# Insurance Institute for Highway Safety
# Crashworthiness Evaluation

## Crash Test Report
## 1999 Saab 9-5 (CF98021)

**Vehicle identification number:** YS3EF48E9X3006053
**Body style:** Midsize four-door sedan
**Engine/transmission:** Transverse 2.3-liter turbocharged 4-cylinder, 4-speed automatic, front-wheel drive

**Standard crashworthiness features:**

Driver and right front passenger front airbags
Driver and right front passenger seat-mounted side airbags (designed to protect head and torso)
Dual-locking shoulder belts (all seating positions)
Automatic shoulder belt height adjusters (front and rear outboard seating positions)
Seat belt crash tensioners (pyrotechnic, front seating positions only)
Seat belt force-limiting mechanisms (front seating positions only)
Center rear lap/shoulder belt
Breakaway brake pedal arm
Active head restraints (front seating positions only)
Rear seat head restraints (outboard seating positions)

**Other standard safety features:**

Four-wheel antilock brakes
Daytime running lamps

**Vehicle specifications (provided by manufacturer):**

| | |
|---|---|
| Wheelbase: | 270 cm |
| Overall length: | 480 cm |
| Overall width: | 179 cm |
| Curb weight: | 1,485 kg (base model with manual transmission) |

**Vehicle specifications (measured):**

| | |
|---|---|
| Front bumper to firewall: | 117 cm |
| Curb weight: | 1,600 kg |
| Test weight: | 1,734 kg (58% front, 42% rear) |
| Overall width: | 178 cm |

**Nominal test parameters:**

40.0 mi/h (64.4 km/h), 40% overlap, deformable barrier face with slotted bumper

**Crash test date:**

October 21, 1998

**Figure 1**
**Precrash and Postcrash Side Views — 1999 Saab 9-5**

## Summary

A 1999 Saab 9-5 was crash tested on October 21, 1998 into a fixed deformable barrier at 40.0 mi/h (64.4 km/h) and a 41 percent overlap on the driver side. A Hybrid III 50th percentile male dummy was positioned in the driver seat with the lap/shoulder belt fastened.

Measures of intrusion taken after the crash indicated the lower instrument panel in front of the dummy moved rearward 2-5 cm. Resultant intrusion in the driver footwell measured 14 cm at the footrest and 16-19 cm at other places on the toepan. The breakaway brake pedal arm was partially dislodged from its mounting bracket. All doors remained closed during the crash. After the crash, the driver door and left rear door required additional effort but no tools to open, and the right front and right rear doors opened with ease.

The driver dummy was restrained by a three-point lap/shoulder belt and an airbag. During the crash, the belt crash tensioner activated and retracted about 8 cm of shoulder belt webbing. The belt force-limiting mechanism allowed about 5 cm of webbing to spool off the retractor, but the total amount of spool-out was unknown. The dummy's head loaded the airbag and then rebounded against the head restraint and B-pillar. After the crash, the upper end of the steering column had moved upward 3 cm and rearward 1 cm.

The maximum resultant head acceleration from the B-pillar contact was 28 g. The right leg had a maximum tibia axial force of –5.9 kN and a maximum lower tibia L-M moment of 244 Nm, significantly contributing to a lower tibia index of 1.25. The right leg also had a maximum upper tibia L-M moment of 157 Nm, which contributed to an upper tibia index of 0.86. The right foot had a maximum resultant acceleration of 178 g.

## Test Conditions

This vehicle had been tested previously in the Institute's Low-Speed Crash Test Program and subjected to an impact on the front corner of the passenger side at 5 mi/h (8 km/h) into a 30 degree angle barrier and a rear impact at 5 mi/h (8 km/h) into a flat barrier. All structural damage on the front was repaired prior to this test (see Appendix, Low-Speed Crash Test Damage Repair Estimate).

This test was conducted according to the procedures specified in the IIHS Offset Barrier Crash Test Protocol (Version VI). The Hybrid III dummy positioned in the driver seat was equipped with instrumented lower legs that included feet modified to include two accelerometers and to have a 45 degree dorsiflexion range with soft stops at all extremes of foot-ankle motion. All dummy seating parameters were set according to the procedures specified for Federal Motor Vehicle Safety Standard 208 compliance testing (49 *CFR* Part 571.208 § 11). The dummy's left foot was placed on the footrest.

Seat back, shoulder belt upper anchorage, and steering column adjustments were set according to the manufacturer's specifications for government crash testing. Other adjustments were set according to the procedure specified for Federal Motor Vehicle Safety Standard 208 compliance testing (49 *CFR* Part 571.208 § 7 and 8). After final positioning of the dummy, measurements from various parts of the dummy to a number of vehicle interior points were made. These measurements and the seat back, shoulder belt upper anchorage, and steering column adjustments are described in the Appendix, Dummy Clearance Measurements.

Vehicle acceleration measurements were made by a triaxial arrangement of accelerometers mounted on the vehicle's longitudinal centerline and 60 cm behind its center of gravity (174 cm behind the front axle). The vehicle speed recorded just prior to impact was 40.0 mi/h (64.4 km/h), and the actual overlap was 41 percent.

## Structural Performance

All doors remained closed during the crash. The driver door aperture shortened 7 cm, as measured at the lower edge of the window. After the crash, the driver door and left rear door required additional effort but no tools to open, and the right front and right rear doors opened with ease.

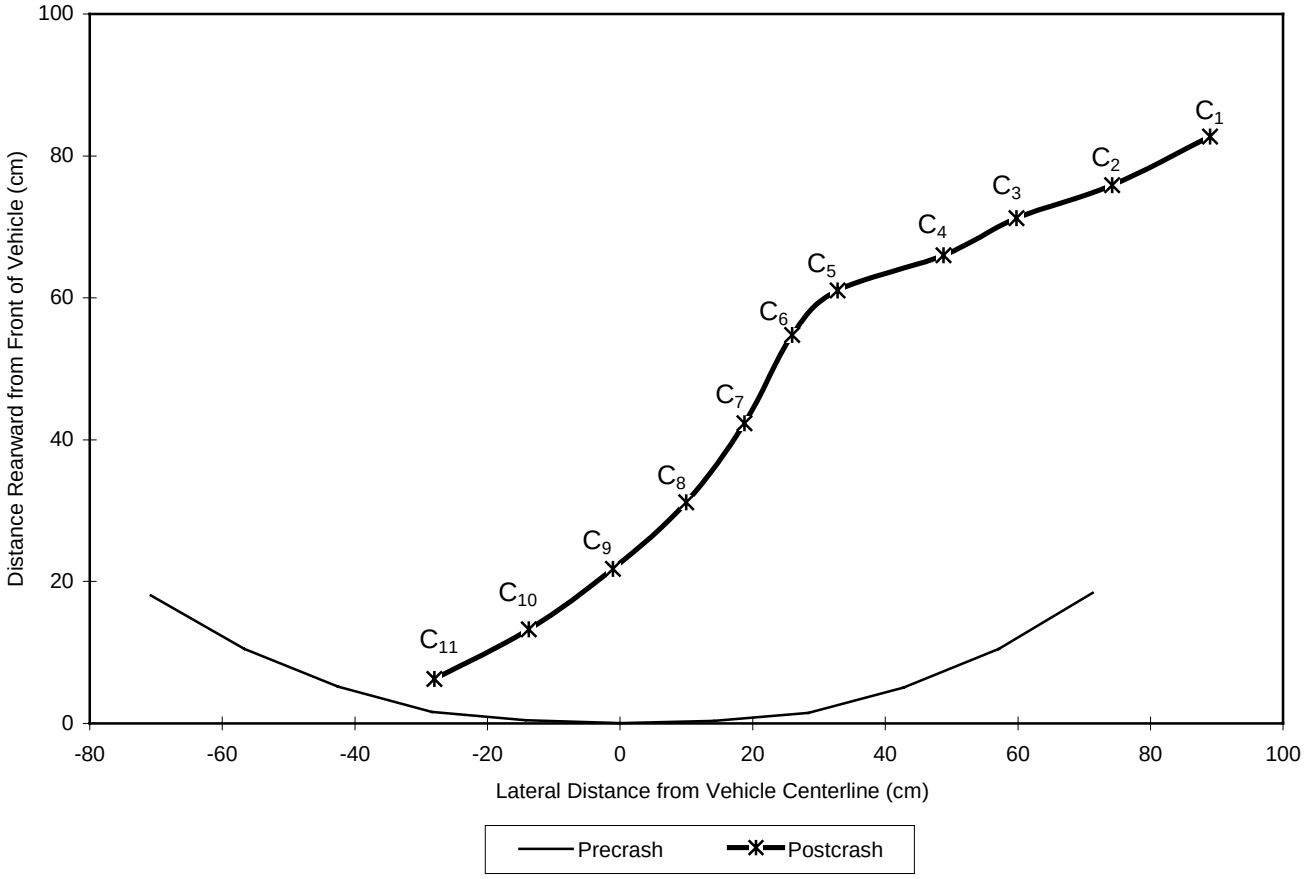
The brake pedal mounting bracket is shaped like a "Y" when viewed from above or below, with the top of the "Y" facing the front of the car. The bracket is bolted to both the toepan and a steering column crossmember under the instrument panel. In a collision with toepan intrusion, the front end of the bracket is pushed rearward. However, movement is limited by the attachment at the steering column, which causes the sides of the Y-shaped bracket to spread apart, which in turn is intended to disengage both ends of the brake arm pivot bolt from the bracket, especially if the driver is applying the brakes. After the crash, one end of the pivot bolt was found dislodged from the mounting bracket, and moderate additional effort (without tools) was required to break the pedal completely free. (The dummy's foot is not placed on the brake pedal before the crash.)

