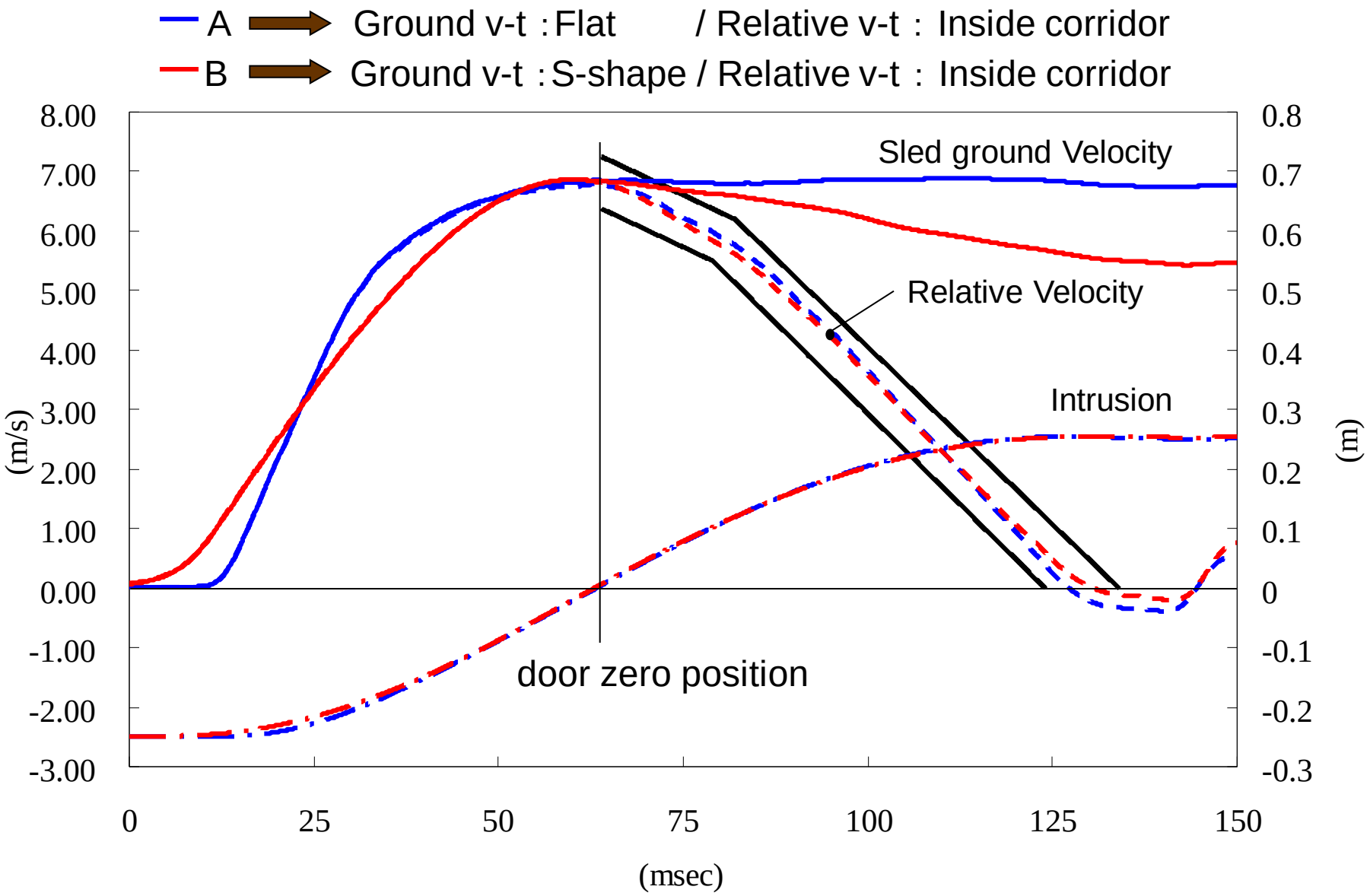
By the use of two-stage honeycomb



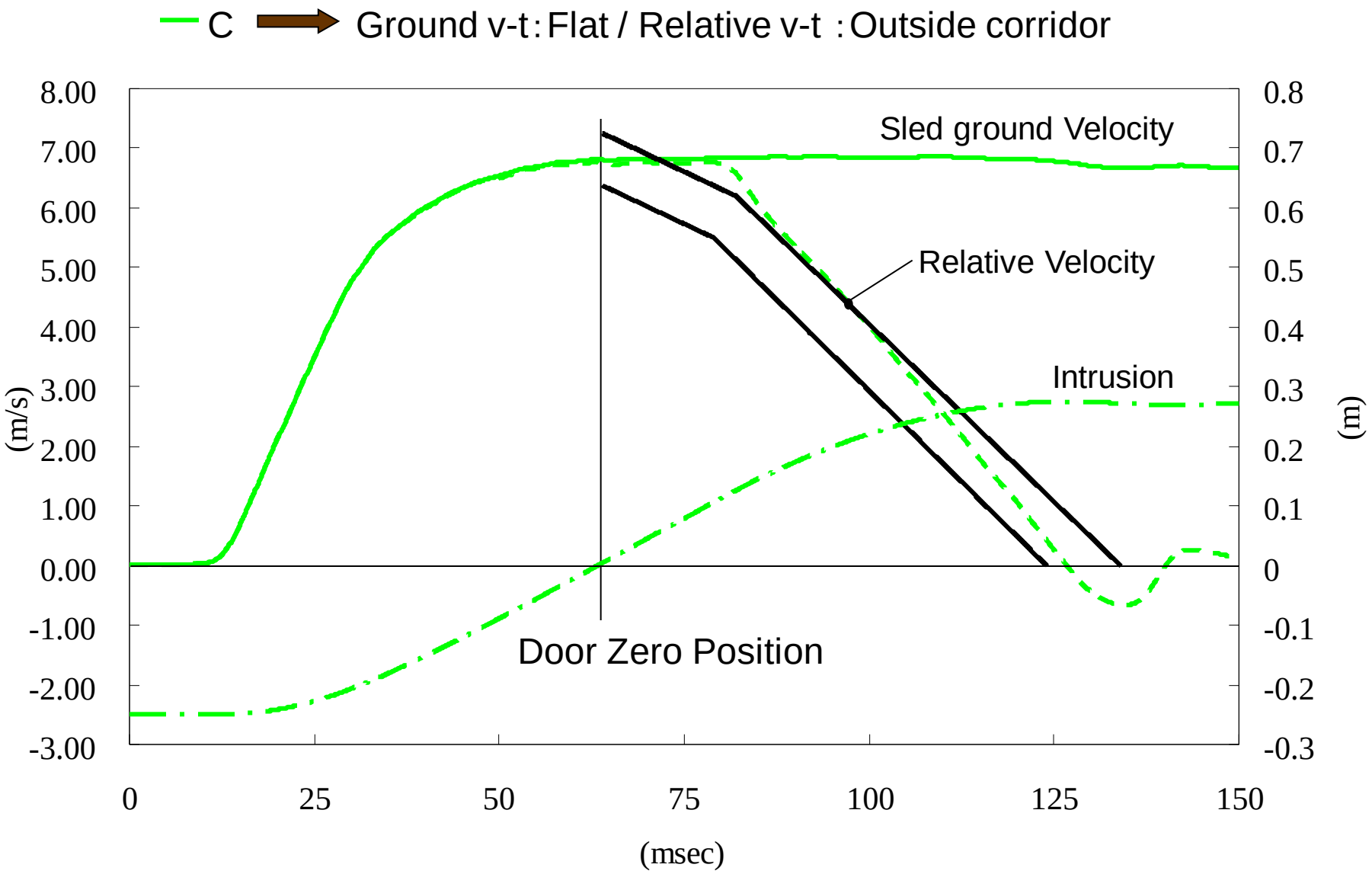


Test with two-stage honeycomb

Developed 2 v-t curves conformed to the corridor



Developed another wave pulse

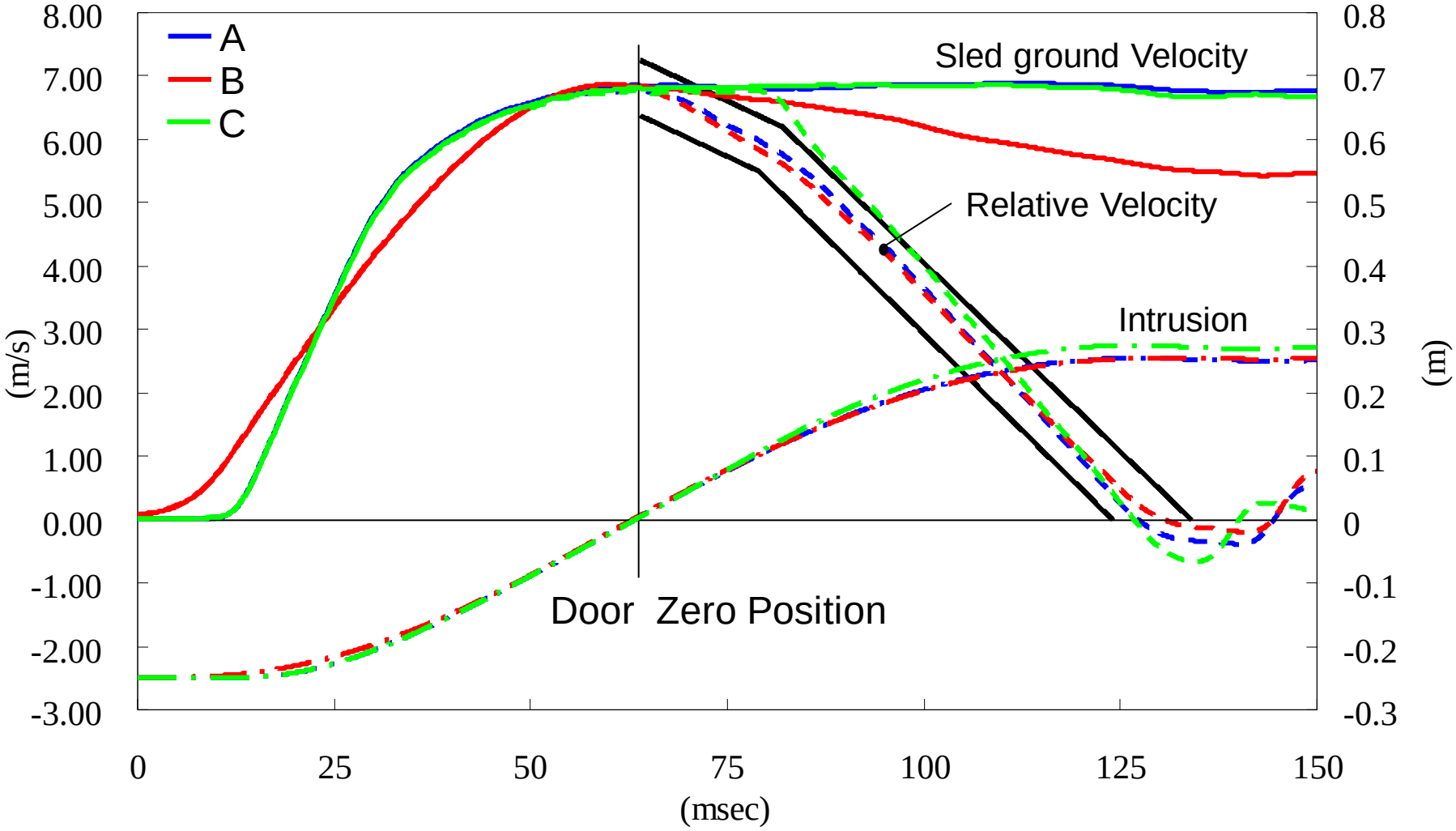


3 Test conditions

A → Ground v-t : Flat / Relative v-t : Inside corridor

B → Ground v-t : S-shape / Relative v-t : Inside corridor

C → Ground v-t : Flat / Relative v-t : Outside corridor



Comparison table

		RELATIVE v-t			
		INSIDE CORRIDOR		OUTSIDE CORRIDOR	
GROUND v-t	Flat	A	CRS ± (X1903)	C	CRS ± (X2002)
			CRS ² (S/B) (X1904)		CRS ² (S/B) (X2001)
	S-shape	B	CRS ± (X2001)		
			CRS ² (S/B) (X2004)		

