

REPORT NUMBER: TWG-CAL-04-03

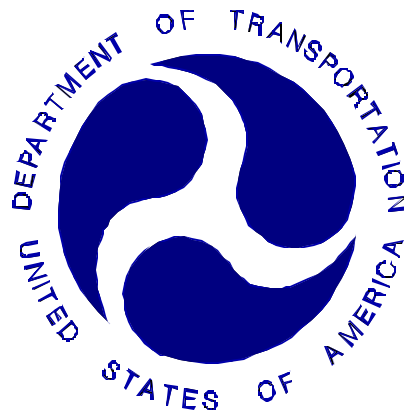
**NEW CAR ASSESSMENT PROGRAM (NCAP)**  
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

2003 SAAB 9-5

NHTSA NUMBER: C30514TWG2

GENERAL DYNAMICS TEST NUMBER: 8642-TWG-03

GENERAL DYNAMICS  
ADVANCED INFORMATION ENGINEERING SERVICES  
TRANSPORTATION SCIENCES CENTER  
P.O. BOX 400  
BUFFALO, NEW YORK 14225



November 14, 2003

**FINAL REPORT**

U. S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
Rulemaking  
Office of Crashworthiness Standards  
Mail Code: NVS-111  
400 Seventh Street, SW, Room No. 5313  
Washington, DC 20590

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-01-D-32005. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared By:

\_\_\_\_\_  
Patrick G. MacDiarmid, Jr., Project Engineer

Approved By:

\_\_\_\_\_  
David J. Travale, Program Manager  
Transportation Sciences Center

Approval Date:

\_\_\_\_\_

FINAL REPORT ACCEPTANCE BY:

Accepted By:

\_\_\_\_\_

Acceptance Date:

\_\_\_\_\_

| TECHNICAL REPORT STANDARD TITLE PAGE                                                                                                                                                                                                                                                   |              |                                                     |                                |                                                                                                                                                                                                                                                                                                    |                    |                    |                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|
| 1. Report No.<br>TWG-CAL-04-03                                                                                                                                                                                                                                                         |              | 2. Government Accession No.                         |                                | 3. Recipient's Catalog No.                                                                                                                                                                                                                                                                         |                    |                    |                    |
| 4. Title and Subtitle<br>Final Report<br>NHTSA No.: C30514TWG2                                                                                                                                                                                                                         |              |                                                     |                                | 5. Report Date<br>November 14, 2003                                                                                                                                                                                                                                                                |                    |                    |                    |
|                                                                                                                                                                                                                                                                                        |              |                                                     |                                | 6. Performing Organization Code<br>CAL                                                                                                                                                                                                                                                             |                    |                    |                    |
| 7. Author(s)<br>Patrick G. MacDiarmid, Jr., Project Engineer<br>David J. Travale, Program Manager                                                                                                                                                                                      |              |                                                     |                                | 8. Performing Organization Report No.<br>8642-TWG-03                                                                                                                                                                                                                                               |                    |                    |                    |
| 9. Performing Organization Name and Address<br>General Dynamics<br>Advanced Information Engineering Services<br>Transportation Sciences Center<br>P.O. Box 400<br>Buffalo, New York 14225                                                                                              |              |                                                     |                                | 10. Work Unit No.                                                                                                                                                                                                                                                                                  |                    |                    |                    |
|                                                                                                                                                                                                                                                                                        |              |                                                     |                                | 11. Contract or Grant No.<br>DTNH22-01-D-32005                                                                                                                                                                                                                                                     |                    |                    |                    |
| 12. Sponsoring Agency Name and Address<br>U.S. Department of Transportation<br>National Highway Traffic Safety Administration<br>Office of Crashworthiness Standards<br>Mail Code: NVS-111<br>400 Seventh SW, Room 5313<br>Washington, D.C. 20590                                      |              |                                                     |                                | 13. Type of Report and Period Covered<br>Final Report,<br>November 14, 2003 - April 30, 2004                                                                                                                                                                                                       |                    |                    |                    |
|                                                                                                                                                                                                                                                                                        |              |                                                     |                                | 14. Sponsoring Agency Code<br>NVS-111                                                                                                                                                                                                                                                              |                    |                    |                    |
| 15. Supplementary Notes                                                                                                                                                                                                                                                                |              |                                                     |                                |                                                                                                                                                                                                                                                                                                    |                    |                    |                    |
| 16. Abstract<br>This side impact out-of-position test was performed in conjunction with a New Car Assessment Program (NCAP). This test was conducted at the General Dynamics Advanced Information Engineering Services Crash Test Facility in Buffalo, New York, on November 14, 2003. |              |                                                     |                                |                                                                                                                                                                                                                                                                                                    |                    |                    |                    |
| <b>Injury Summary</b>                                                                                                                                                                                                                                                                  |              |                                                     |                                |                                                                                                                                                                                                                                                                                                    |                    |                    |                    |
| <b>HIC15</b>                                                                                                                                                                                                                                                                           | <b>HIC36</b> | <b>Clip (g's)</b>                                   | <b>Chest Displacement (mm)</b> | <b>NIJ<br/>NTF</b>                                                                                                                                                                                                                                                                                 | <b>NIJ<br/>NTE</b> | <b>NIJ<br/>NCF</b> | <b>NIJ<br/>NCE</b> |
| 87.9                                                                                                                                                                                                                                                                                   | 87.9         | 37.2                                                | 3.6                            | 0.93                                                                                                                                                                                                                                                                                               | 0.36               | 0.90               | 0.34               |
| 17. Key Words<br>New Car Assessment Program (NCAP)<br>Side Airbag Out-of-Position                                                                                                                                                                                                      |              |                                                     |                                | 18. Distribution Statement<br><u>Copies of this report are available from:</u><br>National Highway Traffic Safety Administration<br>Technical Reference Division<br>Room 5111 (NAD-52)<br>400 Seventh St., S.W.<br>Washington, D.C. 20590<br>Telephone No. (202) 366-4946<br>ATTN: Robert Hornicle |                    |                    |                    |
|                                                                                                                                                                                                                                                                                        |              |                                                     |                                |                                                                                                                                                                                                                                                                                                    |                    |                    |                    |
| 19. Security Classification of Report<br>UNCLASSIFIED                                                                                                                                                                                                                                  |              | 20. Security Classification of Page<br>UNCLASSIFIED |                                | 21. No. of Pages<br>32                                                                                                                                                                                                                                                                             |                    | 22. Price          |                    |

## TABLE OF CONTENTS

| <u>Section</u> |                                                 | <u>Page No.</u> |
|----------------|-------------------------------------------------|-----------------|
| 1              | PURPOSE AND SUMMARY OF TEST                     | 1-1             |
| 2              | DATA SHEETS                                     | 2-1             |
|                | Data Sheet 1 – Test Summary                     | 2-1             |
|                | Data Sheet 2 – Vehicle Parameter Data           | 2-2             |
|                | Data Sheet 3 – Dummy Positioning in Vehicle     | 2-3             |
|                | Data Sheet 4 – Dummy Injury Criteria Values     | 2-4             |
| A              | PHOTOGRAPHS                                     | A-1             |
| B              | CHILD DUMMY RESPONSE DATA TRACES                | B-1             |
| C              | TEST EQUIPMENT LIST AND CALIBRATION INFORMATION | C-1             |

## TABLE OF PHOTOGRAPHS

| <u>Figure</u> | <u>Photograph Title</u>            | <u>Page</u> |
|---------------|------------------------------------|-------------|
| Figure A- 1   | PRE-TEST VEHICLE LEFT SIDE VIEW    | A- 3        |
| Figure A- 2   | POST-TEST VEHICLE LEFT SIDE VIEW   | A- 3        |
| Figure A- 3   | VEHICLE CERTIFICATION PLACARD      | A- 4        |
| Figure A- 4   | VEHICLE TIRE PLACARD               | A- 4        |
| Figure A- 5   | PRE-TEST FRONTAL VIEW OF DUMMY     | A- 5        |
| Figure A- 6   | POST-TEST FRONTAL VIEW OF DUMMY    | A- 5        |
| Figure A- 7   | PRE-TEST RIGHT SIDE VIEW OF DUMMY  | A- 6        |
| Figure A- 8   | POST-TEST RIGHT SIDE VIEW OF DUMMY | A- 6        |
| Figure A- 9   | PRE-TEST LEFT SIDE VIEW OF DUMMY   | A- 7        |
| Figure A- 10  | POST-TEST LEFT SIDE VIEW OF DUMMY  | A- 7        |

## TABLE OF DATA PLOTS

| PLOT | PLOT NAME[UNITS, CHANNEL FILTER CLASS]   | PAGE |
|------|------------------------------------------|------|
| 1    | P2 Head x [g, CFC_1000]                  | B-3  |
| 2    | P2 Head y [g, CFC_1000]                  | B-3  |
| 3    | P2 Head z [g, CFC_1000]                  | B-3  |
| 4    | P2 Head Resultant [g, CFC_1000]          | B-3  |
| 5    | P2 Head Rear z [g, CFC_1000]             | B-4  |
| 6    | P2 Upper Neck Fx [N, CFC_1000]           | B-5  |
| 7    | P2 Upper Neck Fy [N, CFC_1000]           | B-5  |
| 8    | P2 Upper Neck Fz [N, CFC_1000]           | B-5  |
| 9    | P2 Upper Neck F Resultant [N, CFC_1000]  | B-5  |
| 10   | P2 Upper Neck Mx [N-m, CFC_600]          | B-6  |
| 11   | P2 Upper Neck My [N-m, CFC_600]          | B-6  |
| 12   | P2 Upper Neck Mz [N-m, CFC_600]          | B-6  |
| 13   | P2 Upper Neck M Resultant [N-m, CFC_600] | B-6  |
| 14   | P2 Lower Neck Fx [N, CFC_1000]           | B-7  |
| 15   | P2 Lower Neck Fy [N, CFC_1000]           | B-7  |
| 16   | P2 Lower Neck Fz [N, CFC_1000]           | B-7  |
| 17   | P2 Lower Neck F Resultant [N, CFC_1000]  | B-7  |
| 18   | P2 Lower Neck Mx [N-m, CFC_600]          | B-8  |
| 19   | P2 Lower Neck My [N-m, CFC_600]          | B-8  |
| 20   | P2 Lower Neck Mz [N-m, CFC_600]          | B-8  |
| 21   | P2 Lower Neck M Resultant [N-m, CFC_600] | B-8  |
| 22   | P2 Chest x [g, CFC_180]                  | B-9  |
| 23   | P2 Chest y [g, CFC_180]                  | B-9  |
| 24   | P2 Chest z [g, CFC_180]                  | B-9  |
| 25   | P2 Chest Resultant [g, CFC_180]          | B-9  |
| 26   | P2 Chest Compression [mm, CFC_600]       | B-10 |
| 27   | P2 Pelvic x [g, CFC_1000]                | B-11 |
| 28   | P2 Pelvic y [g, CFC_1000]                | B-11 |
| 29   | P2 Pelvic z [g, CFC_1000]                | B-11 |
| 30   | P2 Pelvic Resultant [g, CFC_1000]        | B-11 |

## SECTION 1

### PURPOSE AND SUMMARY OF TEST C30514TWG2

#### 1.1 PURPOSE

The purpose of this test was to obtain data in a static out-of-position side impact. These data constitute part of the general consumer information collected by the New Car Assessment Program (NCAP) sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract No. DTNH22-01-D-32005.

#### 1.2 SUMMARY

The effects of a seat mounted side airbag deployment in a 2003 Saab 9-5 with an out-of-position three-year-old child were evaluated. The test was performed by General Dynamics Advanced Information Engineering Services on November 14, 2003. Pre-and post-test photographs of the vehicle and dummy can be found in Appendix A.

One high-speed digital camera was used to document the side airbag deployment event. The camera was placed in line with the right-front seat centerline as to capture the deployment event. The recorded image rate is 1000 frames per second.