No fuel system leaks were observed after the crash. In addition, no fuel system leaks were observed when the vehicle was rotated onto its right side to allow postcrash photography.

Figure 2 shows the overhead view of the crash deformation. Figure 3 illustrates the precrash and postcrash contour measures of the front bumper cover profile and the resulting permanent crush. Figure 4 illustrates the corresponding measures of both the front bumper reinforcement bar and upper crossmember of the radiator support. Figure 5 shows the precrash and postcrash views from below. Figure 6 illustrates the deformation of the side rails, floor rails, and engine cradle, which are visible in Figure 5.

**Figure 2**
**Overhead View of Crash Deformation — 1999 Saab 9-5**

**Figure 3**
**Front Bumper Cover Crush Contour — 1999 Saab 9-5**




| | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | $C_8$ | $C_9$ | $C_{10}$ | $C_{11}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Postcrash Contour (cm)** | 83 | 76 | 71 | 66 | 61 | 55 | 42 | 31 | 22 | 13 | 6 |
| **Precrash Contour (cm)** | 18 | 11 | 5 | 1 | 0 | 0 | 0 | 2 | 5 | 11 | 18 |
| **Resulting Crush (cm)** | 65 | 65 | 66 | 65 | 61 | 55 | 42 | 29 | 17 | 2 | –12 |

The length of the reference line was 142 cm precrash and 117 cm postcrash.

