Memorandum

U.S. Department
of Transportation

National Highway Traffic Safety Administration

Vehicle Research and Test Center P.O. Box B37
East Liberty, Ohio 43319
(937) 666-4511

INFORMATION Redacted PURSUANT TO THE FREEDOM OF INFORMATION ACT (FOIA), 5 U.S.C . 552(B)(6)

Subject: FINAL REPORT: "Investigation of Dorel Center Front Adjusters"

Date: JUL - 5 2012

From: Roger A. Saul
Director
Vehicle Research and Test Center

Reply to
Attn. Of:

To: Frank Borris
Director
Office of Defects Investigation

Attached is a revised pdf of the final report titled "Investigation of Dorel Center Front Adjusters." This report completes the requirements for this program.

1 Attachment

#

Get it together!
SAFETY BELTS SAVE LIVES
AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

Memorandum

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

**Vehicle Research and Test Center P.O. Box B37
East Liberty, Ohio 43319
(937) 666-4511**

Subject: FINAL REPORT: "Investigation of Dorel Center Front Adjusters"

Date: JUL - 5 2012

From: Roger A. Saul
Director
Vehicle Research and Test Center

Reply to
Attn. Of:

To: Frank Borris
Director
Office of Defects Investigation

Attached is a revised pdf of the final report titled "Investigation of Dorel Center Front Adjusters." This report completes the requirements for this program.

1 Attachment

#

[redacted]

[redacted]

INITIALS/SIG
DATE
RTG SYMBOL
INITIALS/SIG
DATE
RTG SYMBOL
INITIALS/SIG
DATE
RTG SYMBOL
INITIALS/SIG
DATE

U:\TRC\Controls-Correspondence\Correspondence\DA Esser\CR 186 (Dorel Ctr Ft Adjuster)\Dorel Center Front Adjusters Final Memo 06-18-12

GRID

Get it together!
SAFETY BELTS SAVE LIVES
(800) 424-9393
Wash. D.C. Area 366-0123

INFORMATION Redacted PURSUANT TO THE FREEDOM OF INFORMATION ACT (FOIA), 5 U.S.C . 552(B)(6)

VRTC-DCD 1174
EA10-005

Investigation of Dorel Center Front Adjusters

VEHICLE RESEARCH AND TEST CENTER
EAST LIBERTY, OHIO 43319

FINAL REPORT
JUNE 2012

U.S. Department of Transportation
National Highway Traffic Safety Administration

Technical Report Documentation Page

1. Report No.`	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Investigation of Dorel Center Front Adjusters		5. Report Date June 2012
		6. Performing Organization Code NVS-313
7. Author(s) Robert Esser		8. Performing Organization Report No. VRTC-DCD 1174
9. Performing Organization Name and Address National Highway Traffic Safety Administration Vehicle Research and Test Center P.O. Box 37, East Liberty, OH 43319		10. Work Unit No. (TRAIS)n code 11. Contract of Grant No.
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration 1200 New Jersey Ave, S.E. Washington, DC 20590		13. Type of Report and Period Covered Final, February 2011 – June 2012 14. Sponsoring Agency Code

15. Supplementary Notes

The author acknowledges the support of this effort by Duane Stoltzfus, Harry Mullins, Scott Ericksen, Rick Hughes, Jared Dowdy, and Tim Cleland without whose help this project would not have been possible.

16. Abstract

Dorel Juvenile Group (DJG) has recalled approximately 800,000 seats of the approximately [redacted] seats that the company produced between May 1, 2008 and April 30, 2009 because the Center Front Adjuster (CFA) is susceptible to not fully closing and locking the webbing strap that passes through it. Because all DJG child seats, both recalled and non-recalled, used the same CFA design, the intent of this test program was to compare CFAs from the non-recalled seats to CFAs from the recalled seats in an effort to determine if the scope of the recall was adequate. Other objectives of this test program were to determine: 1) the root cause of the defect, 2) the adequacy of the remedy, 3) any adverse effects the remedy may have on the performance of the CFA and adjustment strap, particularly dynamic performance, and 4) the durability of the remedy.

Forty-one sample seats (21 recalled and 20 non-recalled) were subjected to inspections, tests, and analysis. Examination revealed that there were no significant physical differences in external visual appearance, measured dimensions, operating forces, seat model, or manufacturing dates between the CFAs that slipped and those that did not slip.

Although a definitive root cause was not identified, after CFA disassembly it was observed that a dark substance was present on the pins of CFAs that slipped but was not present on the pins of CFAs that did not slip. As this was the only difference identified between CFAs that slipped vs. those that did not, it is reasonable to conclude that this substance may increase the inherent friction between the pin and the pawl adversely affecting its ability to fully return and engage the webbing. The composition of the substance, possibly corrosion, is not known.

Because the remedy was to lubricate the CFA with oil, tests were conducted to ensure that the process of oiling CFAs, both slipping and non-slipping, did not interfere with the proper operation of the CFA. The Tensile test, Force vs. Deflection test, Durability test, and the FMVSS 213 sled tests did not identify any performance issues with the oil remedied CFAs. That is, slipping CFAs began to operate properly after the remedy was applied, while non-slipping CFAs continued to operate properly after the remedy was applied.

17. Keywords	18. Distribution Statement		
Dorel, CFA, Child Seat, Center Front Adjuster			
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages	22. Price

Form DOT F1700.7 (8-72) **Reproduction of completed page authorized**

TABLE OF CONTENTS

Section **Page**

Technical Report Documentation Page i

List of Figures iv

List of Tables v

1.0 Introduction 1

2.0 Test Items 3

3.0 Test Procedures 5

3.1 Group One Testing 5

3.1.1 Incoming Inspection and Documentation of As-Received Condition 5

3.1.2 Webbing Measurements 5

3.1.3 Pawl Measurement 6

3.1.4 Individual CFA Testing 6

3.1.5 Determination of force Required to Pull Webbing Through CFA 7

3.1.5.1 Dorel Test Procedure 8

3.1.5.2 Modified DJG Test Procedure 8

3.1.5.3 Tensile Strength Tests 9

3.1.6 Force vs. Deflection Tests 10

3.1.7 FMVSS 213 Sled Tests 11

3.1.8 Durability Testing 13

3.1.9 Component Measurements 15

3.2 Group Two Testing 16

4.0 Test Results 17

4.1 Group One Test Results 17

4.1.1 Receiving Inspection 17

4.1.2 CFA Measurements 18

4.1.3 DJG Pull Tests 19

4.1.4 Tensile Tests 20

4.1.5 Force vs. Deflection Tests 20

4.1.6 Sled Test Results 21

4.1.7 Durability Tests 21

4.1.8 Component Measurements 23
4.2 Group Two Rest Results 24
4.2.1 Force vs. Deflection Tests 24
4.2.2 Component Inspections and Measurements 25
5.0 Discussion 28
Appendix I - Photos of Typical Seat and Components 30
Appendix II – Dorel Test Procedure 34
Appendix III – Dorel Recall Procedure 36
Appendix IV – Sled Test Data Plots 38
Appendix V – Group One Test Protocol 55
Appendix VI – Group Two Test Protocol **(Confidential)** 64

LIST OF FIGURES

Figure		Page
1	Typical Seat as Received	1
2	CFA Mounted in Seat	1
3	Typical CFA	2
4	Component Parts of CFA	2
5	Measurement of Webbing Width	6
6	Measurement of Webbing Thickness	6
7	Pull Test	8
8	CFA in TST Machine	9
9	CFA Fixture for TST Machine	10
10	Force vs. Deflection Measuring Device	11
11	Setup for First Sled Test	12
12	Setup for Second Sled Test	13
13	Durability Test Device	14
14	Load Application Head	14
15	Disassembled CFA Pins	26

LIST OF TABLES

Table		Page
1	Group One: Sample Seats from Consumers	3
2	Group Two: Sample Seats Provided by DJG	4
3	Group One Test Matrix	7
4	Measurement Location and Method	16
5	Disassembled CFAs by Sample ID and CFA Date	17
6	Results of Incoming Inspections for Group One	18
7	Results of Physical Measurements for Group One	19
8	Results of DJG Pull Tests for Group One	20
9	Force vs. Deflection Test Results for Group One	20
10	Sled Test Results	21
11	Durability Test Results	21
12	Deflection and Durability Testing	22
13	Group One 1 Dimensional Measurements with DJG Specifications	23
14	Group One Dimensional Measurement without DJG Specifications	24
15	Force vs. Deflection Test Results for Group Two	25
16	Group Two Dimensional Measurements with DJG Specifications	27
17	Group Two Dimensional Measurement without DJG Specifications	28

1.0 INTRODUCTION

This test program was performed at the Vehicle Research and Test Center (VRTC) in response to a request by the Office of Defects Investigation (ODI) of the National Highway Traffic Safety Administration (NHTSA). The subject of this test program is the Center Front Adjuster (CFA) used in multiple models of child and infant seats manufactured by Dorel Juvenile Group (DJG).

The CFA acts as a clamp that locks the webbing strap that connects to the upper torso restraint (UTR) harness on the subject seats. Its primary function is to lock the UTR in place once it has been adjusted. The CFA is located low on the front of the seat and consists of a frame, a pawl, a pivot pin, and a spring. The CFA webbing passes between the frame and the pawl and is locked into place by teeth on the underside of the pawl that engage the webbing. The pawl and spring are mounted on the pin and the clamping force is provided by the spring. The spring fits into a milled-out section of the pawl called the "spring pocket.[1]" The UTR is tightened by pulling on the webbing that passes through the CFA. The UTR is loosened by depressing the pawl, thus allowing the webbing to go back through the CFA.

Figure 1 shows a typical seat with the CFA installed. Figure 2 shows a close-up view of the CFA mounted in the same seat with the upholstery pulled back. Figure 3 shows a typical CFA after removal from the seat. Figure 4 shows the component parts of the CFA. The circular dimple shown in the pawl in Figure 4 was machined into the pawl for test purposes by VRTC and is not part of Dorel's design.



Figure 1
Typical Seat as Received

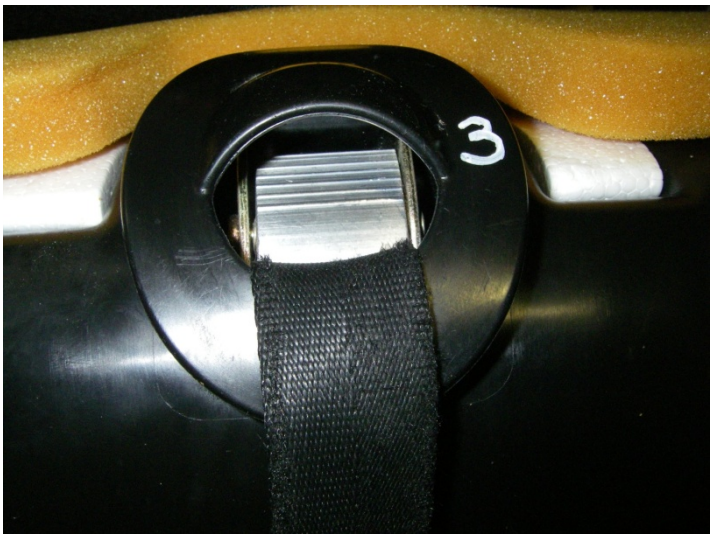


Figure 2
CFA Mounted in Seat (Upholstery Pulled Back)

[1] See Appendix 1 for photos identifying the spring pocket and other CFA component parts.

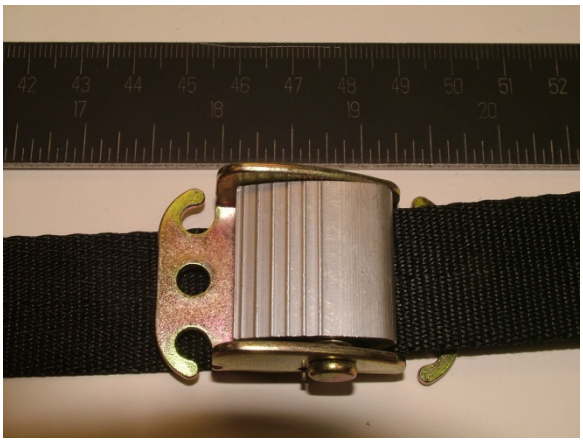


Figure 3
Typical CFA

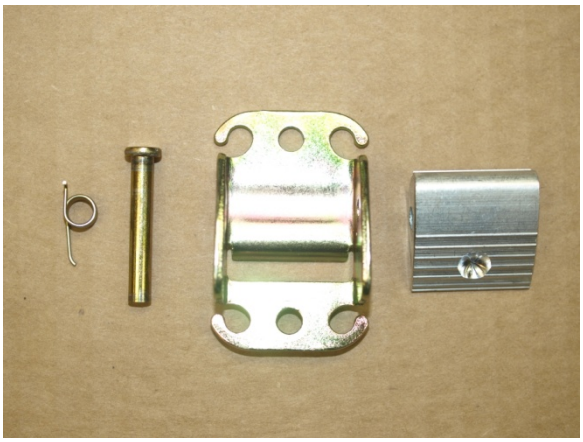


Figure 4
Component Parts of CFA

A condition develops in some of the subject DJG child seat products where the CFA does not adequately lock the webbing strap in the adjusted position (i.e., the strap "slips"). DJG identified a certain period of production (May 1, 2008 through April 30, 2009) as the scope of production in which a CFA is susceptible to not fully closing and locking the webbing strap (the "defect") and has recalled approximately 800,000 of approximately [redacted] seats it produced during that time.[2] The "slipping" condition is not known to occur during a crash event, when protection to the occupant would be required, but instead could occur when a child moves around in the seat and pushes against the UTR creating looseness in the harness. A loose UTR may contribute to an increased risk of occupant injury in the event of a crash. The recall repair kit for the recalled seats (the "remedy") consists of a small tube of vegetable-quality oil and instructions to the consumer to apply two drops of oil to each end of the CFA pivot pin in order to reduce friction and thus allow the CFA to operate properly (i.e. allowing the teeth on the underside of the pawl to properly engage the webbing).[3]

Because all DJG child seats, both recalled and non-recalled, produced between May 1, 2008 and April 30, 2009 used the same CFA design, the intent of this test program was to compare CFAs from the non-recalled seats to CFAs from the recalled seats in an effort to determine if the scope of the recall was adequate. Other objectives of this test program were to determine: 1) the root cause of the defect, 2) the adequacy of the remedy, 3) any adverse effects the remedy may have on the performance of the CFA and adjustment strap, particularly dynamic performance, and 4) the durability of the remedy.

[2] *See* NHTSA Safety Recall No. 11C-001. Recalled seat platforms include the Prospect, OnBoard, Alpha Omega Elite, Alpha Omega, Mico, Enspira, Priori, Vantage, Avenue and Uptown.
[3] *See* Appendix III, Dorel Recall Procedure.

2.0 TEST ITEMS

ODI was able to obtain 23 used DJG seats from consumers (Group One). These seats were purchased randomly without regard to whether the CFA slipped or not. Twenty-two of these seats were shipped directly to VRTC by the consumers.[4] Each seat underwent a receiving inspection before being subjected to various tests. The receiving inspections showed that the CFA slipped on four of the 22 seats and appeared to function properly on the remaining 18 seats. Of the four CFAs that slipped, two were from seats within the recalled population and two were from the non-recalled population.

Table 1 shows the Group One sample seats received from consumers.

Table 1: Group One: Sample Seats from Consumers

VRTC ID	CFA Slips	Model Number	Seat Mfr. Date	CFA Mfr. Date	Model Platform	Brand	Recalled
EBD 01	Yes	22790	1/7/09	9/3/08	DELUXE	EDDIE BAUER	Yes
VAN01	Yes	22554	9/9/08	7/29/08	VANTAGE	SAFETY 1ST	Yes
APX 01	No	22537	12/12/08	9/26/08	APEX 65	SAFETY 1ST	No
APX 02	No	22537	12/12/08	9/26/08	APEX 65	SAFETY 1ST	No
APX03	No	22530	5/8/08	3/16/08	APEX 65	SAFETY 1ST	No
APX 04	No	22534	10/9/08	8/13/08	APEX 65	ALPHA	No
DD 01	No	22353	8/28/08	10/5/07	22	DISNEY	No
SD 01	No	22322	5/22/08	4/24/08	D22	SAFETY 1ST	No
HBB 02	No	22233	3/17/09	1/14/09	HBB	COSCO	No
EBD 03	No	22858	12/9/08	10/10/08	HBB	EDDIE BAUER	No
EBD 04	No	22858	1/5/09	6/5/08	HBB	EDDIE BAUER	No
HBB 01	No	22233	3/3/09	11/6/08	HBB	COSCO	No
VEN 01	Yes	22231	7/14/08	4/25/08	VENTURA	COSCO	No
HBB 03	No	22206	11/3/08	9/19/08	HBB	COSCO	No
SCE 03	No	22123	11/5/08	8/13/08	SCENERA	COSCO	No
SCE 02	No	22162	10/20/08	9/11/08	SCENERA	COSCO	No
SCE 01	No	22123	7/28/08	6/11/08	SCENERA	COSCO	No
SCE 05	No	22120	10/1/08	8/2/08	SCENERA	COSCO	No
SUM 01	No	22244	1/13/09	8/5/08	SUMMIT	SAFETY 1ST	No
EBD 02	No	22800	3/11/09	1/29/09	HBB	EDDIE BAUER	No
SCE 06	Yes	22113	2/11/09	6/27/08	SCENERA	COSCO	No
SCE 04	No	22123	5/2/08	3/16/08	SCENERA	COSCO	No

[4] ODI paid for the cost of shipping. The other seat was sent to ODI.

Upon completion of testing of the Group One seats, 19 additional used seats were provided by DJG for a second series of tests (Group Two). These seats had been returned to DJG from consumers due to webbing slippage through the CFA. They were hand-carried from DJG's manufacturing facility in Columbus, Indiana, to VRTC by a VRTC representative. The incoming inspections that were performed at VRTC showed that all 19 CFAs slipped. All of these seats were from within the recall population.

Table 2 shows the Group Two seats provided by DJG.

