

EFFECT OF IN-POSITION VS. OUT OF POSITION ON 6 YEAR OLD ATD¹ INJURY VALUES

(Report Summary)

TEST MATRIX:

- All tests were conducted at a certified crash test facility using the FMVSS 213 test protocol (qv).
- Five tests: Out Of Position (OOP) procedure +3" slouch (H Point 3 inches forward)
- Five tests: In-position with a CG-Lock Technology device for booster seats with or without a back
- Tests were non-consecutive

A series of 10 tests was conducted utilizing a 6 year old H III ATD instrumented for capture of HIC, Chest g and Pelvis g. The ATD was placed on a typical, readily available booster seat (with and without a back) to determine the effect on in-position versus out-of-position (OOP) injury numbers.



Control and test runs were performed non-sequentially.

The run results were segmented into in-position and OOP as shown below.

The mean and standard deviations for each data set was calculated. The two sample sets were compared utilizing the T-Test function in Microsoft's Excel spreadsheet. A two tailed test was performed on the data. For a two tailed test at $P < .05$ the null hypothesis, that the two sample means are the same was rejected.

With the dummy installed into the booster seat per the manufacturer's directions, then moved slightly to simulate typical child motion, data was collected then segmented into in-position and OOP as shown on the next page:

¹ Anatomical Test Devices ("crash test dummies")

Run/Condition Chest g's Pelvis g's HIC

Using A CG-Lock technology Device

Booster with back

| | | | |
|-------------|-------|-------|-----|
| V1a-15lbs | | | |
| 12-16-08-03 | 39.6 | | 434 |
| V2 lt fit | | | |
| 12-16-08-06 | 43.99 | 49.23 | 471 |
| V1a-15lbs | | | |
| 12-16-08-07 | 45.4 | 45.02 | 444 |

Booster no back

| | | | |
|-------------|-------|-------|-----|
| V2 tight | | | |
| 12-16-08-11 | 42.39 | 58.98 | 311 |
| V2 easy | | | |
| 12-16-08-12 | 51.93 | 53.52 | 496 |

OOP+3" / No CG-Lock technology Device

Booster with & without back

| | | | |
|-------------|-------|-------|-----|
| 12-16-08-05 | 46.42 | | 402 |
| 12-16-08-08 | 50.96 | 63.27 | 497 |
| 12-16-08-09 | 56.6 | 67.55 | 632 |
| 12-16-08-10 | 54.49 | 60.32 | 479 |
| 12-16-08-13 | 53.19 | 62.13 | 498 |

TEST RESULTS:

In-position - i.e. - normally belted with no slouching resulting from using a CG-lock Technology device provides approximately:

- 70 HIC reduction on average ($p = 0.189$)² (HIC is a relative score of head injury potential)
- 7.7g lower resultant chest g's ($p = 0.0222$)
- 11.7g lower resultant pelvis g's ($p = 0.0214$)

² See "Analysis Methodology" section

CONCLUSIONS:

When the data is appropriately segmented between in-position due to utilizing a CG-Lock Technology Device and out of position with slouching, there is approximately a:

15 % improvement in Resultant – Chest g's
20 % improvement in Resultant – Pelvis g's

In general, lower g forces correlate with reduced injury potential.

While the HIC values were lower for the CG-Lock tests it can not be inferred that the mean for this data set is different than the mean for the OOP + 3" data set.

Examination of test kinematics shows that the tests conducted where the dummy was belted-in with the CG-lock devices show more control in regard to dummy restraint and motion.



Example FMVSS 213 crash pulse at 30 mph post-impact
ATD positions:

Left is without a SeatSnug or CG-Lock on the seatbelt

Right is with a SeatSnug or CG-Lock on the seatbelt

ANALYSIS METHODOLOGY

The mean and standard deviations for each set was calculated. The two sample sets were compared utilizing the T-Test function available in Microsoft's Excel spreadsheet. The output of this analysis function is the P statistic. This statistic is used to test the null hypothesis that the two sample means are the same. For a two tailed test with $P < .05$ the null hypothesis is rejected.

The T-Statistic utilized implies that at the 95% confidence level the means are not the same for the respective chest populations and pelvis populations. That is, the null hypothesis is rejected. The null hypothesis can not be rejected for the HIC. The head is at the end of the inverted body pendulum and as a result can only be considered under secondary control of pelvis or chest motion. On average there was a 70 HIC reduction for the testing that was done. However, again, it should be emphasized that statistically the null hypothesis can not be rejected for HIC.