**Figure 4**
**Front Bumper Bar and Upper Radiator Support Crossmember Crush Contour — 1999 Saab 9-5**

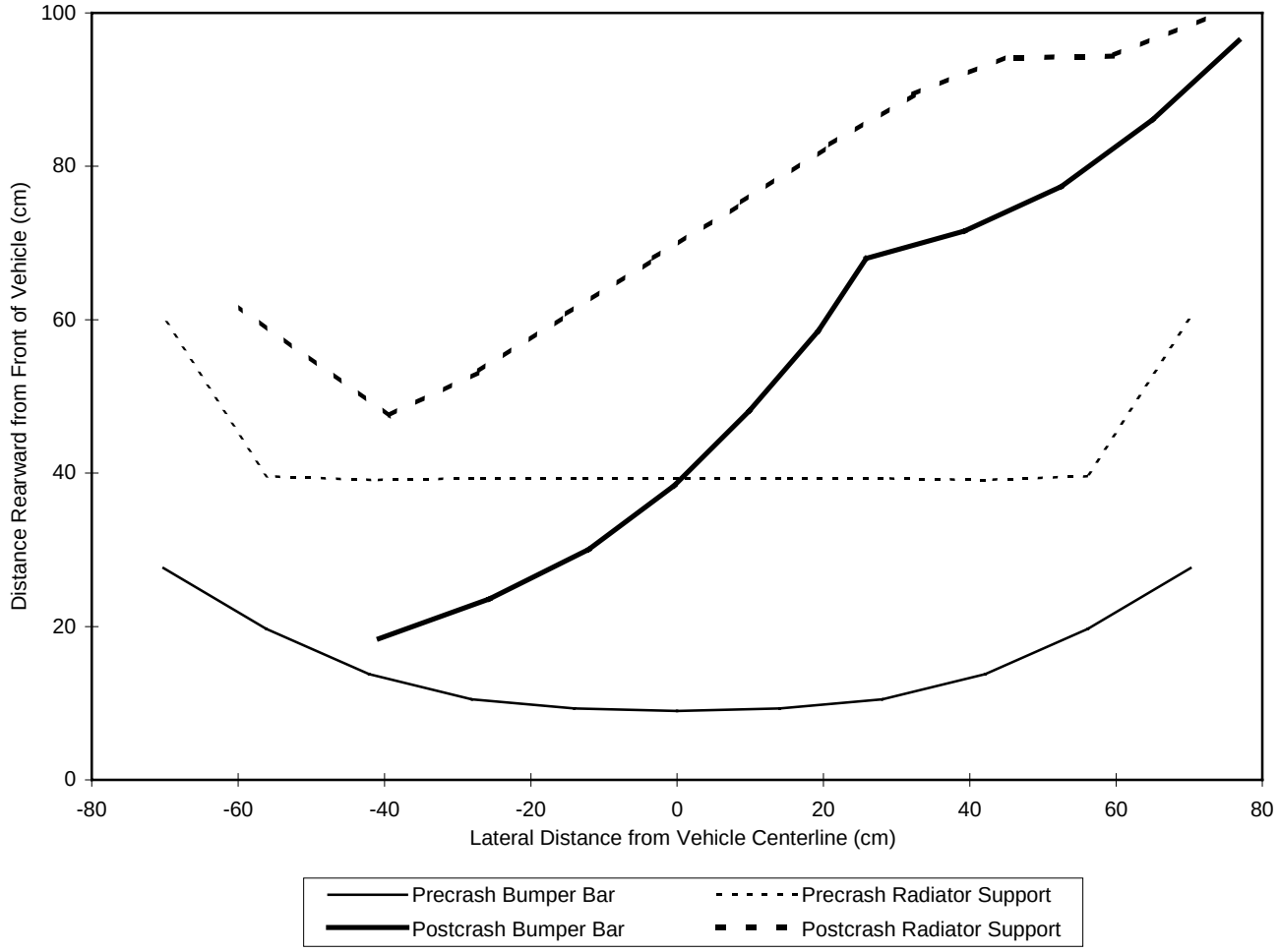


**Figure 5**
**Precrash and Postcrash Views from Below — 1999 Saab 9-5**

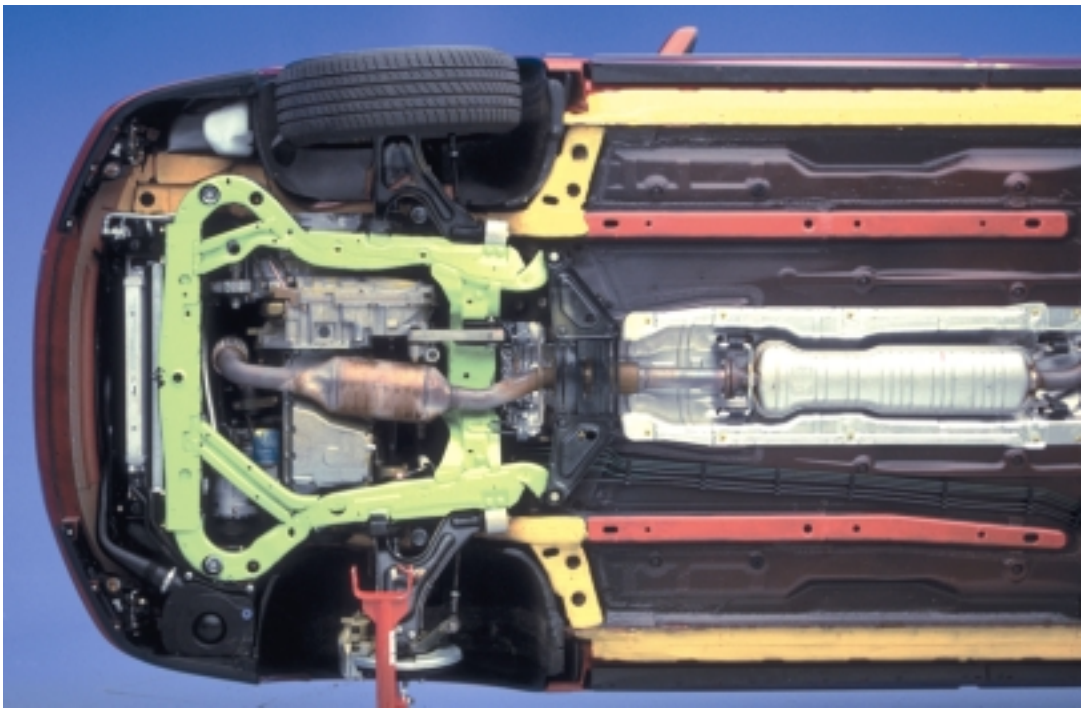
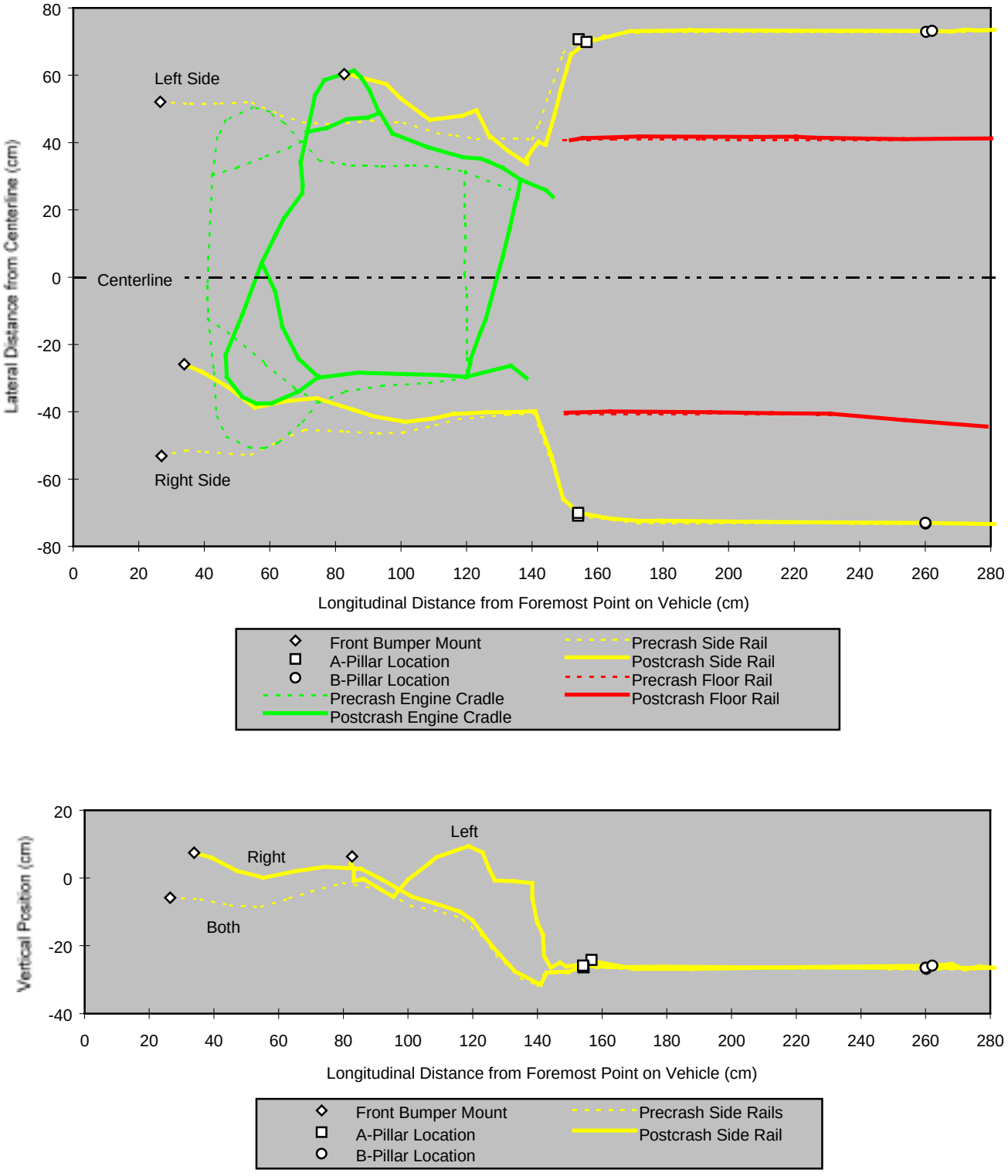


**Figure 6**
**Structural Deformation, Views from Below and Side — 1999 Saab 9-5**



Various measures of intrusion were made after the crash. These residual measures of intrusion typically are less than the maximum deformation that occurs during the crash. The primary coordinate reference system for these measures is described in the IIHS Offset Barrier Crash Test Protocol (Version VI). The measures of deformation shown in Table 1 have been adjusted to better reflect the displacement of the various target locations relative to the driver. This was done by subtracting the average component displacements of the four seat-attachment bolts, which also were measured relative to the primary coordinate system, from the respective components of displacement for each of the target locations. The average displacement of the four seat-attachment bolts relative to the primary reference system also is shown in Table 1.

**Table 1**
**Residual Measurements of Intrusion Relative to Driver Seat — 1999 Saab 9-5**

| Selected Locations* | Longitudinal | Lateral | Vertical | Resultant |
|---|---|---|---|---|
| Steering column (cm) | –1 | –1 | 3 | 3 |
| Left lower instrument panel (cm) | –5 | –1 | 2 | 5 |
| Right lower instrument panel (cm) | –2 | –1 | 1 | 2 |
| Brake pedal (cm)** | –3 | 0 | –4 | 5 |
| Left toepan (cm) | –17 | –3 | 6 | 18 |
| Center toepan (cm) | –17 | –3 | 7 | 19 |
| Right toepan (cm) | –15 | –3 | 5 | 16 |
| Footrest (cm) | –13 | –2 | 4 | 14 |
| Average displacement of the four seat-attachment bolts from primary reference system (cm) | –2 | 1 | –1 | n/a |

* All measurements taken on driver side. From the driver's position, positive is forward, left, and up.
** The brake pedal arm was separated from its mounting bracket before postcrash intrusion measurements were taken. The pedal arm was then reattached, and the brake pedal was allowed to drop against the toepan when the postcrash measurements were taken. Because of considerable lateral play, the lateral component was regarded as zero.

## Restraint System Performance

### Airbags

***Driver:*** The uninflated driver airbag is approximately 63 cm in diameter, and the excursion of its center when inflated is limited by three tethers. The airbag is vented by two holes located at positions corresponding to 10 and 2 o'clock on the forward-facing surface of the airbag. Analysis of the high-speed film taken from camera positions B and D indicated the airbag deployed at 22 ms into the crash and appeared to be fully inflated at 64 ms. The seat-mounted side airbag did not deploy during the crash.

***Passenger:*** The top-mounted passenger airbag deployed at an angle and is untethered. The cylinder-shaped airbag is vented by one hole located at the outboard lateral end. The airbag did not contribute to windshield damage during deployment. The seat-mounted side airbag did not deploy during the crash.