Table 2: Group Two: Sample Seats Provided by DJG

VRTC ID	Model Number	CRS Date	CFA Date	Model Platform	Brand	Dorel Return ID
1	22486TTH	6/10/08	4/22/08	PRIORI	MAXI COSI	9174505
2	22486TTH	7/10/08	4/26/08	PRIORI	MAXI COSI	91790195
3	22486GIP	11/7/08	9/16/08	PRIORI	MAXI COSI	91821188
4	22486TTH	10/6/08	8/20/08	PRIORI	MAXI COSI	92444950
5	22158GRS	1/9/09	8/22/08	AOE	ALPHA	91977076
6	222741GRT	7/29/08	6/10/08	ENSPIRA	EDDIE BAUER	92073145
7	22741WNW	12/26/08	9/22/08	ENSPIRA	EDDIE BAUER	91764026
8	22172XXX	1/6/09	6/24/08	AO	SAFETY 1ST	91815085
9	22741BWD	11/6/08	9/24/08	ENSPIRA	EDDIE BAUER	92711094
10	22554PCR	10/23/08	9/18/08	VANTAGE	SAFETY 1ST	
11	22657PST	8/13/08	6/2/08	ONBOARD	EDDIE BAUER	92452647
12	22152BVL	11/21/08	8/7/08	AO	SAFETY 1ST	91915548
13	22158GRS	9/16/08	7/28/08	AOE	Alpha	92575307
14	22456CAB	11/18/08	10/9/08	AOE	SAFETY 1ST	7633555465
15	22159SGT	11/11/08	9/24/08	AOE	SAFETY 1ST	92336232
16	22476GIP	4/2/09	1/23/09	PRIORI	MAXI COSI	91754651
17	22356NTR	1/12/09	5/22/08	ONBOARD	SAFETY 1ST	91738185
18	22412MOM	11/21/08	8/7/08	AO	SAFETY 1ST	92946794
19	22148RDH	8/21/08	6/27/08	AOE	SAFETY 1ST	91785121

Group One and Group Two sample seats were subjected to two different phases of testing.[5]

[5] *See generally* Test Protocol Phase One, Appendix V and Test Protocol Phase Two: CFA Measurement Protocol, Appendix VI. The Phase one protocol does not describe the FMVSS No. 213 testing. Phase one addressed items such as incoming inspections, measurements of intact CFAs, force deflection tests and pull tests. ODI developed a test sequence for each seat in Group one for this phase of testing. ODI subjected some, but not all, Group two seats to the tests described in the Phase one test protocol. The Phase Two protocol addresses the disassembly of the CFAs.

3.0 TEST PROCEDURES

3.1 Group One Testing

The test sample seats used for Group One are listed in Table 1 above (sample seats from consumers). Group One included the following examination and testing:

3.1.1 Incoming Inspection and Documentation of As-Received Condition

Each seat was photographed in the as-received condition.[6] Most of the CFAs and straps were removed[7] and the physical parameters of the webbing and CFA listed below were measured or otherwise determined.

- CFA ID
- Splitter Plate ID
- Strap ID
- Length of Frayed Webbing
- Webbing Width
- Webbing Thickness
- Lateral Movement of Pawl

3.1.2 Webbing Measurements

The thickness and width of each strap were measured at 8", 16" and 24" from the end that was attached to the belt splitter.[8] The webbing width was measured using a digital caliper. The thickness was measured using a digital height gage. In order to ensure repeatable results among all the test items and to ensure that any webbing irregularities were pulled flat, the webbing was placed on a level granite layout table, an 8.6-lb steel block was placed across the webbing at the stitching end to anchor it, and a 5-lb weight was hung from the splitter plate.

Figure 5 shows a typical width measurement. Figure 6 shows a typical thickness measurement.

[6] Photos of a typical seat and the component parts of the CFA are shown in Appendix I.
[7] Two of the seats from the consumer samples were kept intact.
[8] The single belt that goes through the CFA is attached to a metal splitter plate that, in turn, attaches to the two shoulder straps and the UTR that restrains the occupant.



Figure 5: Measurement of Webbing Width



Figure 6: Measurement of Webbing Thickness (Also shows anchor block)

3.1.3 Pawl Movement

In the as-received condition, an attempt was made to move the pawl sideways on the pin (i.e., within the frame assembly) using only the force that could be generated by one finger. (approximately 2 lb) If the pawl moved, the pawl was moved as far as it would go in one direction, the clearance between the pawl and the frame was measured using a digital caliper, the pawl was moved as far as it would go in the opposite direction, and the clearance was measured again. The difference between the two measurements was recorded as the Lateral Movement of the Pawl.

3.1.4 Individual CFA Testing

A test matrix was developed to test individual CFAs using various procedures. Testing included two different test procedures that attempted to pull the webbing through the CFA, force vs. deflection measurements of the pawl, dynamic sled tests of the entire seat per the FMVSS 213

test protocol, and durability testing of the CFA after instituting the repair per DJG's recall. Not all seats were subjected to every test procedure.

The test matrix for Group One is shown in Table 3. Test procedures for these tests are described following Table 3.

Table 3: Group One Test Matrix

VRTC ID	CFA Slips	Pull Test	Pull Test 2	Tensile Pre Oil	Oil	Tensile Post Oil	Over Oil	Tensile Over Oil	213 Sled Test	Force/defl. Test	Durability Test	Dissasemble CFA
EBD 01	Yes	x			X				Test 1	x		X
VAN01	Yes	x		X								
APX 01	No			X	X	X	X	X		x	X	X
APX 02	No			X						x		
APX 03	No		x	X						x		X
APX 04	No			X	X	X				x	X	
DD 01	No			X						x		X
SD 01	No			X						x		
HBB 02	No			X	X	X				x	X	X
EBD 03	No			X					Test 1	x		X
EBD 04	No			X			X	X		x	X	
HBB 01	No		x	X						x		X
VEN 01	Yes			X								
HBB03	No			X						x		
SCE 03	No			X	X	X				x		X
SCE 02	No		x	X						x		X
SCE 01	No						X		Test 2	x		X
SCE 05	No			X						x		X
SUM 01	No			X					Test 2	x		
EBD 02	No		x	X						x		X
SCE 06	Yes	x										
SCE 04	No			X						x		X

3.1.5 Determination of Force Required to Pull Webbing through the CFA

The objective of these tests was to determine how much force was required to pull the CFA strap back through a CFA that was slipping. Two different test objectives were established, one which tested the slipping CFA in the seat it was originally manufactured on, and another which transferred a slipping CFA into different seat types (platforms) to determine if the CFA continued to slip.

3.1.5.1 DJG Test Procedure (Pull Test in Original Seat)

This test procedure was based on a procedure provided by DJG.[9] The DJG procedure was chosen in order to provide direct comparability between VRTC test results and DJG test results. After determining the proper location at which the webbing contacted the CFA upon proper UTR adjustment with both a CRABI dummy (infant) and a 3-year old dummy, each of the three selected test seats (EBD01, VAN01, and SCE06) was firmly attached to a rigid table, the webbing was set to the appropriate location in the CFA, a round bar was placed behind the UTR webbing, and a force was applied manually in the horizontal direction. The force required to pull the webbing through the CFA was observed on a force gage and recorded manually by an observer. For repeatability, five tests were performed at each of the two webbing positions and the results were averaged. Figure 7 shows a seat under test for this procedure. This test is referred to as the "Pull Test" on the test matrix (Table 3).

3.1.5.2 Modified DJG Test Procedure (Pull Test in Different Seat)

As additional testing, the CFA from VAN 01 was removed from the seat and installed, in turn, on non-slipping seats APX 03, HBB 01, SCE 02, and EBD 02 and the above procedure was repeated. This test is referred to as "Pull Test 2" on Table 3.



Figure 7: Pull Test

[9] *See* Appendix II, Dorel Test Procedure.

3.1.5.3 Tensile Strength Tests

One purpose of these tests was to ensure that oiling non-slipping CFAs did not interfere with the proper operation of the CFA. On these non-slipping CFAs, tests were performed before applying the remedy ("tensile pre oil"), after applying the remedy ("tensile post-oil"), and after applying more oil than specified by Dorel for the remedy ("tensile over oil") as specified in the test matrix (Table 3). This procedure is referred to as "Tensile" in the test results section. One slipping CFA (VEN01) was also tensile tested, without applying any oil, to see if a slipping CFA would withstand the 150 lb. load, as discussed below.

A fixture was fabricated that allowed a CFA and its webbing to be mounted in VRTC's tensile strength test (TST) machine. Since DJG uses a proof load of 150 lb during the manufacturing process,[10] this force was applied to the webbing during VRTC's testing as well. The TST was adjusted to apply the load at the rate of 1 inch/minute. The TST was adjusted so that the test was automatically terminated when either 150 lb of belt loading or 1 inch of belt slippage was reached. Webbing load and movement were recorded electronically. Figure 8 shows the test setup for this procedure. Figure 9 shows the fixture that was used to hold the CFA during this test.

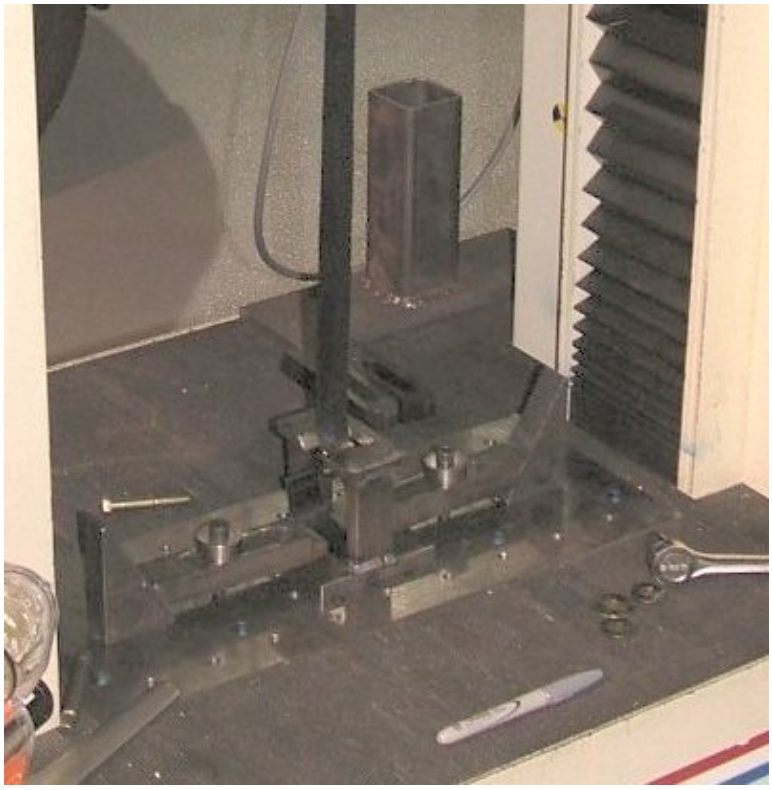


Figure 8: CFA in TST Machine

[10] PE10-009 DJG Information Request Response, question 12. This test is performed as part of a manufacturing quality check at the end of the production process to ensure the CFA is working properly.



Figure 9: CFA Fixture for TST Machine

3.1.6 Force vs. Deflection Tests

It was noted that the pawl on some CFAs was more difficult to depress than the pawl on other CFAs. It was hypothesized that if a CFA allowed belt slippage, it was because the pawl did not return completely to the locked position (i.e., contacting the webbing material with sufficient force) and that requiring more force to depress the pawl might be an indicator of this condition. This test was developed in order to measure the amount of force that was required to depress the pawl through its range of travel on individual CFAs.

Each tested CFA was prepared by machining a ¼-inch dimple into the pawl to facilitate depressing the pawl. A jig was fabricated that allowed the dimple to be machined at the same location on each pawl. Figure 4 above shows a pawl with the machined dimple.

The force that was required to depress the pawl was applied by an electric stepper motor[11] and measured by a 50-lb load cell. The distance traveled was measured by a linear potentiometer. A fixture was fabricated that held the stepper motor vertically but allowed it to pivot in one axis so it could follow the rotation of the CFA pawl.

[11] The stepper motor is a linear actuator that can be controlled in 0.001" increments.

In order to minimize measurement error due to the rotation of the pawl during the test, a ¼- inch stainless steel ball was placed between the dimple in the pawl and a similarly dimpled end of the load application portion of the stepper motor. Additionally, the CFA was mounted in the fixture so that the pawl was perpendicular to the load application device when the pawl was approximately half way through its arc of travel. The stepper motor and fixture are shown in Figure 10.

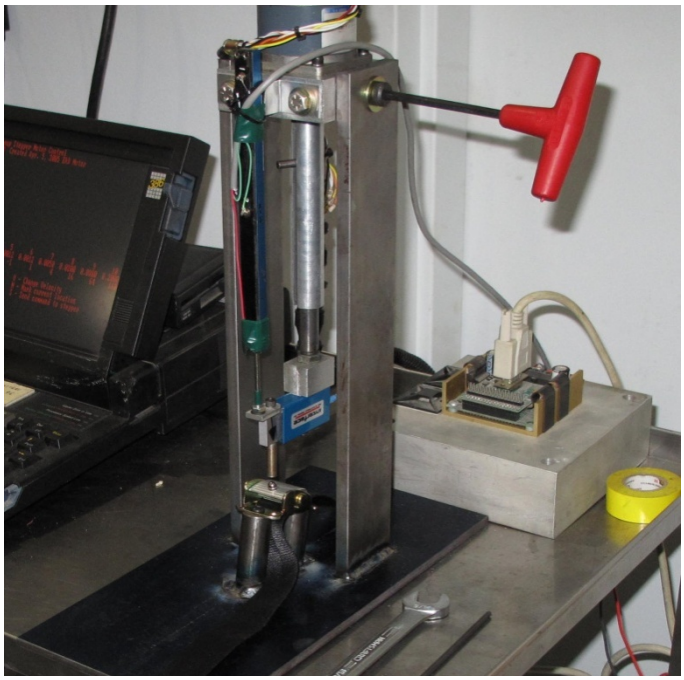


Figure 10: Force vs. Deflection Measuring Device

3.1.7 FMVSS 213 Sled Tests

The purpose of these tests was to quantify how much, if any, webbing would pass through the CFA in a standardized simulated vehicle crash and to determine if the seats adequately protected the occupant in the event that webbing did pass through the CFA.

Two sled tests were performed using the FMVSS 213 sled test procedure.[12] Two seats manufactured by DJG were tested per sled test with a 3-year old Hybrid III dummy properly restrained in each seat. The first sled test was conducted using one slipping CFA that was oiled prior to the test, and one non-slipping CFA that was not oiled. The second sled test utilized one non-slipping CFA that was "over oiled" and one non-slipping CFA that was not oiled. Specific seats that were tested are listed in the test matrix (Table 3).

[12] The Test Procedure is available at:
http://www.nhtsa.gov/DOT/NHTSA/Vehicle%20Safety/Test%20Procedures/Associated%20Files/TP213-9a.pdf

In addition to the electronic and photographic data that were gathered, the length of webbing that was exposed in front of each CFA was measured manually before and after each test to determine if any webbing had slipped through the CFA during the test. Figure 11 shows the pre-test configuration of the first test. Figure 12 shows the pre-test configuration of the second test.



Figure 11: Setup for First Sled Test



Figure 12: Setup for Second Sled Test

3.1.8 Durability Testing

The objective of the durability testing was to verify that DJG's recall remedy of oiling the pin and pawl posed no adverse effects to the proper operation of the CFA[13]. This testing was performed to ensure that the CFAs continued to operate properly after 30,000 cycles of use.

A fixture was fabricated that allowed the pawl to be mechanically cycled. The device consisted of an electric motor, a speed-reducing pulley system, a cam to convert rotational movement into linear movement, a linear bearing, and a rubber-tipped load application head. The actuating arm applied force to the pawl to cause it to travel through its full range of motion. When the actuating arm then retracted, the CFA spring caused the pawl to return to its starting position. The application rate was set at 200 cycles per minute. The overall test fixture is shown in Figure 13. The load application head is shown in Figure 14.

[13] The seats used for this test did not have slipping CFAs.



Figure 13: Durability Test Device

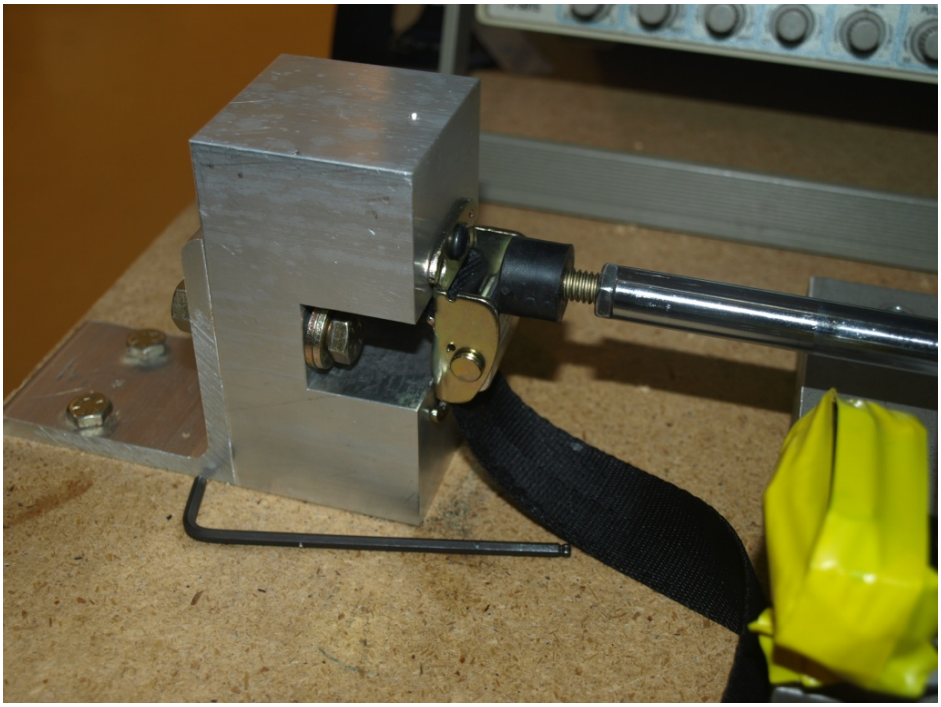


Figure 14: Load Application Head

After baseline force vs. deflection data were gathered, the CFA was lubricated following the instructions that were supplied with the recall remedy repair kit.[14] Two drops of oil were squeezed onto each end of the pivot pin through the gap between the frame and the pawl. Any excess oil was wiped away. The pawl was then cycled by hand five times to work the oil onto the pivot pin.

After lubricating the CFA, a second set of force/deflection data was gathered.

The CFA was then mounted in the durability fixture and the fixture was activated. Without any additional oiling, the CFA was removed and tested on the force/deflection fixture at 20,000, 25,000, and 30,000 cycles.

3.1.9 Component Measurements

Upon completion of the above testing,[15] thirteen CFAs were randomly chosen for disassembly.[16] Disassembly was accomplished by removing the strap, wrapping the CFA in tape to prevent contamination of the CFA due to milling debris (swarf), removing the pin by milling off its swaged end, and carefully driving the pin out of the frame with a hammer and drift punch. Once disassembled, each component of the CFA was carefully photographed and measured. The results were then compared to the design specifications provided by DJG.

The measuring devices that were employed included a digital caliper (see Figure 5), digital height gage (see Figure 6), digital micrometer, feeler gages, and a go/no-go gage. Table 4 lists the parameters that were measured, the location on the part where the measurement was taken, and the device that was used to make the measurement.

The test protocol for this section is provided in Appendix VI. The protocol indicates where the measurements are to be taken and includes confidential dimensioned engineering drawings.

[14] Dorel's recall instructions are provided in Appendix III.
[15] This testing includes the testing described in Test Protocol Phase One, Appendix V.
[16] That is, these CFAs were subjected to Phase Two testing. *See* Test Protocol Phase 2: CFA Measurement Protocol, Appendix VI.