Comparison of Dummy Loading

Comparison 1 A vs. B

1. CRS ±（ISOFIX CRS with Support leg / No Tether Strap）
2. CRS ²（Fasten with Seat belt ）

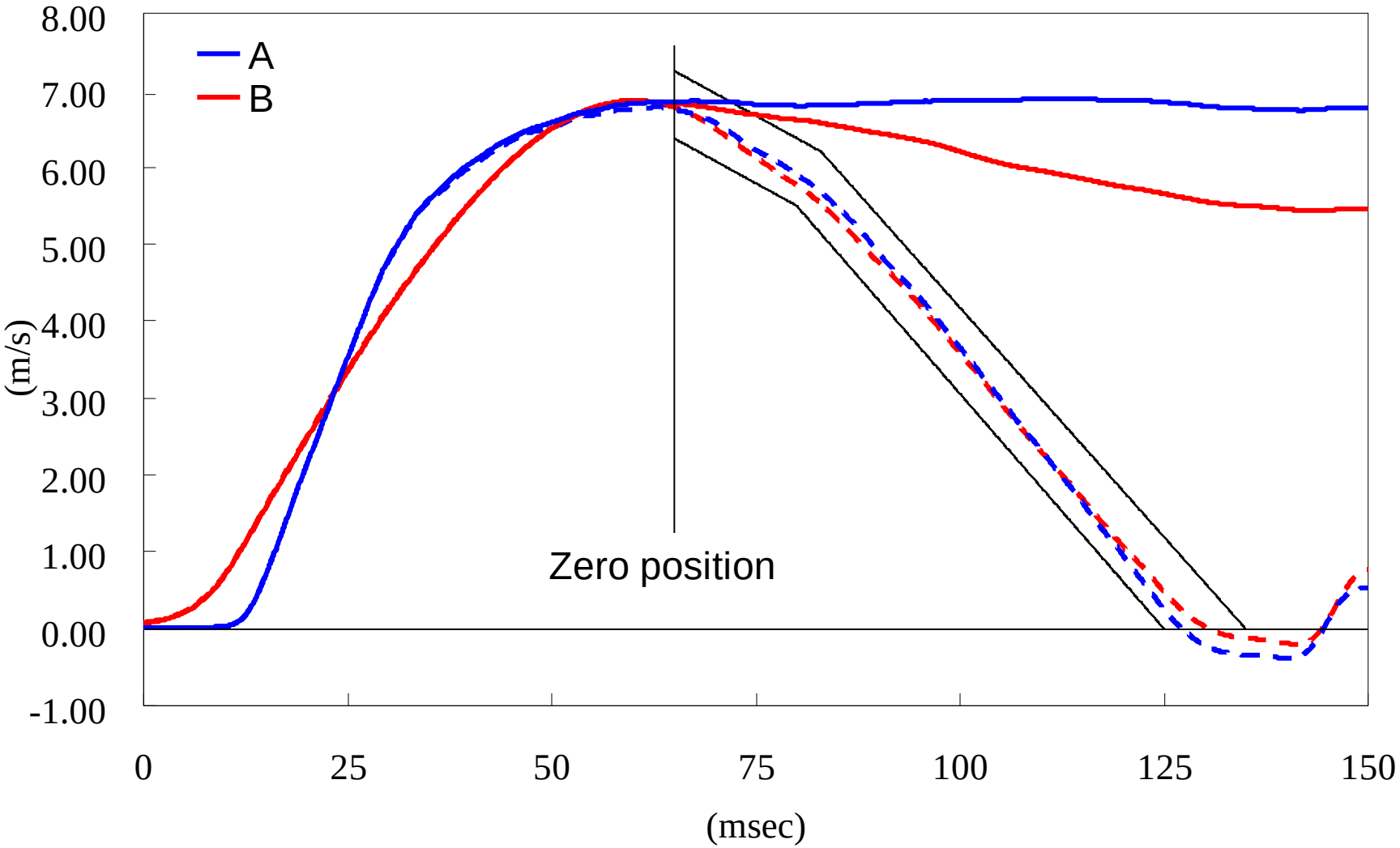
Comparison 2 A vs. C

1. CRS ±（ISOFIX CRS with Support leg / No Tether Strap）
2. CRS ²（Fasten with Seat belt ）

Test Condition

1. Dummy
   Q3s(SBL-C)
2. Impact door
   No Armrest
   Velocity = 25 km/h
3. ISOFIX Anchorage
   Slidable
4. Intrusion
   Max = 250 mm