### Seat Belts

This vehicle is equipped with dual-locking lap/shoulder belts with sliding latch plates at all five seating positions and automatic upper anchorage height adjusters at the front and rear outboard seating positions. The front belts also are equipped with pyrotechnic crash tensioners and mechanical force-limiting mechanisms. Both the front inboard and outboard lower anchorage points are attached to and move with the seats. During the crash, about 8 cm of webbing was pulled by the crash tensioner into the retractor through the D-ring (18-24 ms), as determined by film analysis of the movement of a tape strip on the belt webbing near the dummy's shoulder. It was not possible to determine the total amount of webbing pulled from the retractor through the D-ring. This was because the B-pillar trim was pulled away from the pillar during the crash, and the dummy's head later rebounded against a pull-string mounted between the B-pillar trim and the belt webbing beyond the D-ring. However, postcrash investigation of the force-limiting torsion bar within the retractor spool indicated it was twisted about 120 degrees from its precrash orientation. This measure, combined with the estimated diameter of the retractor spool and stowed webbing (45 mm), suggested the force limiter contributed about 5 cm of webbing to the total amount pulled from the retractor spool.

### Seat

Postcrash examination of the driver seat rails indicated no discernible movement of the seat in its tracks during the crash. Deformation of the floor under the driver seat caused the seat to pitch forward and tip outward slightly. During the crash, the seat back flexed forward considerably but not enough to contact the dummy's head, which was loading the airbag at the time.

### Steering Column

The upper end of the steering column moved upward 3 cm and rearward 1 cm relative to the driver seat. The portion of the steering column between the instrument panel and steering wheel has an energy-absorbing, tube-in-tube design and was found compressed 1 cm following the crash. The telescoping column adjustment mechanism also gave way, allowing an additional compression of 2 cm from the precrash midrange setting. A short segment of the column just above the toepan, supported by a universal joint at each end, was bent laterally to about a 90-degree angle (compared with about 30 degrees on an undamaged Saab 9-5). There was no apparent axial movement between the upper column bracket and its juncture with the instrument panel crossbeam.

## Dummy Kinematics

### Head, Neck, and Torso

Analysis of the high-speed film taken from camera position D indicated the dummy's head began to load the airbag at 78 ms into the crash (14 ms after the airbag was fully inflated). Paint transferred from the dummy's face indicated the nose loaded the airbag 3 cm above and 1 cm to the left of its center. As the dummy's head loaded the airbag, it tilted outward slightly and rotated slightly to face right. During rebound from the airbag, the right rear of the head contacted

the outboard part of the head restraint at about 236 ms and pushed the restraint rearward along with the upper portion of the seat back. The left upper rear portion of the head then contacted the front edge of the B-pillar at 258 ms. Table 2 provides the timing of these events.

**Table 2**
**Restraint System Performance and Dummy Kinematics — 1999 Saab 9-5**

| Event | Time (ms) |
|---|---|
| Deployment of airbag | 22 |
| Airbag fully inflated | 64 |
| Face begins to load airbag | 78 |
| Right rear of head contacts head restraint | 236 |
| Left upper rear of head contacts B-pillar | 258 |

**Figure 7**
**Dummy and Vehicle Interior, Postcrash — 1999 Saab 9-5**

### Legs and Feet

***Left leg and foot:*** Paint transferred from the dummy's left knee indicated the knee contacted the padded knee bolster immediately below the instrument panel, 2 cm above and 3 cm to the left of the left instrument panel intrusion reference point. Paint transferred from the dummy's left shin indicated the shin primarily contacted the padded bolster immediately below the knee impact location. A much smaller amount of paint was transferred from the shin to a separate lower section of the bolster made of hard plastic, which was found cracked. The left foot was found fully dorsiflexed, considerably everted, and internally rotated about 20 degrees, with the back of the heel on a downward buckle in the floormat/carpeting and the sole suspended just behind the intruded footrest and left side of the toepan.

***Right leg and foot:*** Paint transferred from the dummy's right knee indicated the knee contacted the padded knee bolster underneath the right half of the steering column, 9 cm directly to the left of the right instrument panel intrusion reference point. A small amount of paint was transferred from the knee to the bottom center of the steering column trim. Paint transferred from the dummy's right shin indicated the shin contacted the padded bolster immediately below the knee impact location and a small portion of the separate lower section of the bolster. The plastic trim of this lower section was found cracked and broken. The right foot was found considerably dorsiflexed, considerably inverted, and externally rotated about 20 degrees. The back of the heel was on a downward buckle in the floormat/carpeting, the lateral heel was against the intruded toepan, and the sole at the toe was resting on the lower part of the accelerator pedal. The lateral toe was against the carpeting and vinyl insert on the side of the central tunnel.

## Dummy Injury Measures

### Head

The maximum vector resultant head accelerations were recorded and the HICs were calculated during an interval that corresponds with the dummy's head excursion into the airbag. The peak resultant head acceleration from the B-pillar contact was 28 g at 263 ms. Table 3 provides a summary of the maximum head injury measurements recorded during the crash.

**Table 3**
**Head Injury Measurements — 1999 Saab 9-5**

| Measure | Published Tolerance Threshold | Result | Time (ms) |
|---|---|---|---|
| Vector resultant acceleration (g) | 80 | 54 | 106 |
| Vector resultant acceleration — 3 ms clip (g) | 80 | 53 | 104-107 |
| Head Injury Criterion (HIC) | 1000 | 471 | 86-122 |
| Head Injury Criterion — 15 ms interval (HIC-15)* | 700 | 289 | 98-113 |

* Canadian Motor Vehicle Safety Regulations (Standard 208) allow the resultant head acceleration to exceed 80 g in airbag-equipped vehicles if HIC-15 is less than 700 (Transport Canada, 1998).

## Neck

Table 4 provides a summary of the maximum neck injury measurements recorded during the crash. None of the recorded neck force measures exceeded the magnitude-duration injury criteria (Figures A-13 to A-16).

**Table 4**
**Neck Injury Measurements — 1999 Saab 9-5**

| Measure | Published Tolerance Threshold | Result | Time (ms) |
|---|---|---|---|
| A-P shear force (kN) | ±3.1 | –0.5 | 157 |
| Axial compression force (kN) | 4.0 | 0.2 | 266 |
| Axial tension force (kN) | 3.3 | 1.2 | 96 |
| Flexion bending moment (Nm) | 310 | 33 | 165 |
| Extension bending moment (Nm) | 122 | 20 | 268 |

## Chest

Table 5 provides a summary of the maximum chest injury measurements recorded during the crash.

**Table 5**
**Chest Injury Measurements — 1999 Saab 9-5**

| Measure | Published Tolerance Threshold | Result | Time (ms) |
|---|---|---|---|
| Vector resultant spine acceleration — 3 ms clip (g) | 60 | 46 | 103-106 |
| Rib compression (mm) | –50 | –31 | 110 |
| Viscous criterion (m/s) | 1.0 | 0.1 | 89 |

## Legs and Feet

***Left leg and foot:*** None of the injury measures exceeded the published threshold values.

***Right leg and foot:*** The right leg had a maximum tibia axial force of –5.9 kN at 75 ms and a maximum lower tibia L-M bending moment of 244 Nm at 75 ms, significantly contributing to a lower tibia index of 1.25 at 75 ms. The maximum resultant foot acceleration was 178 g at 74 ms. The right leg also had a maximum upper tibia L-M moment of 157 Nm at 75 ms, which contributed to an upper tibia index of 0.86 at 75 ms.

The right upper tibia A-P bending moment had a time signature similar to the tibia axial force (Figures A-40 and A-45). The ratio of the A-P bending moment to the axial force (approximately 0.04 m from 65 to 82 ms into the crash) is approximately the same as the distance (in meters) between a line through the knee and ankle joints and the upper load cell midline due to the bent shape of the dummy's tibia. Therefore, the upper tibia bending could have resulted from the foot force acting through the moment arm of the tibia bend rather than from transverse forces applied by contact with the knee bolster, and as a result, no upper tibia A-P or resultant moments are reported. The reported right upper tibia index was calculated from only the upper tibia L-M moment and tibia axial force.

Table 6 provides a summary of the maximum leg and foot injury measurements recorded during the crash.