One part 572, Hybrid III three-year-old child anthropomorphic test device (ATD), was placed in the right front seat situated in the forward facing position according to dummy placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The child dummy was instrumented with head, chest, and pelvic triaxial accelerometers. In addition, a head rear accelerometer, chest displacement and upper and lower six axial neck force and moment load cell sensors were utilized.

Twenty-three channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains dummy response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The Hybrid III three-year-old child dummy's visible contact points were as follows: The airbag to the back of the head and back of the right side of the torso of the ATD.

The three-year-old child dummy was placed on a booster block and oriented in the forward facing position on the outboard portion of the seat cushion. The dummy's spine was aligned with the leading edge of the seat bolster with the head placed between but not in contact with the seat bolster and the B-Pillar with the neck/torso junction aligned vertically with the top edge of the airbag module. The dummy legs were aligned so that they crossed the heel placement points at a location of 50 mm from the leading edge of the seat cushion and 75 mm to either side of the seat cushion centerline. The dummy's heels were in line with leading edge of the seat cushion. The dummy's right arm was placed on the arm rest with the forearm and hand aligned along the armrest. The dummy's left arm was in contact with the seatback with the left forearm located such that the fingertips contacted the booster seat. This orientation complies with section 3.3.2.1 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group dated August 8, 2000.

## SECTION 2

### DATA SHEET NO. 1

#### TEST SUMMARY

##### TEST CONFIGURATION INFORMATION:

|                             | TEST DATA                 | DESCRIPTION                                                           |
|-----------------------------|---------------------------|-----------------------------------------------------------------------|
| <b>Seating Position:</b>    | P2                        | Right Front Seating Position                                          |
| <b>Test:</b>                | 3.3.2.1*                  | Forward facing Hybrid-III three-year-old child dummy on booster block |
| <b>Airbag:</b>              | Seatback                  | Seatback side airbag                                                  |
| <b>Booster Block</b>        | 300mm x 450 mm x<br>75 mm | Block consisted of HD36 foam with a density of 44.8 g/L               |
| <b>ATD Type/Serial No.:</b> | P572P/142                 | Hybrid III three-year-old child dummy                                 |

\*- Procedure as defined by Lund, et al and the Technical Working Group dated August 8, 2000

|                                |    |                           |
|--------------------------------|----|---------------------------|
| <u>Number of Data Channels</u> | 23 |                           |
| <u>Number of Cameras:</u>      | 0  | <u>Real Time</u>          |
|                                | 1  | <u>High Speed Digital</u> |
|                                | 0  | <u>High Speed Film</u>    |

##### VISIBLE DUMMY CONTACT POINTS

|                             |                                                                 |
|-----------------------------|-----------------------------------------------------------------|
| <b>Head Contact:</b>        | The back of the head was struck by the airbag during deployment |
| <b>Upper Torso Contact:</b> | The back of the right side of the torso.                        |
| <b>Lower Torso Contact:</b> | The back of the right side of the torso.                        |
| <b>Left Knee Contact:</b>   | None                                                            |
| <b>Right Knee Contact:</b>  | None                                                            |



## DATA SHEET 2

### VEHICLE PARAMETER DATA

#### TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2003 Saab 9-5 4-Door Sedan

Vehicle Body Color: Red VIN: YS3EB49E833013371

Vehicle NHTSA No.: C30514 Month & Year of Manufacture: 09/02

Engine Data: 4 Cylinders; - CID; 2.3 Liters; - cc

Engine Placement: - Longitudinal; or X Lateral

Transmission: 5 Speed; - Manual; X Automatic; - Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Odometer Reading 150 km

Supplemental Airbag Restraints:

Front Occupant: X Frontal; - Knee; X Side (Head/Torso); - Curtain

Rear Occupant: - Frontal; - Knee; - Side; - Curtain

Options: X A/C; X Power Steering; X Power Brakes; X Power Windows

#### DATA FROM TIRE PLACARD

Recommended Tire Size: P215/55R16 93V

\* Recommended Cold Tire Pressure: 240 kPa FRONT; 220 kPa REAR

#### DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P215/55R16 93V; Manufacturer: Pirelli

Tire Pressure with Maximum Capacity Vehicle Load: Front: 350 kPa; Rear: 350 kPa

Treadwear: 400; Traction: A; Temperature: A

#### VEHICLE CAPACITY DATA:

Number of Occupants: 2 Front; 3 Rear; - 3rd Seat; 5 Total

Type of Front Seats: X Bucket; - Bench; - Split Bench;

Type of Rear Seats: - Bucket; - Bench; - Split Bench; X Contoured

Type of Front Seat Back: - Fixed; X Adjustable with X Lever or - Knob

Type of Rear Seat Back: X Fixed; - Adjustable with - Lever or - Knob

Vehicle Max Capacity Loading = 421 kg (A)

No. of Occupants x 68.04 kg. = 340.2 kg (B)

Vehicle Cargo Capacity = 80.8 kg (A-B)

#### TEST VEHICLE DELIVERED WEIGHT WITH MAXIMUM FLUIDS:

|                                   |                                   |
|-----------------------------------|-----------------------------------|
| Left Front = <u>501.0</u> kg      | Left Rear = <u>308.0</u> kg       |
| Right Front = <u>487.0</u> kg     | Right Rear = <u>300.0</u> kg      |
| TOTAL FRONT = <u>988.0</u> kg     | TOTAL REAR = <u>608.0</u> kg      |
| % of Total Weight = <u>61.9</u> % | % of Total Weight = <u>38.1</u> % |
| TOTAL WEIGHT = <u>1596</u> kg     |                                   |

\* Tire pressure used in test.

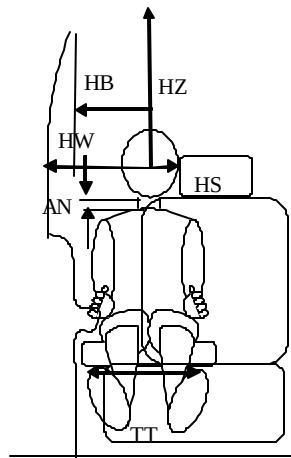
‡ This vehicle had previously been tested in an Indicant FMVSS 214 side impact on May 14, 2003.

## DATA SHEET NO. 3

### CHILD DUMMY POSITIONING IN VEHICLE

NHTSA No. C30514TWG2

#### Measurements for Seat Mounted Airbags



X-Y View

HZ = Head CG to Roof  
 HC = Head CG to C-Pillar  
 HB = Head CG to B-Pillar  
 HS = Head CG to Seat  
 HW = Head CG to Window  
 TT = Toe to Toe  
 AN = Top of the Airbag Module to the Head/Neck Junction

| Measurements for Position #2 (Right Front) |                |
|--------------------------------------------|----------------|
|                                            | Dimension (mm) |
| HZ                                         | 325            |
| HW                                         | 176            |
| HC                                         | -              |
| HB                                         | 210            |
| HS                                         | 158            |
| TT                                         | 150            |
| AN                                         | 7              |
| Airbag Module Length                       | 330            |
| Airbag Module Width                        | 50             |
| Foam Block Depth <sup>1</sup>              | 300            |
| Foam Block Width <sup>1</sup>              | 450            |
| Foam Block Thickness <sup>1</sup>          | 75             |

<sup>1</sup> Foam block consisted of HD36 foam material with a density of 44.8 g/L

# DATA SHEET 4

## CHILD DUMMY INJURY CRITERIA VALUES

NHTSA No. C30514TWG2

|                        |      | MAXIMUM VALUE |           |         |           |
|------------------------|------|---------------|-----------|---------|-----------|
|                        |      | Position #2   |           |         |           |
| DESCRIPTION            | Unit | Maximum       | Time (ms) | Minimum | Time (ms) |
| Head X                 | g    | 121.4         | 10.7      | -15.6   | 11.1      |
| Head Y                 | g    | 5.4           | 10.7      | -48.1   | 11.9      |
| Head Z                 | g    | 23.7          | 12.6      | -95.7   | 10.5      |
| Head Resultant         | g    | 133.8         | 10.8      | 0.0     | -47.4     |
| Head Rear Z            | g    | 66.3          | 12.4      | -72.4   | 11.2      |
| Upper Neck Fx          | N    | 1515.9        | 10.7      | -66.8   | 141.4     |
| Upper Neck Fy          | N    | 14.5          | 163.9     | -247.0  | 11.0      |
| Upper Neck Fz          | N    | 1181.4        | 12.3      | -1280.3 | 10.6      |
| Upper Neck F Resultant | N    | 1915.4        | 10.6      | 0.0     | -29.3     |
| Upper Neck Mx          | N-m  | 9.9           | 15.4      | -2.4    | 40.0      |
| Upper Neck My          | N-m  | 33.0          | 10.7      | -9.2    | 37.7      |
| Upper Neck Mz          | N-m  | 1.9           | 80.2      | -9.2    | 27.5      |
| Upper Neck M Resultant | N-m  | 33.1          | 10.8      | 0.0     | -5.6      |
| Lower Neck Fx          | N    | 731.1         | 12.9      | -69.9   | 40.5      |
| Lower Neck Fy          | N    | 43.4          | 25.5      | -261.0  | 12.5      |
| Lower Neck Fz          | N    | 1291.4        | 12.6      | -445.3  | 10.3      |
| Lower Neck F Resultant | N    | 1491.2        | 12.6      | 0.0     | -27.7     |
| Lower Neck Mx          | N-m  | 2.2           | 167.0     | -10.6   | 12.7      |
| Lower Neck My          | N-m  | 12.0          | 138.7     | -34.3   | 12.9      |
| Lower Neck Mz          | N-m  | 1.6           | 89.3      | -8.0    | 21.0      |
| Lower Neck M Resultant | N-m  | 35.7          | 12.9      | 0.0     | -22.4     |
| Chest X                | g    | 54.8          | 9.8       | -6.0    | 25.4      |
| Chest Y                | g    | 1.3           | 6.4       | -15.9   | 11.8      |
| Chest Z                | g    | 12.3          | 9.3       | -22.5   | 12.0      |
| Chest Resultant        | g    | 56.4          | 9.5       | 0.0     | -37.5     |
| Chest Displacement     | mm   | 1.9           | 27.0      | -3.6    | 12.7      |
| Pelvic X               | g    | 10.1          | 17.1      | -8.4    | 12.4      |
| Pelvic Y               | g    | 2.1           | 69.2      | -6.5    | 23.8      |
| Pelvic Z               | g    | 6.7           | 10.0      | -34.4   | 12.9      |
| Pelvic Resultant       | g    | 35.2          | 12.9      | 0.0     | -3.6      |

# DATA SHEET 4

## CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

NHTSA No. C30514TWG2

|                           | HEAD INJURY CRITERIA (HIC) |                          |                          |                                                             |       |                          |                          |                                                             |
|---------------------------|----------------------------|--------------------------|--------------------------|-------------------------------------------------------------|-------|--------------------------|--------------------------|-------------------------------------------------------------|
|                           | HIC15                      |                          |                          |                                                             | HIC36 |                          |                          |                                                             |
|                           | HIC                        | t <sub>1</sub><br>(msec) | t <sub>2</sub><br>(msec) | Average<br>Acceleration<br>t <sub>1</sub> to t <sub>2</sub> | HIC   | t <sub>1</sub><br>(msec) | t <sub>2</sub><br>(msec) | Average<br>Acceleration<br>t <sub>1</sub> to t <sub>2</sub> |
|                           |                            |                          |                          |                                                             |       |                          |                          |                                                             |
| Position #2 – Right Front | 87.9                       | 10.2                     | 14.5                     | 52.9                                                        | 87.9  | 10.2                     | 14.5                     | 52.9                                                        |

|                           | CLIP SUMMARY* |                       |                       |      |
|---------------------------|---------------|-----------------------|-----------------------|------|
|                           | CLIP (g's)    | t <sub>1</sub> (msec) | t <sub>2</sub> (msec) | CSI  |
|                           |               |                       |                       |      |
| Position #2 – Right Front | 37.2          | 8.6                   | 12.6                  | 70.8 |

\* The maximum chest resultant acceleration is defined as the maximum acceleration which exceeds 0.003 seconds in duration.