Comparison 1

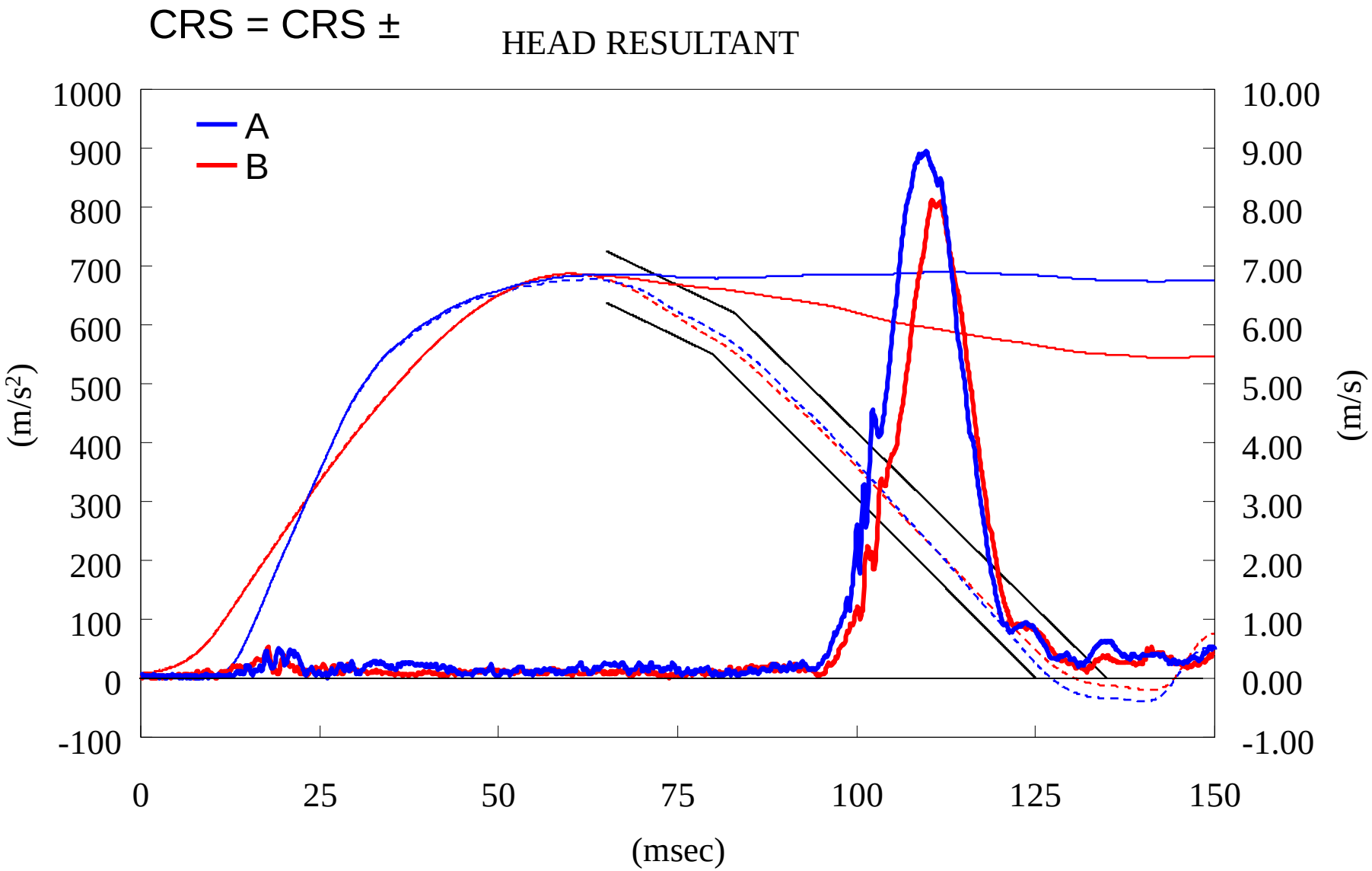


Comparison 1-①　CRS=CRS ±

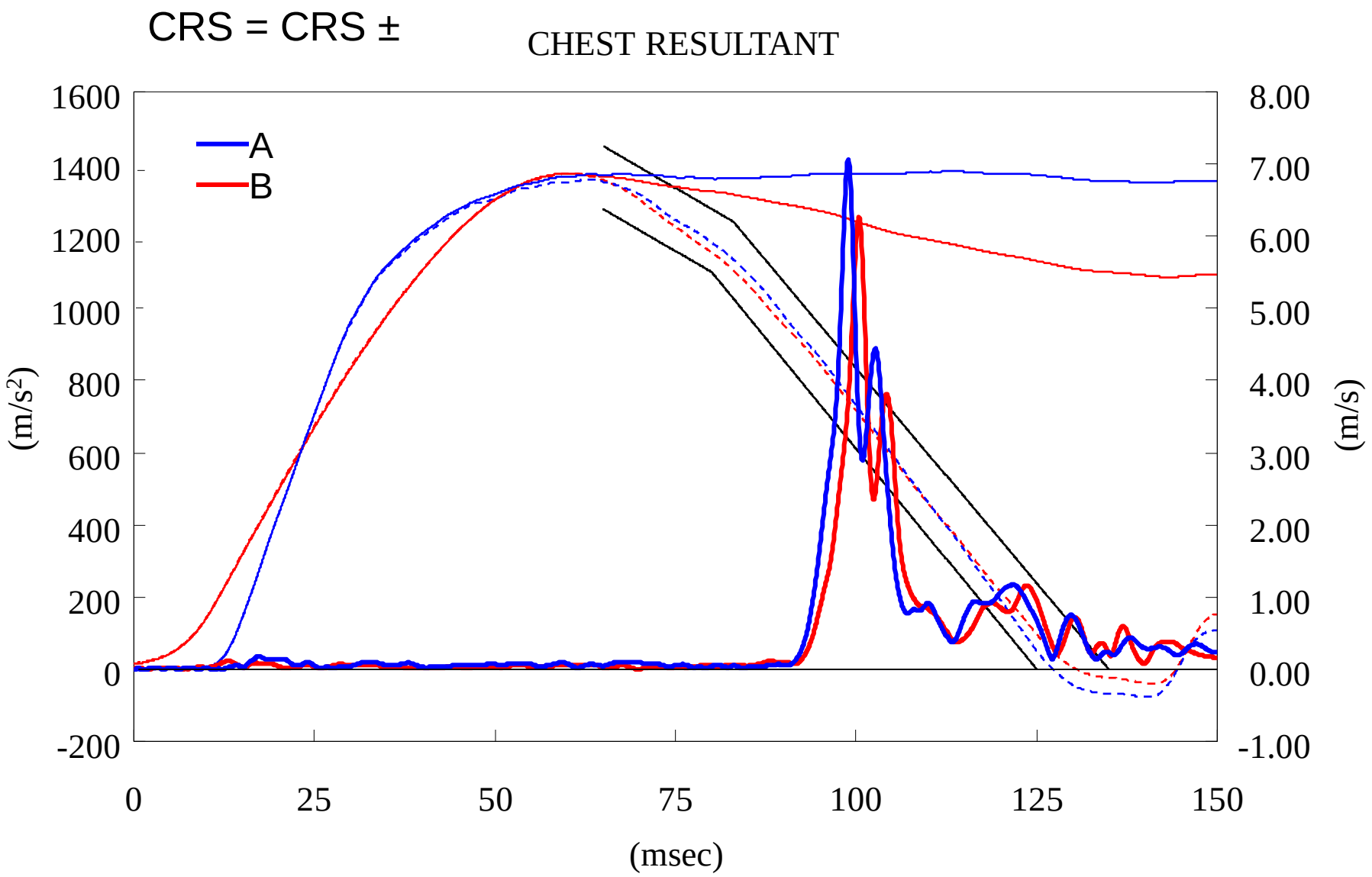
A （Flat curve v-t, Inside / x1903)

B (S curve v-t , Inside / x2004)

Dummy loading (Head acceleration)

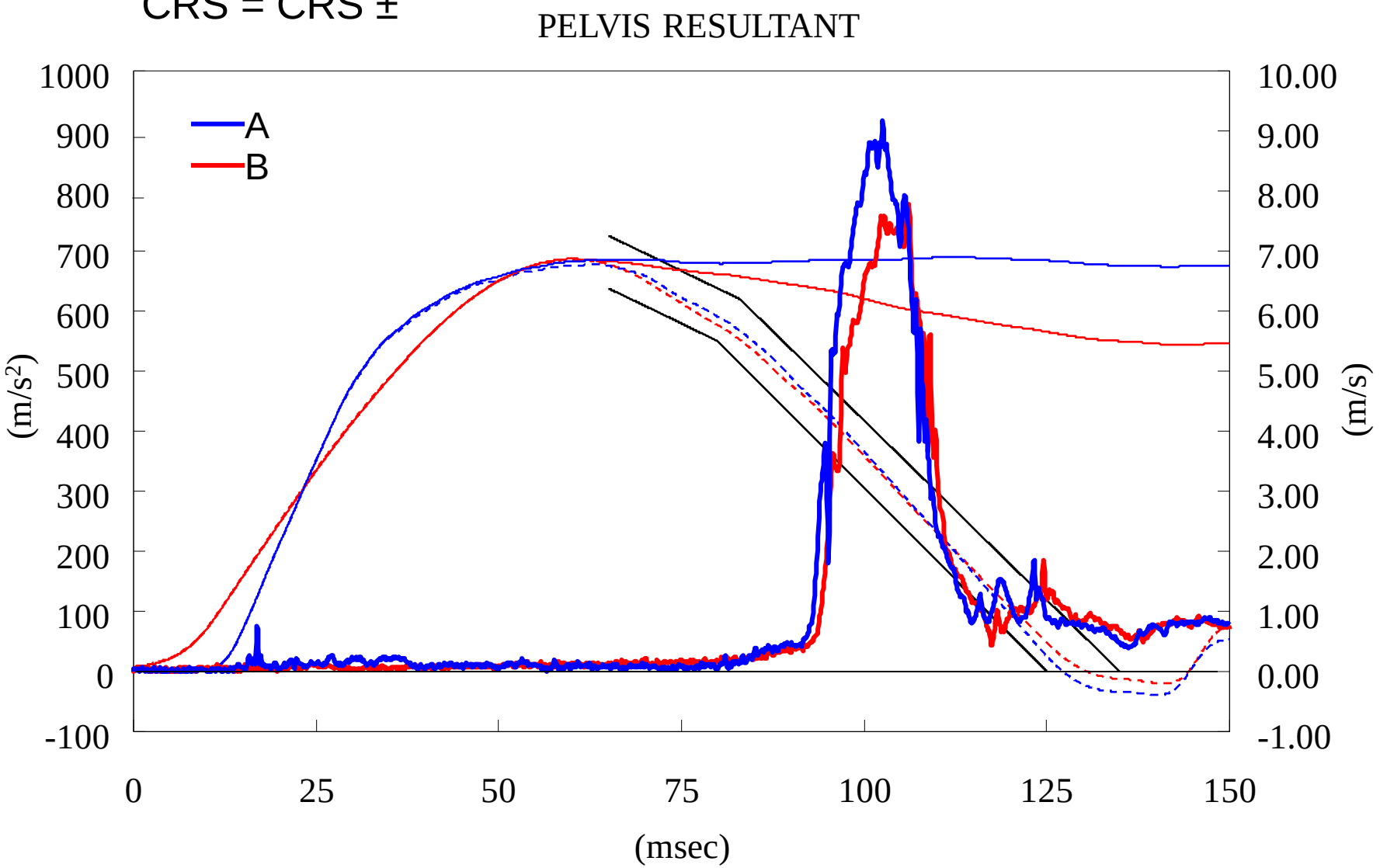


Dummy loading (Chest acceleration)



Dummy loading (Pelvis acceleration)

CRS = CRS ±

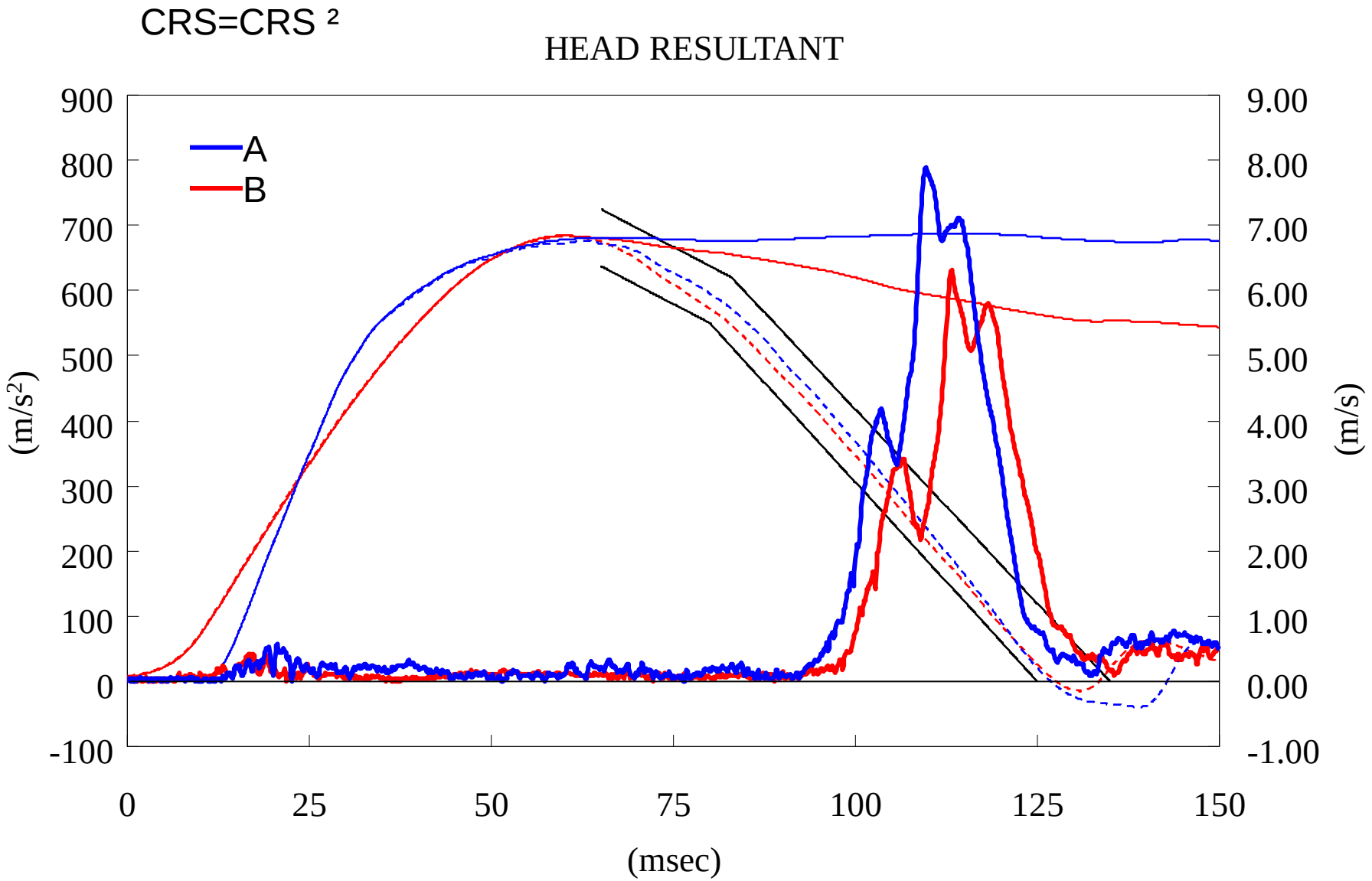


Comparison1-② CRS=CRS ² (S/B)