## Table 6
## Leg and Foot Injury Measurements — 1999 Saab 9-5

| Measure | Published Tolerance Threshold | Left | | Right | |
|---|---|---|---|---|---|
| | | Result | Time (ms) | Result | Time (ms) |
| Femur axial force (kN) | –9.1* | –3.7 | 109 | –6.1 | 92 |
| Tibia-femur displacement (mm) | –15 | –3 | 110 | –3 | 95 |
| **Upper Tibia** | | | | | |
| L-M moment (Nm) | ±225 | 31 | 128 | 157 | 75 |
| A-P moment (Nm) | ±225 | –73 | 71 | ** | n/a |
| Vector resultant moment (Nm) | 225 | 77 | 71 | ** | n/a |
| Index | 1.00 | 0.38 | 71 | 0.86 | 75 |
| **Lower Tibia** | | | | | |
| L-M moment (Nm) | ±225*** | 27 | 85 | 244 | 75 |
| A-P moment (Nm) | ±225*** | –58 | 103 | 27 | 73 |
| Vector resultant moment (Nm) | 225*** | 59 | 103 | 244 | 75 |
| Axial force (kN) | –8.0*** | –1.5 | 70 | –5.9 | 75 |
| Index | 1.00 | 0.27 | 103 | 1.25 | 75 |
| **Foot** | | | | | |
| A-P acceleration (g) | ±150 | –43 | 70 | –140 | 72 |
| I-S acceleration (g) | ±150 | –59 | 76 | –139 | 74 |
| Vector resultant acceleration (g) | 150 | 69 | 77 | 178 | 74 |

* This critical value is for instantaneous loading. Femur loads are compared with magnitude-duration injury criteria in Figures A-24 and A-37.

** The upper tibia A-P bending could have resulted from the foot force acting through the moment arm of the tibia bend rather than from transverse forces applied by contact with the knee bolster; therefore the A-P and resultant moments are not indicated. The listed upper tibia index was calculated from only the upper tibia L-M moment and tibia axial force.

*** These published thresholds are for fractures of the tibia. Ankle and foot injuries have been associated with bending moments as low as 50-100 Nm, and heel fractures have been associated with axial forces as low as –6.0 kN.

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## Appendix

Low-Speed Crash Test Damage Repair Estimate

Dummy Clearance Measurements

Graph Index — index to graphs of time plots of dummy and vehicle data

Manufacturer's window sticker

# Low-Speed Crash Test Damage Repair Estimate

## 1999 Saab 9-5 Four-Door Sedan: 5 mi/h Front into Angle Barrier

Test Number: LA98019
VIN: YS3EF48E9X3006053
Mileage: 40
Features: Driver and passenger airbags, side impact airbags, four-wheel antilock brakes, air conditioning, automatic transmission, heated power mirrors, keyless entry system, power door locks, power windows, heated back glass, power driver and front passenger seats, tilt and telescoping steering wheel, cruise control, fog lamps, moonroof, and two-stage paint.

| | Part | | Labor | |
|---|---|---|---|---|
| **Description** | **Mfg. No** | **Price** | **Operation** | **Hours** |
| Bumper absorber, front | 4560041 | $100.00 | Replace* | 2.8 |
| Bumper retainer, upper right front | 4560066 | 6.60 | Replace** | |
| Bumper cover, front | | | Repair/align | 2.0 |
| Bumper cover, front | | | Refinish | 3.6 |
| Bumper reinforcement bar, front | | | Repair/align* | 1.0 |
| Bumper reinforcement bar, front | | | Refinish | 0.2 |
| Frame sidemember, right front | | | Repair/align* | 1.0 |
| Headlamp assembly, right front | 4832465 | 220.00 | Replace | 0.3 |
| Headlamps | | | Aim | 0.5 |
| Headlamp wiper bracket, right | | | Repair/align | 0.5 |
| Lamp assembly, parking and turn signal, right front | 4912580 | 54.00 | Replace | |
| Lamp assembly, side marker, right front fender | | | Remove/reinstall | 0.1 |
| Fender, right front | | | Repair/align* | 2.0 |
| Fender, right front | | | Refinish | 1.9 |
| Inner fender panel, right front | | | Repair/align* | 1.0 |
| Inner fender panel, right front | | | Refinish | 0.3 |
| “SE” nameplate, right front fender | | | Remove/reinstall | 0.2 |
| Molding, right front fender | | | Remove/reinstall | 0.2 |
| Paint and materials | | 108.00 | | |
| Total Parts | | $488.60 | | |
| Total Labor | | 598.40 | | 17.6 |
| Grand Total | | $1,087.00 | | |

* This item was repaired or replaced as indicated before the 40 mi/h frontal offset test.
** This item was repaired rather than replaced before the 40 mi/h frontal offset test.

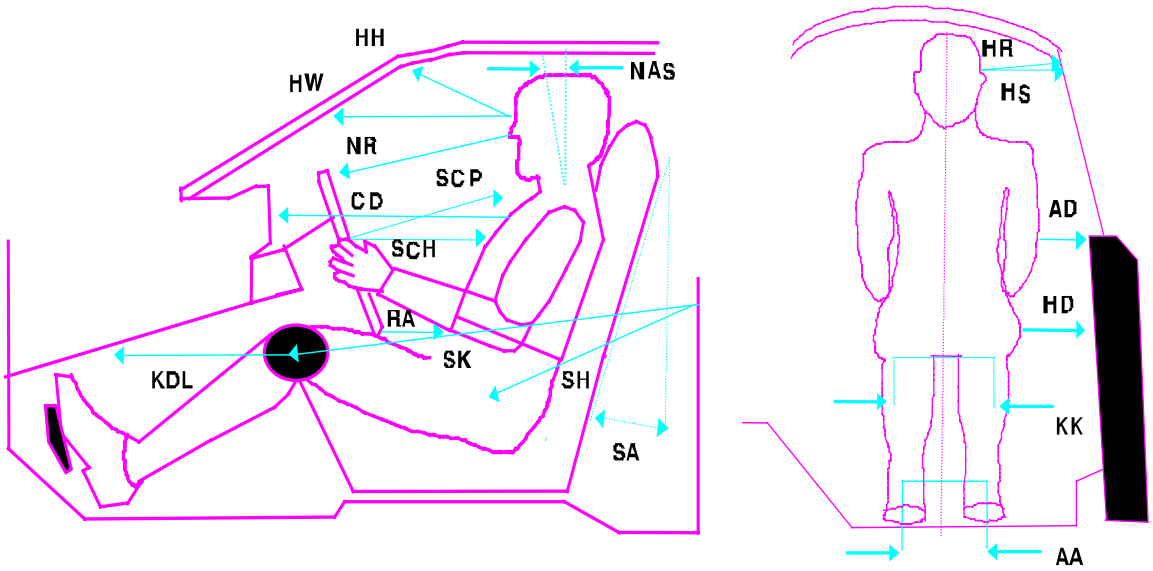
# Dummy Clearance Measurements

**Test Number:** CF98021
**Vehicle Make/Model:** Saab 9-5
**Vehicle Model Year:** 1999
**Seat Type**: Electrically adjusted bucket seat (fore/aft, seat height, and seat back angle)

**Manufacturer's Specifications**
**Seat Back Information:** Reclined to 18°, as measured on rear of seat back frame
**Upper Belt Anchorage:** Automatic (self-adjusting)
**Steering Column Adjustment:** Set to midpoint of tilt and telescopic adjustment ranges

