ATTACHMENT A – GRACO COMMENT FIGURES AND TABLES

Docket NHTSA-2020-0093

April 2, 2021

Docket Management Facility
U.S. Department of Transportation
West Building, Ground Floor, Room W12-140
1200 New Jersey Avenue S.E.
Washington, D.C. 20590

RE: ***Comments to Docket NHTSA-2020-0093***
Attachment A – Figures and Tables Referenced in Graco's Written Comments

This attachment provides Figures 1 through 19 and Tables 2 through 7 that are referenced in the body of the comments provided by Graco Children's Products Inc. Figures and tables are provided in the following pages in the order that they appear in the comments.

Table 1. Graco NPRM Evaluation Test Program Summary.

Anthropometric Test Dummy (ATD)	Number of Tests		
	Rear-Facing	Forward-Facing	Booster
CRABI 12-month-old (49 CFR 572 Subpart R)	25	57	-
Hybrid III 3-year-old (49 CFR 572 Subpart P)	23	27	-
Hybrid III 6-year-old (49 CFR 572 Subpart N)	6	103	75
Weighted H-III 6-year-old (49 CFR 572 Subpart S)	-	6	5
Hybrid III 10-year-old (49 CFR 572 Subpart T)	-	-	17
Totals	54	193	101

Table 2. Repeatability and Reproducibility Comparison.

Seat	Mode	Lab	Qty	HIC CV%	C/R CV%	HE CV%	KE CV%
Seat A	6YO BPB	Graco	3	17	3.3	2.6	0.9
		Calspan	9				
Seat B	6YO No Back BPB	Graco	3	47.6	4.6	4	2.2
		Calspan	2				
	6YO W/Back BPB	Graco	3	24	3	1.1	3.6
Seat C	6YO BPB	Graco	3	7.5	6	2.9	2.3
		Calspan	3				
Seat D	6YO W/Back BPB	Graco	4	21	8.7	1.7	3.8
		Calspan	6				
Seat E	6YO No Back BPB	Graco	3	16	6	4	2
		Calspan	3				
Seat F	6YO BPB	Graco	3	32	3.2	2.3	2
		Calspan	3				
Seat G	6YO BPB	Calspan	3	22	3.3	4.1	1.5
		Graco	4				
Seat H	6YO TII Harness	Graco	27	10.7	7	2	1.7
		Calspan	12				

Key: 6YO = HIII-6C ATD; BPB = Belt-positioning booster; TII Harness = CRS used internal harness/attached with Type II belts; C/R = chest resultant acceleration; HE = head excursion; KE = knee excursion

Table 3. Repeatability Review of Calspan Data.

Seat	Mode	Lab	Qty	HIC CV%
Seat A	6YO BPB	Calspan	9	10.4
Seat B	6YO No Back BPB	Calspan	2	1.8
Seat C	6YO BPB	Calspan	3	5.4
Seat D	6YO W/Back BPB	Calspan	6	20.6
Seat E	6YO No Back BPB	Calspan	3	10
Seat F	6YO BPB	Calspan	3	11.7
Seat G	6YO BPB	Calspan	3	11.4
Seat H	6YO TII Harness	Calspan	12	6.2

		Acc. (g)	Vel. (kph)	HIC 36	HIC 15	Head Clip (g)	Chest Disp (mm)	Chest Clip (g)	Head Exc (mm)	Knee Exc (mm)
CALSPAN	RR04-19-02	23.3	48.6	521	309	54.7	-37.7	51.1	490	580
	RR04-19-03	23.2	48.5	429	254	51.1	-38.8	51.2	476	586
	RR04-19-05	23	47.4	457	293	54.9	-36.6	52.2	497	609
	Mean	23.2	48.2	469.0	285.3	53.6	-37.7	51.5	487.7	591.7
	Std Dev	0.2	0.7	47.2	28.3	2.1	1.1	0.6	10.7	15.3
	% CV	1%	1%	10.1%	9.9%	4.0%	2.9%	1.2%	2.2%	2.6%
VRTC	S150917-1_Right_86	21.75	47.3	479	266	53.3	-38	56.6	466	589
	S150918-1_Right_88	21.7	47.3	573	334	58.2	-37.7	60.1	491	599
	S150921-1_Right_90	21.65	47.3	535	330	58.9	-41.3	59.6	495	598
	Mean	21.7	47.3	529.0	310.0	56.8	-39.0	58.8	484.0	595.3
	Std Dev	0.1	0.0	47.3	38.2	3.1	2.0	1.9	15.7	5.5
	% CV	0%	0%	8.9%	12.3%	5.4%	5.1%	3.2%	3.2%	0.9%
CALSPAN + VRTC	Mean	22.4	47.7	499.0	297.7	55.2	-38.4	55.1	485.8	593.5
	Std Dev	0.81	0.63	53.52	32.94	2.95	1.61	4.17	12.19	10.48
	% CV	4%	3.6%	1.3%	10.7%	11.1%	5.3%	4.2%	2.5%	1.8%

Figure 1. NHTSA Report No. 213R&R-CAL-19-108, Table 4, "Reproducibility of the Graco Affix 6yo with 3 pt belt restraint" (Detail).

		Acc. (g)	Vel. (kph)	HIC 36	HIC 15	Head Clip (g)	Chest Disp. (mm)	Chest Clip (g)	Head Exc. (mm)	Knee Exc. (mm)
CALSPAN	RR04-19-01	22.9	47.3	456	285	53.3	-12.5	44.6	670	737
	RR04-19-04	23.3	48.4	490	299	54.2	-13.4	45.6	703	749
	RR04-19-09	23.5	47.9	474	284	53.8	-14.5	45.7	694	752
	Mean	23.2	47.9	473.3	289.3	53.8	-13.5	45.3	689.0	746.0
	Std Dev	0.3	0.6	17.0	8.4	0.5	1.0	0.6	17.1	7.9
	% CV	1%	1%	3.6%	2.9%	0.8%	7.4%	1.3%	2.5%	1.1%
VRTC	S150909-1_Right_76	21.9	47.2	570	405	64.7	-21.7	44.5	664	725
	S150909-1_Right_78	22	47.3	535	358	61.3	-20.2	43.0	656	725
	S150911-1_Right_80	21.85	47.3	535	334	59.2	-20	43.3	676	740
	Mean	21.9	47.3	546.7	365.7	61.7	-20.6	43.6	665.3	730.0
	Std Dev	0.1	0.1	20.2	36.1	2.8	0.9	0.8	10.1	8.7
	% CV	0%	0%	3.7%	9.9%	4.5%	4.5%	1.8%	1.5%	1.2%
CALSPAN + VRTC	Mean	22.6	47.6	510.0	327.5	57.8	-17.1	44.5	677.2	738.0
	Std Dev	0.75	0.48	43.50	47.94	4.71	4.02	1.13	18.03	11.49
	% CV	3.3%	1.0%	8.5%	14.6%	8.2%	23.6%	2.5%	2.7%	1.6%