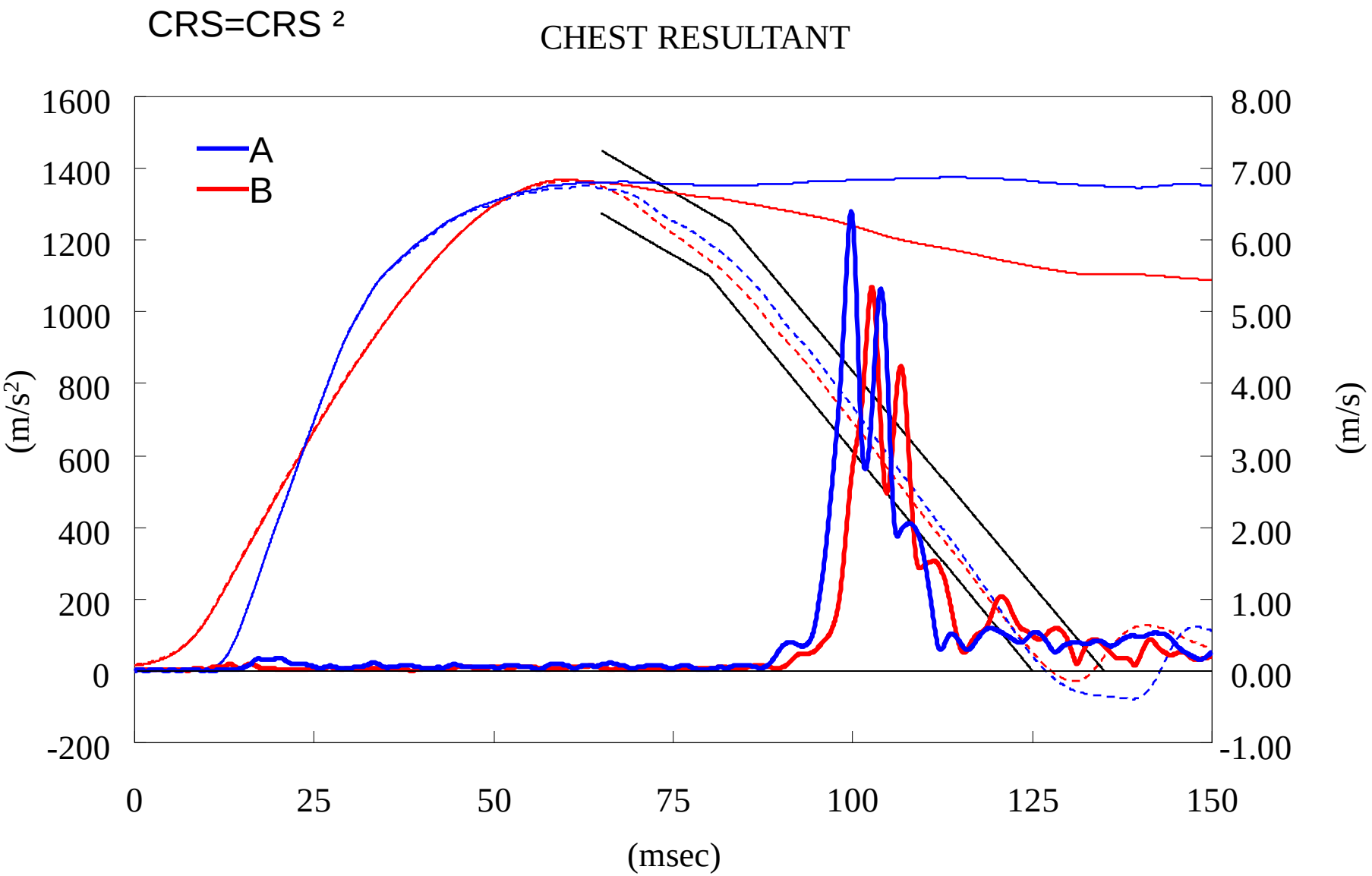
A （Flat curve v-t, Inside /x1904）

B（S curve v-t , Inside /x2005）

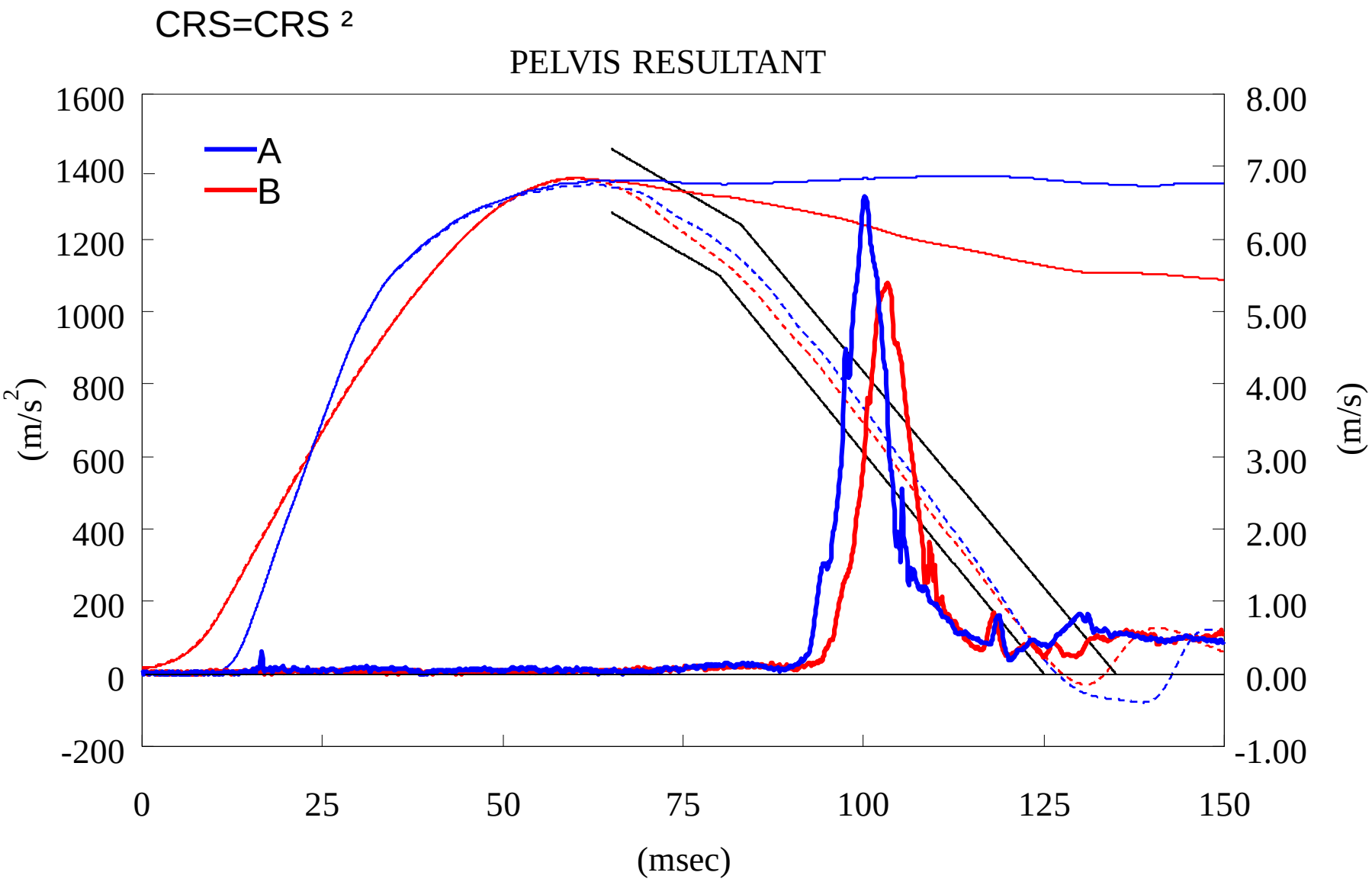
Dummy loading (Head acceleration)



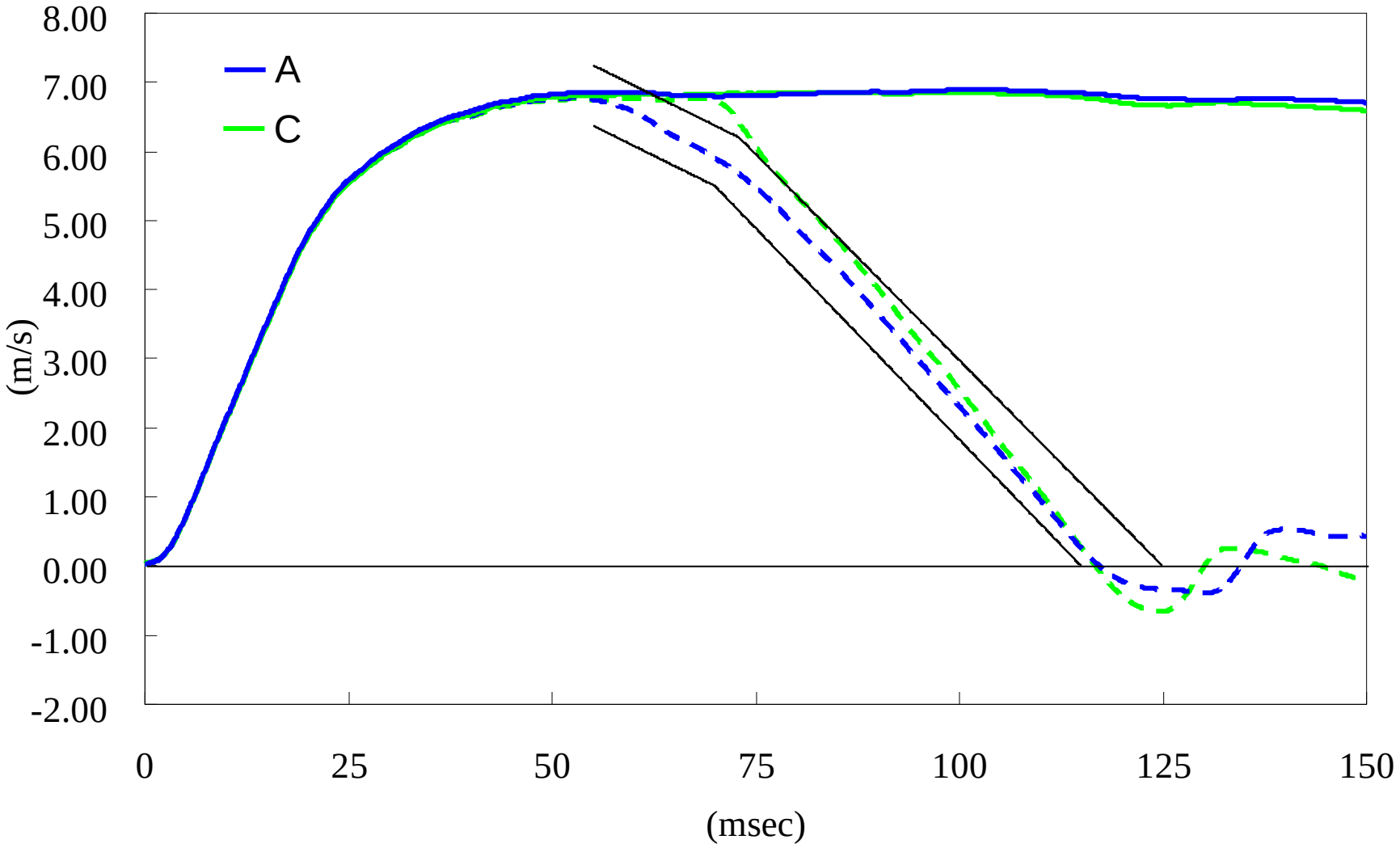
Dummy loading (Chest acceleration)



Dummy loading (Pelvis acceleration)