### Position 2 Neck Injury Summary (HIII 3 year old – Out of Position)

| Nij V10 | Nij  | Time (ms) | Z Force (N) | X Force (N) | Y Moment<br>(N-m) |
|---------|------|-----------|-------------|-------------|-------------------|
| Ntf     | 0.93 | 12.3      | 1181.0      | 529.7       | 25.6              |
| Nte     | 0.36 | 35.2      | 70.3        | -31.2       | -8.9              |
| Ncf     | 0.90 | 10.7      | -890.8      | 1313.4      | 33.0              |
| Nce     | 0.34 | 39.4      | -0.5        | -13.9       | -9.1              |

**Peak Tension (CFC1000) 1181.4 N**

**Peak Compression (CFC1000) -1280.3 N**

### Critical Values

| Nij Intercepts    |        |                  |        | Peak Limits |         |
|-------------------|--------|------------------|--------|-------------|---------|
| Tension (CVt)     | 2120 N | Extension (mCVe) | 27 N-m | Tension     | 1430 N  |
| Compression (CVc) | 2120 N | Flexion (mCVf)   | 68 N-m | Compression | -1380 N |

Condyle Offset 0.0

## **APPENDIX A**

### **PHOTOGRAPHS**

## TABLE OF PHOTOGRAPHS

| <u>Figure</u> | <u>Photograph Title</u>            | <u>Page</u> |
|---------------|------------------------------------|-------------|
| Figure A- 1   | PRE-TEST VEHICLE LEFT SIDE VIEW    | A- 3        |
| Figure A- 2   | POST-TEST VEHICLE LEFT SIDE VIEW   | A- 3        |
| Figure A- 3   | VEHICLE CERTIFICATION PLACARD      | A- 4        |
| Figure A- 4   | VEHICLE TIRE PLACARD               | A- 4        |
| Figure A- 5   | PRE-TEST FRONTAL VIEW OF DUMMY     | A- 5        |
| Figure A- 6   | POST-TEST FRONTAL VIEW OF DUMMY    | A- 5        |
| Figure A- 7   | PRE-TEST RIGHT SIDE VIEW OF DUMMY  | A- 6        |
| Figure A- 8   | POST-TEST RIGHT SIDE VIEW OF DUMMY | A- 6        |
| Figure A- 9   | PRE-TEST LEFT SIDE VIEW OF DUMMY   | A- 7        |
| Figure A- 10  | POST-TEST LEFT SIDE VIEW OF DUMMY  | A- 7        |



Figure A-1: Pre-Test Vehicle Left Side View



Figure A-2: Post-Test Vehicle Left Side View





Figure A-3: Vehicle Certification Placard



Figure A-4: Vehicle Tire Placard





Figure A-5: Pre-Test Frontal View of Dummy



Figure A-6: Post-Test Frontal View of Dummy



Figure A-7: Pre-Test Right Side View of Dummy



Figure A-8: Post-Test Right Side View of Dummy





Figure A-9: Pre-Test Left Side View of Dummy



Figure A-10: Post-Test Left Side View of Dummy

## **APPENDIX B**

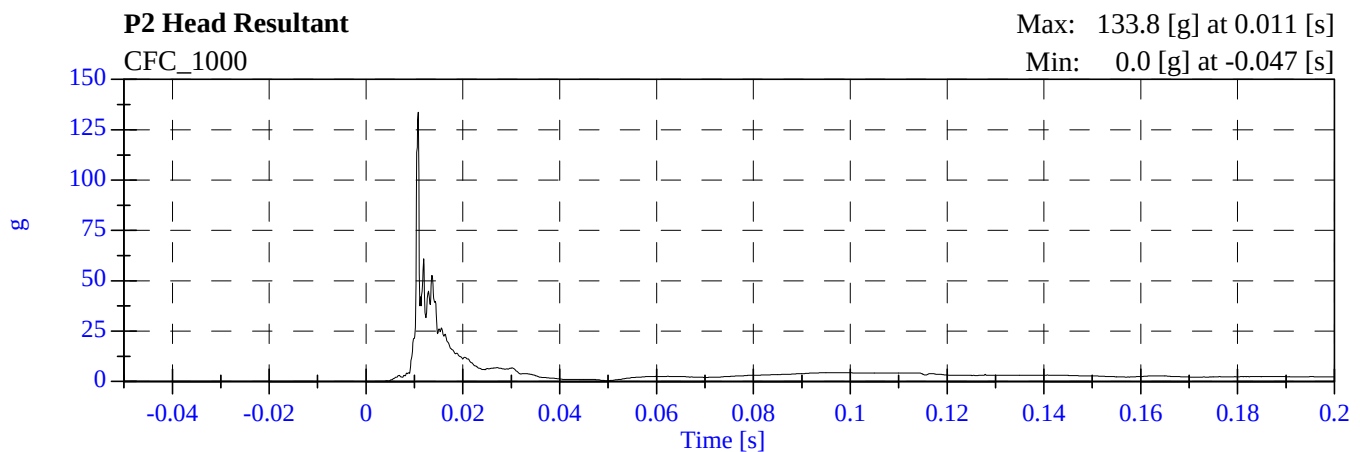
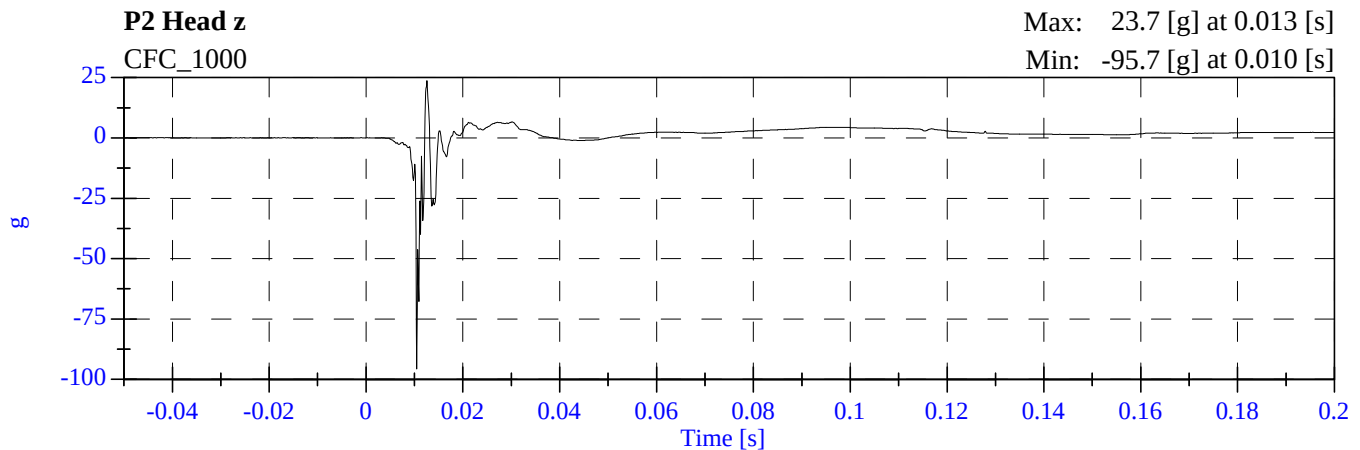
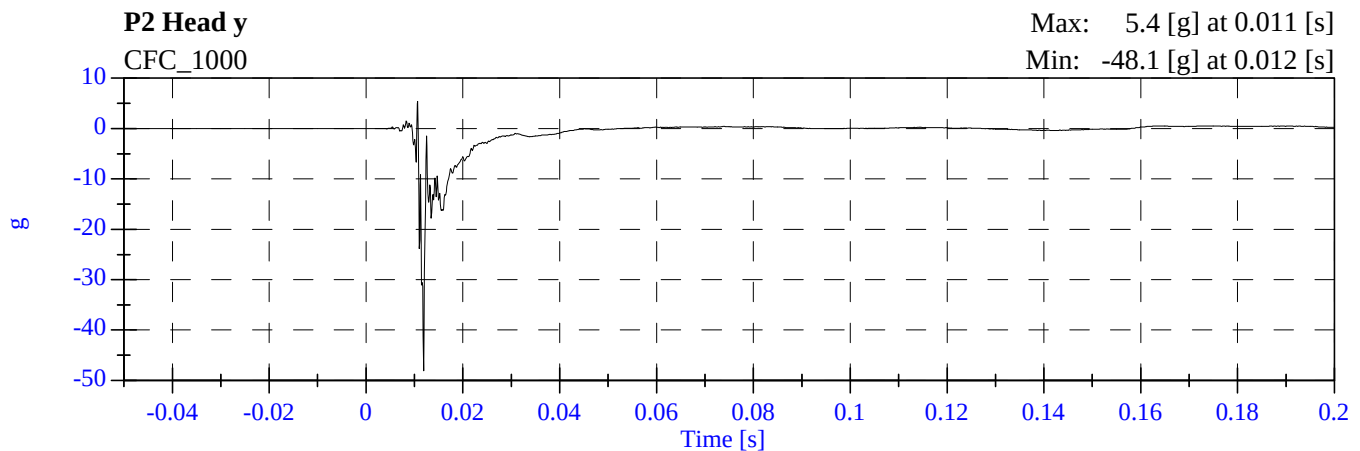
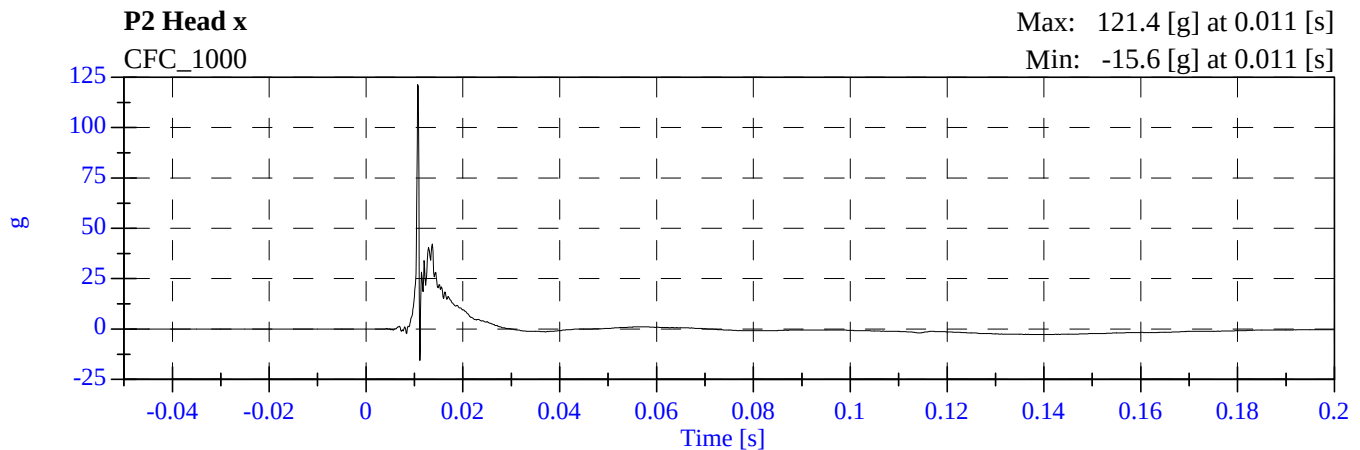
### **CHILD DUMMY RESPONSE DATA TRACES**