Figure 2. NHTSA Report No. 213R&R-CAL-19-108, Table 5, "Reproducibility of the Graco Nautilus 6yo with 3 pt belt" (Detail).

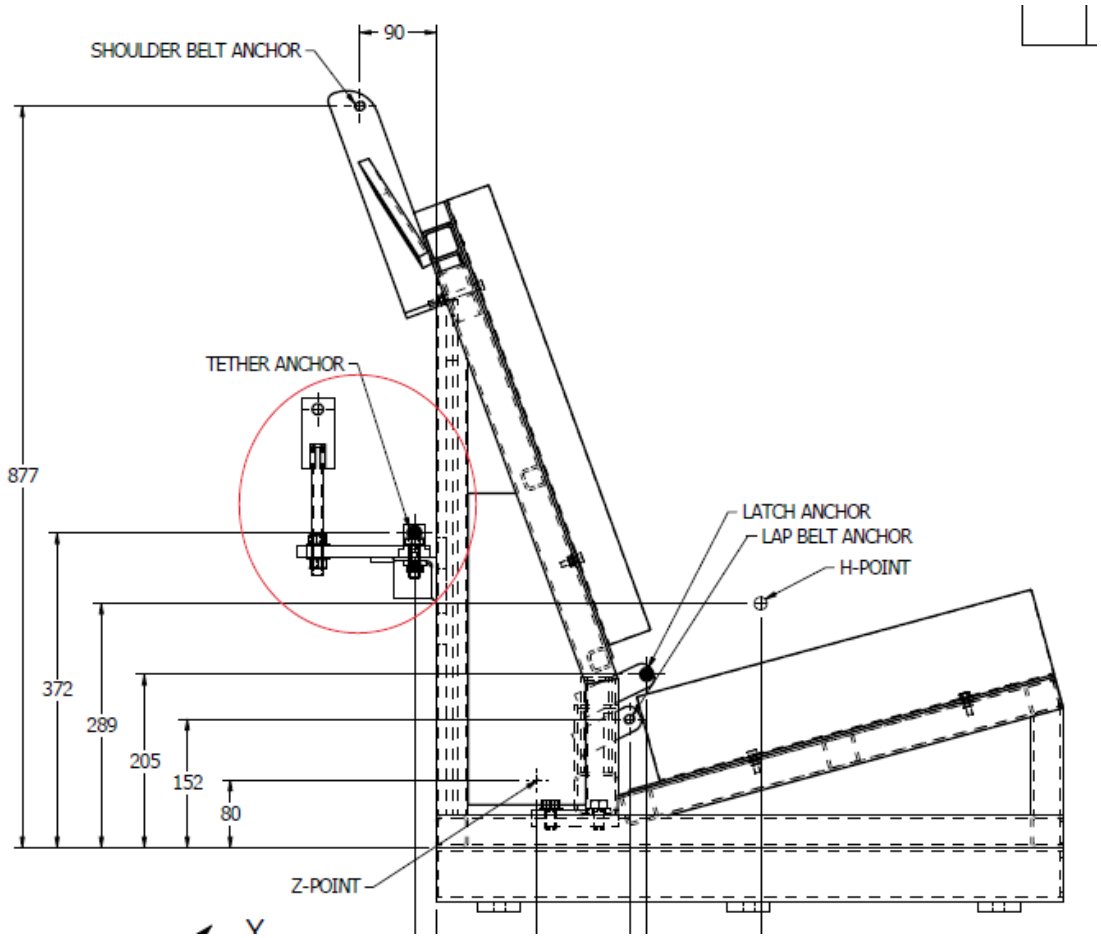

Figure 3. Detail from Drawing 3021-1000 Bench Seat Schematic Showing Tether Anchor Mounting (Circled in Red).

Figure 4. Still Image from High Speed Video Showing Upward Flexion of the Rear Shelf Mount (Original Plane of the Rear Locking Belt Mounting Bar Assembly Shown as a Dashed Red Line).

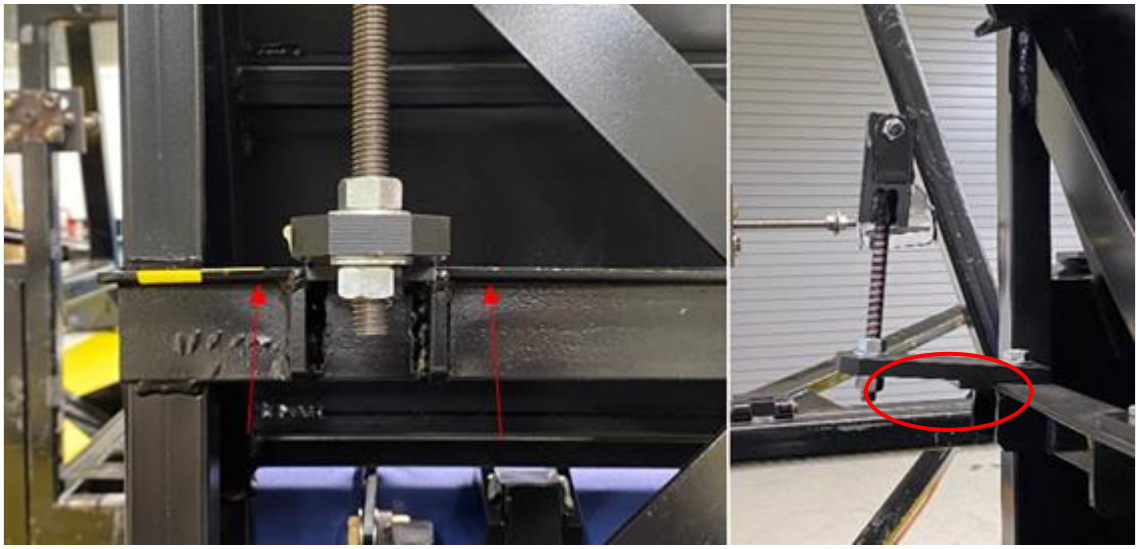

Figure 5. Detail of Rear Shelf Mount Showing Local Permanent Deformation.