Comparison 2

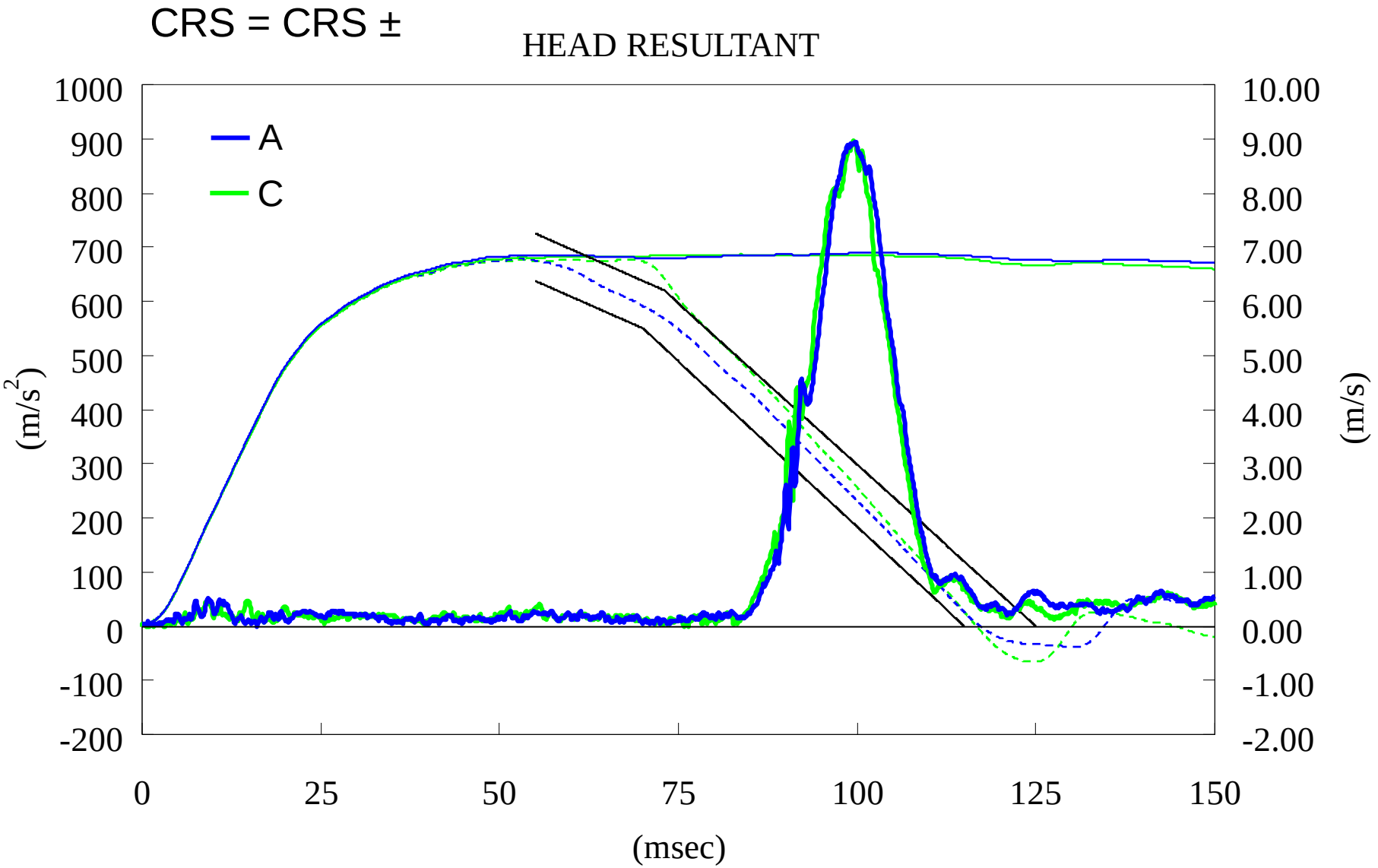


Comparison 2-①　CRS=CRS ±

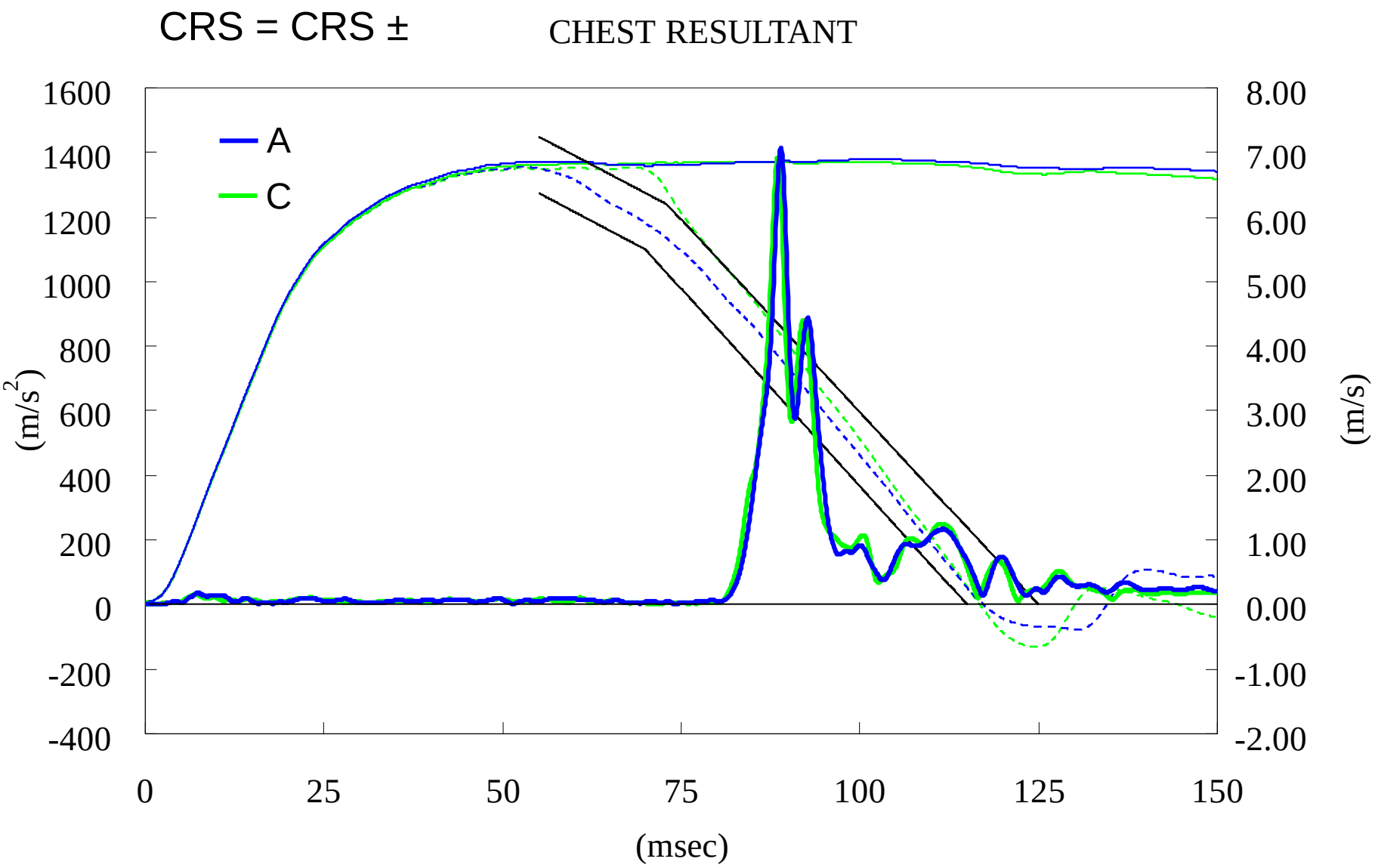
A （Flat curve v-t, Inside/ x1903)

C（Flat curve v-t, Outside/ x2002）

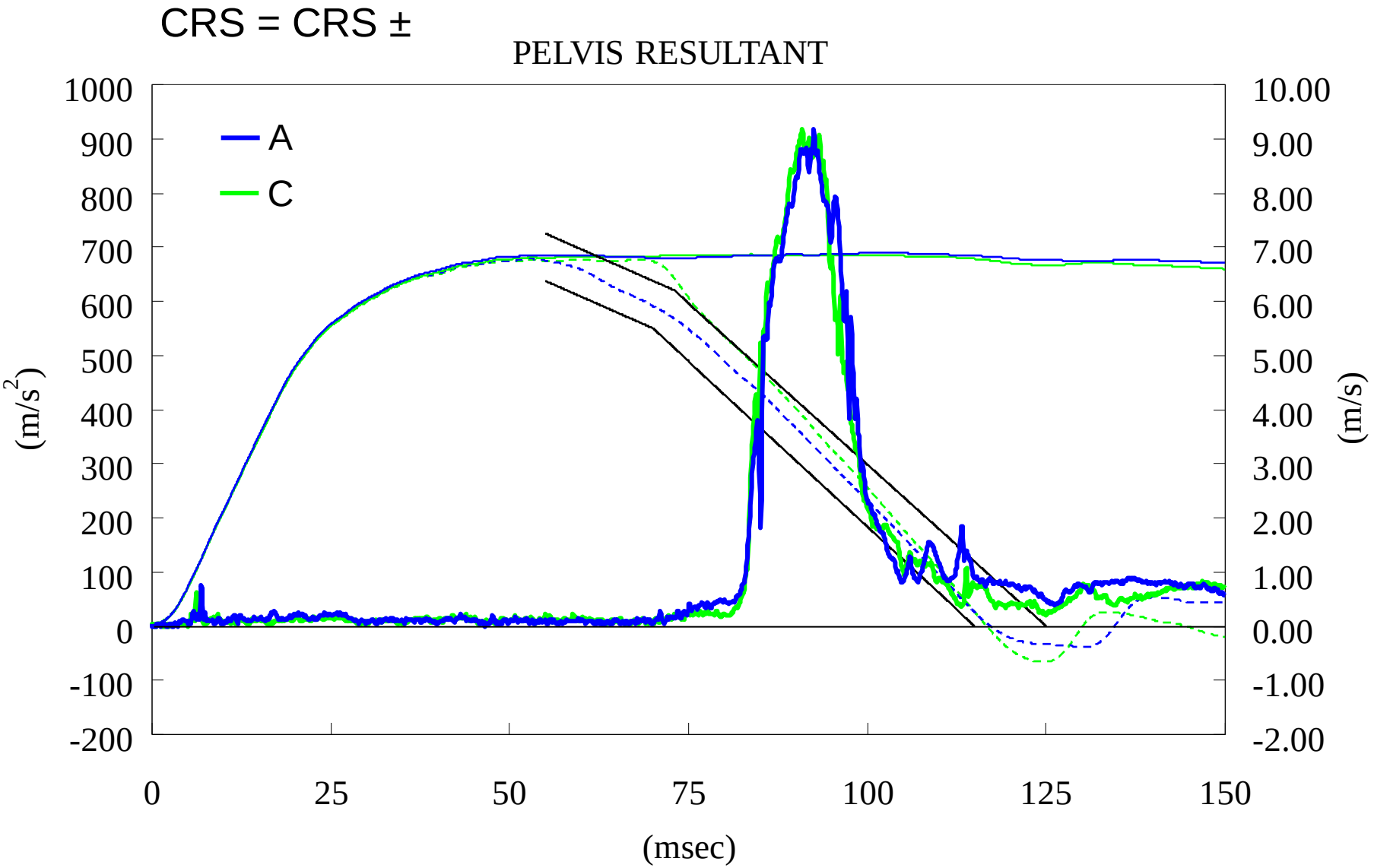
Dummy loading (Head acceleration)