## TABLE OF DATA PLOTS

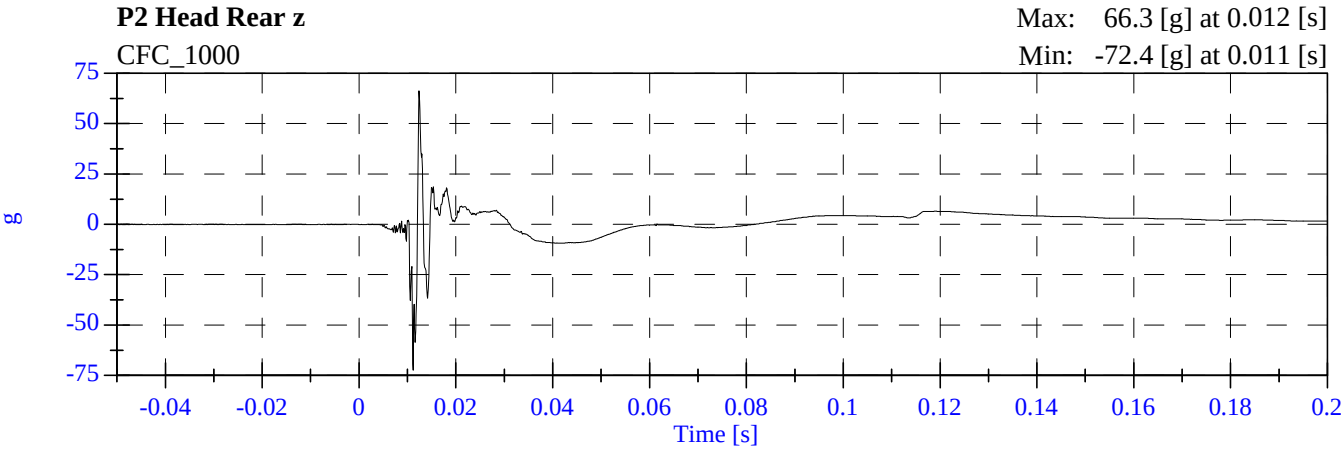
| <b>PLOT</b> | <b>PLOT NAME[UNITS, CHANNEL FILTER CLASS]</b> | <b>PAGE</b> |
|-------------|-----------------------------------------------|-------------|
| 1           | P2 Head x [g, CFC_1000]                       | B-3         |
| 2           | P2 Head y [g, CFC_1000]                       | B-3         |
| 3           | P2 Head z [g, CFC_1000]                       | B-3         |
| 4           | P2 Head Resultant [g, CFC_1000]               | B-3         |
| 5           | P2 Head Rear z [g, CFC_1000]                  | B-4         |
| 6           | P2 Upper Neck Fx [N, CFC_1000]                | B-5         |
| 7           | P2 Upper Neck Fy [N, CFC_1000]                | B-5         |
| 8           | P2 Upper Neck Fz [N, CFC_1000]                | B-5         |
| 9           | P2 Upper Neck F Resultant [N, CFC_1000]       | B-5         |
| 10          | P2 Upper Neck Mx [N-m, CFC_600]               | B-6         |
| 11          | P2 Upper Neck My [N-m, CFC_600]               | B-6         |
| 12          | P2 Upper Neck Mz [N-m, CFC_600]               | B-6         |
| 13          | P2 Upper Neck M Resultant [N-m, CFC_600]      | B-6         |
| 14          | P2 Lower Neck Fx [N, CFC_1000]                | B-7         |
| 15          | P2 Lower Neck Fy [N, CFC_1000]                | B-7         |
| 16          | P2 Lower Neck Fz [N, CFC_1000]                | B-7         |
| 17          | P2 Lower Neck F Resultant [N, CFC_1000]       | B-7         |
| 18          | P2 Lower Neck Mx [N-m, CFC_600]               | B-8         |
| 19          | P2 Lower Neck My [N-m, CFC_600]               | B-8         |
| 20          | P2 Lower Neck Mz [N-m, CFC_600]               | B-8         |
| 21          | P2 Lower Neck M Resultant [N-m, CFC_600]      | B-8         |
| 22          | P2 Chest x [g, CFC_180]                       | B-9         |
| 23          | P2 Chest y [g, CFC_180]                       | B-9         |
| 24          | P2 Chest z [g, CFC_180]                       | B-9         |
| 25          | P2 Chest Resultant [g, CFC_180]               | B-9         |
| 26          | P2 Chest Compression [mm, CFC_600]            | B-10        |
| 27          | P2 Pelvic x [g, CFC_1000]                     | B-11        |
| 28          | P2 Pelvic y [g, CFC_1000]                     | B-11        |
| 29          | P2 Pelvic z [g, CFC_1000]                     | B-11        |
| 30          | P2 Pelvic Resultant [g, CFC_1000]             | B-11        |

# TWG Test - Saab 9-5

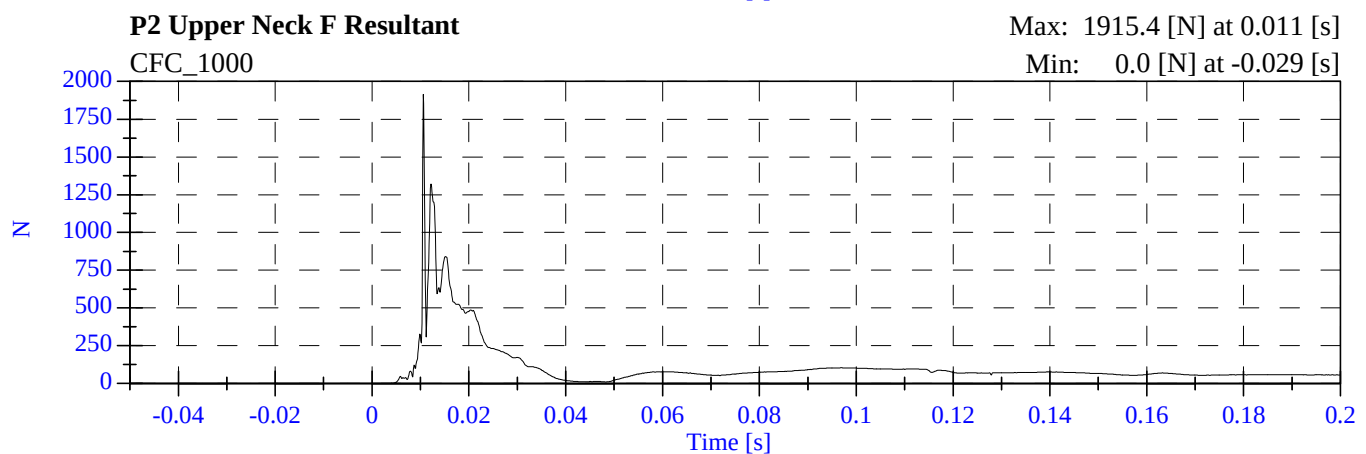
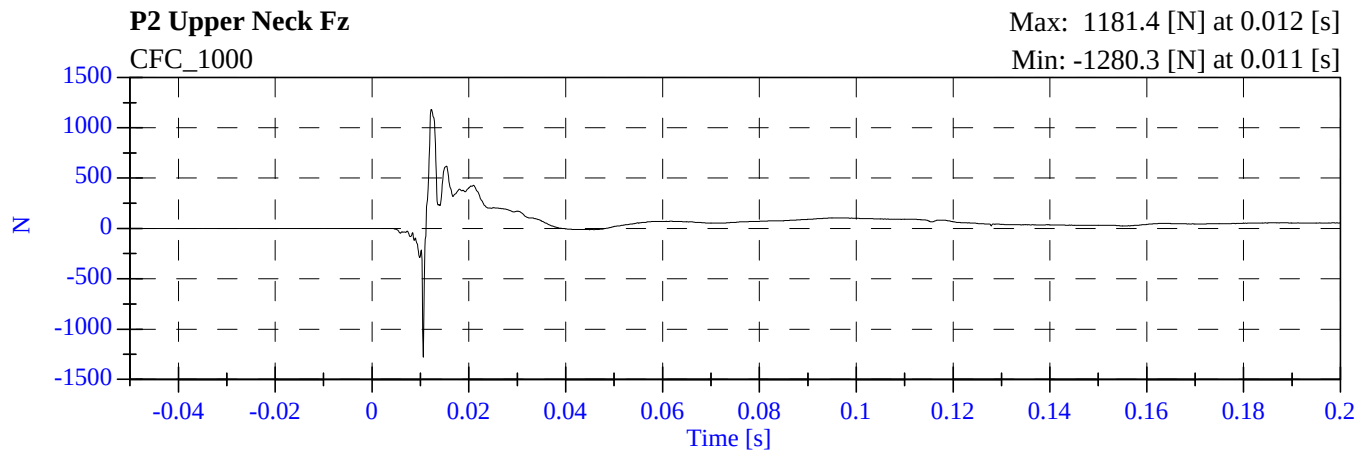
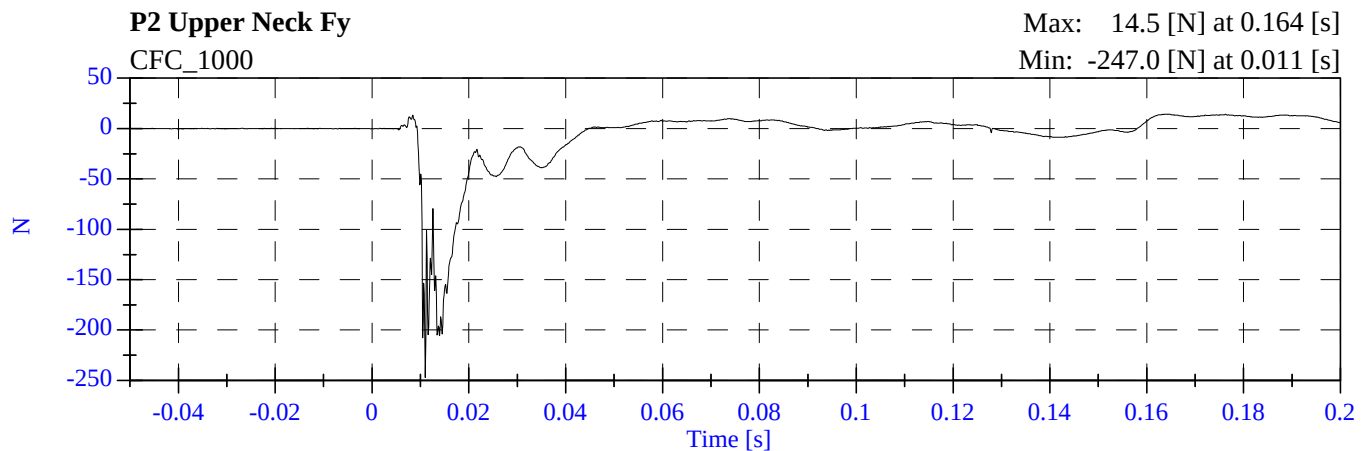
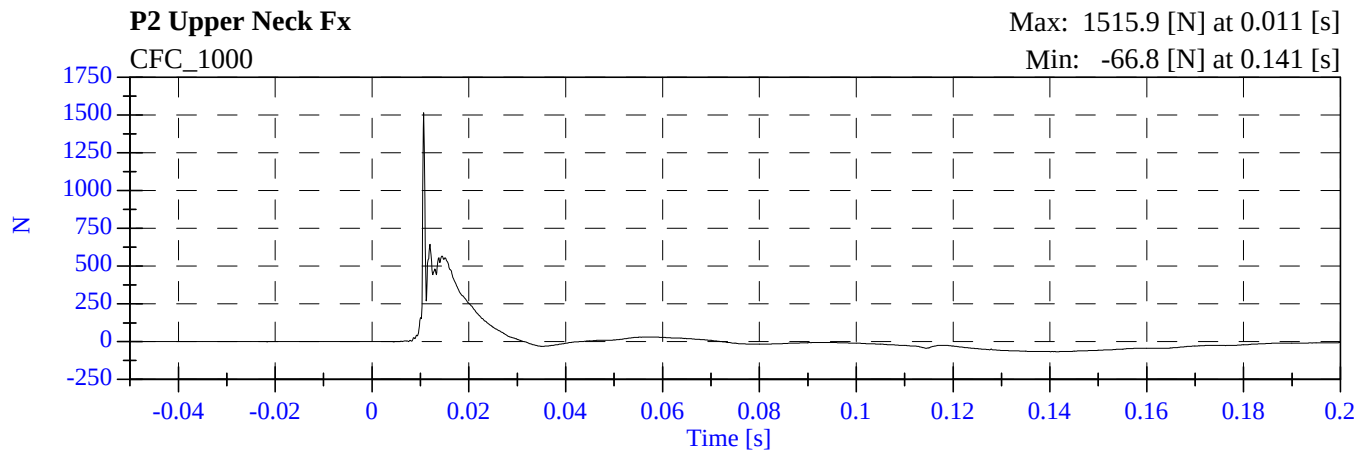
## C30514TWG2 - November 14, 2003