Table 4: Measurement Location and Method

Item	Measurement Location	Measuring Device
Number of Grooves on Pawl	Grooves in pawl	Visual Examination
Pin Diameter	Both ends & middle	Micrometer
Frame Width, Inside	At pin hole and at each end of frame	Caliper
Pin Hole Diameter	Two perpendicular measurements in each hole	Caliper
Bearing Surface Height	Four measurements in different orientations	Caliper
Pawl Width	At pin hole and at each end of pawl	Caliper
Pawl Hole Diameter	Two perpendicular measurements in each hole	Caliper & Go/NoGo Gage
Spring Pocket Depth	Two measurements at each end of pocket	Height Gage
Spring Shelf Depth	Each end of shelf	Height Gage
Spring Coil Height	Flat part of coil ends	Micrometer
Spring Coil Inside Diameter	Two perpendicular measurements in each side of coil.	Caliper
Spring Wire Diameter	Straight part of spring wire	Micrometer
Frame Width, Outside	At pin hole and at each end of frame	Caliper
Frame Hole Location, Horizontal	Reference from mounting hole	Height Gage
Frame Hole Location, Vertical	Reference from mounting hole	Height Gage
Lateral Movement of Pawl	Between pawl and frame	Digital Caliper

The CFAs that were disassembled are listed in table 3 above.

3.2 Group Two Testing

CFAs from seats 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, and 18 provided by DJG (Table 2) and CFAs from VEN 01 and SUM 01 from Group One (Table 1) were chosen for examination in the Group Two testing. Generally, these specific DJG seats were selected because the CFA manufacture date closely matched the CFA manufacture dates of specific non-recalled seats from Group One. Table 5 shows the CFAs used by seat ID and CFA manufacture date for Group One and Group Two.

Group two testing consisted of duplicating the activities described in sections 3.1.1, 3.1.2, 3.1.3, 3.1.6, and 3.1.9 for the CFAs listed above.[17] The test protocol in Appendix VI also applies to Group Two.[18]

[17] *See generally* Test Protocol Phase One, Appendix V.
[18] *See* Test Protocol Phase Two: CFA Measurement Protocol, Appendix VI.

Table 5: Disassembled CFAs by Sample ID and CFA Date

Group One		Group Two	
VRTC ID	**CFA Date**	**CFA Date**	**VRTC ID**
Sce 01	6/11/08	6/10/08	6
Sce 02	9/11/08	9/16/08	3
Sce 03	8/13/08		
Sce 04	3/16/08		
Sce 05	8/21/08	8/20/08	4
		8/22/08	5
Sum 01	8/5/08	8/7/08	12
Ven 01	4/25/08	4/26/08	2
Apx 01	9/26/08	9/22/08	7
		9/24/08	15
Apx 03	3/16/08		
		8/7/08	18
EBD 01	9/3/08		
EBD 02	1/29/09		
EBD 03	10/10/08	10/9/08	14
		6/2/08	11
HBB01	11/6/08		
HBB02	1/14/09	1/23/09	16
OC1	10/6/07		
OC2	8/3/10		
DD 01	6/14/08	6/24/08	8

4.0 TEST RESULTS

4.1 Group One Test Results

Results from Group One testing are shown below.

4.1.1 Receiving Inspection

Table 6 shows the findings of the receiving inspections performed on Group One.

Table 6: Results of Incoming Inspections for Group One

VRTC ID	Frame ID	Strap ID	CFA Manufacture Date	Splitter Plate ID	CFA Slip
SCE 01	BO3-B	806110	6/11/2008	8SI11	No
SCE 02	BO3-G1	G809110	9/11/2008	8SI21	No
SCE 03	BO3-H	G808131	8/13/2008	8SG20	No
SCE 04	BO2-V1	TAG-803161	3/16/2008	8SI04	No
SCE 05	BO3-G	G80821	8/21/2008	8SI17	No
SCE 06		806270	6/27/2008	8SH12	Yes
SUM 01	BO3-G	G808050	8/5/2008	8SG17	No
VEN 01	BO2-Y	804251	4/25/2008	8SH09	Yes
APX 01	BO3-J	G809262	9/26/2008	8SI22	No
APX 02	BO3-J	G809262	9/26/2008	8SG22	No
APX 03	BO2-V1	803161	3/16/2008	8SH04	No
APX 04	BO3-H	G808131	8/13/2008	8SG20	No
EBD 01	BO3-I	G809030	9/3/2008	8SI20	Yes
EBD 02	BO3-L	G901291	1/29/2009	8SI27	No
EBD 03	BO3-J	G810101	10/10/2008	8SI23	No
EBD 04	BO3-A	806051	6/5/2008	8SI11	No
HBB01	BO3-J	G811062	11/6/2006	8SG22	No
HBB02	BO3-K	G901140	1/14/2009	8SG26	No
HBB03	BO3-J1	G809191	9/19/2008	8SG21	No
VAN 01	B03-D	G807291	7/29/2008	8SI17	Yes
DD 01	BO3-A	806140	6/14/2008	N/A	No
SD 01	BO2-S1	804240	4/24/2008	N/A	No

4.1.2 CFA Measurements

Table 7 shows the results of the physical measurements for lateral movement of the pawl and webbing examination of the individual CFAs for Group One.

Table 7: Results of Physical Measurements for Group One

VRTC ID	Lateral Movement of Pawl (in.)	Webbing Examination Dimensions Average (in.)			CFA Slip
		Width	Thickness	Abrasion Length	
SCE 01	0.018	1.002	0.063	None	No
SCE 02	None	1.005	0.066	None	No
SCE 03	0.017	1.013	0.061	None	No
SCE 04	0.024	0.997	0.062	None	No
SCE 05	None	1.013	0.059	None	No
SCE 06	Seat was sent to ODI and was not available for this testing				Yes
SUM 01	None	0.990	0.066	None	No
VEN 01	None	1.009	0.069	6	Yes
APX 01	None	1.014	0.064	2	No
APX 02	None	1.020	0.063	3.5	No
APX 03	None	0.994	0.061	None	No
APX 04	None	1.017	0.063	7.5	No
EBD 01	None	1.018	0.067	7	Yes
EBD 02	None	1.012	0.062	None	No
EBD 03	None	1.013	0.061	None	No
EBD 04	None	0.987	0.065	None	No
HBB01	None	1.014	0.065	2.4	No
HBB02	None	1.019	0.064	2	No
HBB03	None	0.979	0.068	None	No
VAN 01	None	1.016	0.065	7.5	Yes
DD 01	None	0.992	0.065	None	No
SD 01	None	1.014	0.062	None	No

4.1.3 DJG Pull Tests

EBD01, SCE06, and VAN01 were known to slip. The results of these tests are shown in the top half of Table 8.

When the slipping CFA from VAN 01 was installed on non-slipping seats SCE 02, APX 03, EBD 02, and HBB 01, it continued to slip in each of these seats but required less force to slip.

It should be noted that the three seats that were known to slip required nearly twice as much force to pull the webbing through the CFA as did the seats that did not previously slip (i.e., the four seats that the slipping CFA from VAN 01 was installed on). While the forces that were required at the two different belt locations on each seat were similar, the force among the seven seats tested varied between 11 and 45 lb.

Table 8 shows the minimum force that was required to pull the webbing through the CFA at both seating positions on each seat.

Table 8: Results of DJG Pull Tests for Group One

VRTC ID	Pull Test avg force (lb)	
	12 CRABI	3-yr H3
EBD 01	45.1	38.8
VAN 01	24.6	24.5
SCE 06	30.4	24.7
SCE 02	15.3	13.7
APX 03	18.7	18.6
EBD 02	19.8	20.8
HBB01	11.1	11.0

4.1.4 Tensile Tests

Even though some of the CFAs slipped when pulled manually, all of the CFAs to which the 150 lb tensile load was applied[19] withstood the load without slipping, including the known slipping CFA VEN 01 (i.e., the CFAs passed the DJG end-of-line test procedure). These tests were conducted on CFAs without the remedy applied (non-oiled), with the remedy applied (oiled), and with more oil than specified in the recall instructions (over-oiled).[20]

4.1.5 Force vs. Deflection Tests

The average force required to depress the pawl varied between 2.8 and 3.6 lb. Table 9 shows the average application force for each CFA that was tested. Only EBD01 was known to slip and was the only one in the population of the recall.

Table 9: Force vs. Deflection Test Results for Group One

VRTC ID	Avg. Application Force (lb)		VRTC ID	Avg. Application Force (lb)
SCE 01	3.4		EBD 01	2.9
SCE 02	3.4		EBD 02	3.4
SCE 03	3.1		EBD 03	3.6
SCE 04	2.8		EBD 04	3.4
SCE 05	3.1		HBB01	3.6
SUM 01	3.2		HBB 02	2.9
APX 01	3.2		HBB 03	3.5
APX 02	3.2		DD 01	3.2
APX 03	2.8		SD 01	2.8
APX 04	2.8			

[19] *See* Table 3.
[20] *See* Table 3.

4.1.6 Sled Test Results

In the first test, approximately ½ inch of belt webbing passed through the CFA on seat EBD 01.[21] There was no measureable belt webbing movement on seat EBD 03.[22] In the second test, approximately ½ inch of belt webbing passed through the CFA on both seats (SCE 01 and SUM 01), neither of which are in the recall population. There is no specification for CFA slippage in the FMVSS 213 test procedure.

Both occupants met all of the requirements of FMVSS 213 in both tests so all four seats were considered to pass the test. The test results are shown in Table 10. Data plots are provided in Appendix IV. All four seats were tethered for these tests.

Table 10- Sled Test Results

	Sled Test #1		Sled Test #2		
Test Speed (mph)	29.36		29.37		
Sled Accel. (G)	21.39		21.30		
Dummies	Hybrid III 3-yr old		Hybrid III 3-yr old		
	Left Seat	**Right Seat**	**Left Seat**	**Right Seat**	**Allowable**
Seat ID	EBD 01	EBD 03	SCE 01	SUM 01	
CFA belt travel (in)	1/2	none	1/2	1/2	
HIC [15]	250.23	136.76	163.18	183.35	
HIC [36]	446.99	235.72	253.47	384.46	1000
HIC [Max]	476.59	269.93	265.52	420.02	
3ms chest accel. (G)	47.88	38.97	44.47	37.22	60
Neck Moment (Nm)	23.50	8.09	19.75	15.73	
Head Excursion (mm)	578	559	559	559	720
Knee Excursion (mm)	692	645	749	635	915

4.1.7 Durability Tests

Four non-slipping CFAs underwent durability testing. The average force required to operate each pawl before, during, and after the testing cycles, is shown in Table 11. Data show that lubricating the pivot pin caused a slight reduction in the force required to operate the pawl in one of the four test samples (APX01) and had no effect in the other three.

Table 11: Durability Test Results

CFA ID	Average Force to Depress Pawl (lb)				
	Lubrication				
	Pre	Post	+20k	+25k	+30k
APX01	2.9	2.8	2.7	2.7	2.7
APX04	2.6	2.7	2.6	2.6	2.6
EBD04	2.8	2.8	2.8	2.8	2.8
HBB02	2.9	2.9	2.9	2.9	2.9

[21] EBD 01 is in the recall scope and had a slipping CFA. It had the recall remedy applied by VRTC prior to the sled test.
[22] EBD 03 was not in the recall scope.

Prior to starting the durability testing, the four CFAs that were to be tested underwent a baseline force vs. deflection test ("Pre" in Table 11). Since this was a repeat of the initial force vs. durability testing that had been performed earlier (Table 9) with the CFAs in the same condition, it was expected that the results from the two sets of tests would be similar. However, as the data in Table 12 shows, three of the four CFAs required less force to operate prior to durability oiling than they did in the initial force vs. deflection test. This suggests that changes to the force vs. deflection characteristics may be occurring simply by exercising the CFAs in normal usage. It is estimated that these CFAs had been operated at least 20 times (while in the possession of VRTC) between the initial tests and the beginning of the durability tests.

Table 12: Deflection and Durability Testing

VRTC ID	Average Force for Pawl Movement (lb)	
	As-Received Condition	At Start of Durability Testing
APX01	3.2	2.9
APX04	2.8	2.6
EBD04	3.4	2.8
HBB02	2.9	2.9

4.1.8 Component Measurements

Table 13 shows the results of the Group One dimensional measurements and comparison to DJG's specifications. Non-complying (out of specification) measurements are highlighted in red. CFA EBD 01 is the only item in this group that is within the scope of the DJG recall, and the only CFA that slips.

Table 13: Group One Dimensional Measurements with DJG Specifications

CFA Component Measurements After Disassembly													
DJG [redacted]													
VRTC CFA ID Number	Average Pin Diameter (mm)	Average Frame Width Inside (mm)	Average Frame Hole Diameter (mm)	Average Bearing Surface Height (mm)	Average Pawl Width (mm)	Average Pawl Hole Diameter (mm)	Average Spring Pocket Depth (mm)	Average Spring Shelf Depth (mm)	Average Coil Stack Height (mm)	Average Coil Inside Diameter (mm)	Average Spring Wire Diameter (mm)	Avg. Frame Hole Horiz. Dim.	Avg. Frame Hole Vertical Dim. (mm)
SCE01	4.91	28.10	5.10	0.20	26.92	4.98	4.71	1.38	4.00	5.54	0.80	16.86	7.23
SCE02	4.92	28.06	4.99	0.22	26.74	4.99	4.18	1.00	4.89	5.51	0.83	16.93	7.34
SCE03	4.92	28.05	5.02	0.26	26.81	4.92	4.46	1.11	4.83	5.60	0.79	16.91	7.31
SCE04	4.95	28.17	5.04	0.10	26.69	5.02	4.51	1.26	4.86	5.59	0.82	16.98	7.33
SCE05	4.97	28.18	5.09	0.04	26.72	4.98	4.36	0.99	4.68	5.60	0.83	16.92	7.27
EBD01	4.94	28.02	5.08	0.19	26.72	5.05	4.38	0.95	Spring lost during disassembly			16.89	7.36
EBD02	4.91	28.09	5.06	0.16	26.75	4.97	4.51	1.20	4.88	5.52	0.83	16.85	7.35
EBD03	4.94	28.04	5.05	0.26	26.76	5.06	4.43	0.97	4.91	5.45	0.85	16.85	7.29
HBB01	4.94	28.13	5.03	0.23	26.76	5.06	4.47	1.18	4.89	5.44	0.82	16.88	7.34
HBB02	4.95	28.09	5.06	0.19	26.80	5.01	4.51	1.17	4.88	5.52	0.82	16.90	7.35
APX01	4.89	28.04	5.12	0.28	26.71	5.14	4.53	1.17	4.85	5.51	0.81	16.95	7.32
APX03	4.94	28.13	5.07	0.09	26.72	4.99	4.45	1.09	4.84	5.48	0.81	16.99	7.34
DD01	4.94	28.25	5.08	0.11	26.76	5.02	4.24	0.99	4.86	5.56	0.83	16.96	7.33

Table 14 shows the results of the Group One dimensional measurements where no DJG dimensions were specified. Again, CFA EBD 01 is the only item in this group that is within the scope of the recall and the only CFA that slips.

Table 14: Group One Dimensional Measurements without DJG Specifications

CFA Component Measurements After Disassembly					
For Informational Purposes Only - No Dorel Specifications					
VRTC CFA ID Number	Average Frame Width Outside (mm)	Lateral Movement of Pawl (mm)	No. of Grooves on Back of Pawl	CFA Slipped Before Disassembly (Yes/No)	5.1 mm Drill In Pawl Hole (Go/NoGo)
SCE01	31.98	0.19	1	No	NoGo
SCE02	32.23	None	2	No	NoGo
SCE03	32.25	0.43	3	No	NoGo
SCE04	32.36	0.61	2	No	NoGo
SCE05	32.24	None	2	No	NoGo
EBD01	32.13	None	2	Yes	*
EBD02	32.24	None	3	No	NoGo
EBD03	32.24	None	3	No	Go
HBB01	32.19	None	4	No	Go
HBB02	32.10	None	4	No	**
APX01	32.16	0.61	7	No	Go
APX03	32.28	None	2	No	NoGo
DD01	32.35	None	2	No	NoGo
*	Go in one orientation, nogo when turned 90 deg				
**	Go on one side, NoGo on other side.				

4.2 Group Two Test Results

The results of the Group Two testing are described below. For Group Two, all CFAs were known to slip except for CFA SUM 01.

4.2.1 Force vs. Deflection Tests

The average force required to depress the pawl varied between 2.6 and 3.6 lb. Table 15 shows the results of the Force vs. Deflection Tests for Group Two[23]. Items 1, 9, 10, 13, and 17 were not tested.

[23] SUM 01 is the only non-slipping CFA. All others have slipping CFAs.

Table 15: Force vs. Deflection Test Results for Group Two

VRTC ID	Avg. Application Force (lb)
2	3.4
3	3.3
4	3.0
5	3.3
6	3.3
7	3.5
8	3.6
11	3.6
12	3.3
14	3.5
15	2.6
16	3.6
18	N/D
VEN01	3.5
SUM01	3.3

N/D = No Data - System Malfunction

4.2.2 Component Inspections and Measurements

Disassembly and examination of the CFAs in Group Two showed that all of the pins exhibited some amount of wear from rotational motion of the pawl on the pin, and that most of them also had a black residue associated with the wear marks. It should be noted that a few of the pins examined in Group One showed some similar, although lighter, wear marks, no such residue was found on the non-slipping CFAs during the Group One examinations.

Figure 15 on the next page show an assortment of the pins after the CFAs were disassembled. The pins on the left are from CFAs from Group One (sample seats from consumers), most of which did not slip. The pins on the right are from CFAs from Group Two (sample seats provided by DJG), all of which slipped. Each photo is identified by the CFA from which the pin was removed.

Before the CFAs were disassembled, it was also noted that the pawl on CFAs that slipped did not fully and smoothly return to the engaged position after having been cycled. The wear and deposits on the pins of the CFAs that slip were thought to reduce the clearance between the pin and the pawl and thus create a potential hindrance to the proper operation of the pawl by preventing the pawl from fully closing and engaging the webbing. The pin wear and deposit condition was only discernible after disassembly of the CFAs.

Pins from Group One



APX03



EBD01 (CFA Slipped)



EBD03

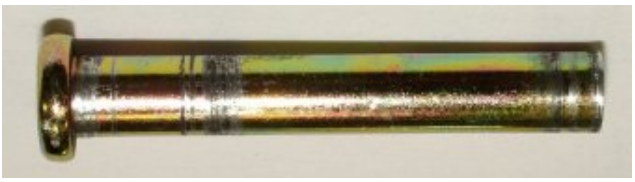


HBB02



SCE03

Pins from Group Two



2



6



8



14



16

Figure 15 – Disassembled CFA Pins

Table 16 shows the results of the Group Two dimensional measurements and comparison to DJG's specifications. Non-complying measurements are highlighted in red.