Dummy loading (Chest acceleration)



Dummy loading (Pelvis acceleration)

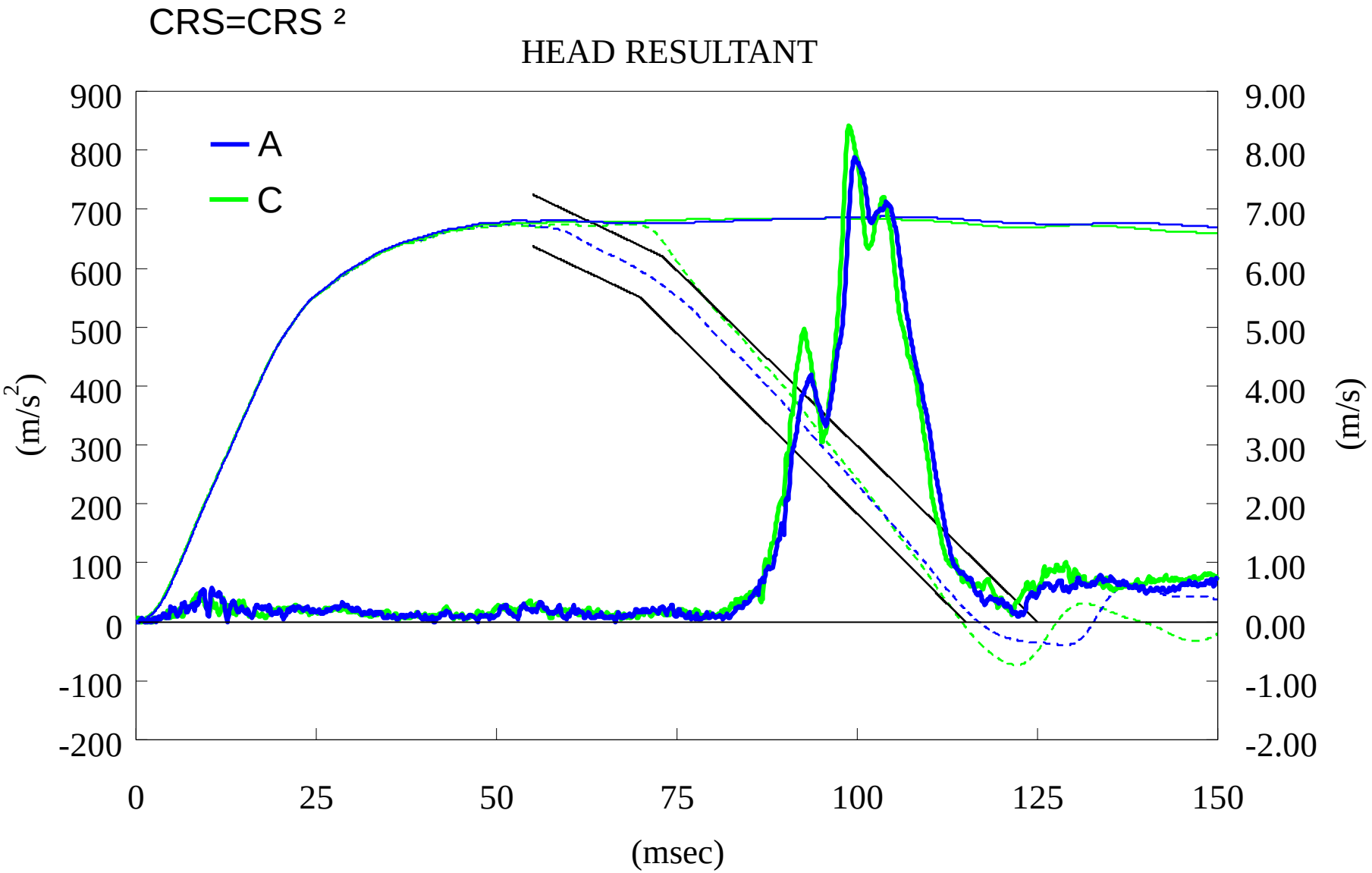


Comparison 2-②　CRS=CRS ²（S/B)

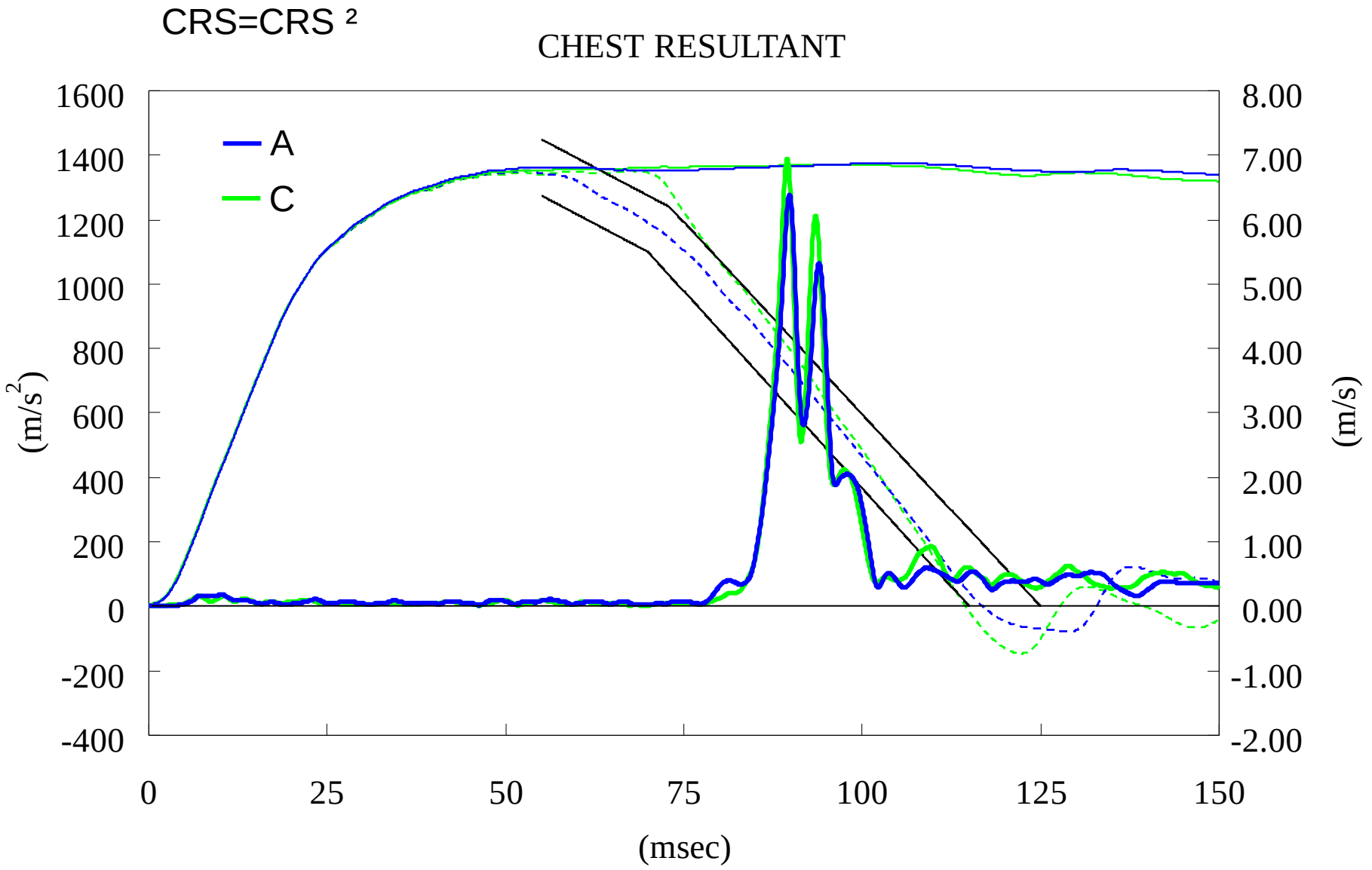
A（Flat curve v-t, Inside /x1904）

C（S curve v-t , Outside/ x2001）

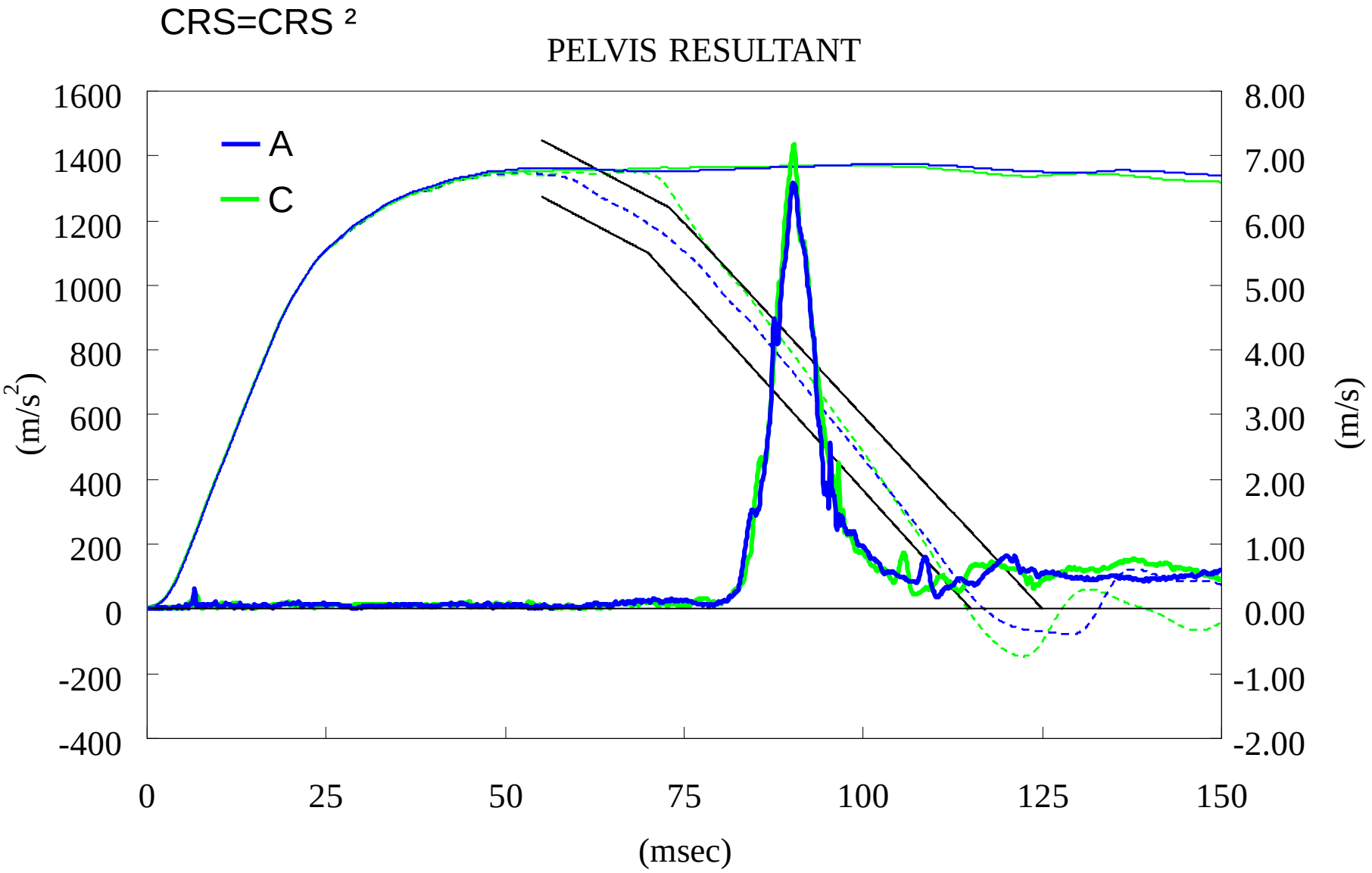
Dummy loading (Head acceleration)



Dummy loading (Chest acceleration)



Dummy loading (Pelvis acceleration)



SUMMARY

1 In order to study the method of GRSP CRS side impact testing, we investigated test conditions that conform to GRSP corridor.