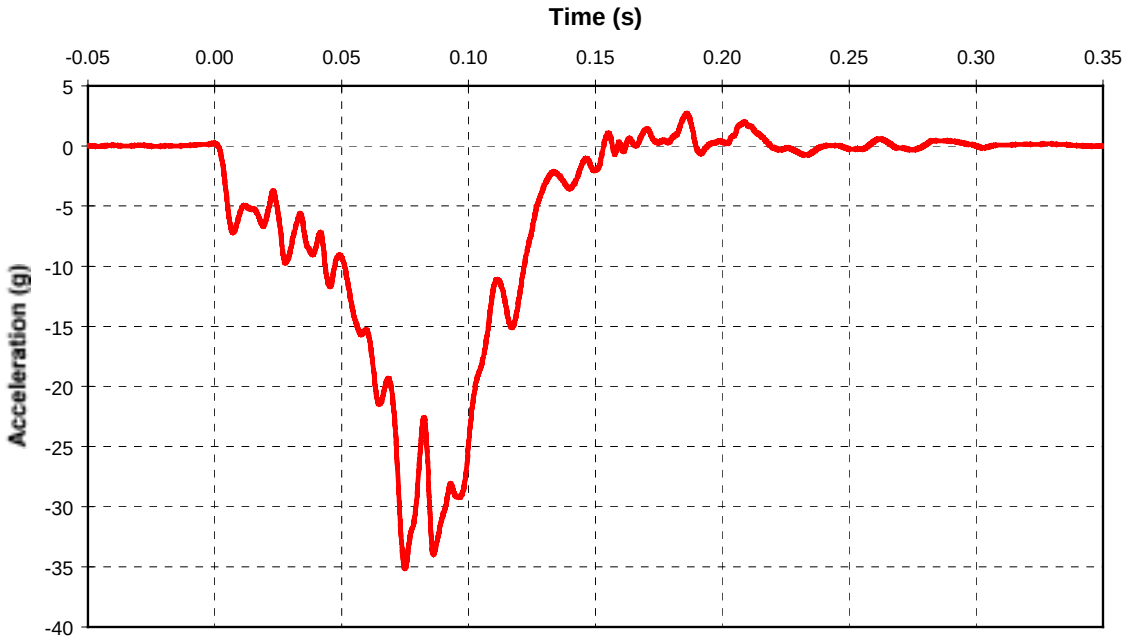
| Location | Code | Measure | Location | Code | Measure |
|---|---|---|---|---|---|
| Head to header | HH | 365 | Neck angle, torso 90 | NAT90 | 18.8° |
| Head to windshield | HW | 625 | Neck angle, seated* | NAS | 3.6° |
| Nose to rim | NR | 409 | Torso angle (NAT90 – NAS) | TA | 15.2° |
| Chest to dash | CD | 632 | Striker to knee** | SK | 554 |
| Rim to abdomen | RA | 233 | Striker to knee angle** | SKA | –1° |
| Knee to dash, left | KDL | 233 | Striker to H-point, horizontal | SHH | 179 |
| Knee to dash, right | KDR | 210 | Striker to H-point, vertical | SHV | 108 |
| Steering wheel to chest, horizontal | SCH | 326 | Ankle to ankle | AA | 330 |
| Steering wheel to chest, perpendicular | SCP | 381 | Knee to knee | KK | 361 |
| Steering wheel to chest, reference | SCR | 372 | Arm to door | AD | 154 |
| Hub to chest, minimum | HCM | 267 | H-point to door | HD | 153 |
| Pelvic angle | PA | 24.6° | Head to A-pillar | HA | 500 |
| Seat back angle | SA | 18° | Head to roof | HR | 220 |
| | | | Head to side window | HS | 283 |

All distance measurements are in millimeters (mm).
* Dummy's neck bracket was adjusted to –7.0° to achieve a level instrumentation plane.
** These measurements were made in a vertical plane containing the striker and parallel to the driver door sill.

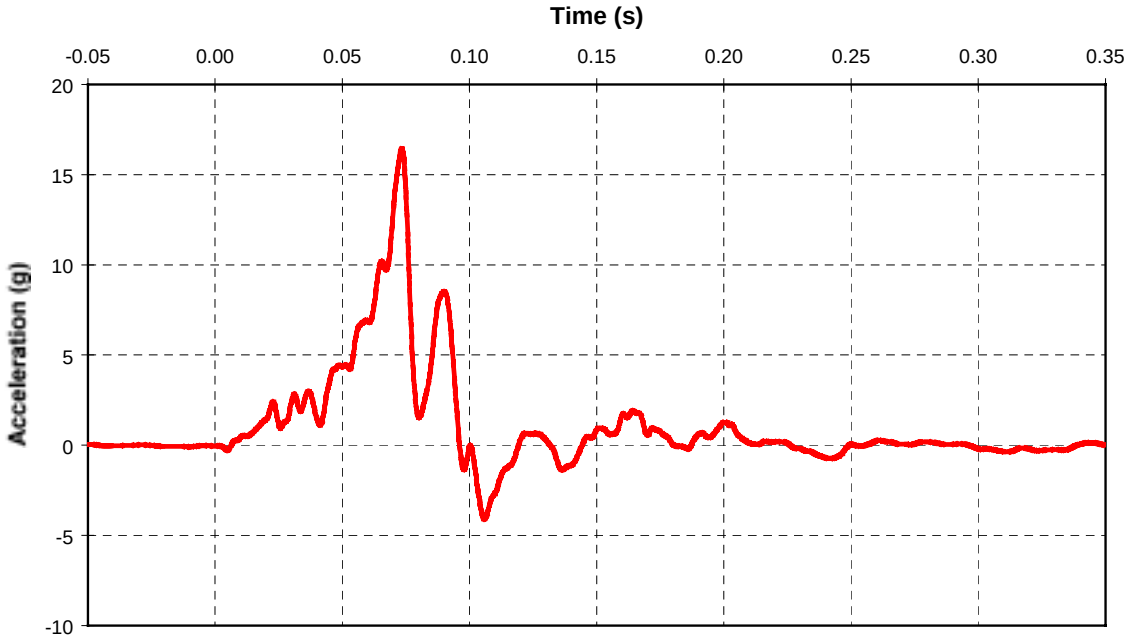


## Graph Index

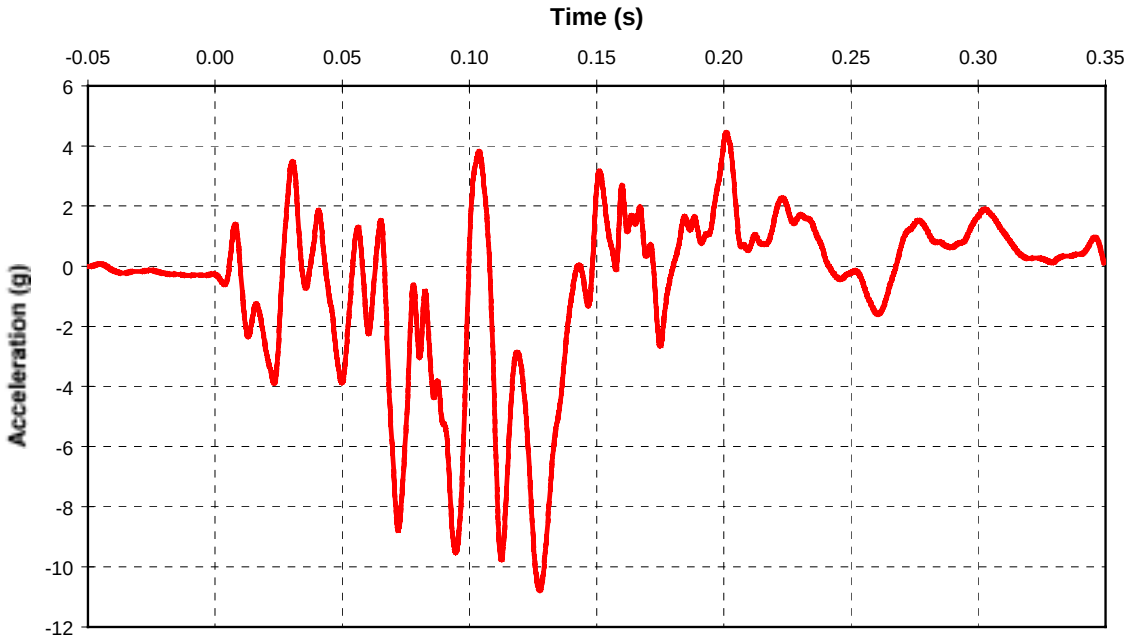
**A- 1 CF98021 1999 Saab 9-5 Vehicle Longitudinal Acceleration**