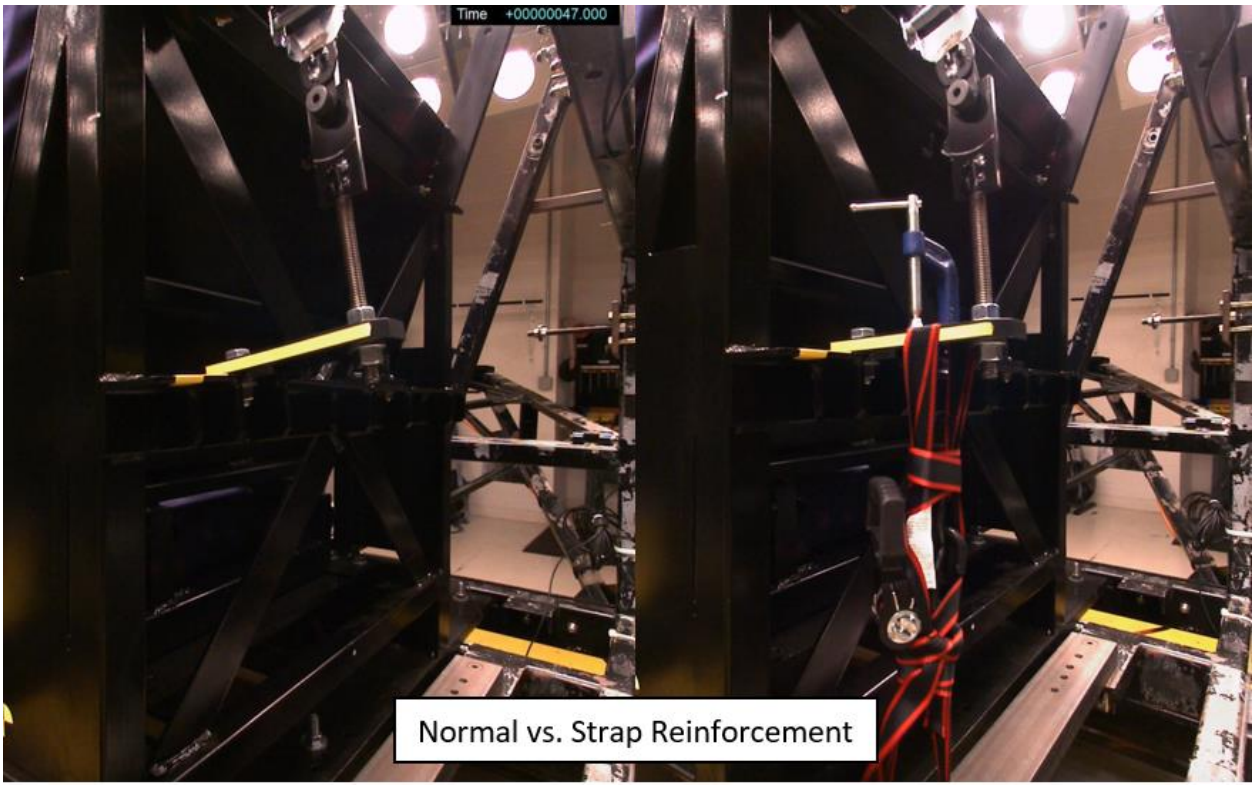

Figure 6. Movement of the Rear Locking Belt Mounting Bar Assembly Cantilevered versus Secured with a Ratchet Strap to Minimize Movement During Testing.

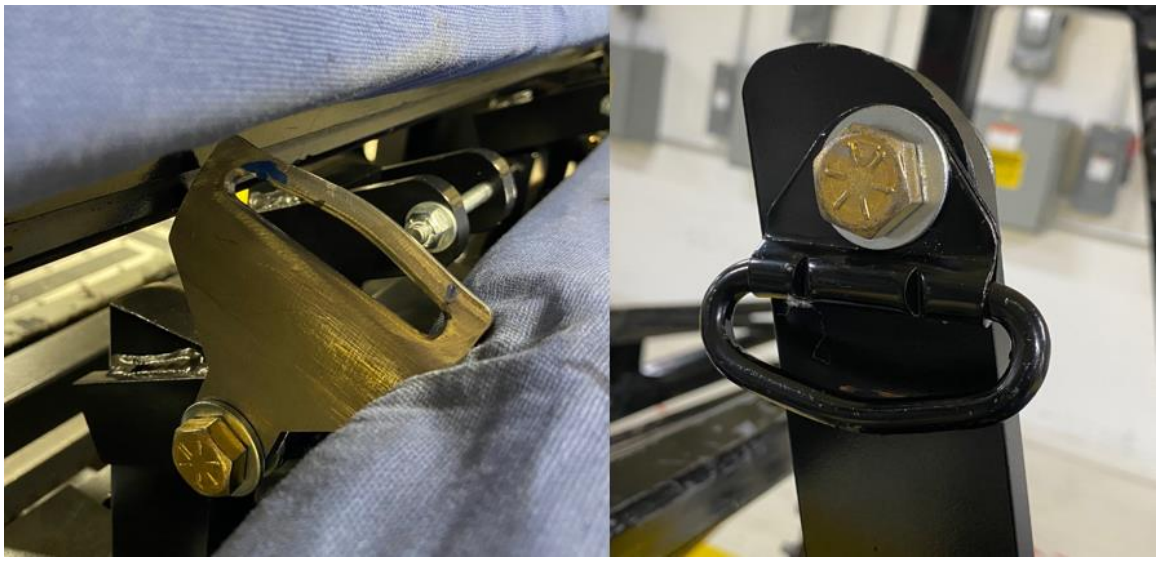

Figure 7. Deformation of the Inboard Lap Belt Anchor (left) and the D-Ring (right).