**TWG Test - Saab 9-5**  
**C30514TWG2 - November 14, 2003**



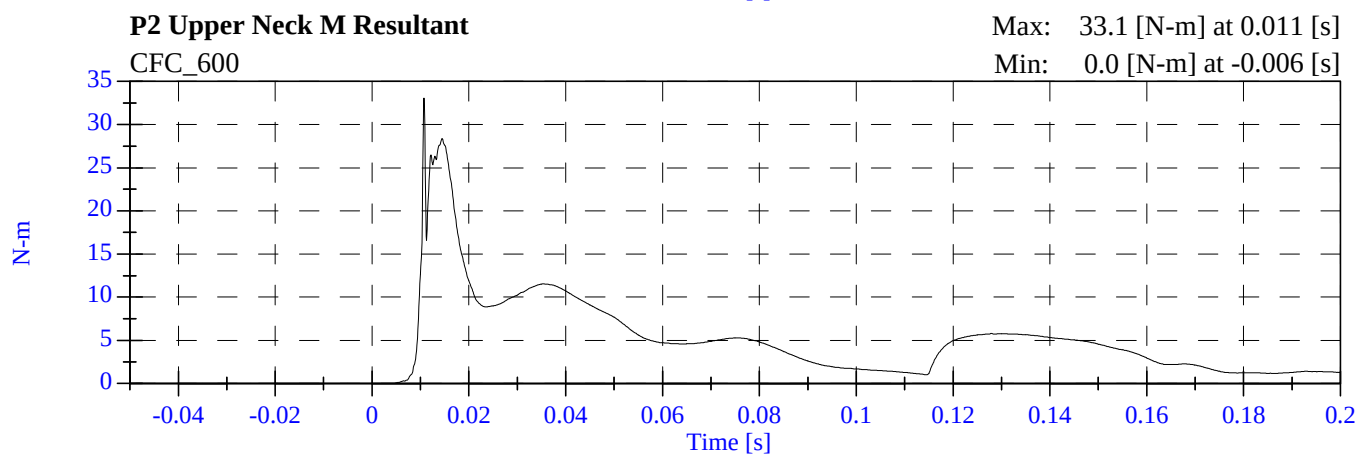
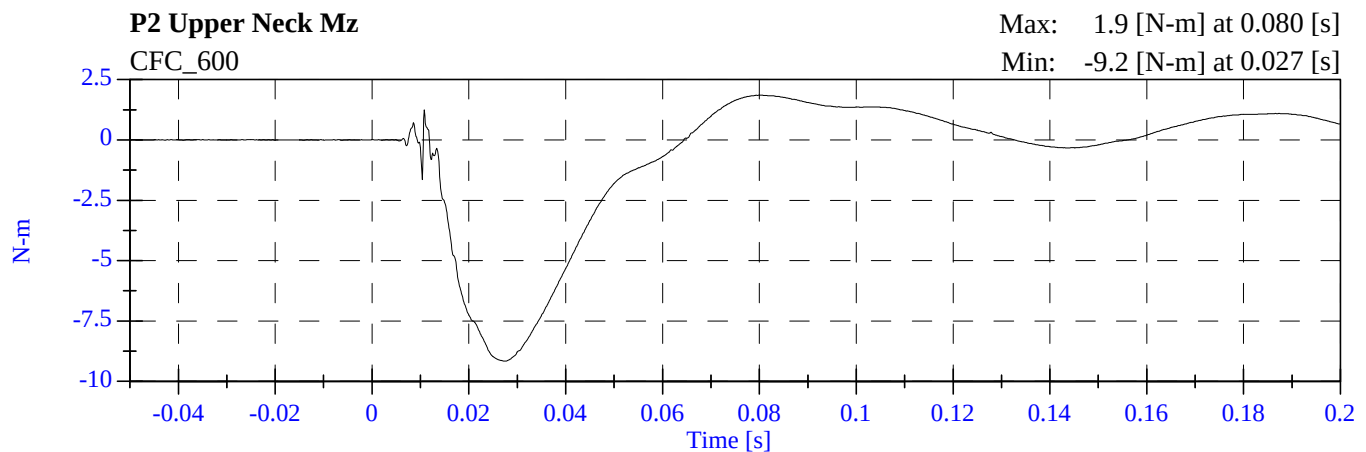
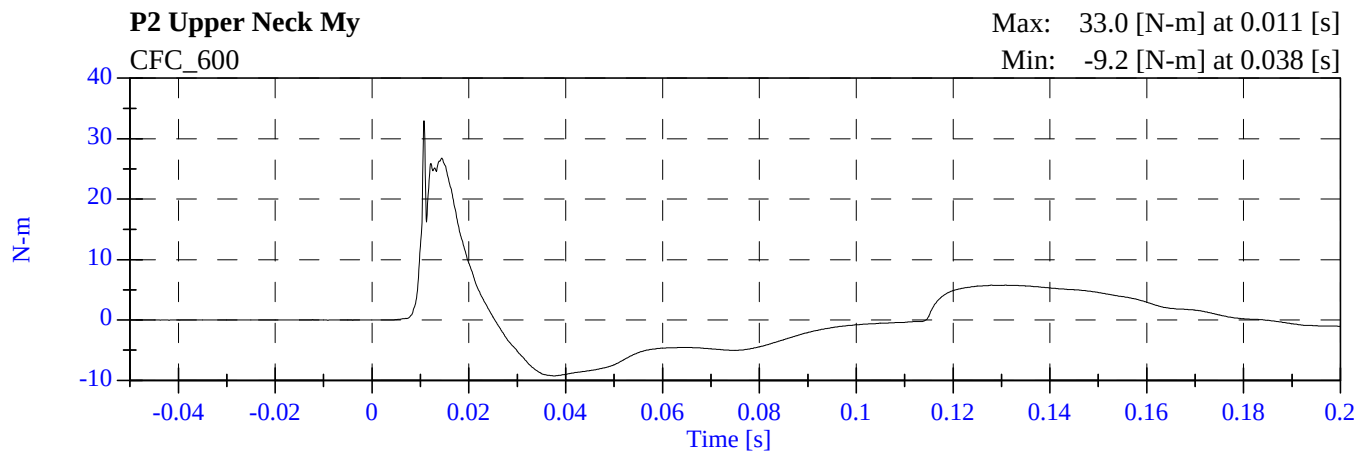
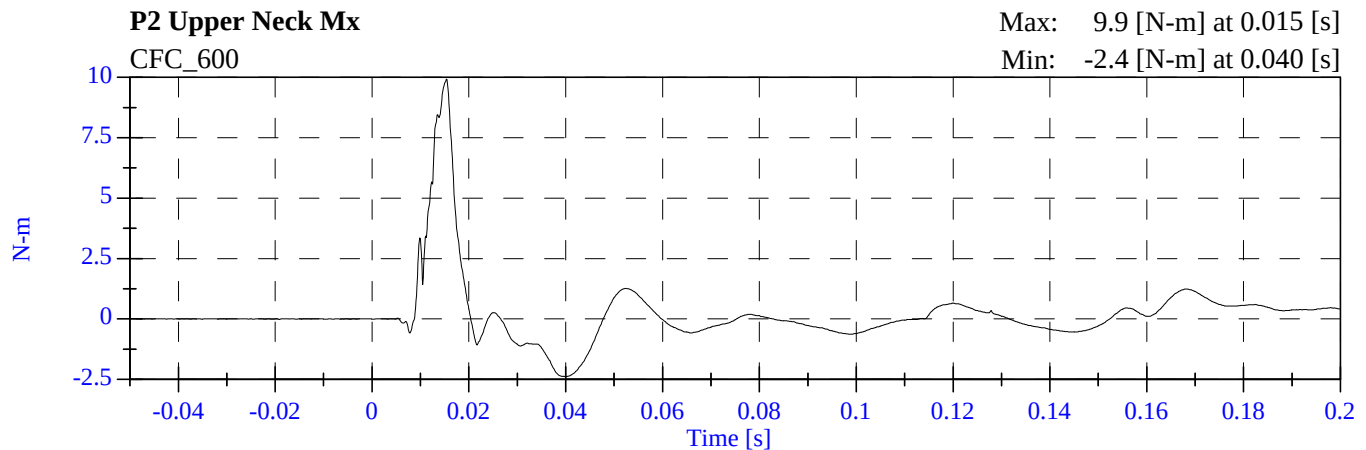
# **TWG Test - Saab 9-5** **C30514TWG2 - November 14, 2003**