2 By use of two-stage honeycomb, it was found that various v-t curves could be created. We developed 2 types of v-t wave pulses (A)(B) that conformed to GRSP corridor requirement.

3 Then, another v-t wave pulse (C) was developed in order to investigate how a difference of wave pulse affects a dummy loading.

4 We compared a dummy loading of (A) with that of (B), and a dummy loading of (A) with that of (C).
2 types of CRS were used for the comparisons respectively.
One is ISOFIX Type（CRS ±）, another is S/B fasten Type（CRS ²）.

5 It was found that a higher value of Ground v-t always generated a higher injury value in the comparison of (A) with (B) regardless of types of CRS.

6 It was found that the value of dummy loading was the same in comparison of (A) with (C) if the ground v-t was the same even when the relative v-t was different.

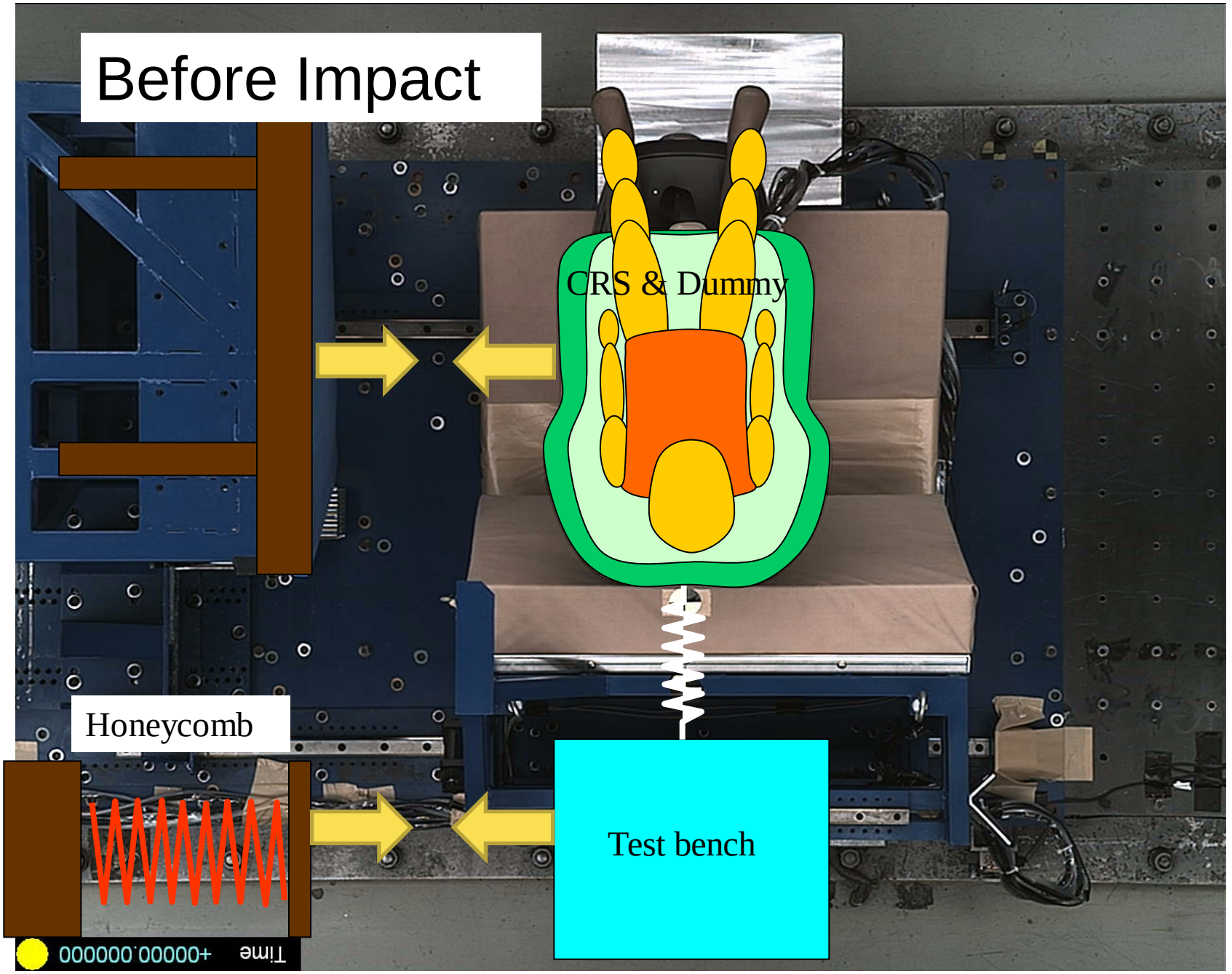
SUMMARY

7 From these results, it can be said that a dummy loading is determined by ground v-t of an impact door.

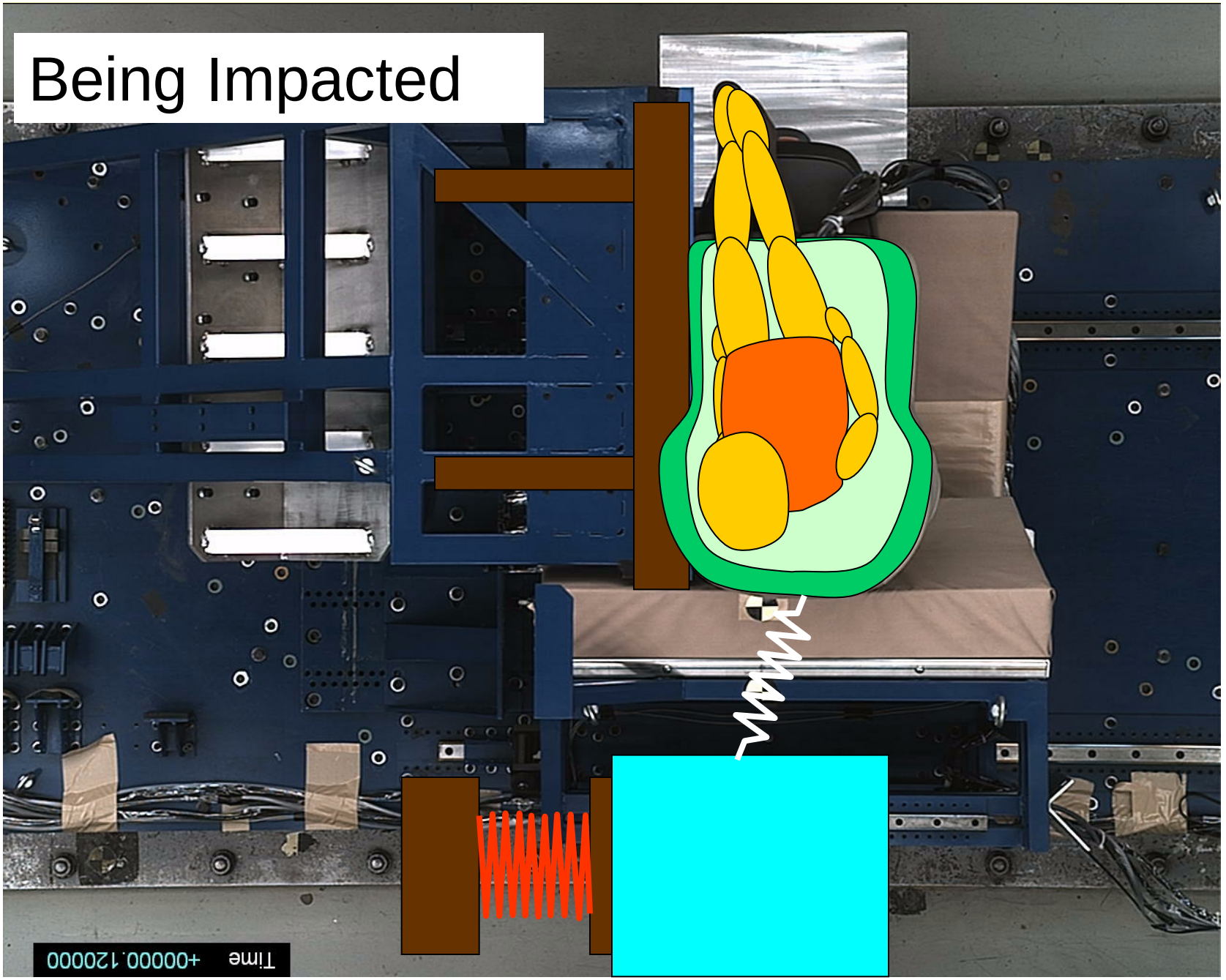
8 In comparison (A) with (C), the injury values are almost identical for the ISOFIX CRS. On the other hand, there is a small difference in the injury values for the CRS secured with the vehicle seat belt.

9 This difference of the injury values may caused by the following phenomenon. In case of S/B Type CRS, a binding force exists between the CRS and the test bench due to the S/B.