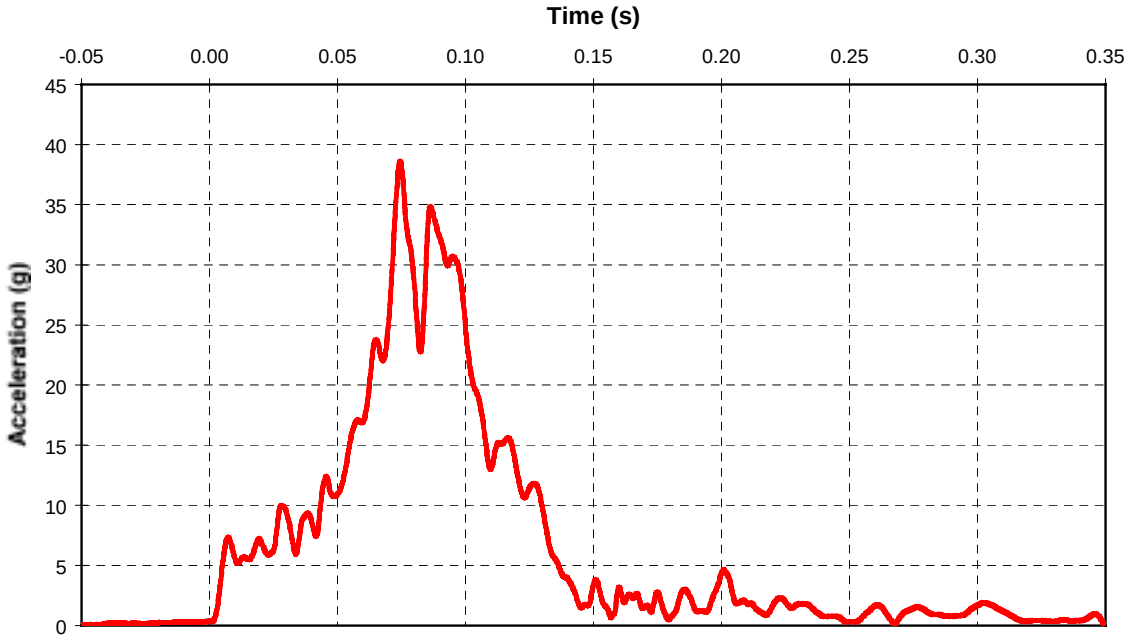

**A- 2 CF98021 1999 Saab 9-5 Vehicle Lateral Acceleration**



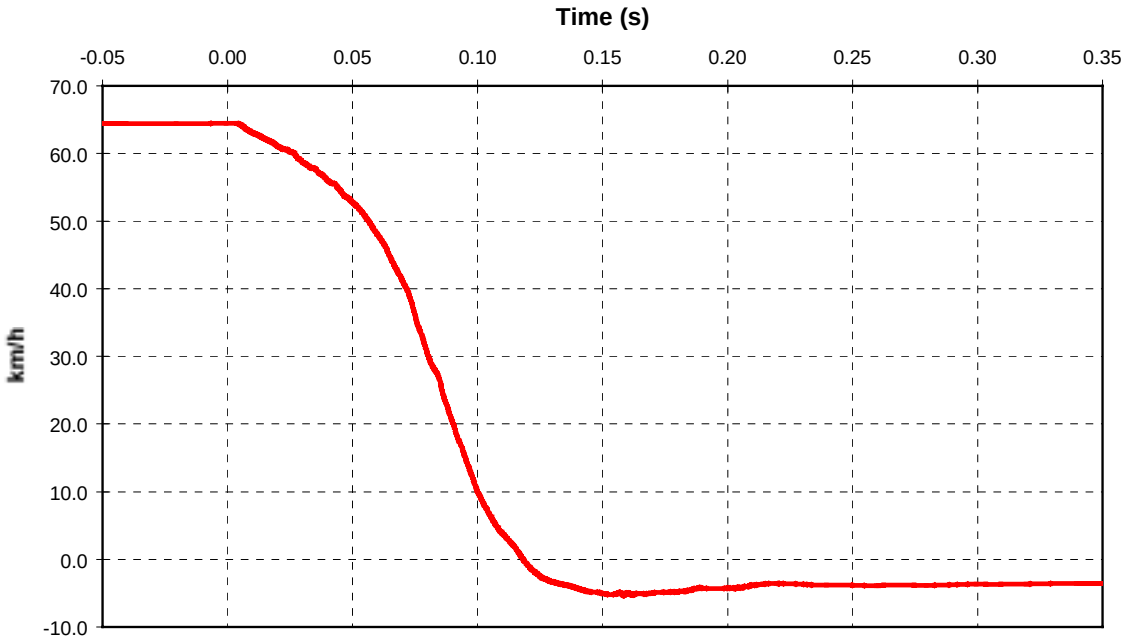
**A- 3 CF98021 1999 Saab 9-5 Vehicle Vertical Acceleration**



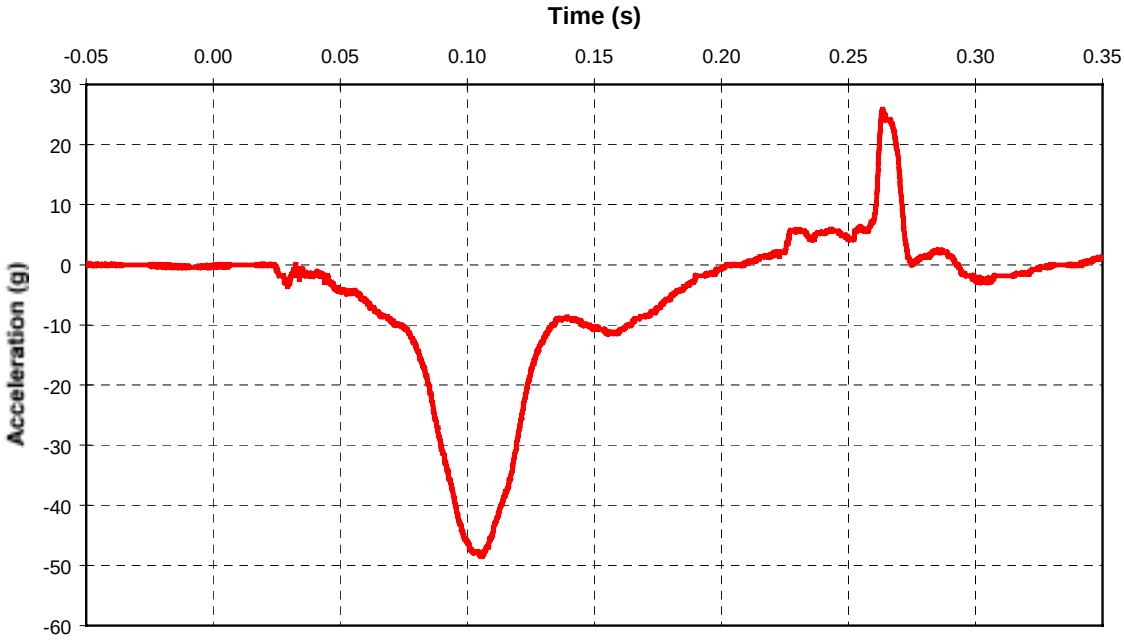

**A- 4 CF98021 1999 Saab 9-5 Vehicle Vector Resultant Acceleration**



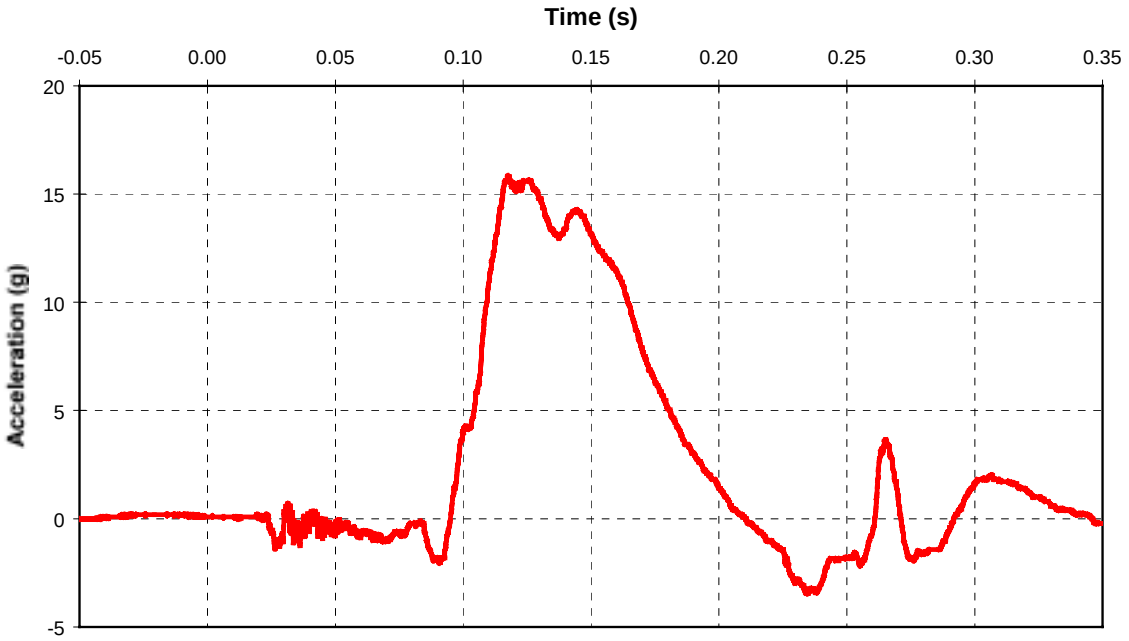
**A- 5 CF98021 1999 Saab 9-5 Integration of Vehicle Longitudinal Acceleration**