Table 16: Group Two Dimensional Measurements with DJG Specifications

CFA Component Measurements After Disassembly													
DJG Spec	+ [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
VRTC CFA ID Number	Average Pin Diameter (mm)	Average Frame Width Inside (mm)	Average Frame Hole Diameter (mm)	Average Bearing Surface Height (mm)	Average Pawl Width (mm)	Average Pawl Hole Diameter (mm)	Average Spring Pocket Depth (mm)	Average Spring Shelf Depth (mm)	Average Coil Stack Height (mm)	Average Coil Inside Diameter (mm)	Average Spring Wire Diameter (mm)	Avg. Frame Hole Horiz. Dim.	Avg. Frame Hole Vertical Dim. (mm)
2	4.96	28.18	5.06	0.20	26.83	5.03	4.77	1.33	4.00	5.44	0.79	16.85	7.31
3	4.91	28.13	5.11	0.30	26.77	5.07	4.41	0.92	4.90	5.52	0.80	16.87	7.35
4	4.94	28.14	5.11	0.33	26.75	5.02	4.41	1.02	4.85	5.58	0.76	16.87	7.36
5	4.95	28.11	5.09	0.29	26.77	5.04	4.39	0.97	4.86	5.52	0.78	16.89	7.32
6	4.94	27.97	5.07	0.24	26.76	4.96	4.48	1.07	4.81	5.54	0.83	17.01	7.45
7	4.92	28.13	5.08	0.28	26.74	5.00	4.41	1.03	4.92	5.49	0.77	16.89	7.34
8	4.94	28.17	5.06	0.18	26.87	5.01	4.62	1.21	4.86	5.52	0.79	16.93	7.20
11	4.98	28.35	5.08	0.23	26.81	5.00	4.40	1.04	4.85	5.52	0.79	16.97	7.28
12	4.93	28.19	5.08	0.24	26.78	5.04	4.44	1.05	4.00	5.54	0.79	16.89	7.39
14	4.96	28.15	5.04	0.26	26.76	5.05	4.48	1.02	4.74	5.58	0.85	16.96	7.45
15	4.91	28.16	5.07	0.29	26.78	4.94	4.26	0.91	4.00	5.51	0.84	16.97	7.48
16	4.97	28.24	5.08	0.25	26.84	5.04	4.07	0.74	4.94	5.48	0.70	16.91	7.39
18	4.97	28.22	5.07	0.26	26.81	5.06	4.58	1.19	4.85	5.54	0.79	16.91	7.45
VEN01	4.98	28.14	5.07	0.25	26.73	5.04	4.62	1.21	4.00	5.51	0.79	16.91	7.27
SUM01	4.97	28.14	5.06	0.28	26.79	5.03	4.47	1.09	4.82	5.61	0.79	16.89	7.36

Table 17 shows the results of the Group Two dimensional measurements where no DJG Dimensions were listed.

Table 17: Group Two Dimensional Measurements without DJG Specifications

For Informational Purposes Only - No Dorel Specifications					
VRTC CFA ID Number	Average Frame Width Outside (mm)	Lateral Movement of Pawl (mm)	No. of Grooves on Back of Pawl	CFA Slipped Before Disassembly (Yes/No)	5.1 mm Drill In Pawl Hole (Go/NoGo)
2	32.19	None	0	Yes	NoGo
3	32.16	None	2	Yes	Go
4	32.28	None	3	Yes	NoGo
5	32.15	None	3	Yes	NoGo
6	31.93	None	4	Yes	NoGo
7	32.17	None	0	Yes	NoGo
8	32.16	None	2	Yes	NoGo
11	32.39	None	1	Yes	NoGo
12	32.33	None	3	Yes	Go
14	32.12	None	3	Yes	Go
15	32.27	None	0	Yes	NoGo
16	32.22	None	6	Yes	NoGo
18	32.11	None	3	Yes	Go
VEN01	32.21	None	0	Yes	NoGo
SUM01	32.32	None	6	No	NoGo

5.0 Discussion

One intent of this test program was to compare CFAs from the non-recalled seats to CFAs from the recalled seats in an effort to determine if the scope of the recall was adequate. Other objectives of this test program were to determine: 1) the adequacy of the remedy, 2) any adverse effects the remedy may have on the performance of the CFA and adjustment strap, particularly dynamic performance, 3) the durability of the remedy, and 4) the root cause.

Forty-one sample seats, consisting of 21 recalled seats and 20 non-recalled seats, were subjected to inspections, tests, and analysis. Careful examination revealed that there were no significant physical differences in external visual appearance, measured dimensions, operating forces, seat model, or manufacturing dates between the CFAs that slipped and those that did not slip.

Although a definitive root cause was not identified, after CFA disassembly it was observed that a dark substance was present on the pins of CFAs that slipped but was not present on the pins of CFAs that did not slip. As this was the only difference identified between CFAs that slipped vs. those that did not, it is reasonable to conclude that this substance may increase the inherent friction between the

pin and the pawl adversely affecting its ability to fully return and engage the webbing. The composition of the substance, possibly corrosion, is not known.

Because the remedy was to lubricate the CFA with oil, tests were conducted to ensure that the process of oiling CFAs, both slipping and non-slipping, did not interfere with the proper operation of the CFA. The Tensile test, Force vs. Deflection test, Durability test, and the FMVSS 213 sled tests did not identify any performance issues with the oil-remedied CFAs. That is, slipping CFAs began to operate properly after the remedy was applied, while non-slipping CFAs continued to operate properly after the remedy was applied.

Appendix I
Photos of Typical Seat and Components



Front of Seat



Side View of Seat



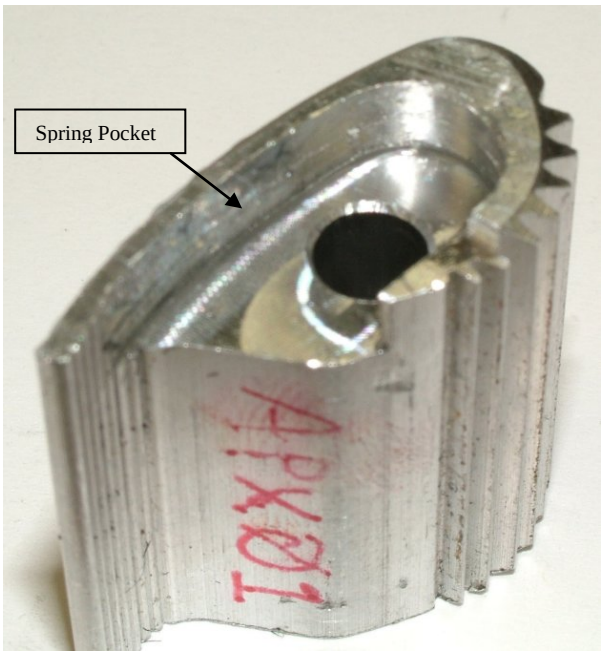
Rear of Seat



Certification Label



Pawl



Pawl



Pin



Spring



Frame



Frame



Frame



Frame

Appendix II
Dorel Test Procedure

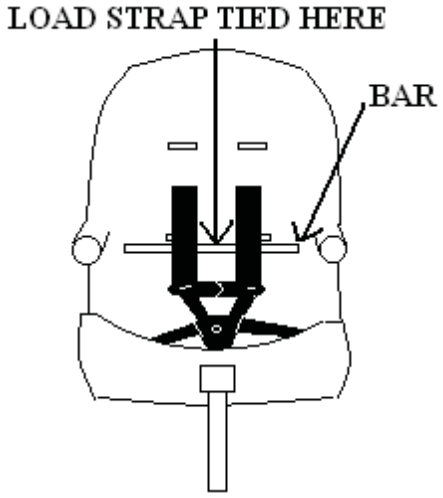
Test Setup

The seats were placed on a solid level surface. They were then anchored from movement by running a strap through the normal belt slot area and anchoring it to the table.

A CRABI dummy was placed as if during normal use. The position of the CFA strap was then marked in relation to the CFA pawl and bracket. The CRABI was removed and the same was repeated with a 3 Year Old dummy. This resulted in 2 marks on the CFA strap, for which the pull test could be repeated several times.

With no dummy in the seats, the harness retainer was connected and the buckle tongues were installed into the buckle housing. Approximately an 8” copper tube was placed behind the harness straps so that each harness could be pulled evenly. A load strap was then tied to the middle of the copper tube so that the force gauge could be connected to the copper tube. While focusing on the CFA strap and the marks that were made, tension force is slowly and horizontally applied the copper bar and load strap until the first movement of the CFA strap is noted. The peak of that force is then recorded. The seat is reset by pulling on the CFA strap past the mark, and then actuating the CFA and pulling on the harness straps until the CFA mark is just below the pawl of the CFA. The measurement is then repeated.

This setup was repeated 10 times for each seat in both the CRABI position of the CFA strap and the 3 Year Old position of the CFA strap.



Appendix III
Dorel Recall Procedure

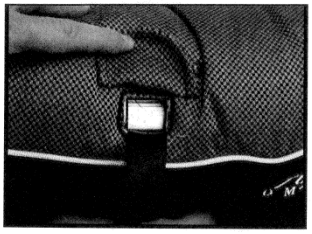
Center Front Adjuster (CFA) Lubricating Instructions

www.djgusa.com

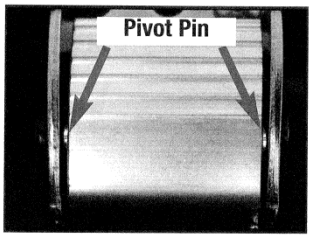
Visit our website to view the instructional video at http://safetynotice.djgusa.com/harn_adjust/media/video.php to assist you in the application of the repair kit.

READ ALL DIRECTIONS BEFORE YOU START

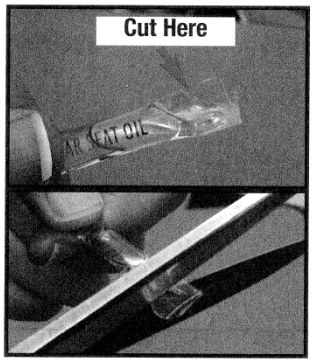
Intended for adult use only.



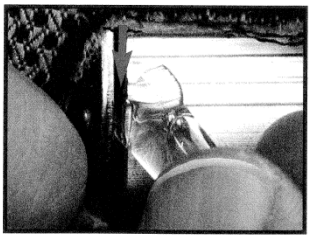
1. Locate and expose the Center Front Adjuster (CFA). The CFA is located in the front of the child restraint. It may be hidden under the flap or you may need to lift the front of the pad to expose the CFA.



2. Locate the CFA pivot pin in the gap, between the gold outside wall and the silver harness release lever, on each side of the harness release lever.



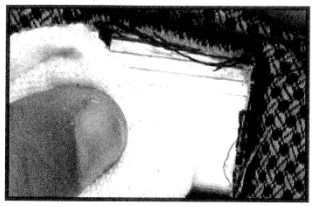
3. Tear or cut the tip off the oil tube. Be careful not to squeeze any oil out while you tear it. **Throw the tip away.**



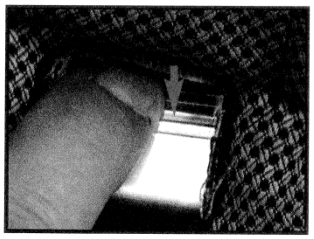
4. Squeeze 2 drops of oil onto the pivot pin on the left side that is **located in the gap**, between the gold outside wall and the silver harness release lever.



5. Squeeze 2 drops of oil onto the pivot pin on the right side that is **located in the gap**, between the gold outside wall and the silver harness release lever.



6. Wipe away any excess oil from the release lever surface.



7. Push down on the harness release lever and release 5 times to work the oil onto the pivot pin.



8. Pull out on the harness straps above the chest clip. **Do Not Push down on the harness release lever.** The harness adjustment strap should not move. If it does move, redo steps 4 thru 8, making sure that the oil is placed on the pivot pin located in the gap, between the gold outside wall and the silver release lever.

Throw away the oil tube when completed and wash your hands.



9. Place the green sticker by the date of manufacture. **DO NOT COVER** any of the information.

You now have completed the center front adjuster lubricating instructions. Adding the oil to the CFA as directed will last the lifetime of your child restraint system. Thank you.

Questions or problems, please call 1-866-623-3139 (Canada 1-866-446-2628) or email harnessadjustment@djgusa.com

Appendix IV
Sled Test Data Plots

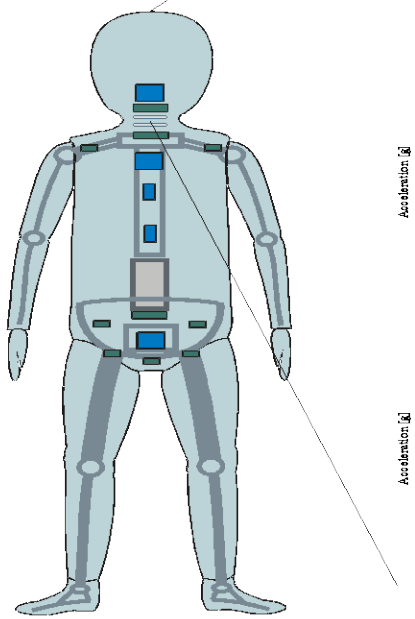
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

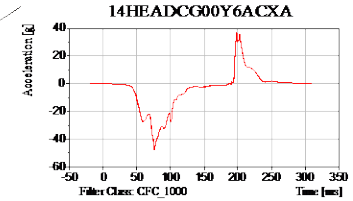
3 ms Duration Acceleration (Head)

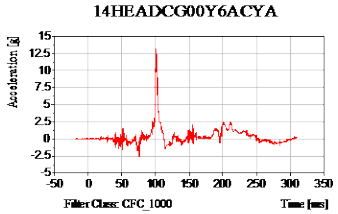
Date: 05/12/2011
Time: 10:27

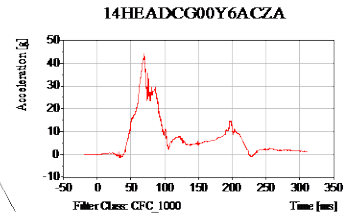
Customer: VRTC
Test Number: Test 1

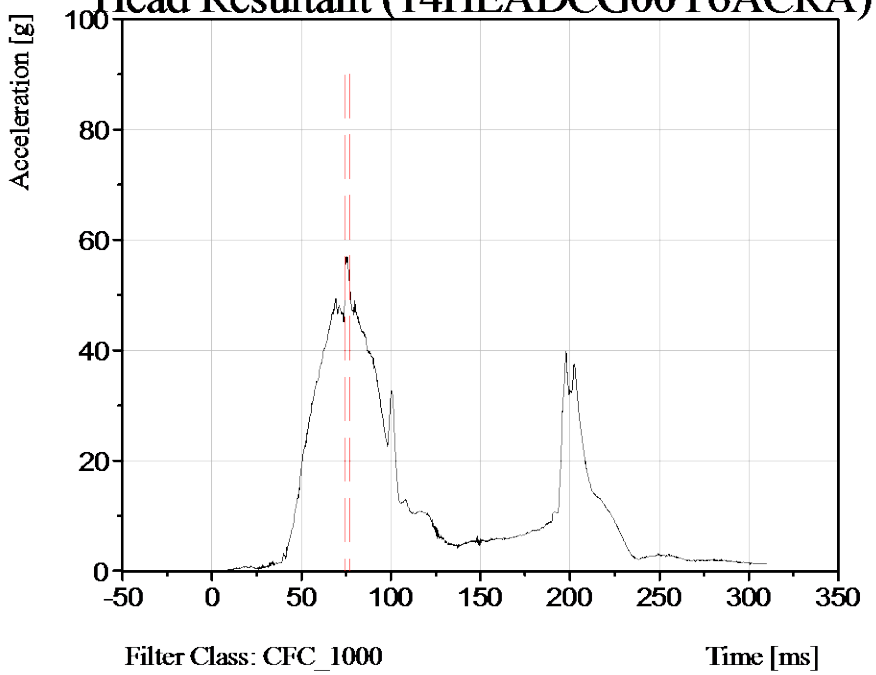
TRC Inc. Test Lab: SLED
Test Number: S110512-1











	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 51.31 g	74.13 ms	77.13 ms

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

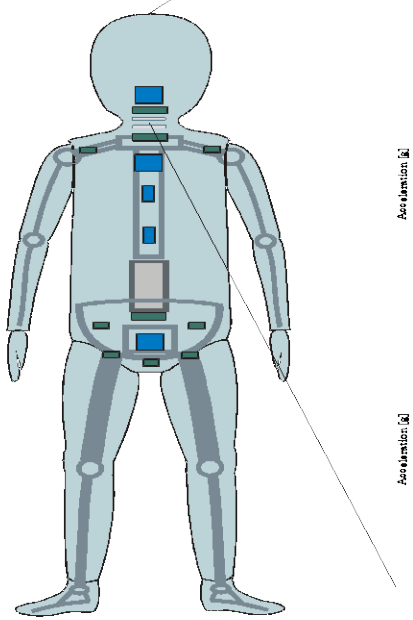
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

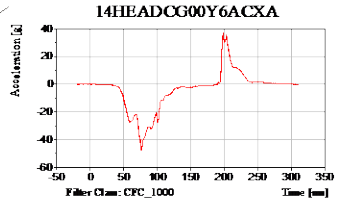
Head Injury Criterion (HIC)

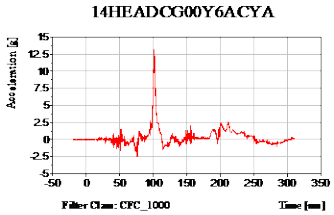
Date: 05/12/2011
Time: 10:27

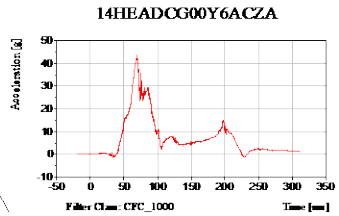
Customer: VRTC
Test Number: Test 1

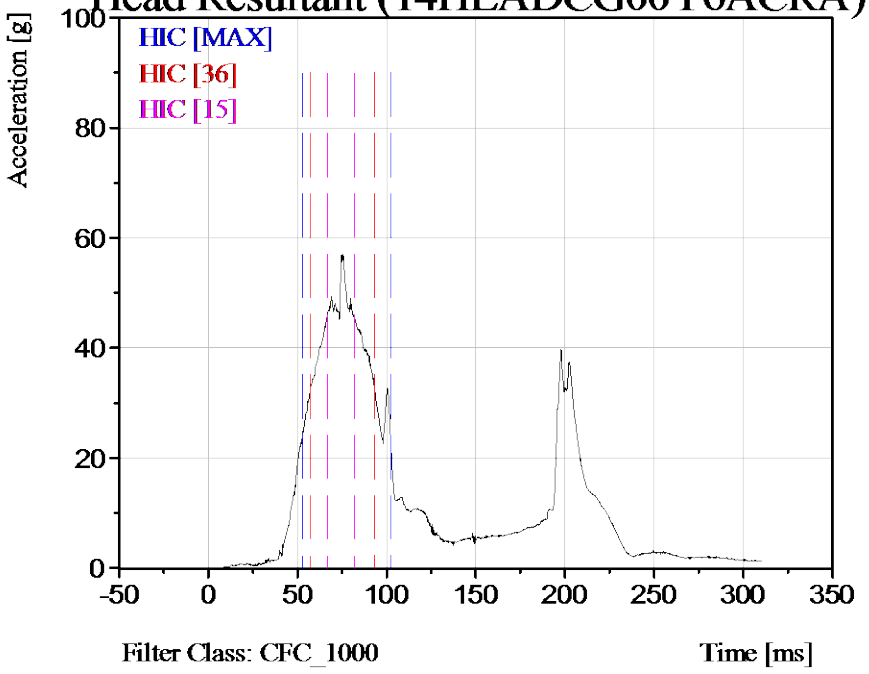
TRC Inc. Test Lab: SLED
Test Number: S110512-1