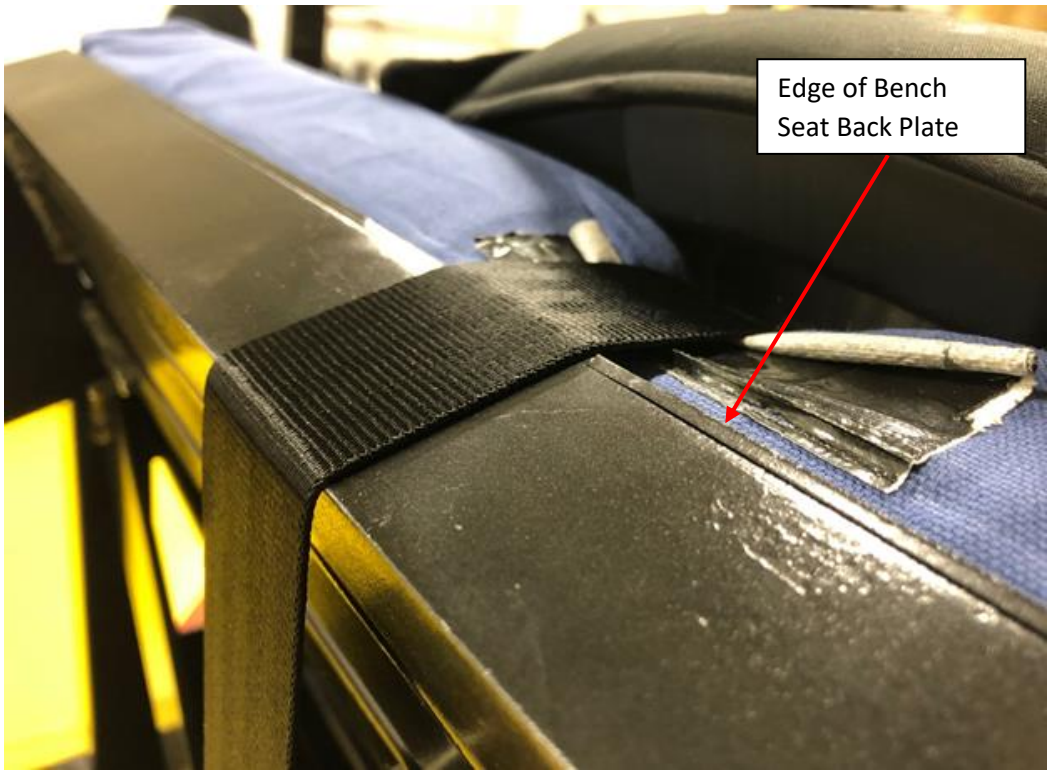

Figure 8. Sharp Edge from Bench Seat Back Plate in the Tether Strap Routing Path.

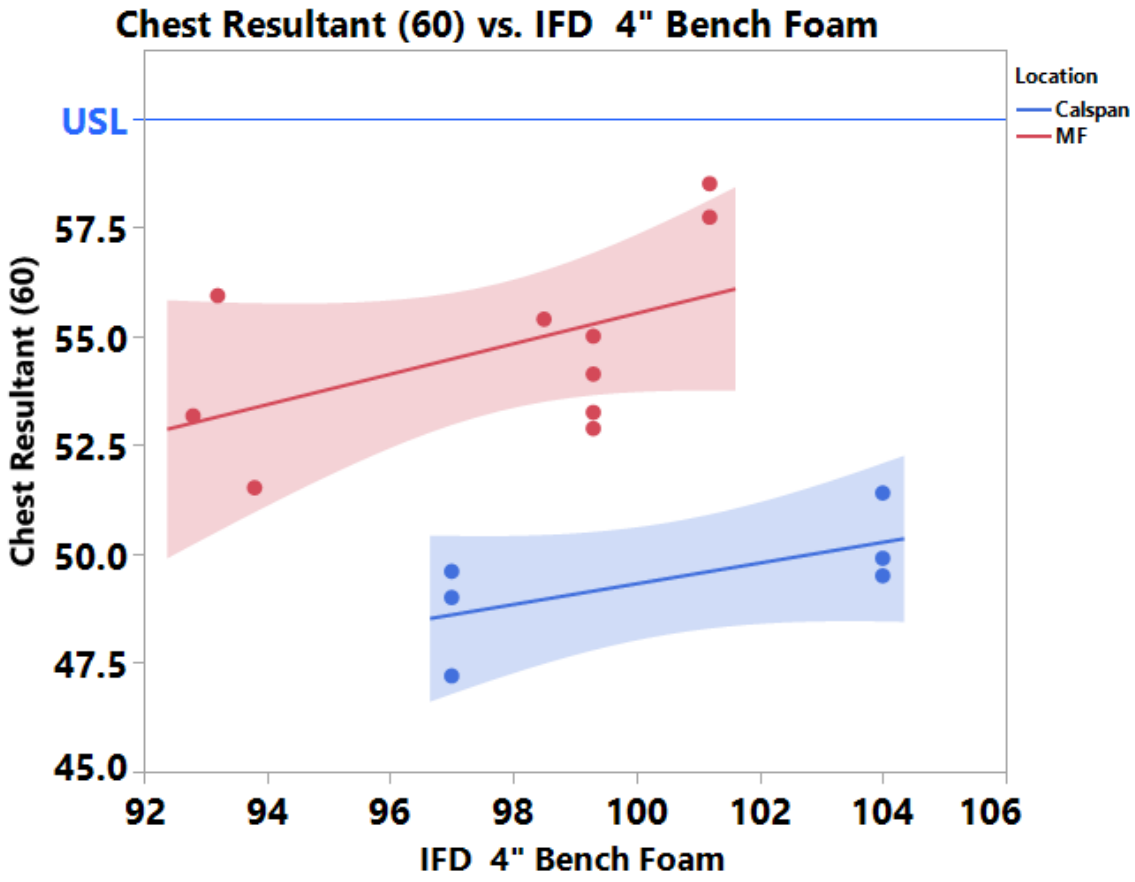

Figure 9. Foam IFD Effects on Resultant Chest Acceleration Values, Seat H.