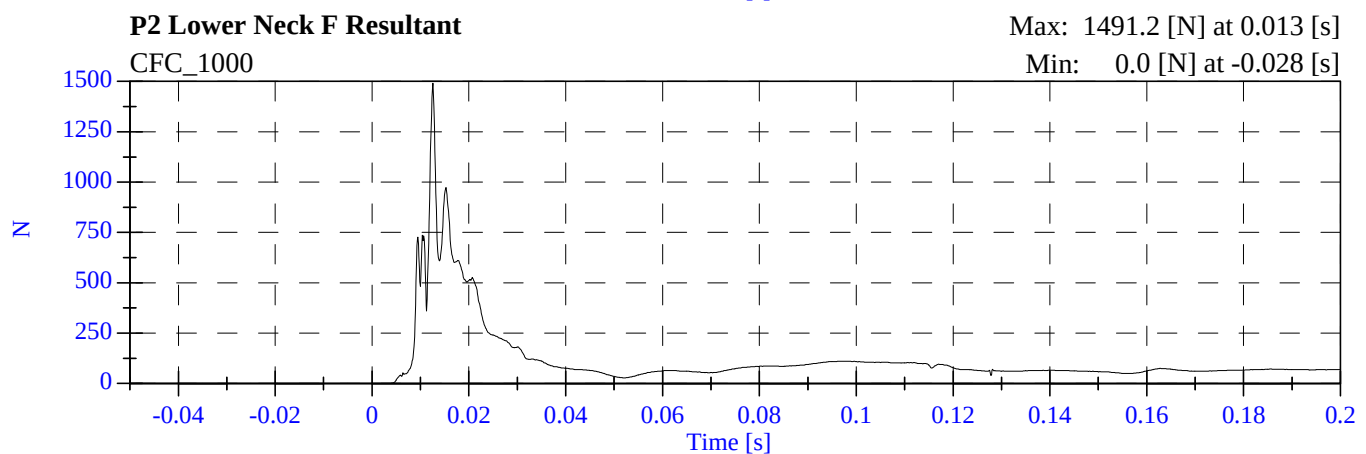
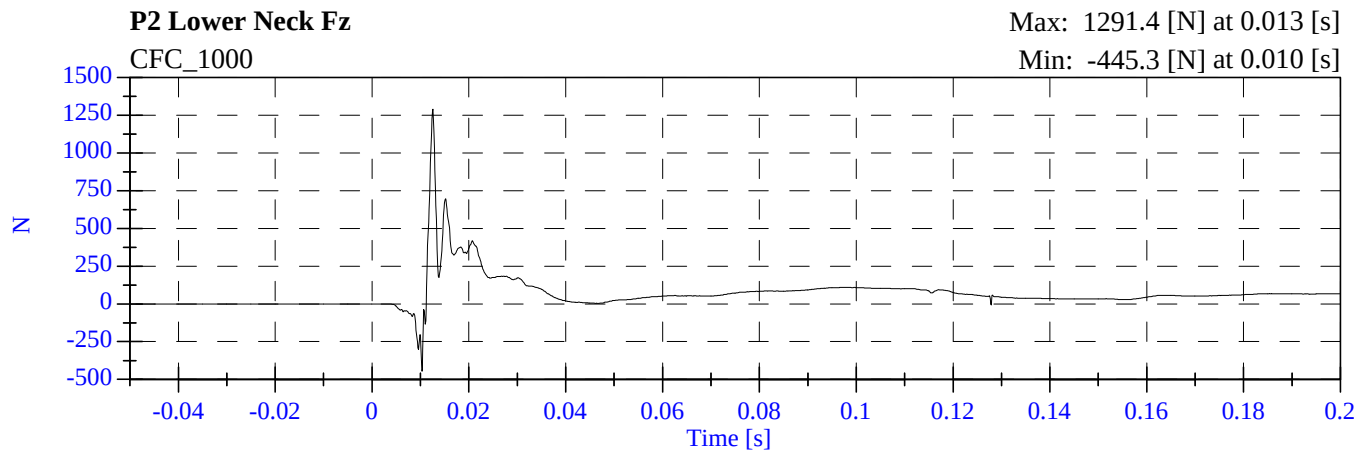
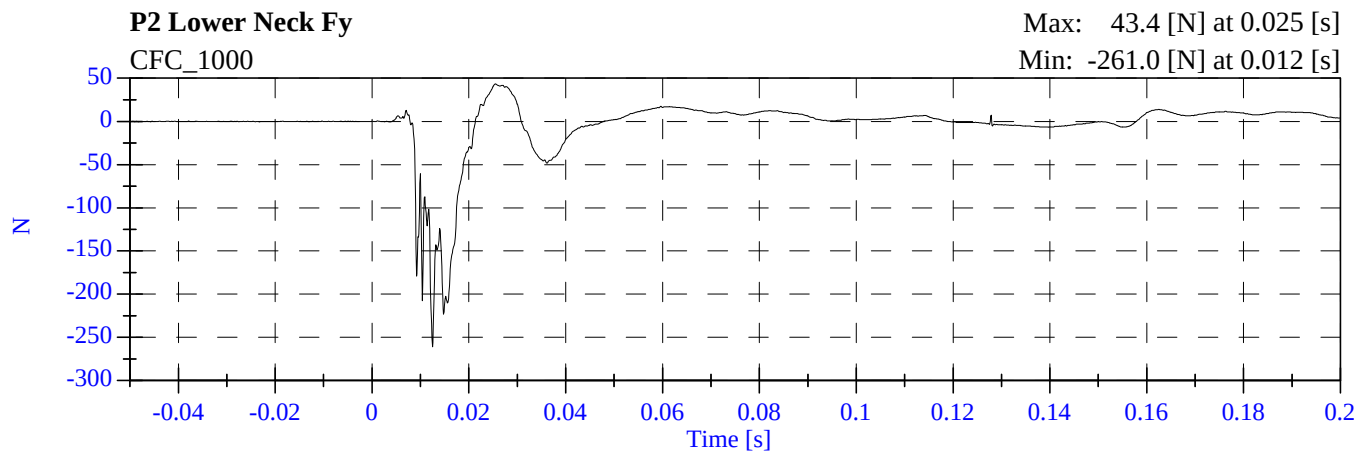
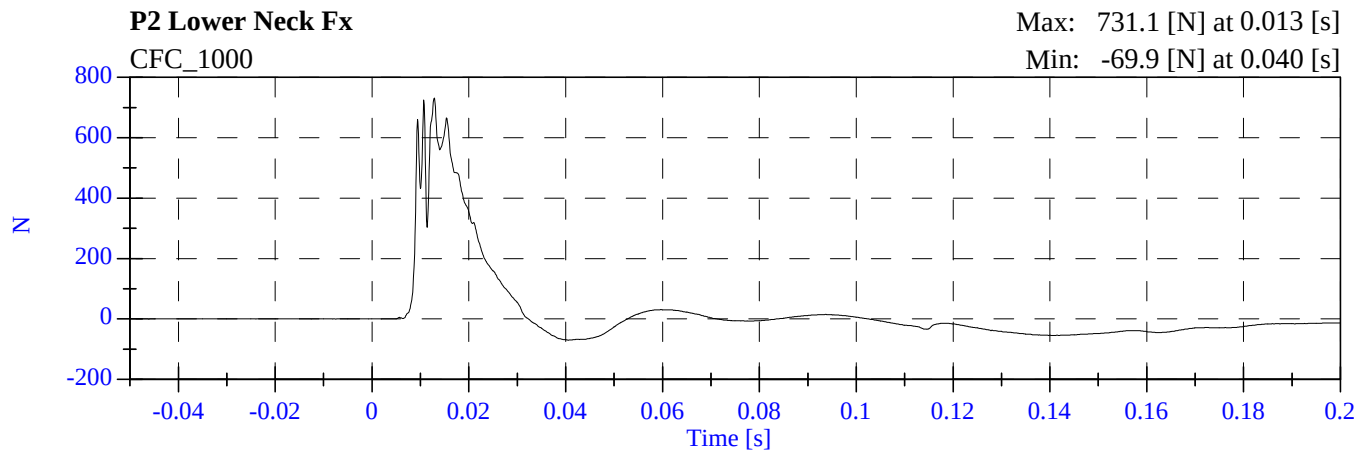
# TWG Test - Saab 9-5

## C30514TWG2 - November 14, 2003



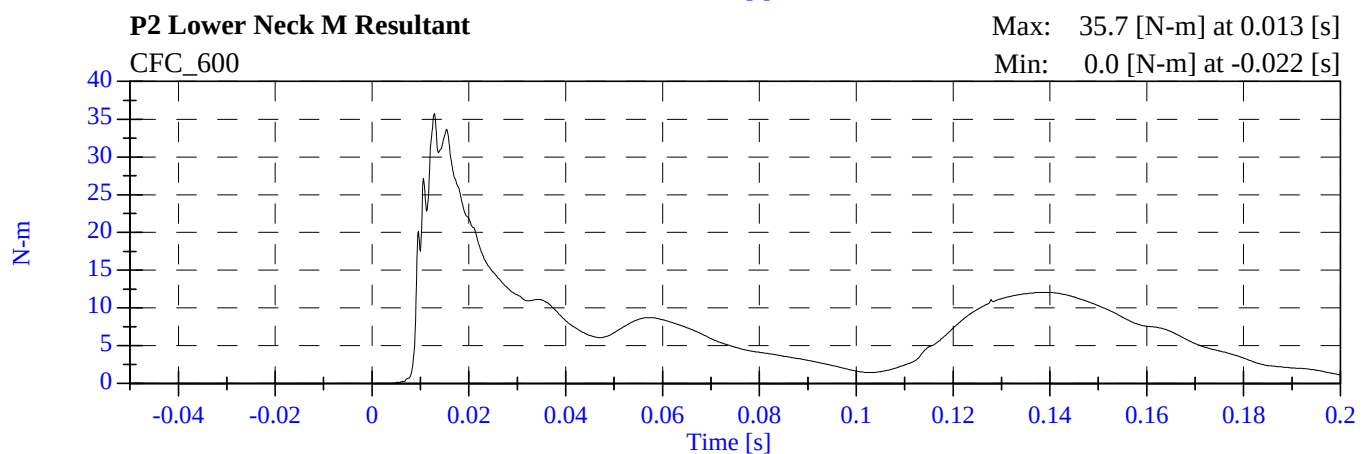
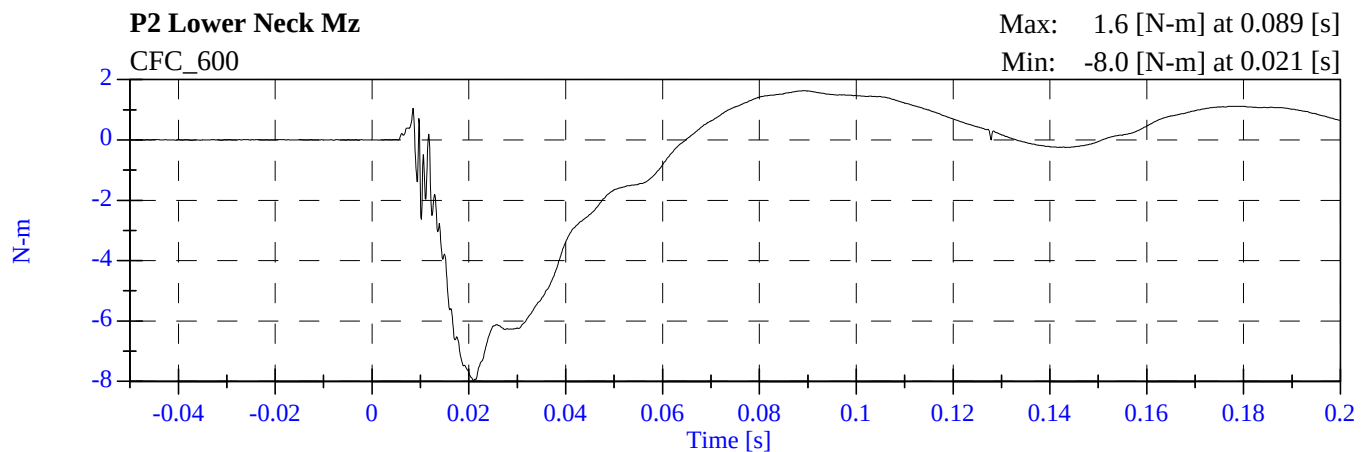
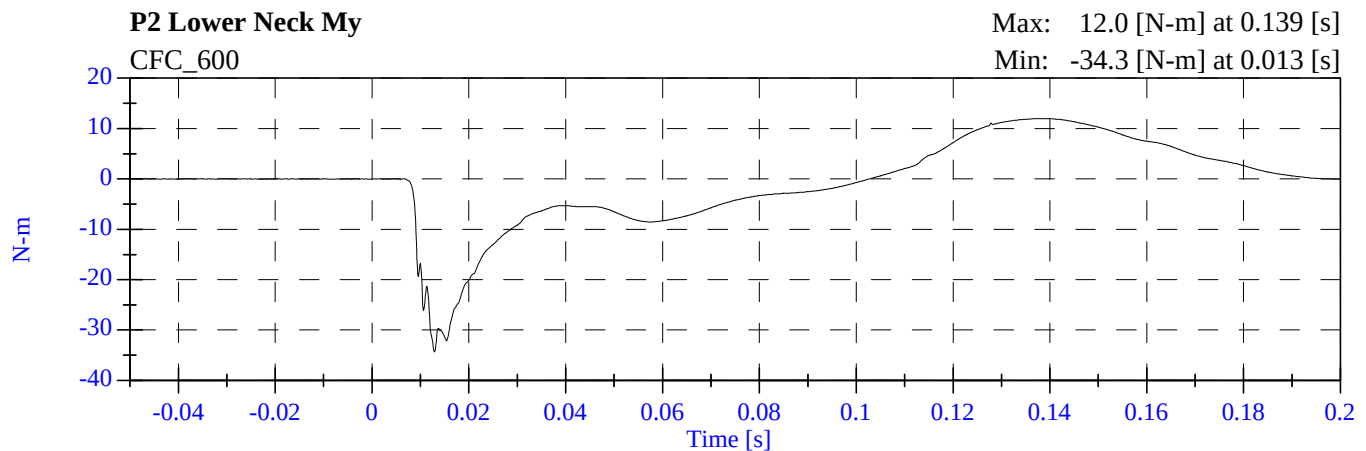
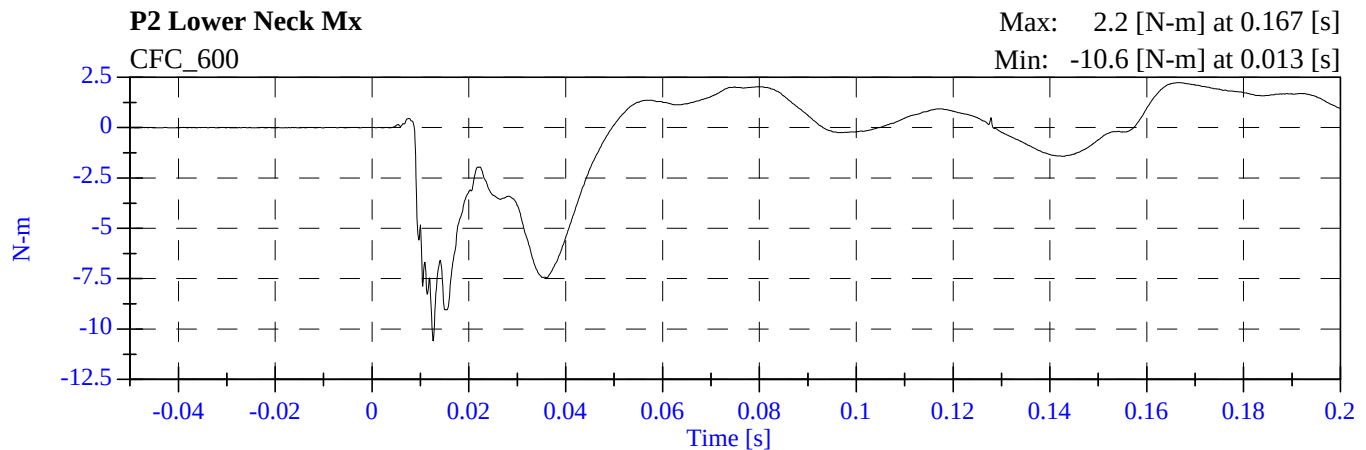
# TWG Test - Saab 9-5