	T1 (Begin)	T2 (End)	Avg. g T1 to T2
HIC [Max.] = 476.57	52.64 ms	102.32 ms	39.13 g
HIC [36] = 446.98	57.20 ms	93.20 ms	43.39 g
HIC [15] = 250.22	66.80 ms	81.84 ms	48.79 g

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

HIC Source Code: SAE J2052 ISO/TC22/SC12/WG3 N 282 (Issued 1990-03-16)

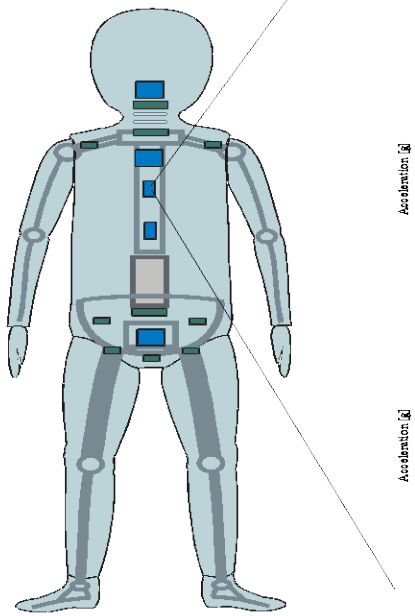
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

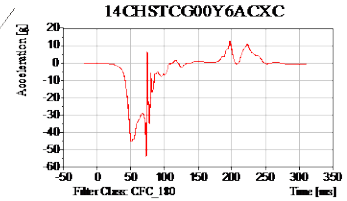
3 ms Duration Acceleration (Chest)

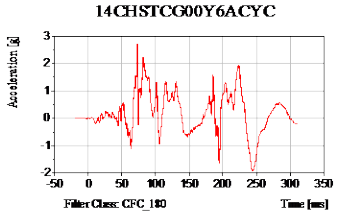
Date: 05/12/2011
Time: 10:27

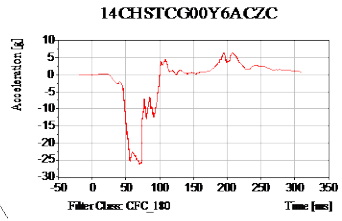
Customer: VRTC
Test Number: Test 1

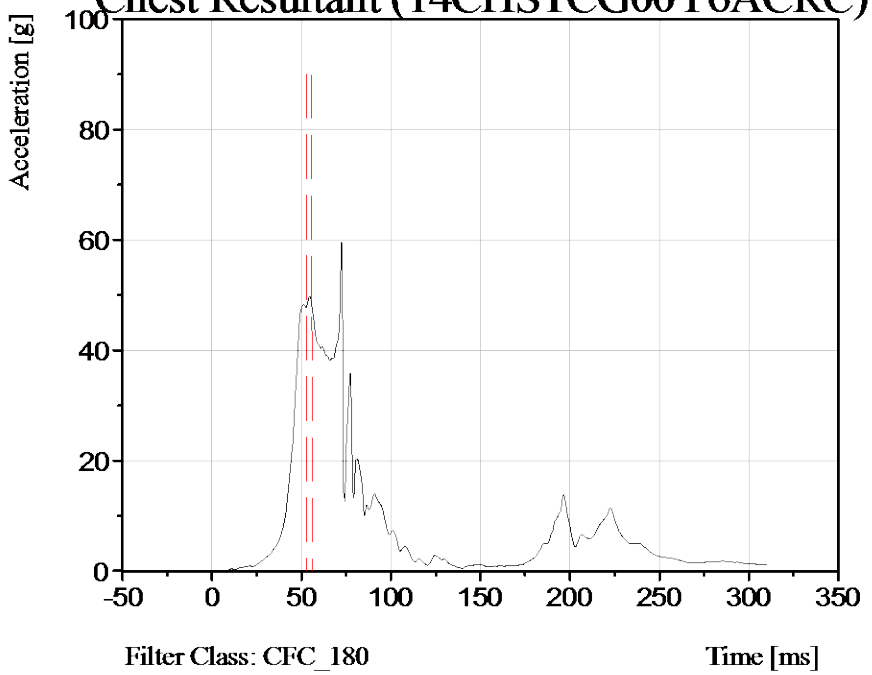
TRC Inc. Test Lab: SLED
Test Number: S110512-1











	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 47.88 g	52.89 ms	55.89 ms
Chest Severity Index = 395.63		

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

Injury Criteria Summary

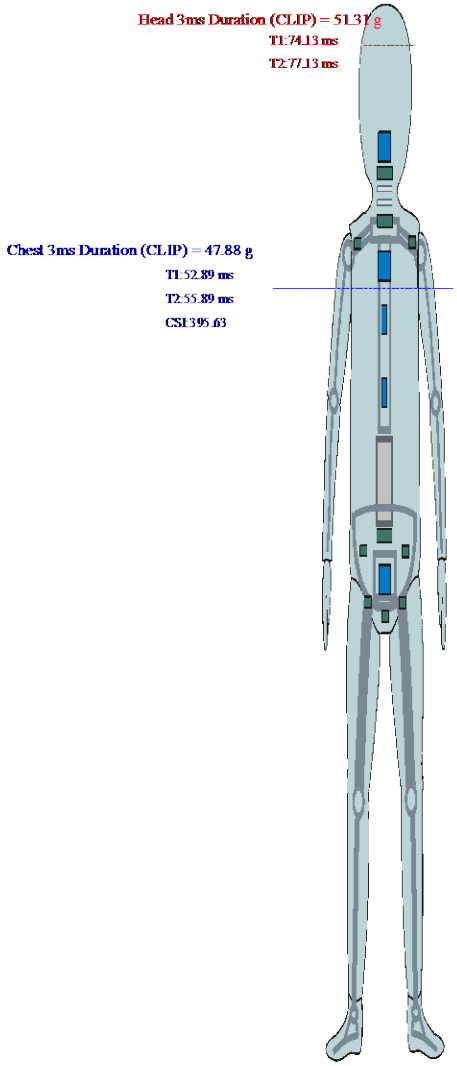
Date: 05/12/2011
Time: 10:27

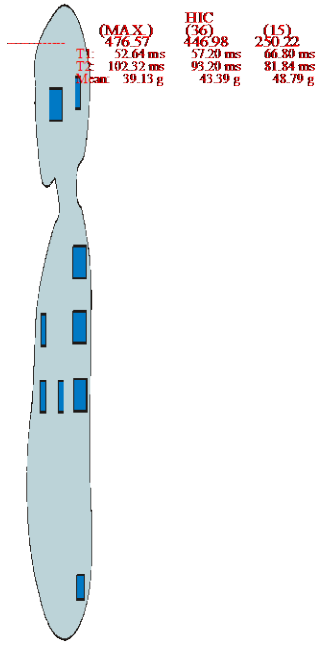
Customer: VRTC

Test Number: Test 1

Dummy:HIII 3 Year Old

Seating Position:
Left Rear Passenger





	(MAX)	HIC (36)	(15)
	476.57	446.98	250.22
T1:	52.64 ms	57.20 ms	66.80 ms
T2:	102.32 ms	93.20 ms	81.84 ms
Mean:	39.13 g	43.59 g	48.79 g

TRC Inc. Test Lab: SLED

Test Number: S110512-1

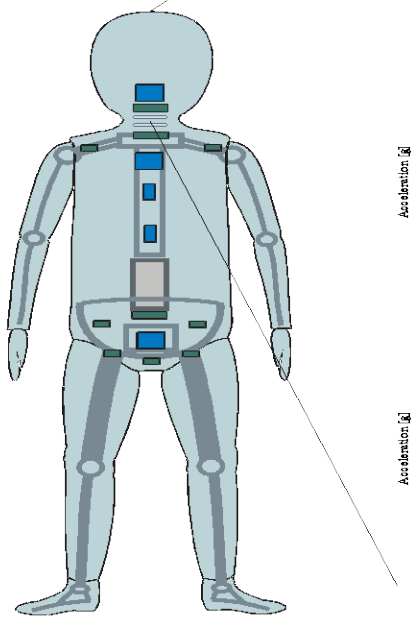
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

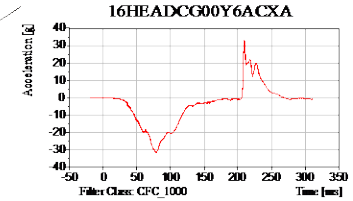
Head Injury Criterion (HIC)

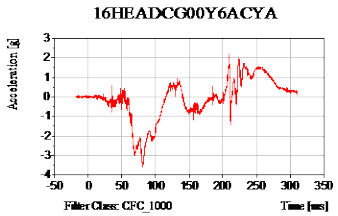
Date: 05/12/2011
Time: 10:27

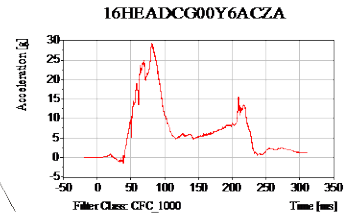
Customer: VRTC
Test Number: Test 1

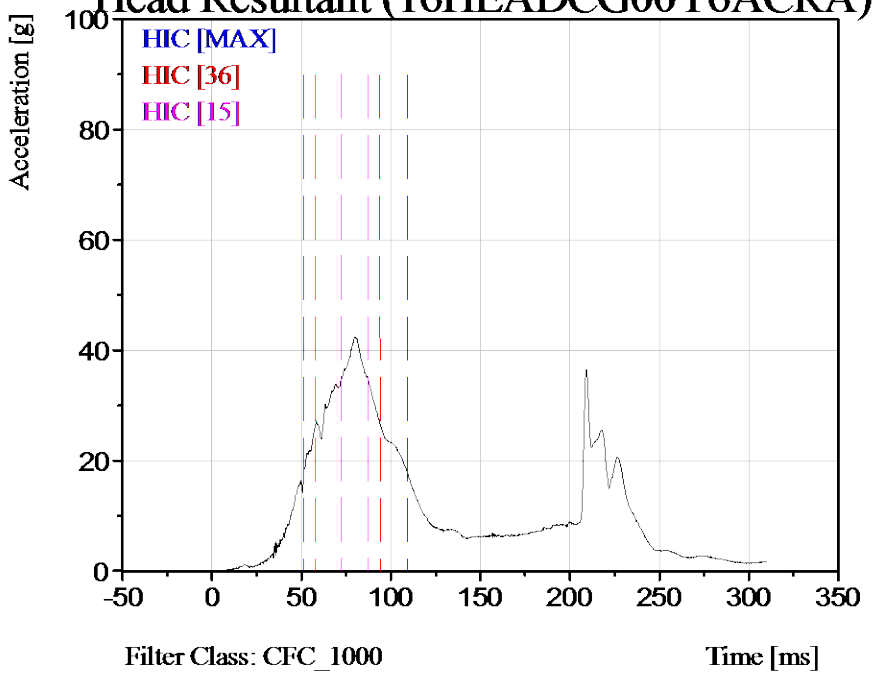
TRC Inc. Test Lab: SLED
Test Number: S110512-1











		T1 (Begin)	T2 (End)	Avg. g T1 to T2
HIC [Max.]	= 269.98	51.36 ms	109.44 ms	29.29 g
HIC [36]	= 235.77	57.92 ms	93.92 ms	33.60 g
HIC [15]	= 136.79	72.16 ms	87.20 ms	38.31 g

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

HIC Source Code: SAE J2052 ISO/TC22/SC12/WG3 N 282 (Issued 1990-03-16)

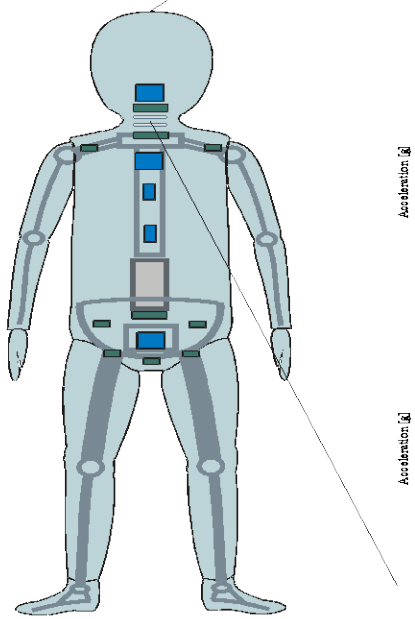
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

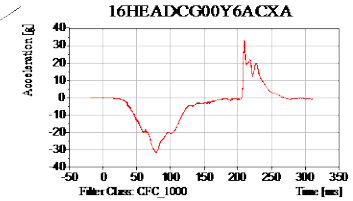
3 ms Duration Acceleration (Head)

Date: 05/12/2011
Time: 10:27

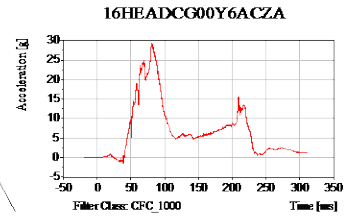
Customer: VRTC
Test Number: Test 1

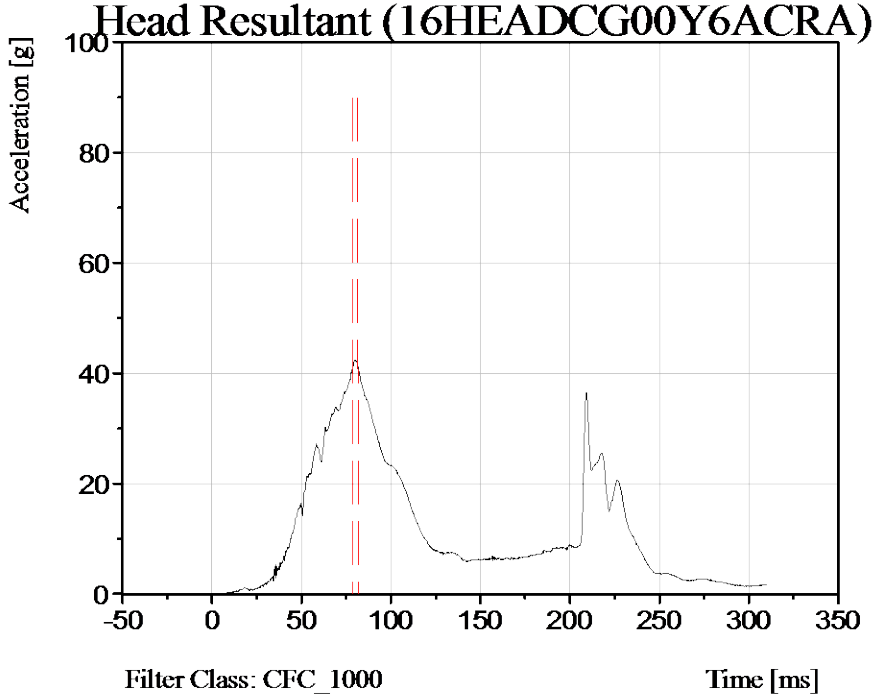
TRC Inc. Test Lab: SLED
Test Number: S110512-1











	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 41.17 g	78.63 ms	81.64 ms

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

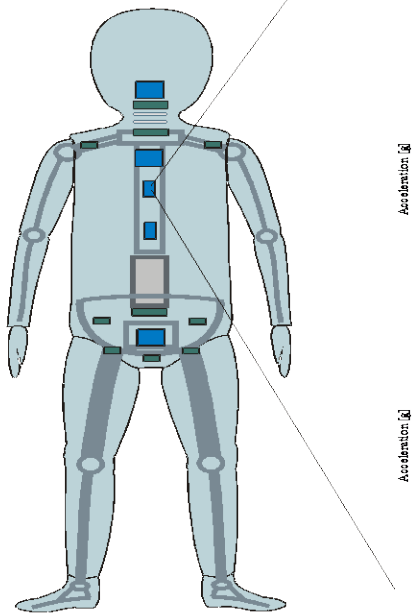
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

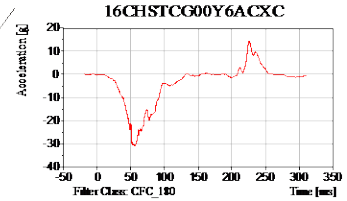
3 ms Duration Acceleration (Chest)

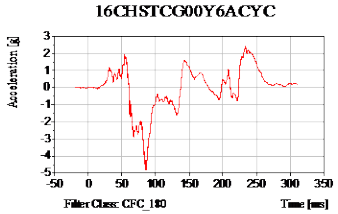
Date: 05/12/2011
Time: 10:27

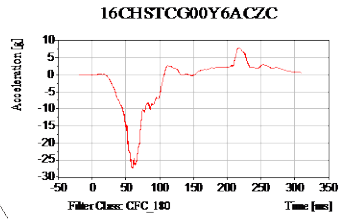
Customer: VRTC
Test Number: Test 1

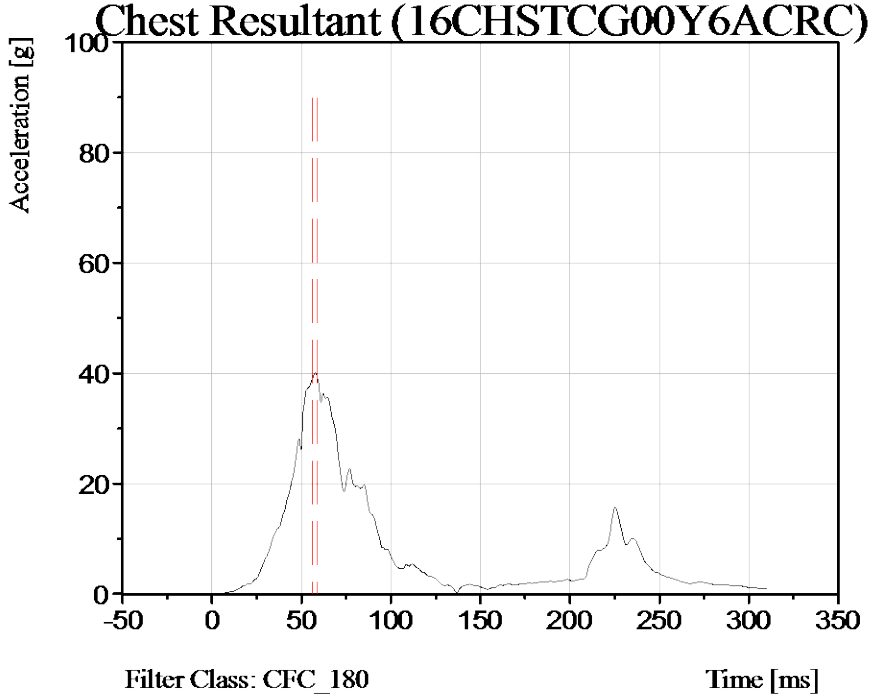
TRC Inc. Test Lab: SLED
Test Number: S110512-1