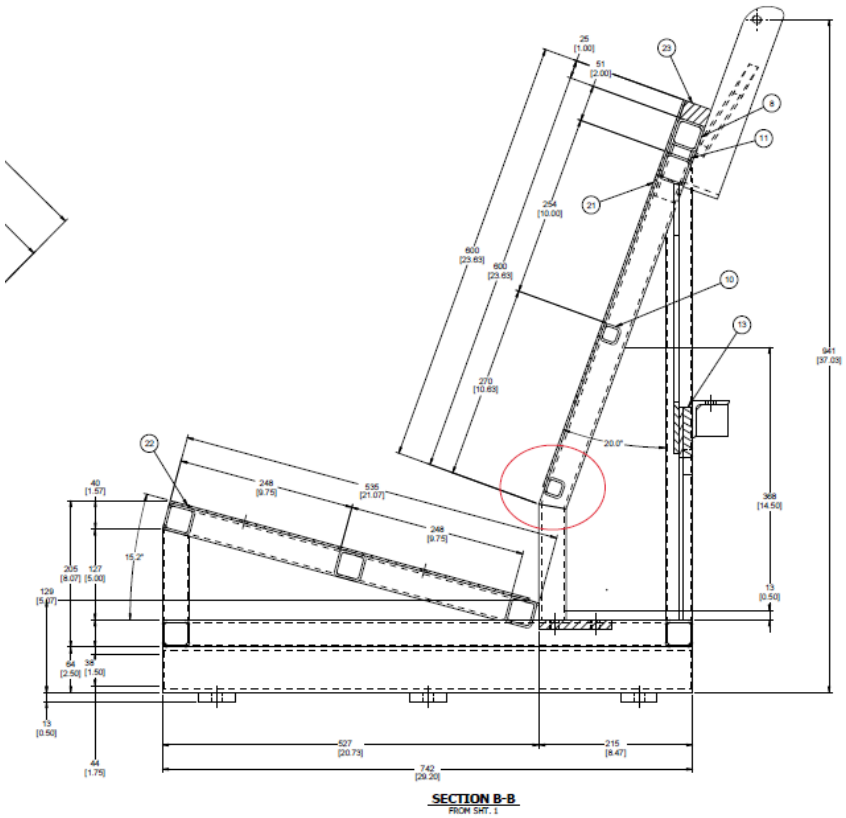

Figure 10. Drawing 3021-015, Sheet 2, Section B-B.

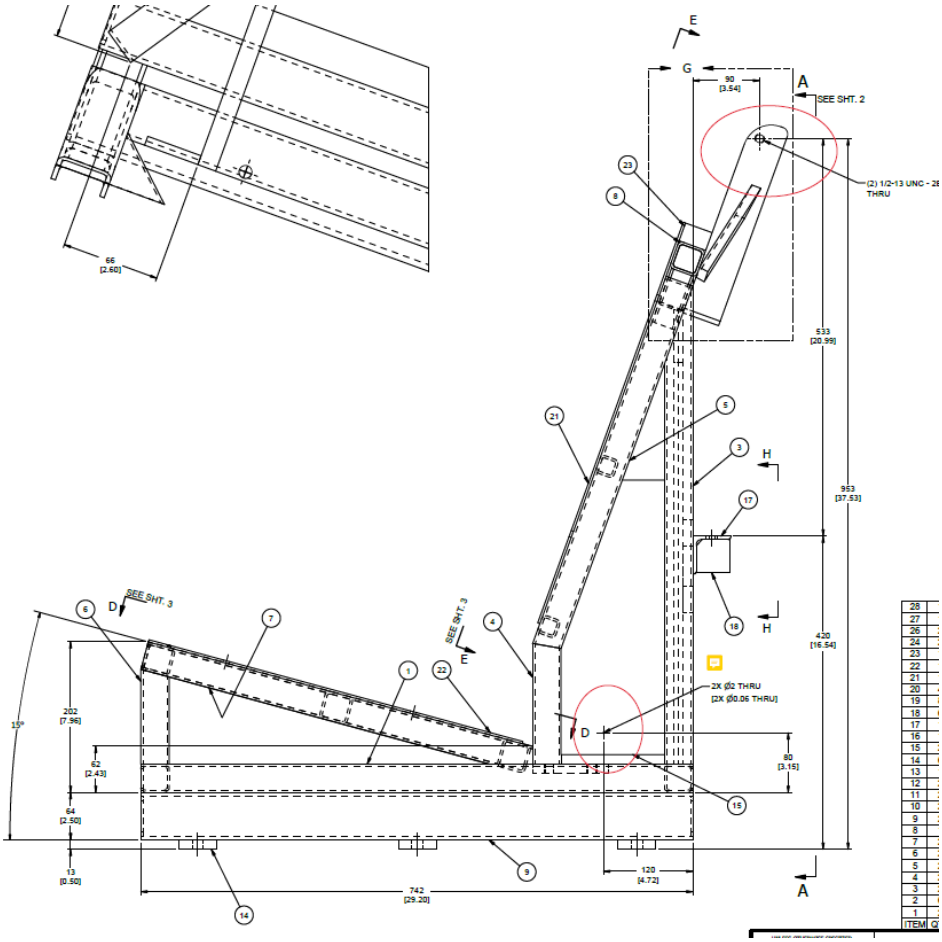

Figure 11. Detail from Drawing 3021-015.