## C30514TWG2 - November 14, 2003



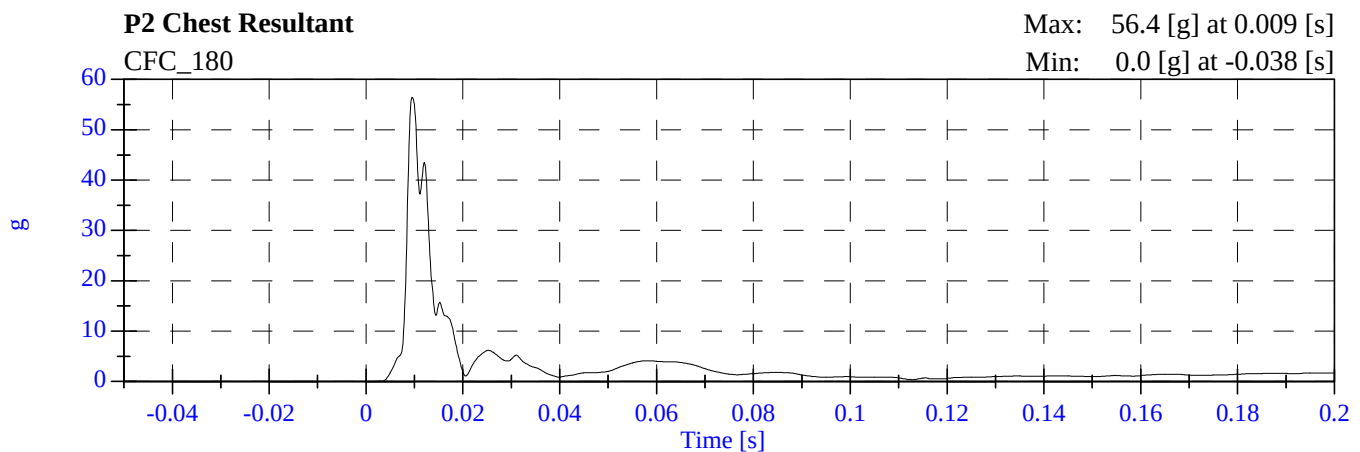
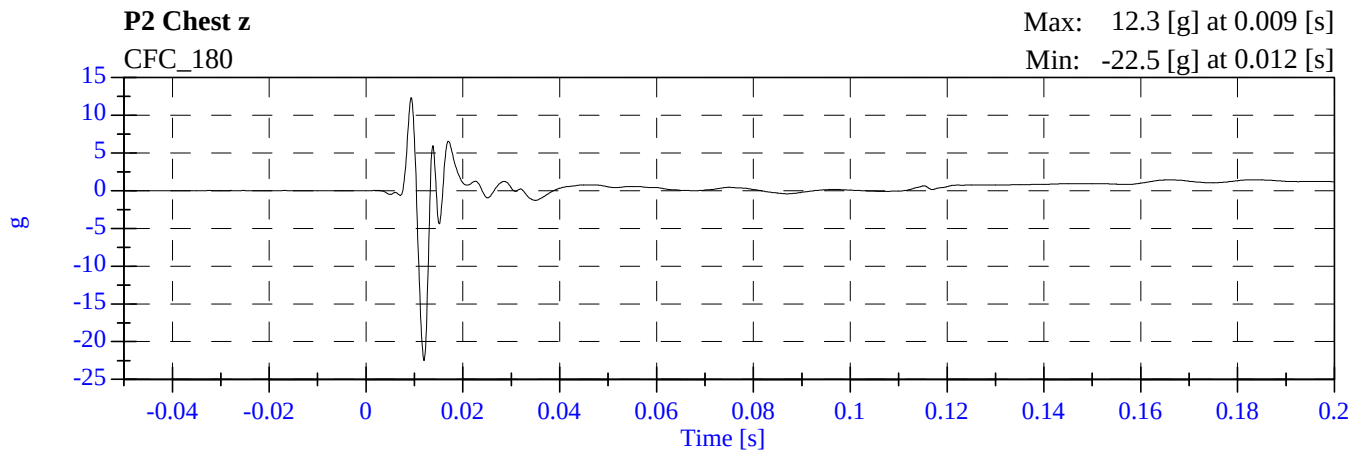
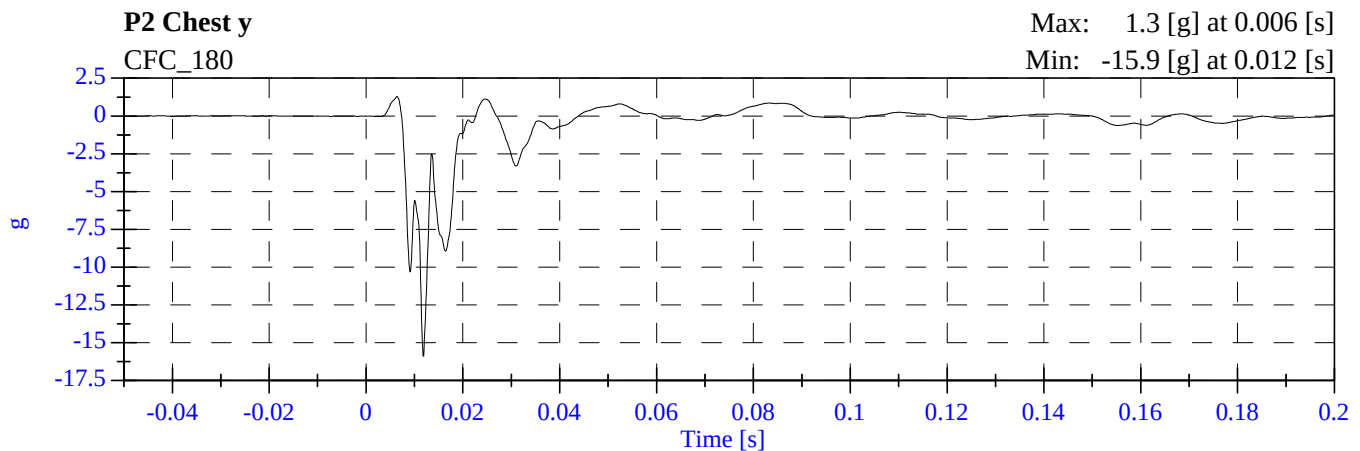
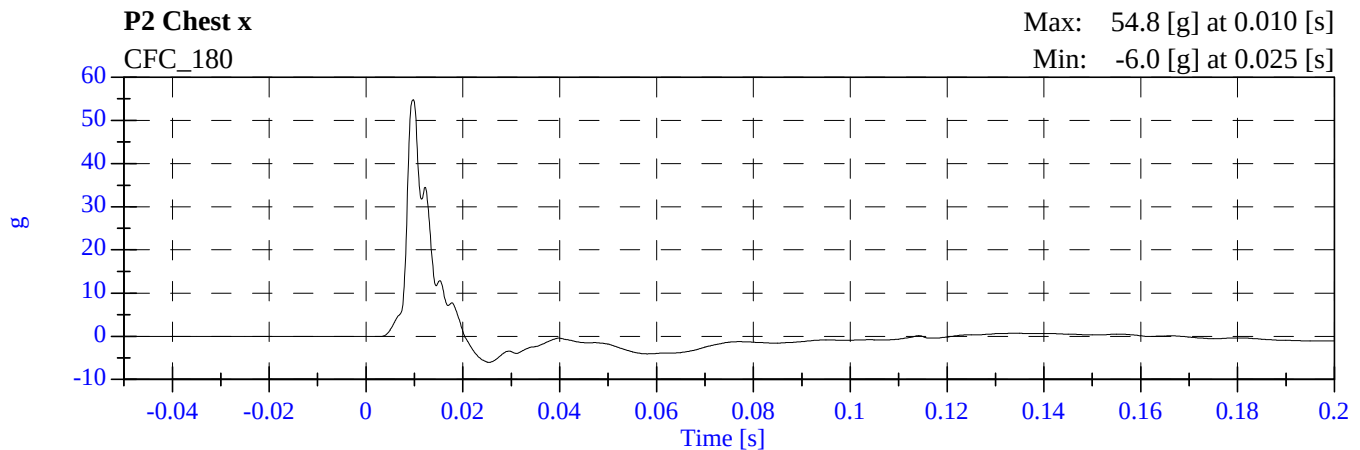
# TWG Test - Saab 9-5