	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 38.97 g	56.13 ms	59.13 ms

Chest Severity Index = 229.57

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, EBD01 & EBD03

Injury Criteria Summary

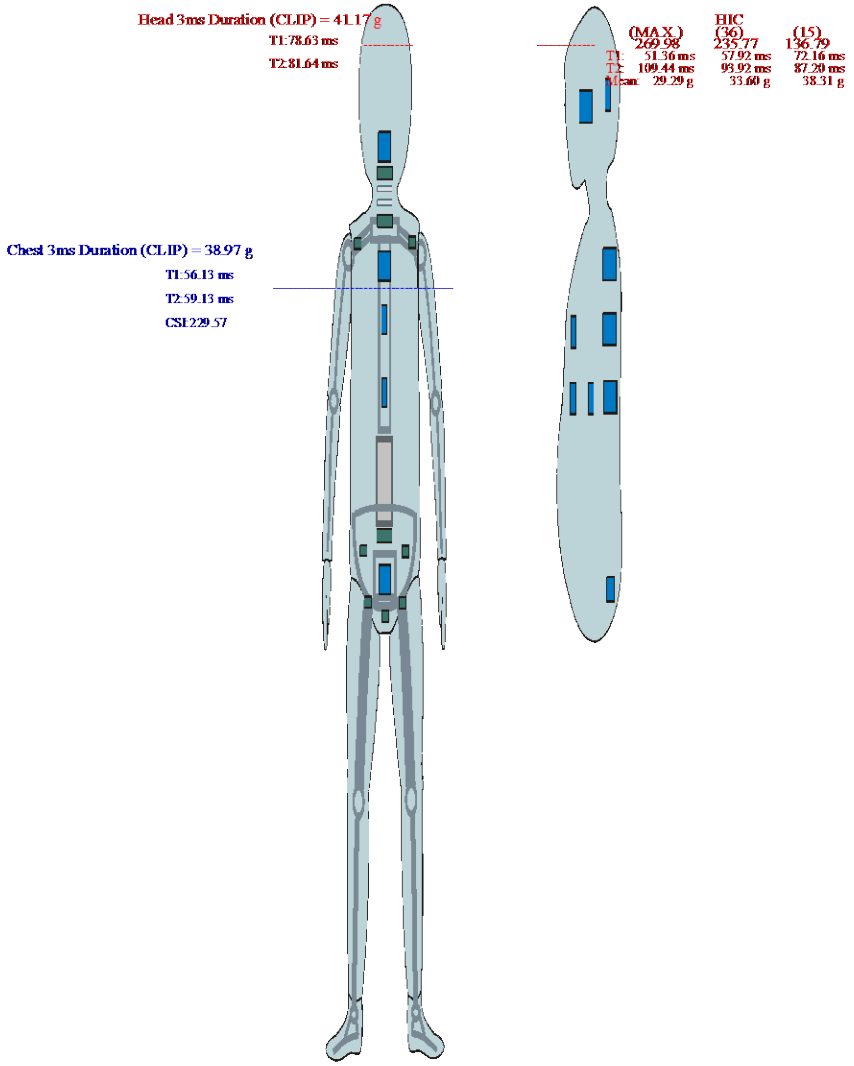
Date: 05/12/2011
Time: 10:27

Customer: VRTC

Test Number: Test 1

Dummy:HIII 3 Year Old

Seating Position:
Right Rear Passenger



TRC Inc. Test Lab: SLED

Test Number: S110512-1

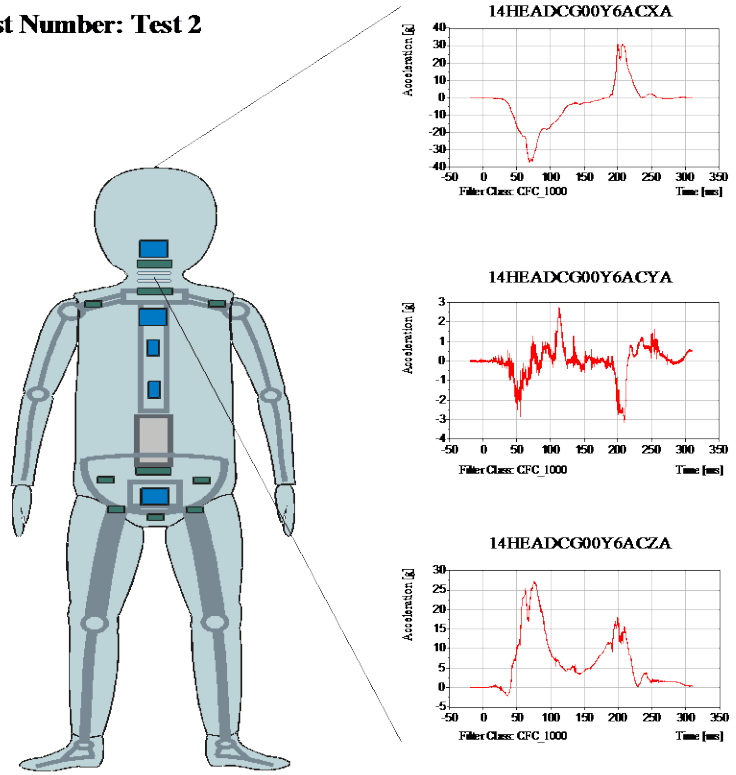
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

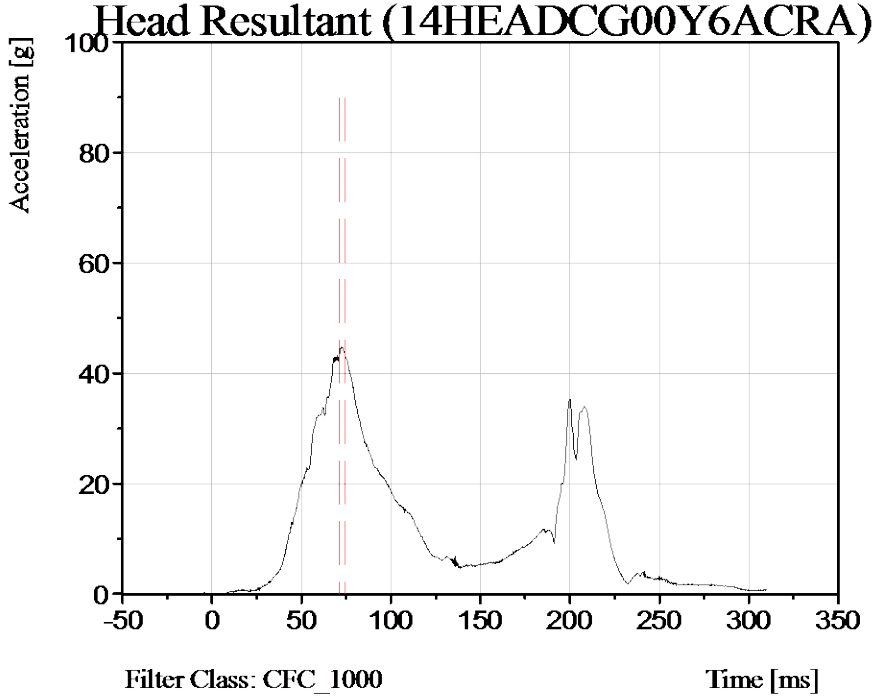
3 ms Duration Acceleration (Head)

Date: 05/12/2011
Time: 1:15 PM

Customer: VRTC
Test Number: Test 2

TRC Inc. Test Lab: SLED
Test Number: S110512-2





	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 43.41 g	71.22 ms	74.22 ms

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

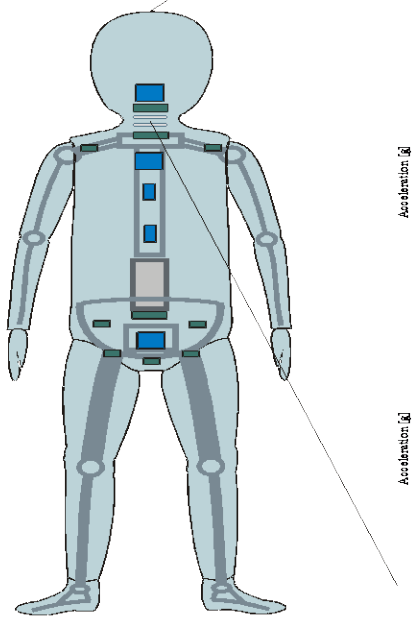
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

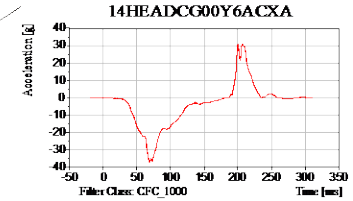
Head Injury Criterion (HIC)

Date: 05/12/2011
Time: 1:15 PM

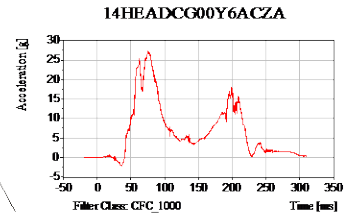
Customer: VRTC
Test Number: Test 2

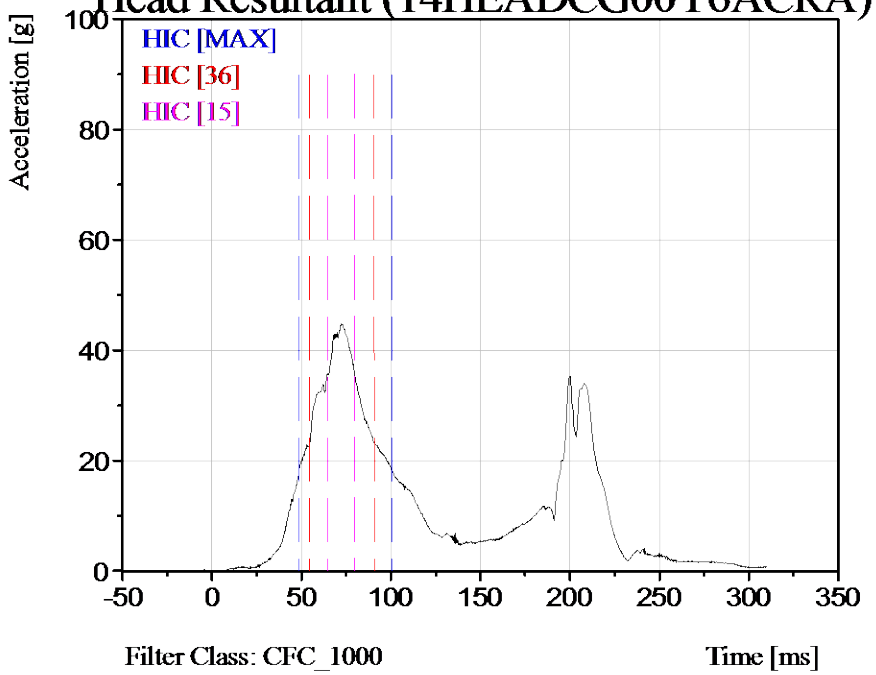
TRC Inc. Test Lab: SLED
Test Number: S110512-2











		T1 (Begin)	T2 (End)	Avg. g T1 to T2
HIC [Max.]	= 265.48	48.80 ms	100.72 ms	30.42 g
HIC [36]	= 253.43	54.64 ms	90.64 ms	34.57 g
HIC [15]	= 163.16	64.72 ms	79.76 ms	41.10 g

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

HIC Source Code: SAE J2052 ISO/TC22/SC12/WG3 N 282 (Issued 1990-03-16)

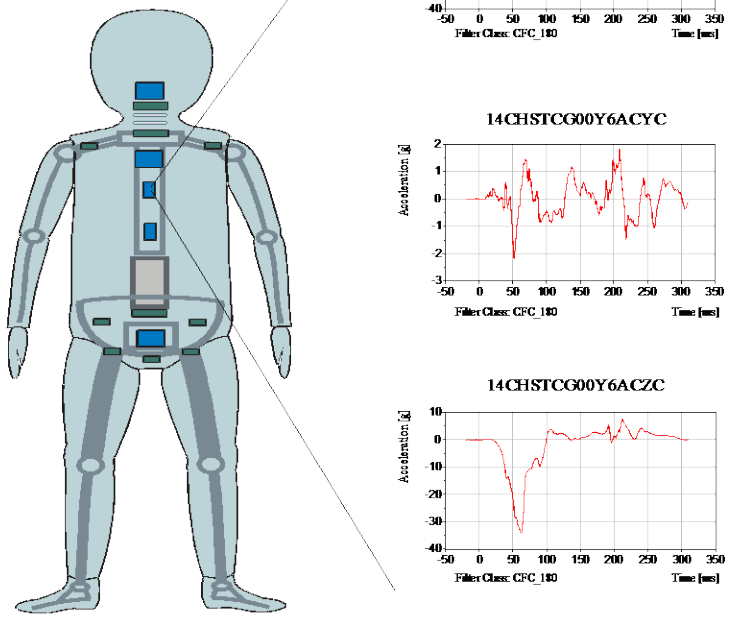
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

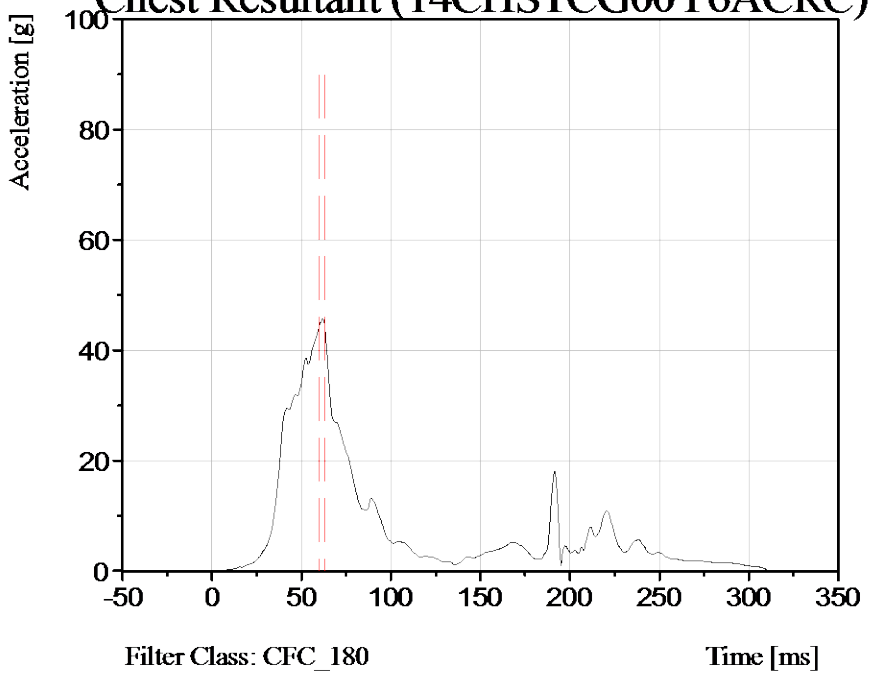
3 ms Duration Acceleration (Chest)

Date: 05/12/2011
Time: 1:15 PM

Customer: VRTC
Test Number: Test 2

TRC Inc. Test Lab: SLED
Test Number: S110512-2





	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 44.47 g	59.96 ms	62.96 ms

Chest Severity Index = 288.20

Dummy:HIII 3 Year Old
Seating Position:
Left Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

Injury Criteria Summary

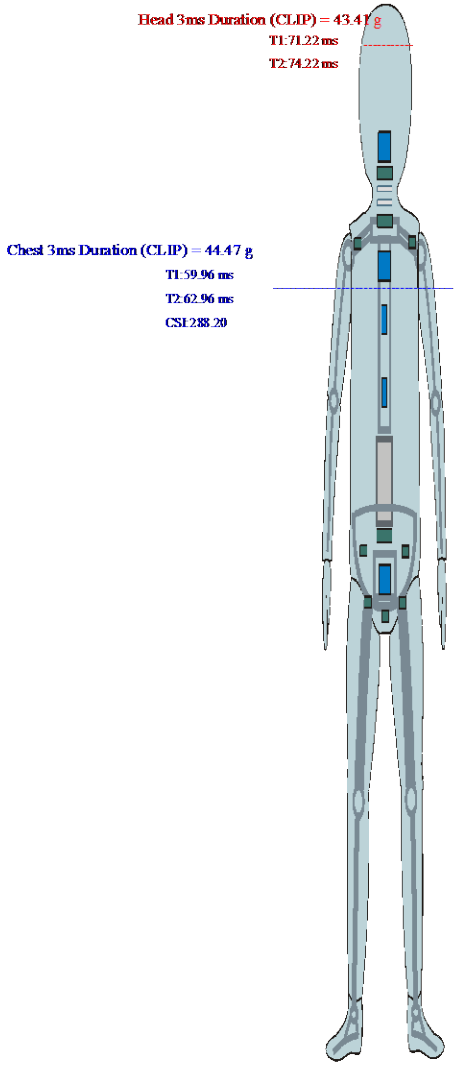
Date: 05/12/2011
Time: 1:15 PM

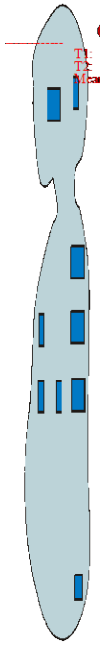
Customer: VRTC

Test Number: Test 2

Dummy:HIII 3 Year Old

Seating Position:
Left Rear Passenger





	(MAX)	HIC (36)	(15)
	265.48	253.43	163.16
T1:	48.80 ms	54.64 ms	64.72 ms
T2:	100.72 ms	90.64 ms	79.76 ms
Mean:	30.42 g	34.57 g	41.10 g

TRC Inc. Test Lab: SLED

Test Number: S110512-2

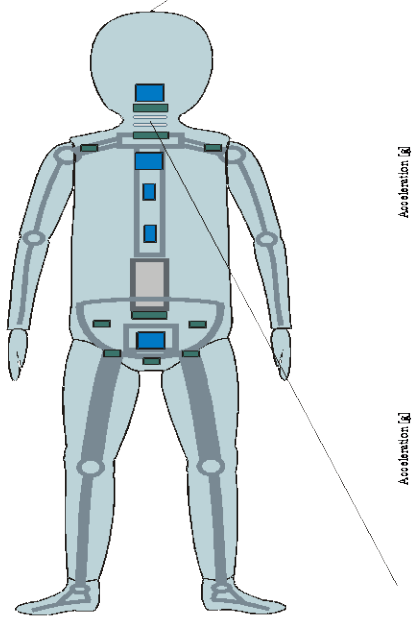
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

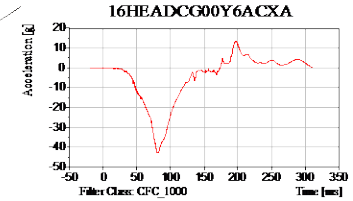
Head Injury Criterion (HIC)