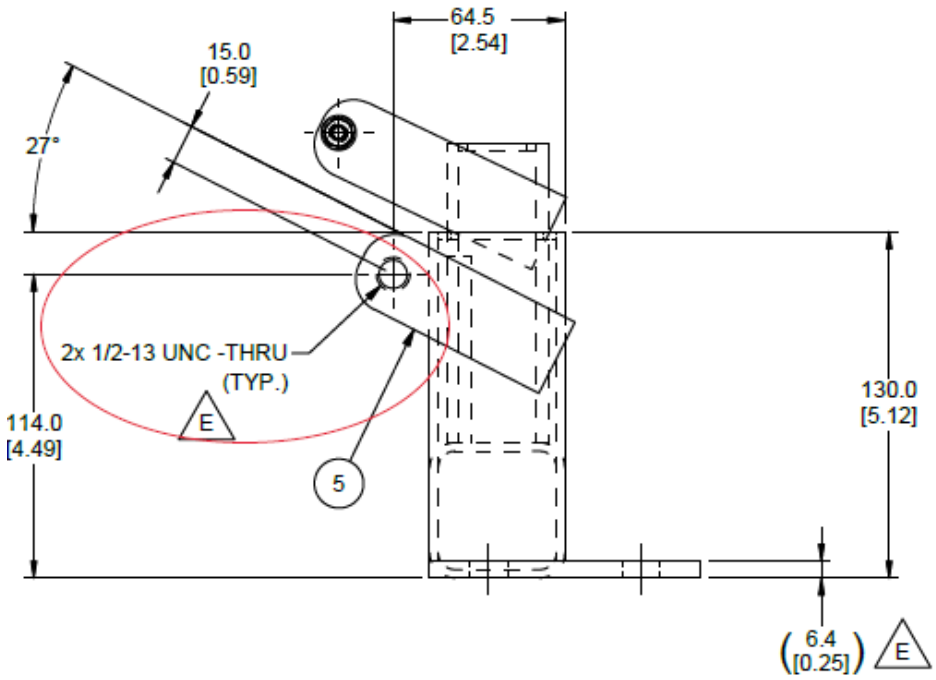

Figure 12. Detail from Drawing 3021-750.

Table 4. Effects of the Harness Tension Method on Test Outcomes.

Internal harness tension method	Measurement	Coefficient of Variation [%]
3-prong gauge	Sled Acceleration	0.2
3-prong gauge	Sled Velocity	0.1
3-prong gauge	HIC	**4.3**
3-prong gauge	Chest Resultant	**2.8**
3-prong gauge	Head Excursion	0.6
3-prong gauge	Knee Excursion	0.6
tension pull device	Sled Acceleration	0.2
tension pull device	Sled Velocity	0.1
tension pull device	HIC	**7.0**
tension pull device	Chest Resultant	**5.5**
tension pull device	Head Excursion	0.7
tension pull device	Knee Excursion	0.5

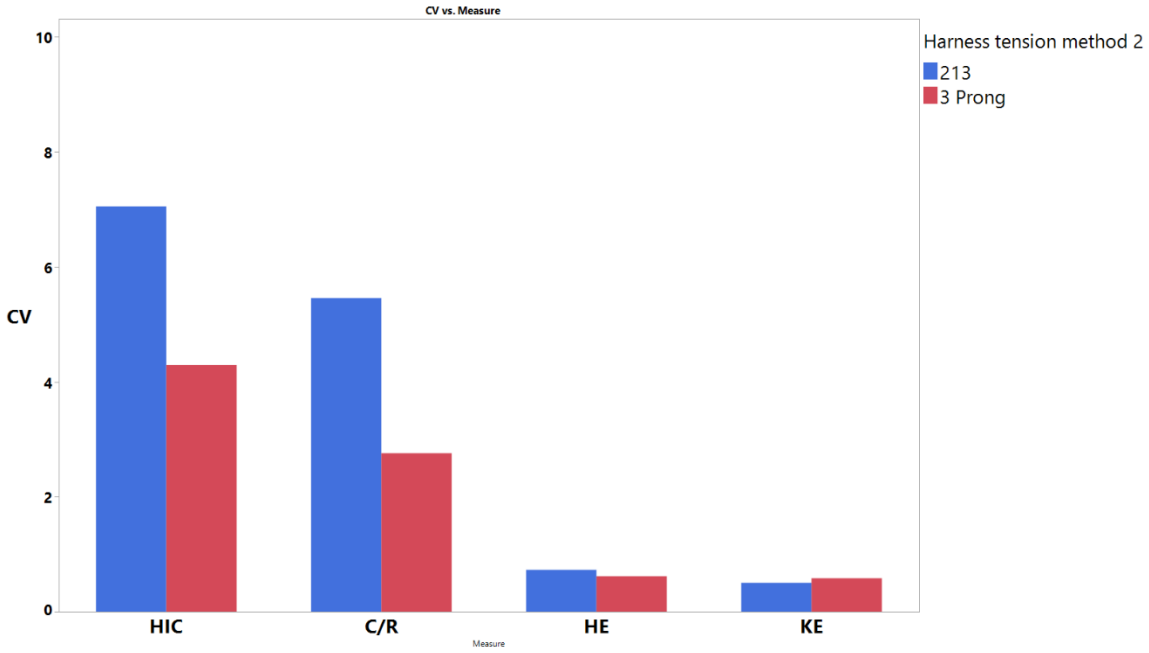

Figure 13. Effect of Harness Tension Method on Test Outcomes.

Figure 14. Recommended Load Cell Location on Tether for Pre-Test Tension Measurement.