## C30514TWG2 - November 14, 2003

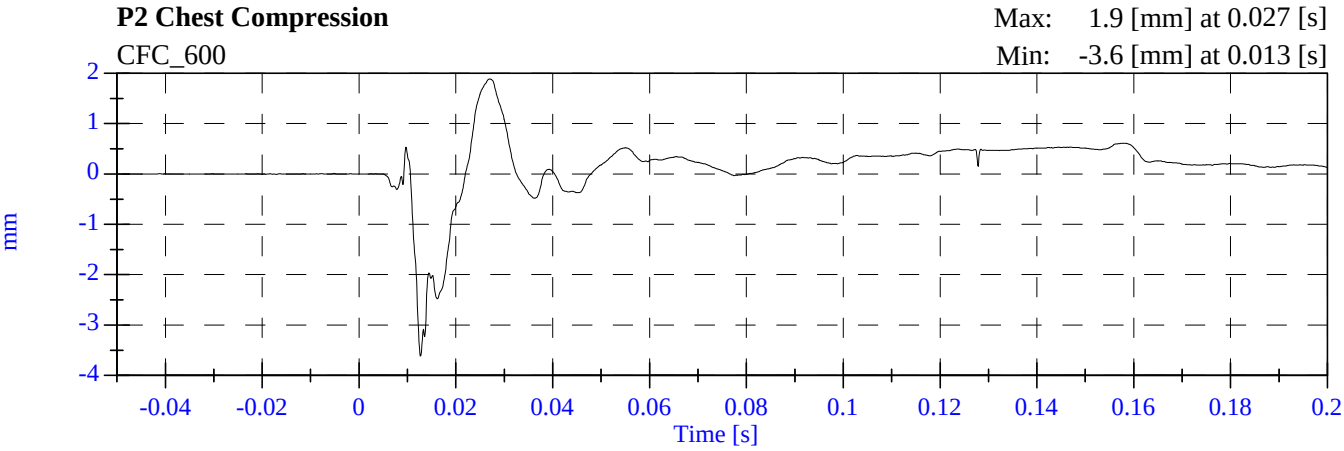


# TWG Test - Saab 9-5

## C30514TWG2 - November 14, 2003

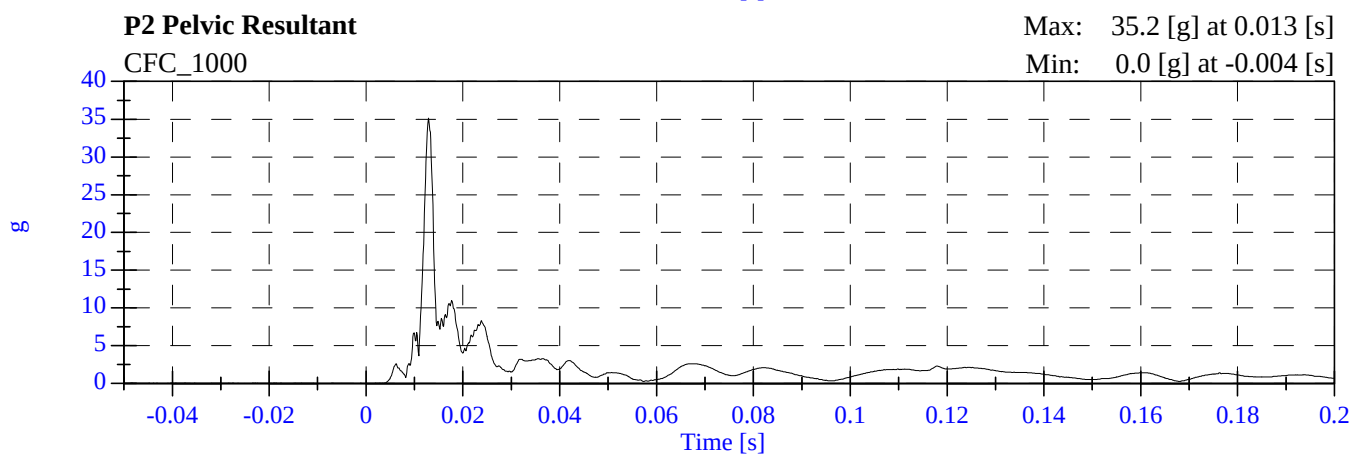
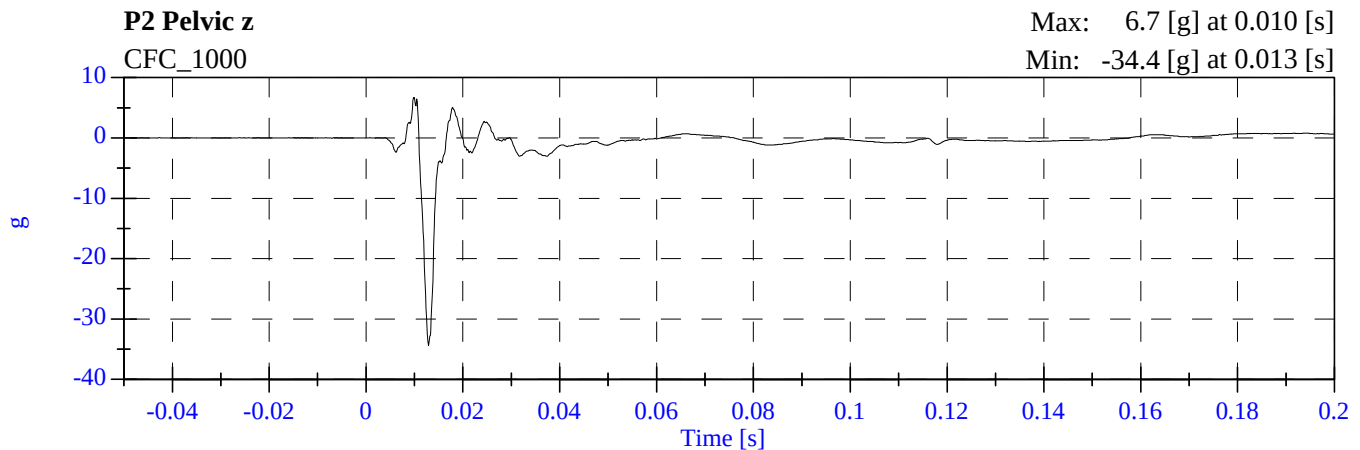
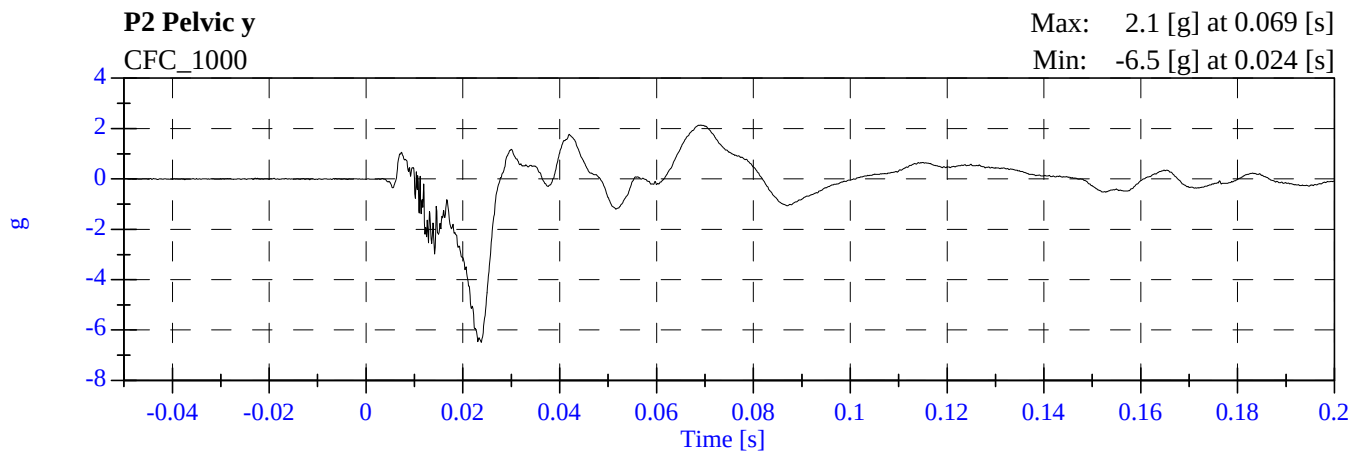
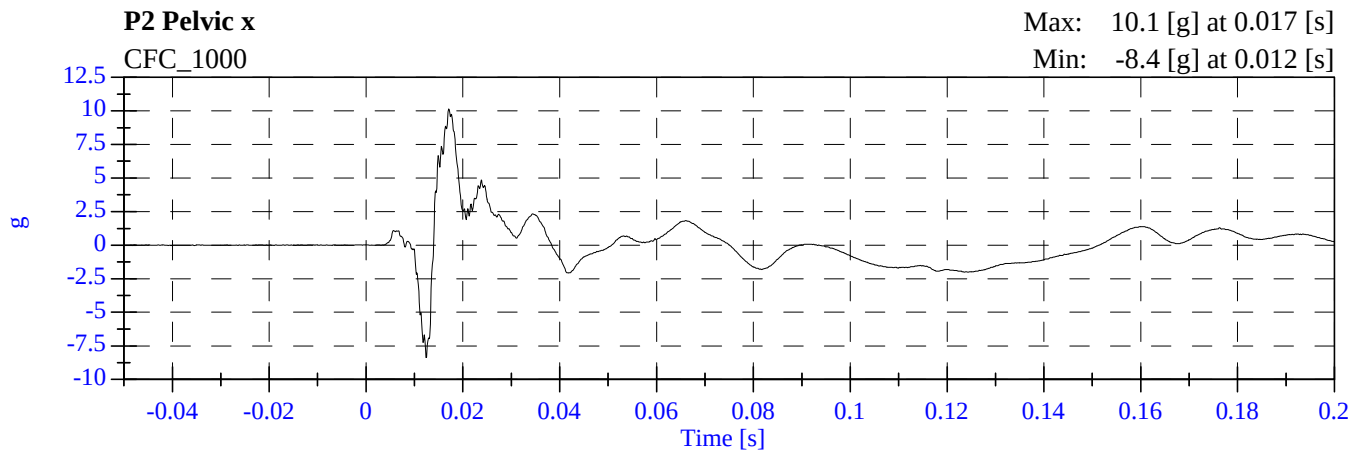


**TWG Test - Saab 9-5**  
**C30514TWG2 - November 14, 2003**



# TWG Test - Saab 9-5

## C30514TWG2 - November 14, 2003



## **APPENDIX C**

### **TEST EQUIPMENT LIST AND CALIBRATION INFORMATION**

# TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

## P572P INSTRUMENTATION

|                      | POSITION #2 (RIGHT FRONT) SERIAL NO.: 142 |              |                  |
|----------------------|-------------------------------------------|--------------|------------------|
|                      | SERIAL NUMBER                             | MANUFACTURER | CALIBRATION DATE |
| HEAD AX              | AC-99108-F29                              | ENTRAN       | 18-Aug-03        |
| HEAD A Y             | AC-99102-F12                              | ENTRAN       | 18-Aug-03        |
| HEAD AZ              | AC-00L13-F03                              | ENDEVCO      | 18-Aug-03        |
| HEAD REAR AZ         | AC-98G18-F18                              | ENTRAN       | 18-Aug-03        |
| UPPER NECK FX        | LC-213-FX                                 | DENTON       | 1-Oct-03         |
| UPPER NECK FY        | LC-213-Fy                                 | DENTON       | 1-Oct-03         |
| UPPER NECK FZ        | LC-213-Fz                                 | DENTON       | 1-Oct-03         |
| UPPER NECK MX        | LC-213-Mx                                 | DENTON       | 1-Oct-03         |
| UPPER NECK MY        | LC-213-My                                 | DENTON       | 1-Oct-03         |
| UPPER NECK MZ        | LC-213-Mz                                 | DENTON       | 1-Oct-03         |
| LOWER NECK FX        | LC-214Fx                                  | DENTON       | 1-Oct-03         |
| LOWER NECK FY        | LC-214-Fy                                 | DENTON       | 1-Oct-03         |
| LOWER NECK FZ        | LC-214-Fz                                 | DENTON       | 1-Oct-03         |
| LOWER NECK MX        | LC-214-Mx                                 | DENTON       | 1-Oct-03         |
| LOWER NECK MY        | LC-214-My                                 | DENTON       | 1-Oct-03         |
| LOWER NECK MZ        | LC-214-Mz                                 | DENTON       | 1-Oct-03         |
| CHEST AX             | AC-99108-F30                              | ENTRAN       | 18-Aug-03        |
| CHEST AY             | AC-99108-F28                              | ENTRAN       | 18-Aug-03        |
| CHEST AZ             | AC-99H30-Z04                              | ENTRAN       | 18-Aug-03        |
| CHEST DISPLACEMENT X | DS-142                                    | SERVO        | 18-Aug-03        |
| PELVIS AX            | AC-99102-F06                              | ENTRAN       | 18-Aug-03        |
| PELVIS AY            | AC-99102-F15                              | ENTRAN       | 18-Aug-03        |
| PELVIS AZ            | AC-99G29-Q13                              | ENTRAN       | 18-Aug-03        |