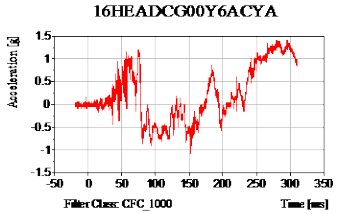
Date: 05/12/2011
Time: 1:15 PM

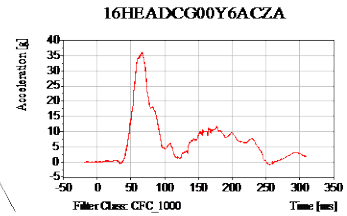
Customer: VRTC
Test Number: Test 2

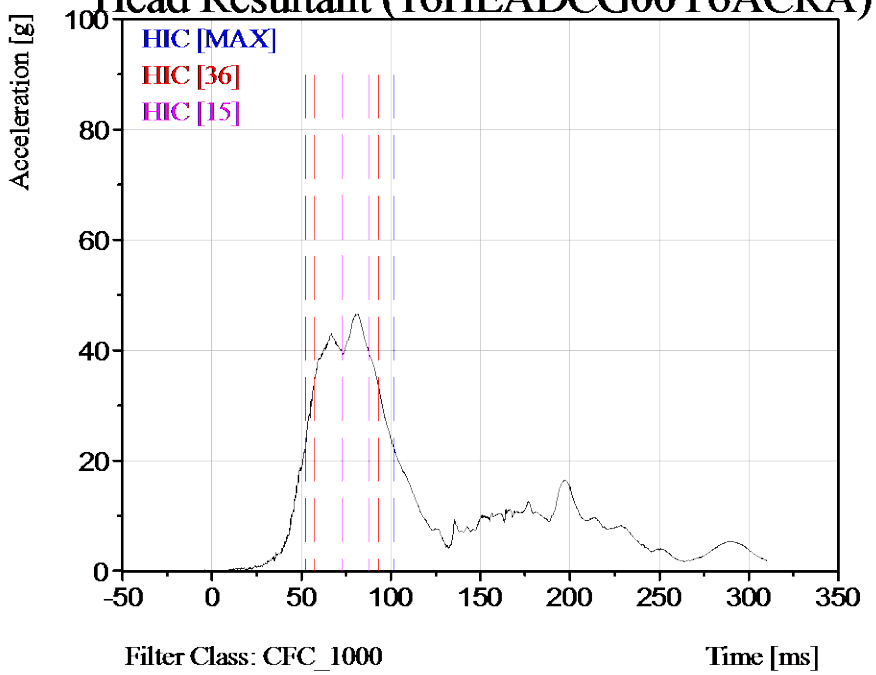
TRC Inc. Test Lab: SLED
Test Number: S110512-2











		T1 (Begin)	T2 (End)	Avg. g T1 to T2
HIC [Max.]	= 420.01	52.08 ms	101.52 ms	37.27 g
HIC [36]	= 384.46	57.12 ms	93.12 ms	40.85 g
HIC [15]	= 183.34	72.88 ms	87.92 ms	43.07 g

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

HIC Source Code: SAE J2052 ISO/TC22/SC12/WG3 N 282 (Issued 1990-03-16)

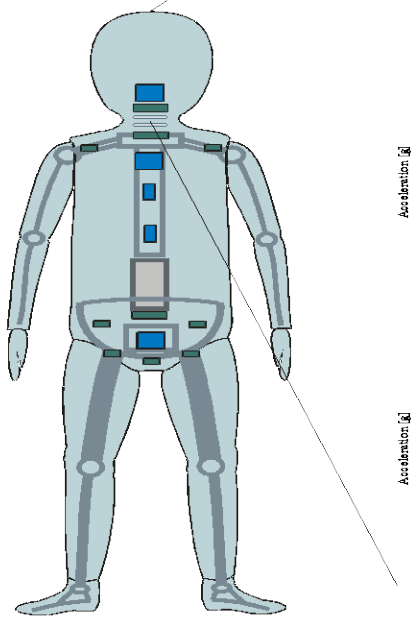
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

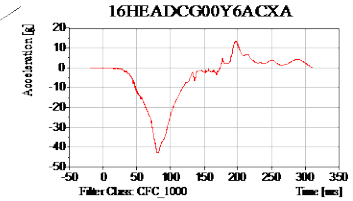
3 ms Duration Acceleration (Head)

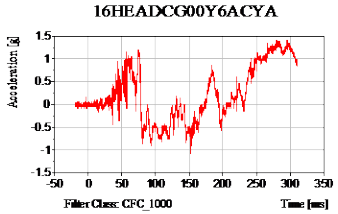
Date: 05/12/2011
Time: 1:15 PM

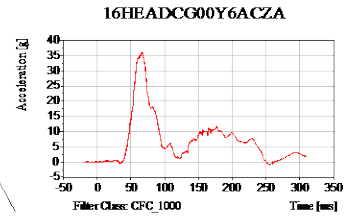
Customer: VRTC
Test Number: Test 2

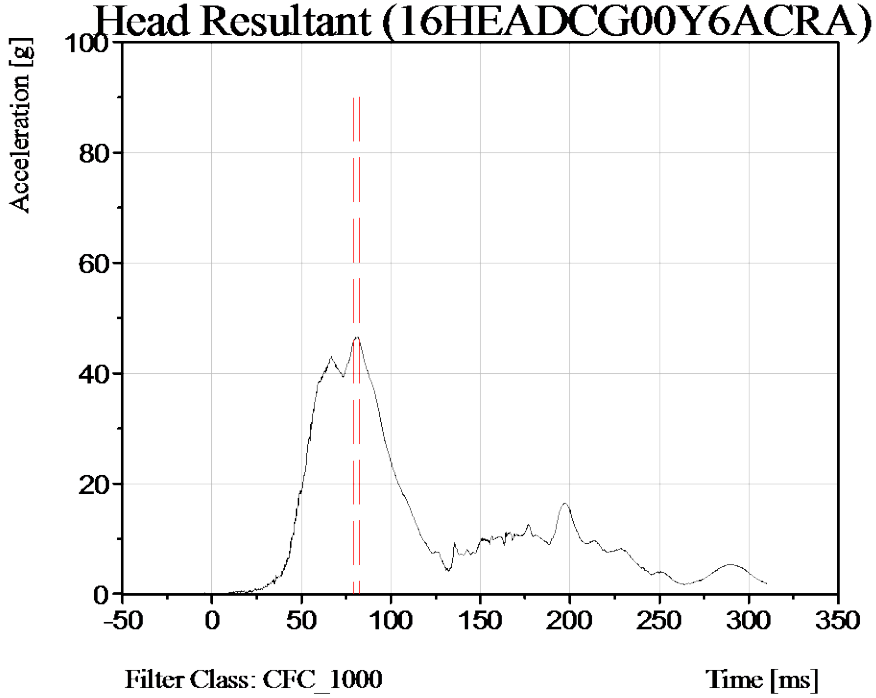
TRC Inc. Test Lab: SLED
Test Number: S110512-2











	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 45.90 g	79.39 ms	82.39 ms

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

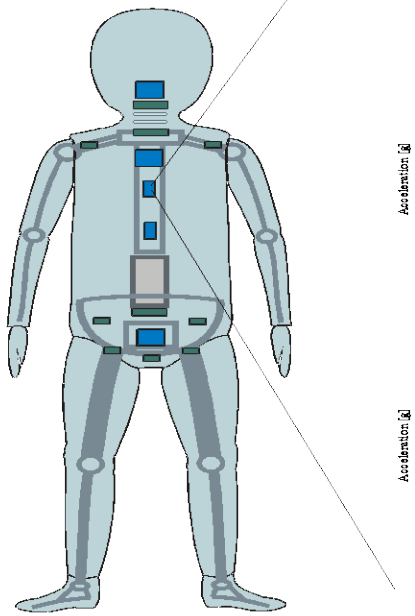
HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

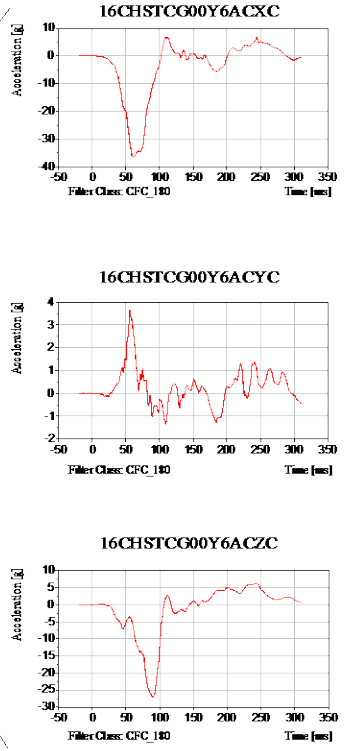
3 ms Duration Acceleration (Chest)

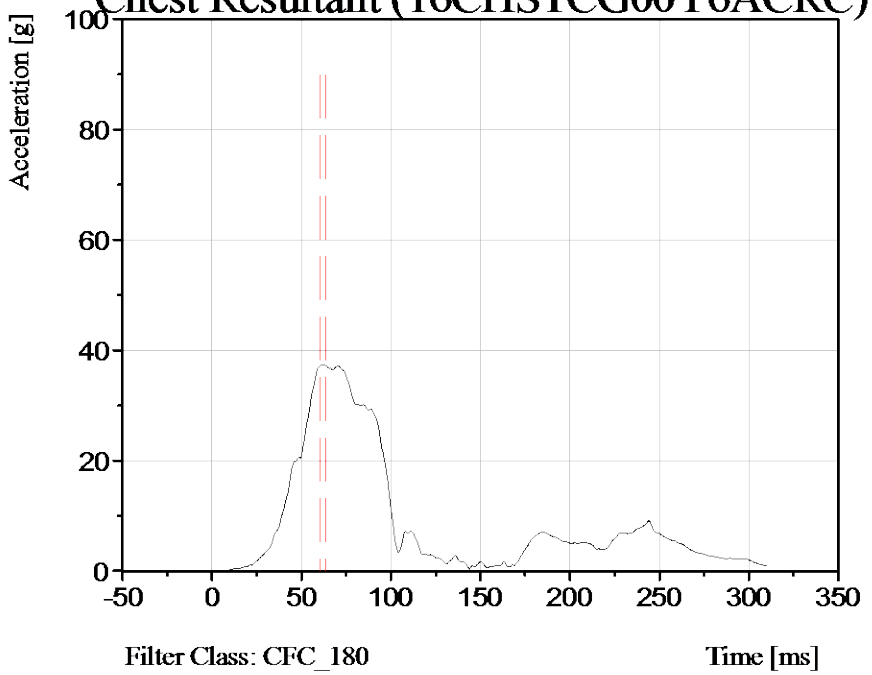
Date: 05/12/2011
Time: 1:15 PM

Customer: VRTC
Test Number: Test 2

TRC Inc. Test Lab: SLED
Test Number: S110512-2







	T1 (Begin)	T2 (End)
3 ms Duration Acceleration = 37.22 g	60.53 ms	63.53 ms

Chest Severity Index = 305.37

Dummy:HIII 3 Year Old
Seating Position:
Right Rear Passenger

3 ms Duration Acceleration Source Code : vbScript w/DIAdem 9.0

HIII-3YO, EA10-005 Dorel CFA, FMVSS 213, SCE01 & SUM01

Injury Criteria Summary

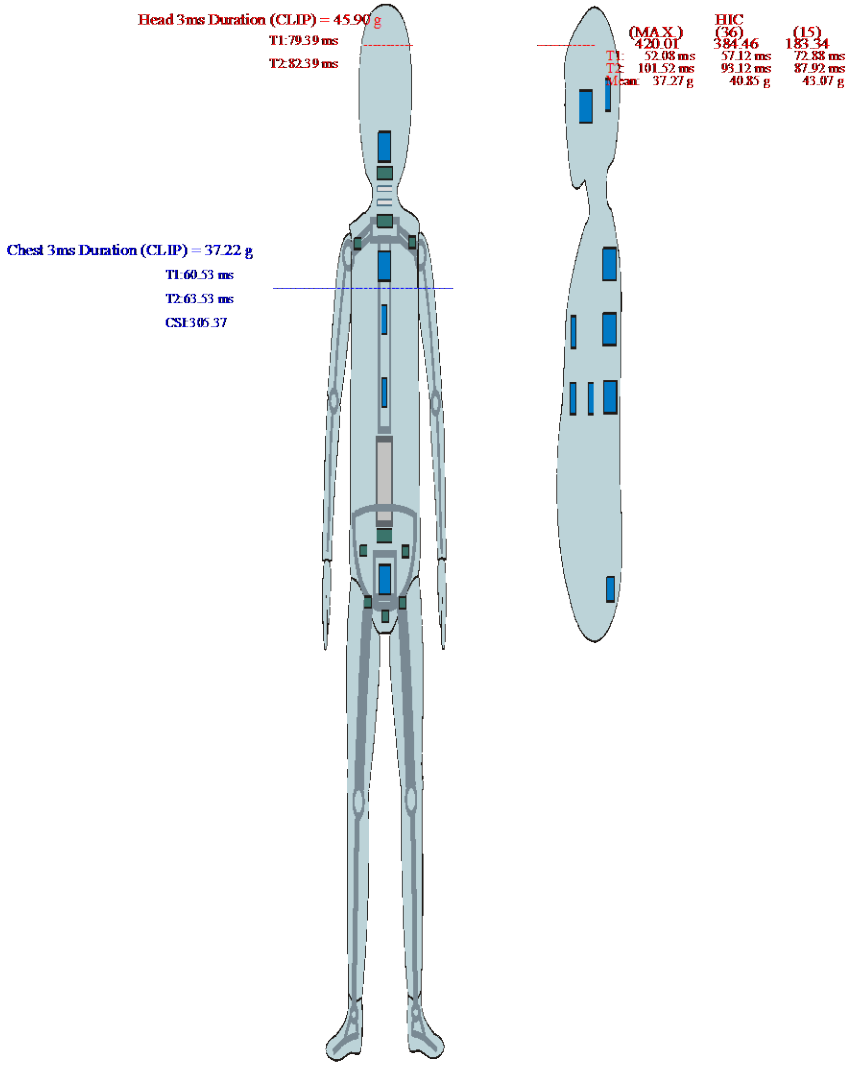
Date: 05/12/2011
Time: 1:15 PM

Customer: VRTC

Test Number: Test 2

Dummy:HIII 3 Year Old

Seating Position:
Right Rear Passenger



TRC Inc. Test Lab: SLED

Test Number: S110512-2

Appendix V
Test Protocol Phase One

CFA Test Protocol
Phase 1

The test sample seats used for this test protocol were obtained by The National Highway Traffic Safety Administration (NHTSA) from consumers and the Dorel Juvenile Group (DJG).

With the exception of EBD01 and VAN01, the test sample seats obtained by NHTSA from consumers were not included in safety recall 11C-001 and the center front adjuster (CFA) does not allow the harness to slip. The seats were manufactured during the same time period as the recalled seats (May 1, 2008 through April 30, 2009) and use the same CFA as the recalled seats.

The test sample seats obtained by NHTSA from DJG were included in safety recall 11C-001 and were returned to DJG from consumers alleging the harness webbing slipped. Inspection by DJG confirmed the CFA allows the harness webbing to slip.

1. Receiving Inspection
   - Take the following photos: (Photographs can be combined if the required information is compatible)
     - Seat from six sides
     - Certification label
     - Close up of CFA showing clearance to seat frame
     - CFA attachment screw and/or locating boss locations
   - Record Splitter ID number
   - Record Strap ID/date of manufacture

2. Verify that DJG samples have CFAs that slip
   - Pull webbing by hand to verify slippage of webbing through CFA.
   - Notify test engineer immediately if webbing does not slip.

3. Document as-received condition of CFA
   Photograph:
   - Condition of both sides with ends of pin
   - Condition of CFA from top, rear (pawl height/spring), front (pawl teeth)

4. Measure pawl/frame clearance at pin
   Using feeler gages, determine the clearance between the pawl and the frame at the pin. Caution: These measurements must be taken with the feeler gage making contact to the pin. The frame has a small boss on one side at the pin hole so this is where the minimum dimension will be located. Care must also be taken not to interact with the pawl spring.

5. Perform pull test per Dorel test procedure
   (Test protocol to be provided under separate cover)

6. Remove CFA & Strap from seat
    - Remove and label splitter to match Seat ID
    - Record CFA ID/Frame batch number

7. Verify that DJG Samples CFA still slips after removal
    - Pull webbing by hand to verify slippage of webbing through CFA
    - If any CFA is found not to slip at this point, stop testing and contact test engineer immediately

8. Measure and record webbing characteristics (thickness, width, abrasion)
    - Mark the webbing at 8", 16", and 24" from splitter by applying a small paint dot to the webbing.
    - Place the webbing flat across a precision ground granite table or other suitable solid and stable surface.
    - Anchor one end in place using steel blocks placed across the webbing or other suitable method. (Fig. 1)
    - Attach a 5 lb weight to the hanging end and hang the weight over the edge of the table. (Fig 2)
    - Measure the webbing width at each of the three marked locations using a set of digital calipers. (Fig 3) Repeat for a total of five measurements at each location.
    - Measure the webbing thickness at three points across the webbing at each of the three marked locations using a motorized height indicator stand or other suitable method.
    - Visually identify any webbing abrasion and measure the length using a tape measure.



Figure 1



Figure 2



Figure 3



Figure 4

9. Measure lateral movement of pawl (Record movement or non-movement)

- Webbing should be in an in use location
  Using only finger pressure and no tools, move pawl to one side movement limit
- Measure clearance between pawl and frame. Place digital caliper between the outside of the frame and the opposite inside of the pawl; set measuring caliper to zero. (Fig. 5)
- Using only finger pressure, move pawl to opposite limit of movement
- Measure movement with caliper. (Fig. 6)
- Record and photographically document both caliper readings.