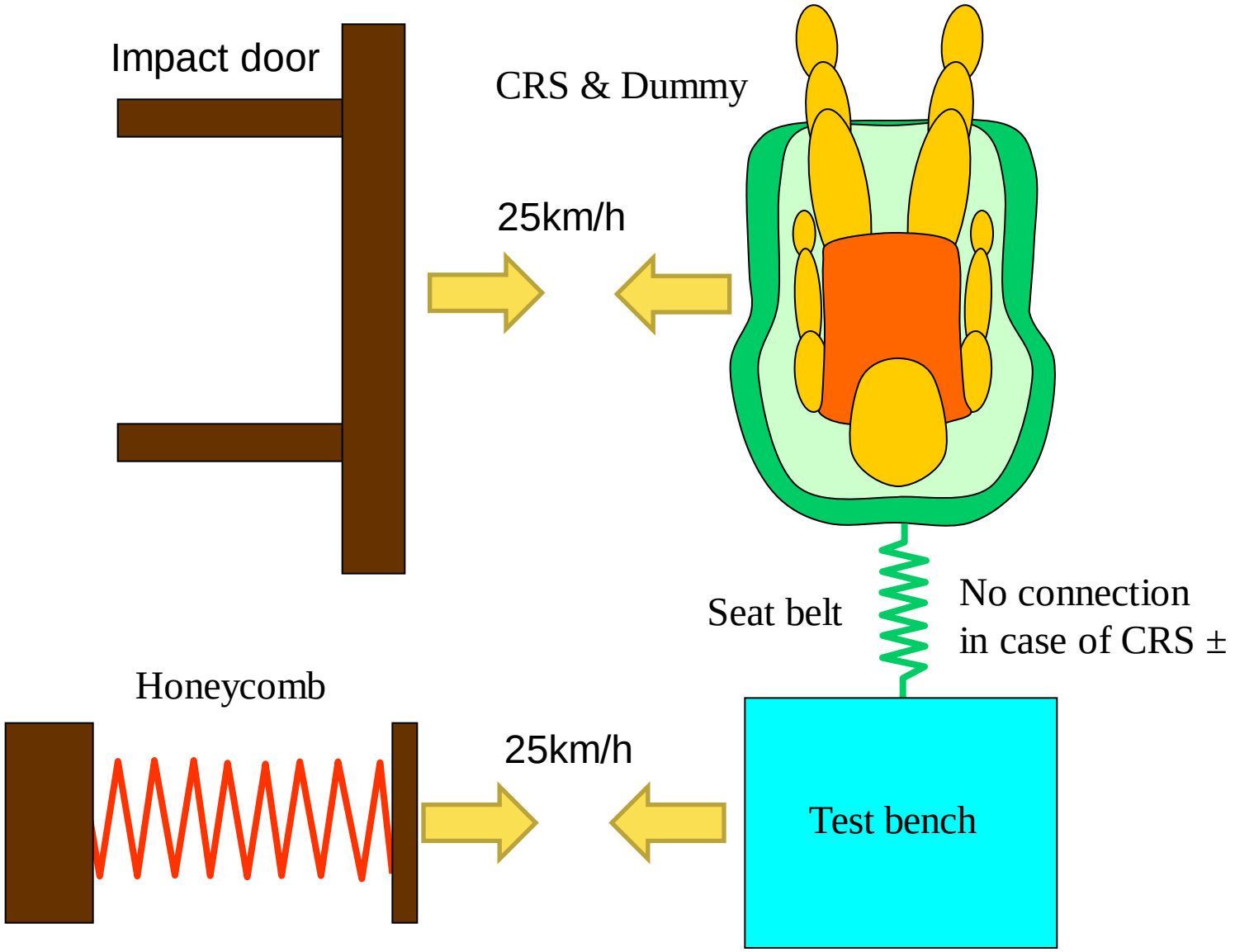
10 This phenomenon is illustrated on next pages.


Before Impact
CRS & Dummy
Honeycomb
Test bench
Time
+00000.000000

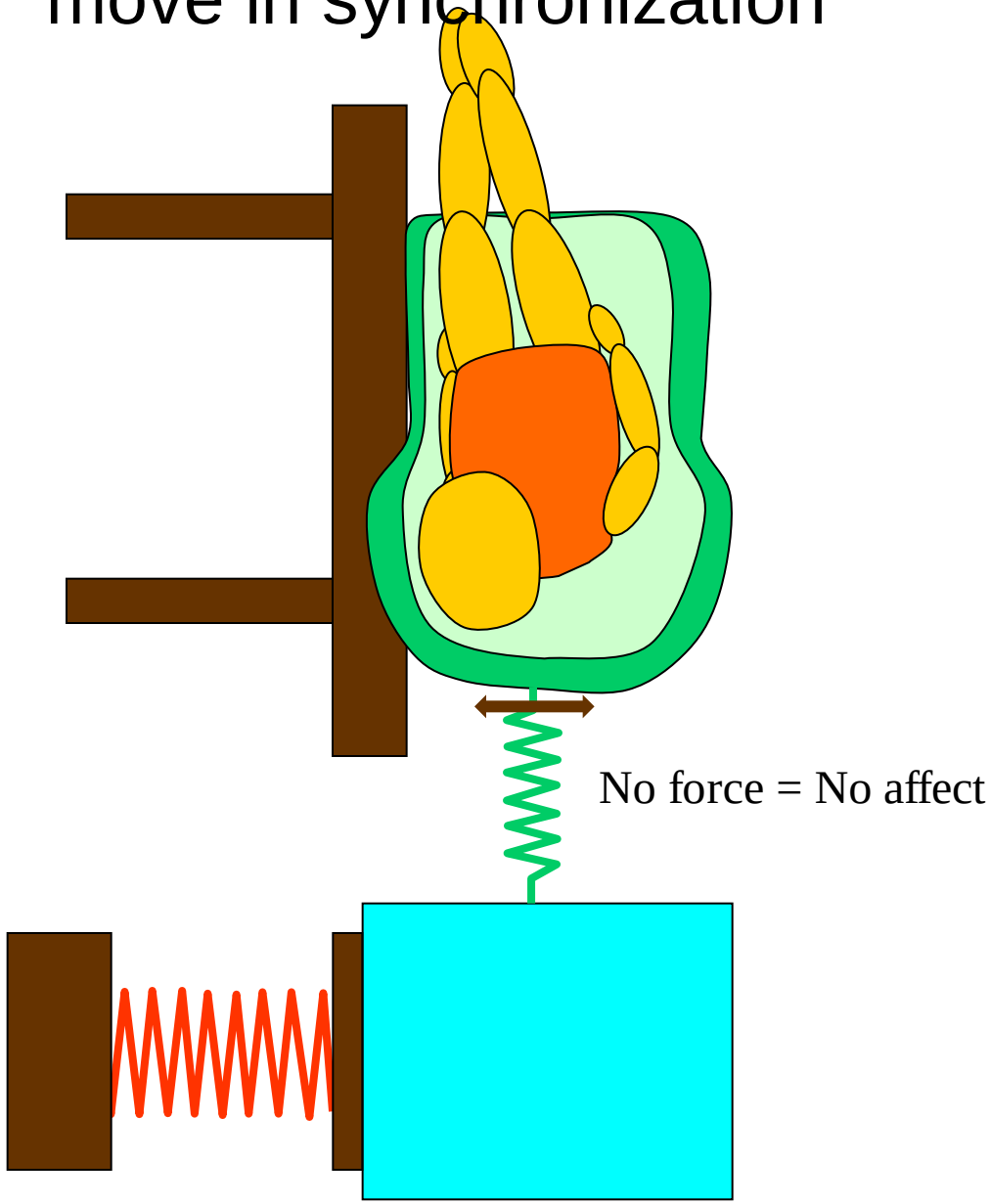
Being Impacted



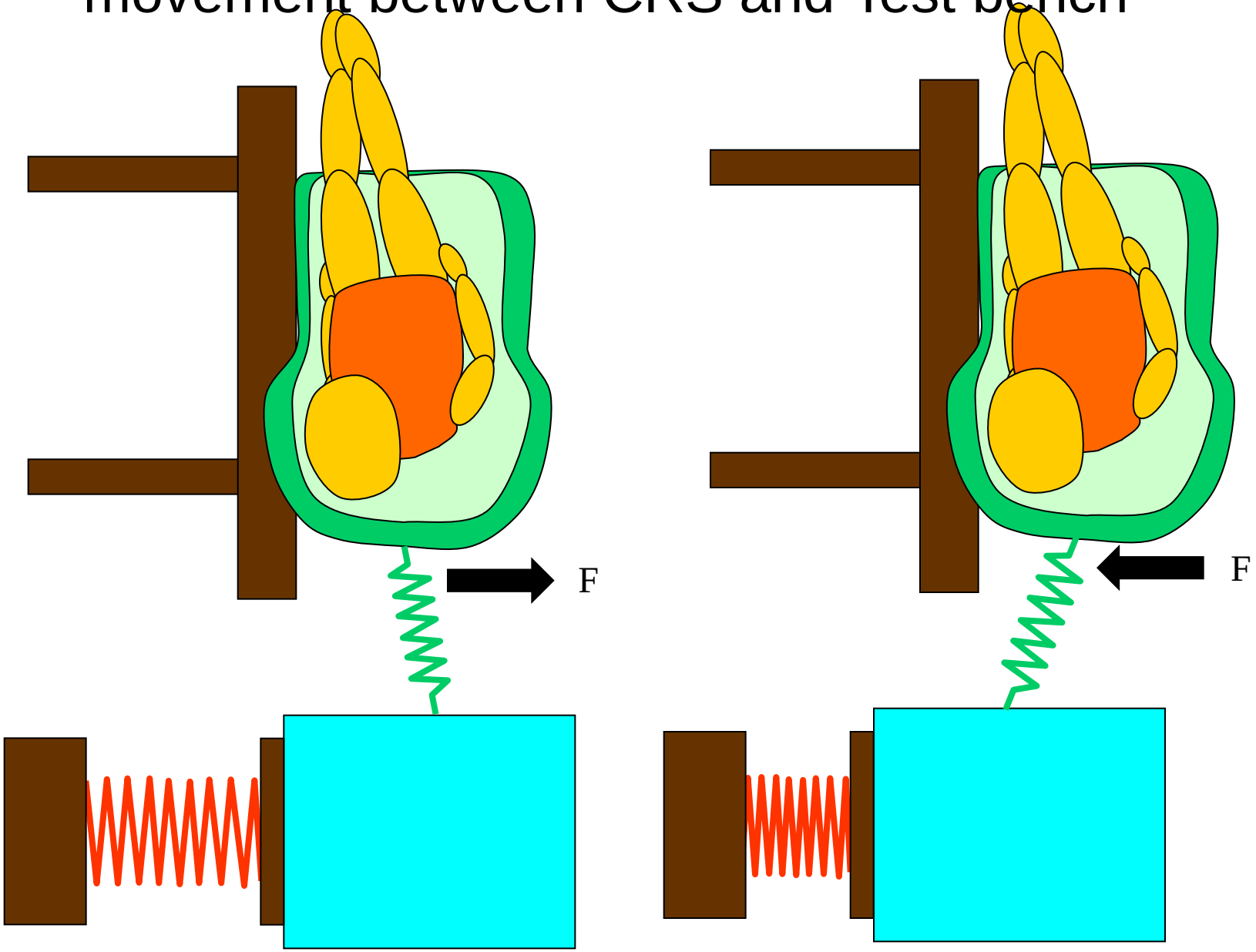
Before Impact



In case that CRS and Test bench move in synchronization



In case that there is a difference in movement between CRS and Test bench



Conclusion

1 It is possible to make Ground v-t curve Flat with accelerating sled system and to create test conditions of Relative v-t curve that conforms to GRSP corridor requirement.

2 Even in the case of S-shape ground v-t curve, it is also possible to create a wave pulse that conforms to GRSP corridor requirement.

3 If Ground v-t histories are the same, the Relative v-t histories have little affect on D/L. D/L is determined almost entirely by Ground v-t.

Conclusion

4 If a binding force exists between a test bench and a CRS such as with a S/B based CRS, D/L is affected by the Relative v-t even when the Ground v-t is the same.

5 A reasonable approach would be to specify a less complex v-t corridor for relative velocity between the impact door and the test bench. The two-stage curve specified in the GRSP procedure is unnecessary.