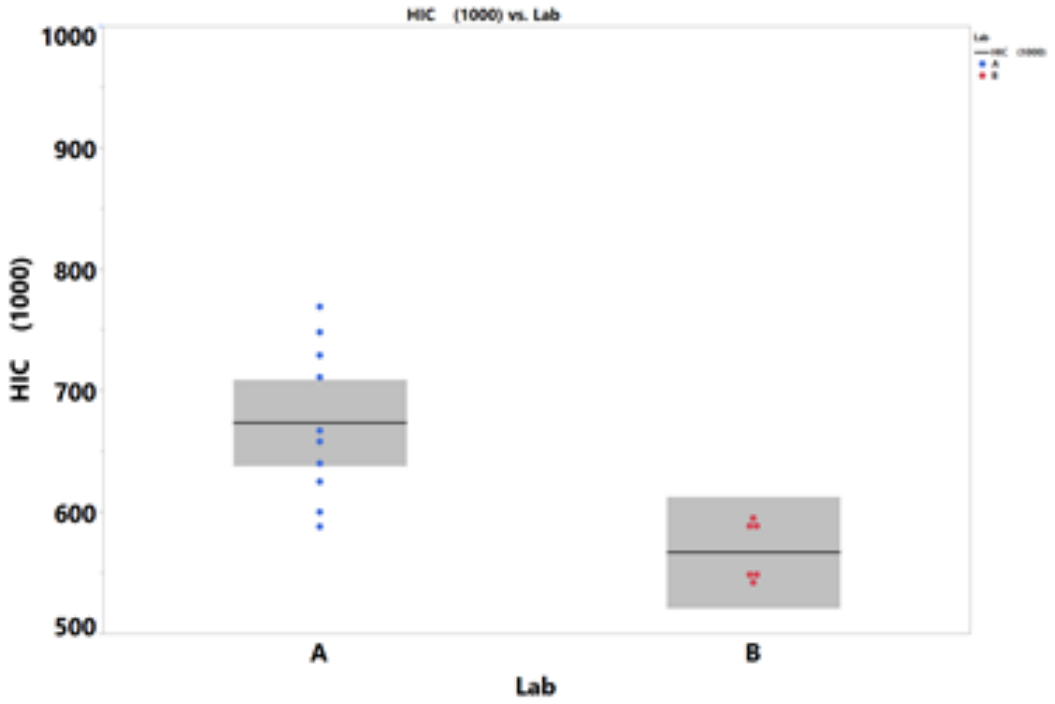

Figure 15. Plot of Seat H HIC Scores Showing Variation Between Two Test Labs.

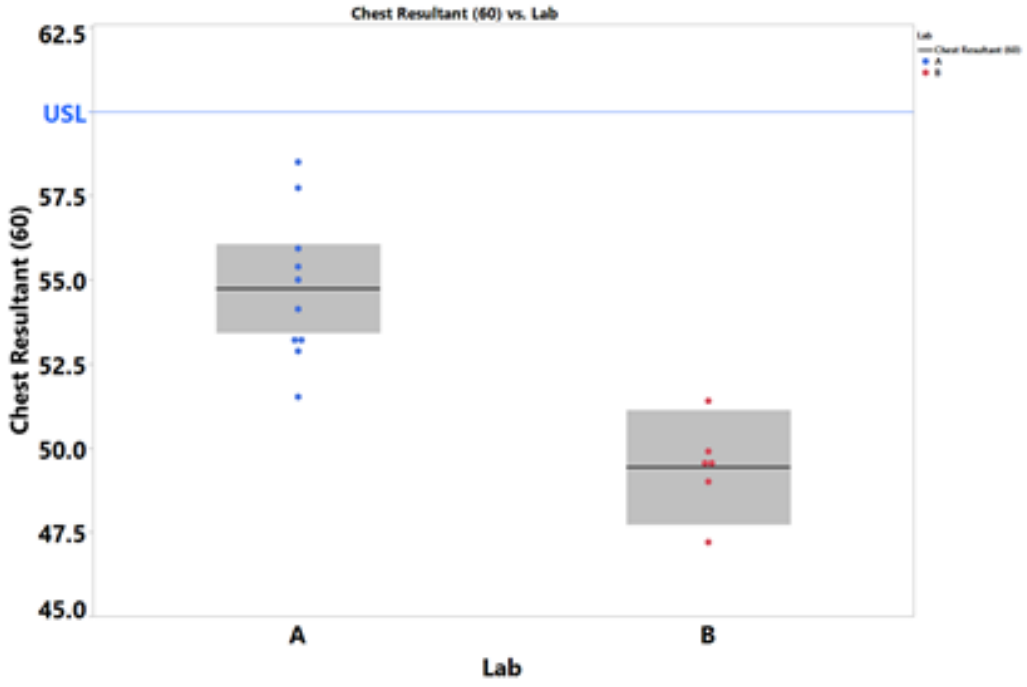

Figure 16. Plot of Seat H Chest Resultant Accelerations Showing Variation Between Two Test Labs.

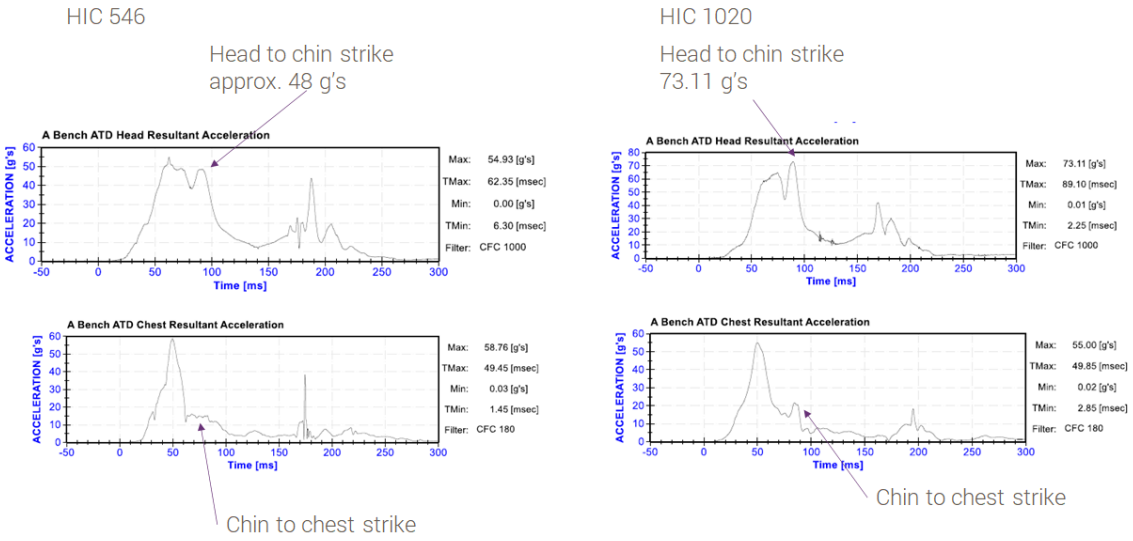

Figure 17. Example Resultant Head and Chest Accelerometer Traces Showing Effect of Unnatural, Non-Anthropometric Chin-to-Chest Strike.