Figure 5



Figure 6

10. Document Condition of Pin
    - Measure overall length of pin
    - Measure outside dimension of frame at the pin
    - Using only finger pressure and no tools:
    - Measure any axial movement of pin
    - Note whether or not pin will rotate

11. Measure force vs. deflection characteristics of pawl
    This test measures the force required to depress the pawl throughout its range of movement

    Test Preparation:

    - Measure pawl height in the as received condition and record. Support the pawl in the fully engaged position by inserting the correct thickness gage block between the frame and the underside edge of the pawl. (Fig. 9)
    - Note the gage block thickness for later reference.
    - Mill a dimple into the face of each pawl to be tested to form a receiver pocket for a 0.250" steel ball. Insure that the dimple is located uniformly the same on all CFAs to be tested. (A jig was fabricated for this purpose and a 5/16th ball mill cutter was used to create the dimple. (Fig. 7 & 8) The CFA was installed in the jig and a 0.070" deep receiver pocket was milled into the pawl face. After the machining process the ball should fit in the dimple in the CFA pawl.) (Fig. 10)

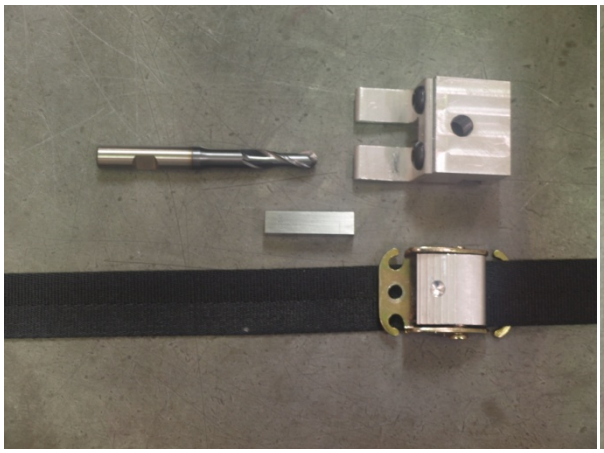


Figure 7

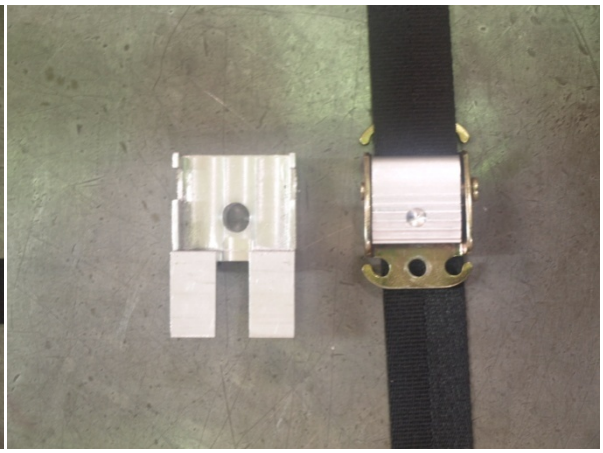


Figure 8

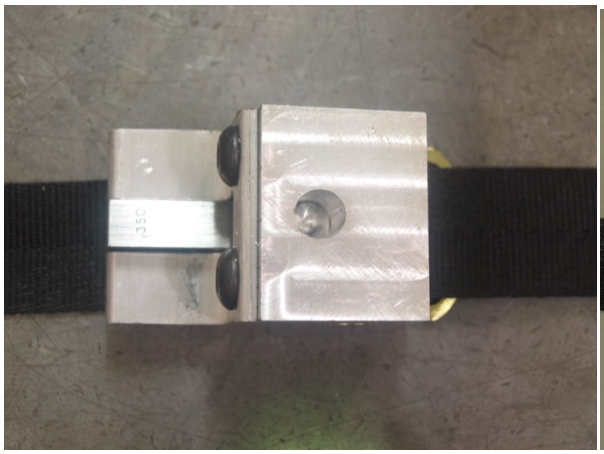


Figure 9



Figure 10

- Fabricate a force/displacement fixture. The fixture design shall allow the dimpled face of the CFA pawl to be mounted perpendicular to the actuator. A linear potentiometer shall be incorporated to measure movement of the pawl. A 0.250" steel ball shall be used between the actuator and the pawl to allow for rotation of the pawl during the test. (VRTC used angled mounting standoffs to hold the CFA in an angled position so that the pawl was in a horizontal position, and thus perpendicular to the actuator. A linear stepper motor actuator was mounted vertically and was coupled with a linear potentiometer. (Fig. 11) After the CFA was installed in the fixture, the steel ball was placed in the locating dimple so that the actuator pressed on the steel ball.) (Fig 12)

Measurements:

- Set the travel limit of the actuator to the value determined by the gage block required to machine the dimple in the CFA pawl.
- With the CFA mounted in the fixture, engage the actuator at the rate of 0.10 inch/second.
- Ensure that the stepper motor applies force in a continuous motion until it reaches the preset limit of travel.
- Upon reaching the preset limit of travel, reverse the stepper motor and continue to record force and position as it returns to the initial start position.
- Perform this test with the pawl at the as-received position

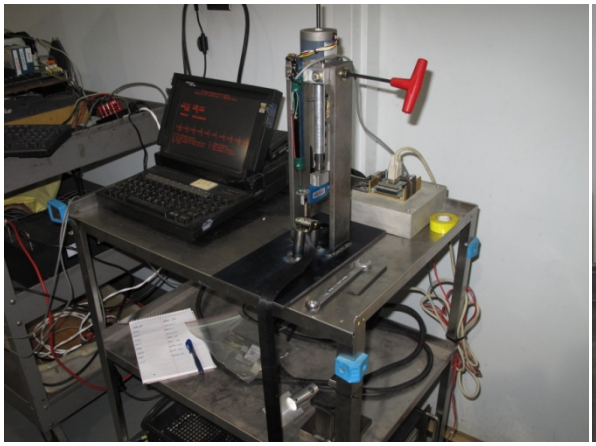


Figure 11

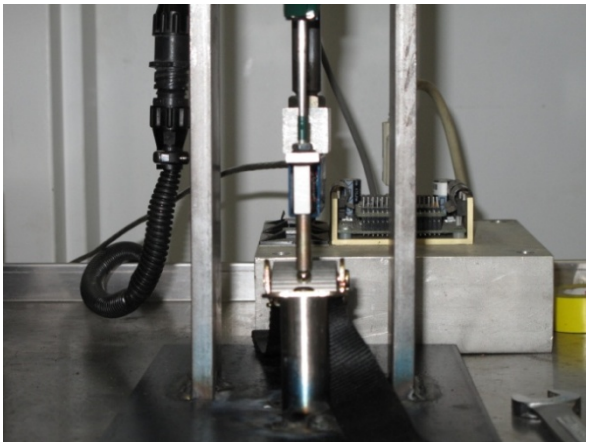


Figure 12

12. Measure Webbing Clamping Capability of CFA (Tensile Strength Test)
    This test measures one of two things. On CFAs that do not slip, this test verifies that the CFA will withstand a strap load of 150 lb. On CFAs that do slip, this test determines the amount of force that is required to pull the webbing through the CFA.

- Fabricate a jig that allows the CFA to be mounted in the tensile test machine such that the splitter-end of the webbing exits the CFA in a vertically upward direction. (Fig 13)
- Attach the fixture holding the CFA to the base of the tensile test machine and attach the splitter to the movable jaw of the tester.
- Adjust the load application speed to 1 inch per minute.
- Adjust the limits of the tensile test machine to halt the test if the force reaches 150 lb or the travel reaches 1 inch, whichever occurs first.
- Install test item and activate the tensile test machine.
- Perform this test at a location that is approximately mid way between the webbing locations identified in Step 5 using only the pawl spring return force to engage the pawl into the webbing.
- Repeat this test at a different location that is approximately mid way between the webbing locations identified in Step 5 after exerting finger force to the pawl to engage the pawl into the locked position against the webbing. Do not retest at the same webbing position.

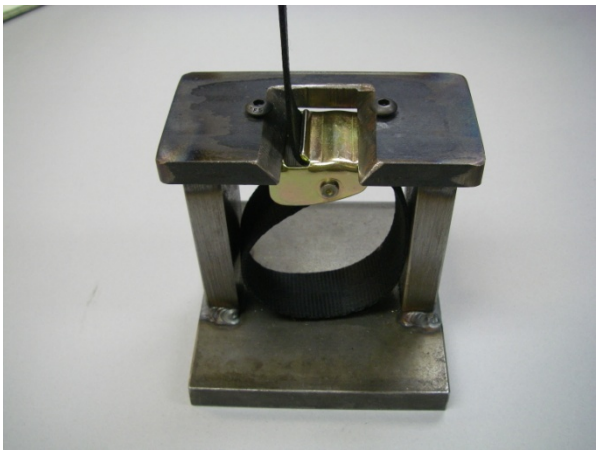


Figure 13

13. <u>CFA Frame Hole Location Measurements</u>

Measurements were made using a Digital Height Gage (DHG) and a precision fixture to hold the CFA. The attached photos document the process.

<u>Test Fixture</u> – A precision fixture was fabricated to hold the test CFA. (Photos 1 & 2) The fixture can be oriented in either a horizontal or vertical position. Using the engineering drawings that were provided by Dorel, dowels were inserted into the fixture that aligned with the CFA mounting hole locations and diameters. A new, nominally 5.1 mm drill bit (actually 5.078 mm) was placed through the pin holes of the CFA frame from which to make measurements. Given

the need to be able to remove the drill bit from the CFA and the CFA from the fixture, the tolerance on measurements made using this method is estimated to be ±0.04 mm.



Photo 1

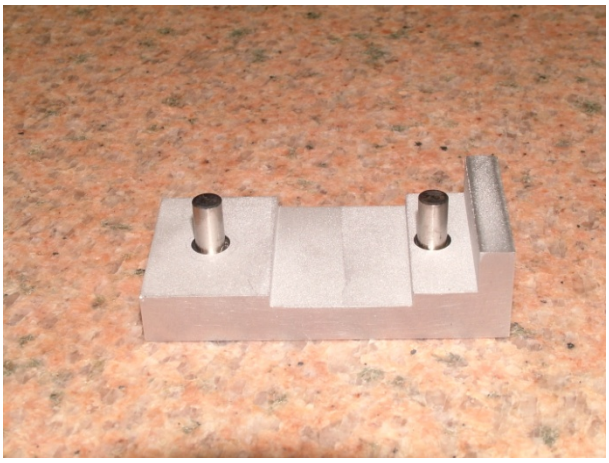


Photo 2

With the CFA frame mounted on the test fixture, the measuring arm was placed on the top of the frame base and set to zero. (Photo 3)

The measuring arm was then placed on top of the drill bit. (Photo 4) With the measuring pin on top of the drill bit and the reading was recorded manually. The value of the radius of the drill bit was then subtracted from the measured value to determine the height of the hole from the CFA frame base. Four measurements were made for each test item and the corrected values were averaged.

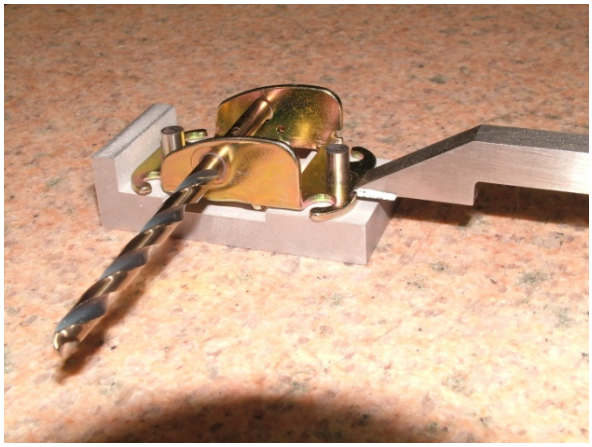


Photo 3



Photo 4

The fixture was then rotated to the vertical position, the measuring arm was placed on the locating dowel, and the measuring device was zeroed. (Photo 3)

The measuring arm was then placed on top of the drill bit and the reading was recorded manually. (Photo 4) In order to determine the actual distance between hole centers, the radius

of the mounting dowel was added to the measured value and the diameter of the drill bit was subtracted from the measured value. Four measurements were made for each test item.

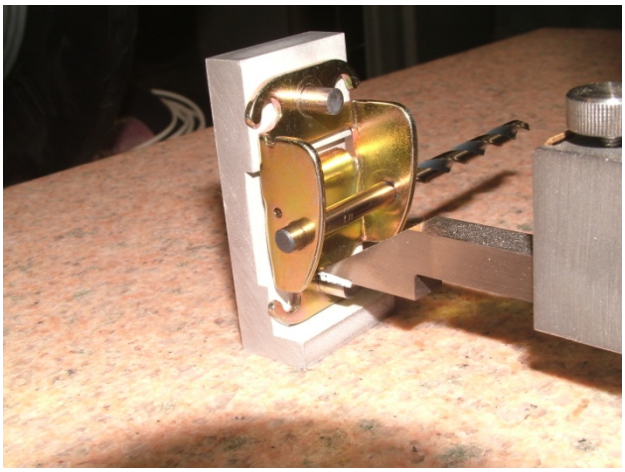


Photo 5

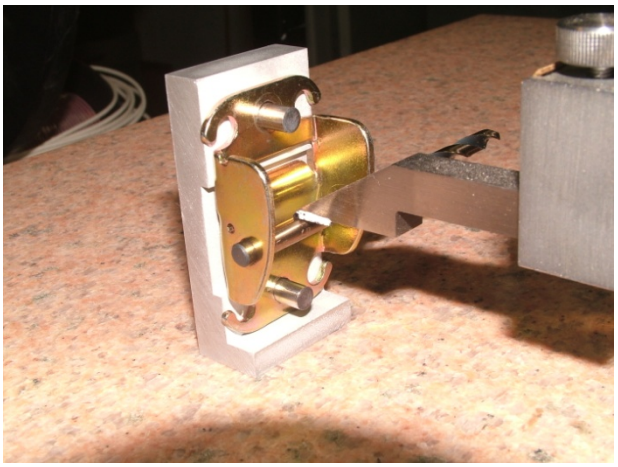


Photo 6

Appendix VI
Test Protocol Phase Two

CFA Component Measurement Protocol

INFORMATION IN THIS SECTION IS CONFIDENTIAL AND MUST BE REDACTED BEFORE PUBLIC RELEASE

CFA Component Measurement Protocol

This test protocol focuses on the engineering specifications of the CFA and each of its four component parts. The four parts are the frame, pawl (release lever), spring, and pin. The CFA will be disassembled and the dimensional measurements of the CFA and its component parts will be measured using digital calipers, digital micrometer, or digital height gage, and recorded. The recorded measurements will then be compared to the engineering specifications and drawings provided by DJG.

1. Disassembly
    - Cut the stitching from the end of the webbing strap and remove the webbing from the CFA.
    - Wrap the CFA in tape (duct tape/gaffer's tape) so that only the end of the pin to be milled off is exposed. (The tape is meant to prevent subsequent machining debris from entering the CFA).
    - Mount the taped CFA in a milling machine. Secure the pin so that it does not rotate during the milling process. Carefully mill off the end of the pin without contacting the frame of the CFA.
    - Ensure that there are no burrs or other such rough edges on the end of the pin after it has been milled.
    - Remove the tape from the CFA.
    - In a clean work area, place the CFA on a clean piece of 8½ x11 paper (to collect any contaminants during disassembly), carefully remove the pin from the CFA taking care not to create any damage to the frame, pawl, or spring while removing the pin. Remove the pin, pawl, and spring and place them on the paper. With a clean brush, lightly brush any contaminants from the CFA component parts onto the paper.
    - Photographically document any contaminants, corroded or abraded metal, etc., collected on the paper during the disassembly process and place them in a suitable sealed container marked with the appropriate CFA identification information.
    - Photographically document the condition of each of the four component parts of the disassembled CFA: the frame, pin, pawl and spring and place them in a suitable sealed container marked with the appropriate CFA information.

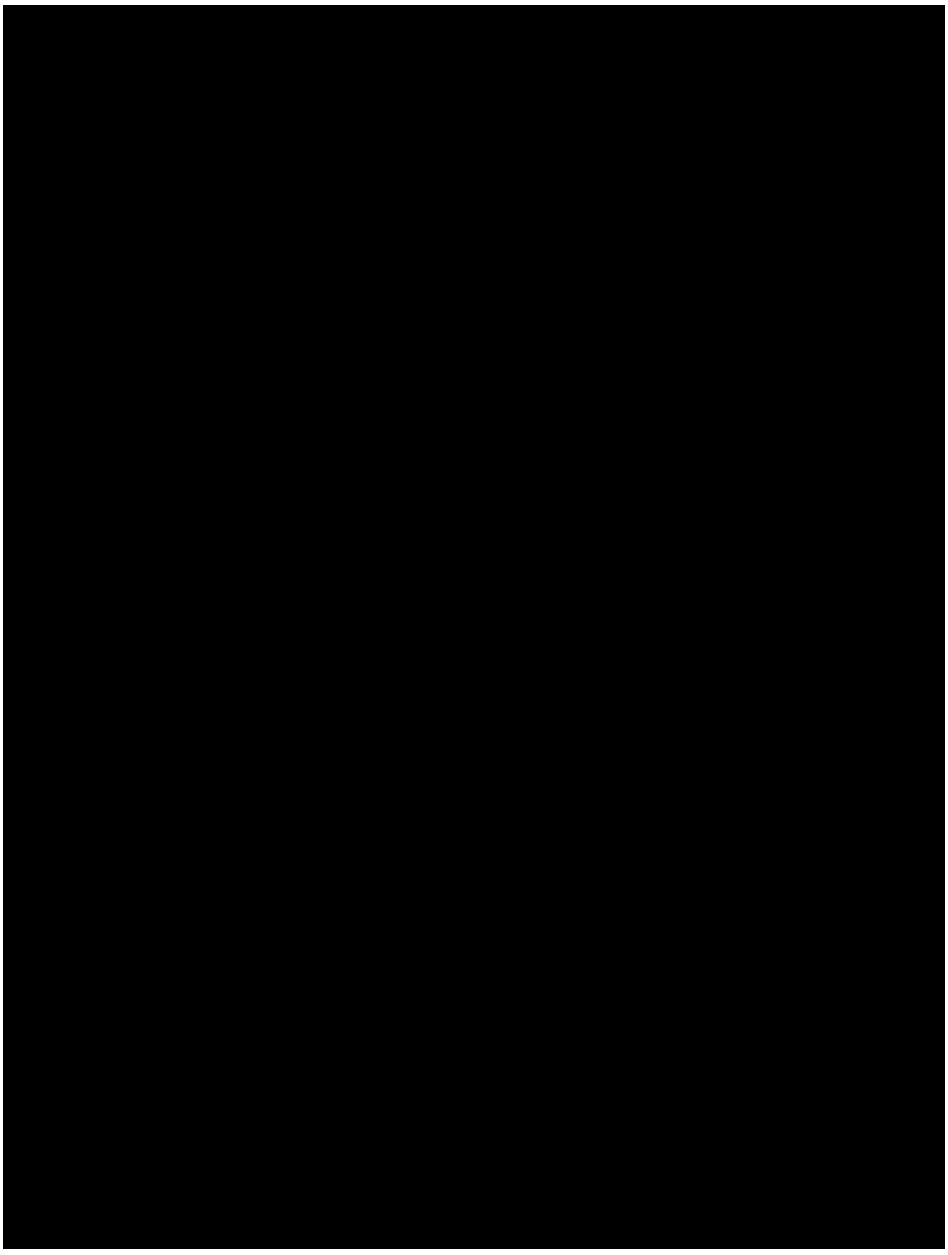
2. Measure and record each of the following CFA component dimensions in millimeters (for reference, relevant portions of the DJG drawings are shown below, with an arrow added to identify the relevant dimensions. The numbers contained on the drawings are the nominal dimensions):
    - Pin diameter at three locations (at both ends and mid-section)



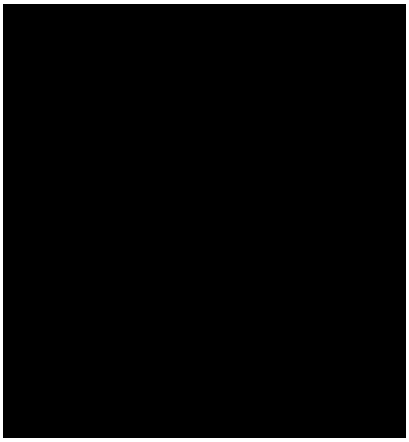
    - Frame pin hole diameter at each side of the frame
    - Frame pin hole location



- Frame outside width (not dimensioned on drawing) at three locations (at the pin hole and forward and aft of the pin hole)
- Frame inside width at three locations (at the pin hole and forward and aft of the pin hole)



- Bearing surface, (i.e., the raised surface on the inside of the frame at the pin hole on the non-spring side of the CFA frame



- Pawl width at three locations (at the pin hole and forward and aft of the pin hole)



- Pawl pin hole diameter



- Spring pocket depth
- Spring (short leg) shelf depth



- Spring coil height
- Spring wire diameter (0.80 music wire)



- Spring coil inside diameter