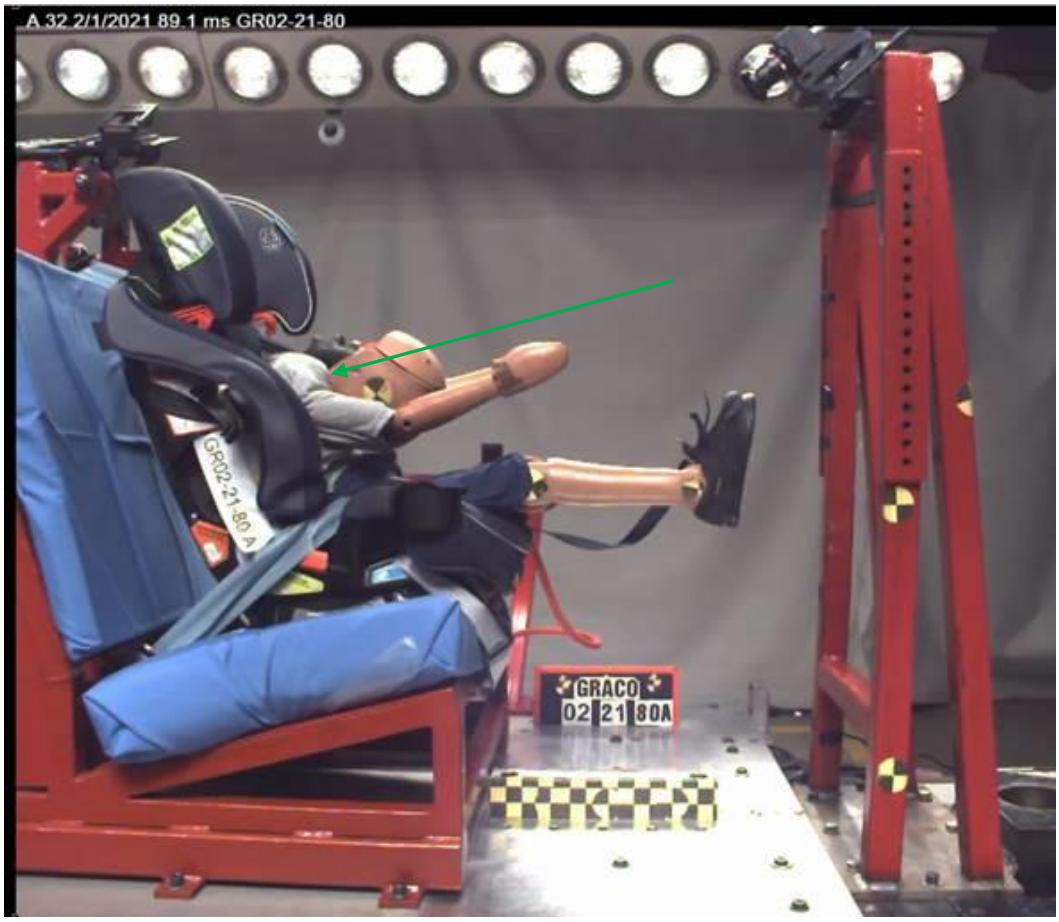

Figure 18. Hybrid III 6-year-old Dummy Chin Striking Chest During Dynamic Test (Green Arrow Pointing to Chin).

Table 5. Results of Hybrid III 6-year-old Booster Tests on One Model of CRS.

Installer	Sled Accel [g]	Sled Velocity [kph]	HIC	Chest resultant [g]	Knee excursion [mm]	Head excursion [mm]
1	23.9	48.0	546	56.7	564	687
2	24.1	48.1	886	56.5	574	699
1	24.0	48.1	689	58.2	472	700
3	24.1	48.1	869	52.1	564	717
3	24.1	48.1	864	52.7	577	720
3	24.1	48.1	1020	53.7	582	731

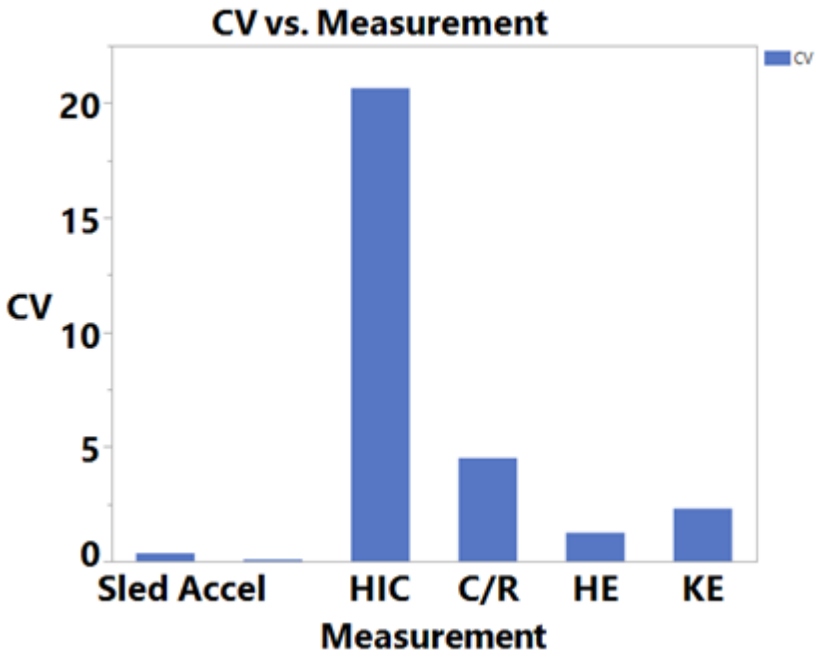

Figure 19. Coefficient of Variation Calculated from Test Series in Table 5.

Table 6. CDC Boys Age and Weight Data, 20 to 30 lb Range.

Percentile	20 lb	22 lb	24 lb	25 lb	26.5 lb	30 lb
5th	14.25 mon	19 mon	26.5 mon	30 mon	36 mon	48 mon
50th	8.5 mon	11 mon	14.5 mon	17.5 mon	19 mon	31 mon
95th	5.5 mon	6.75 mon	8.5 mon	9.5 mon	11.25 mon	16.5 mon

Table 7. CDC Girls Age and Weight Data, 20 to 30 lb Range.

Percentile	20 lb	22 lb	24 lb	25 lb	26.5 lb	30 lb
5th	17 mon	22.5 mon	30 mon	34 mon	42 mon	54 mon
50th	10.75 mon	13.75 mon	17.75 mon	19.75 mon	24 mon	34 mon
95th	7 mon	8.5 mon	10.75 mon	12 mon	14 mon	20 mon