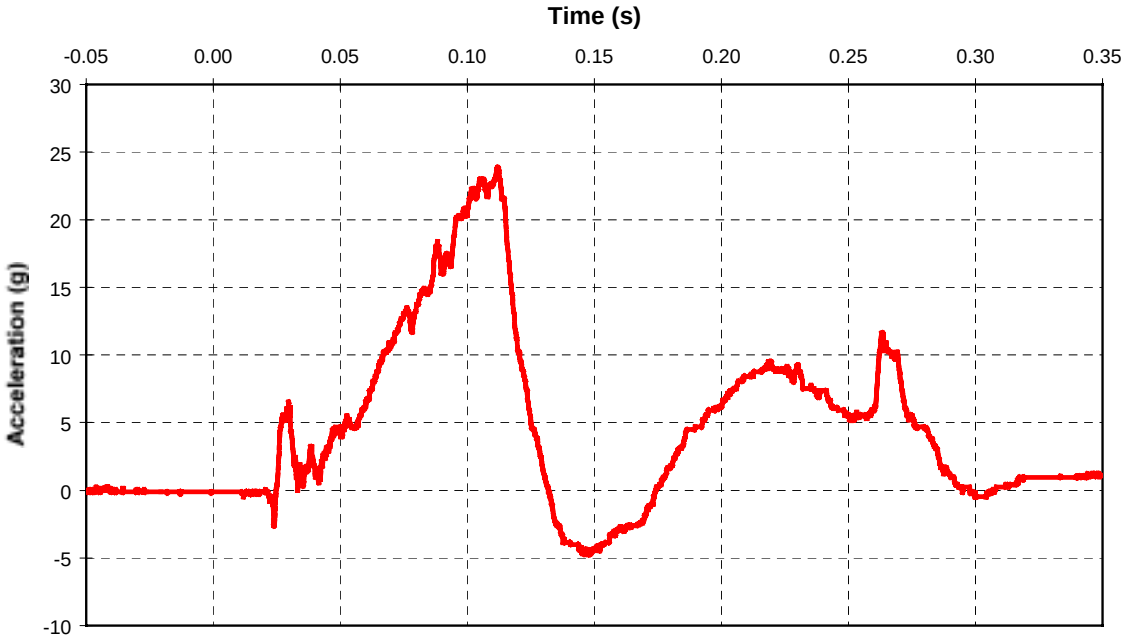

**A- 6 CF98021 1999 Saab 9-5 Head A-P Acceleration**



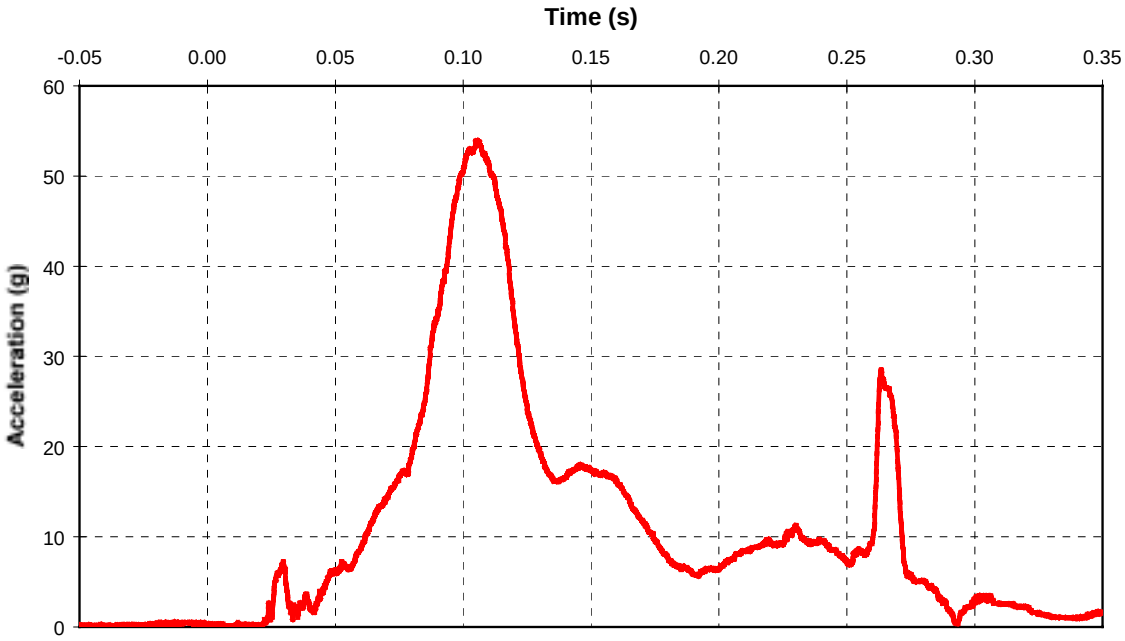
**A- 7 CF98021 1999 Saab 9-5 Head L-M Acceleration**



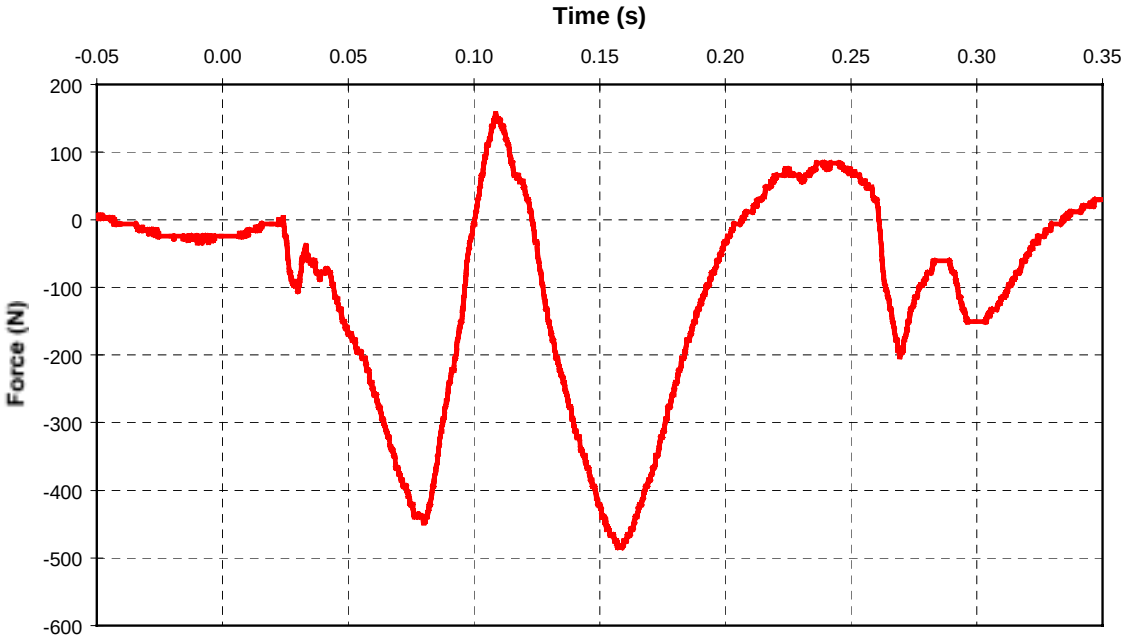

**A- 8 CF98021 1999 Saab 9-5 Head I-S Acceleration**



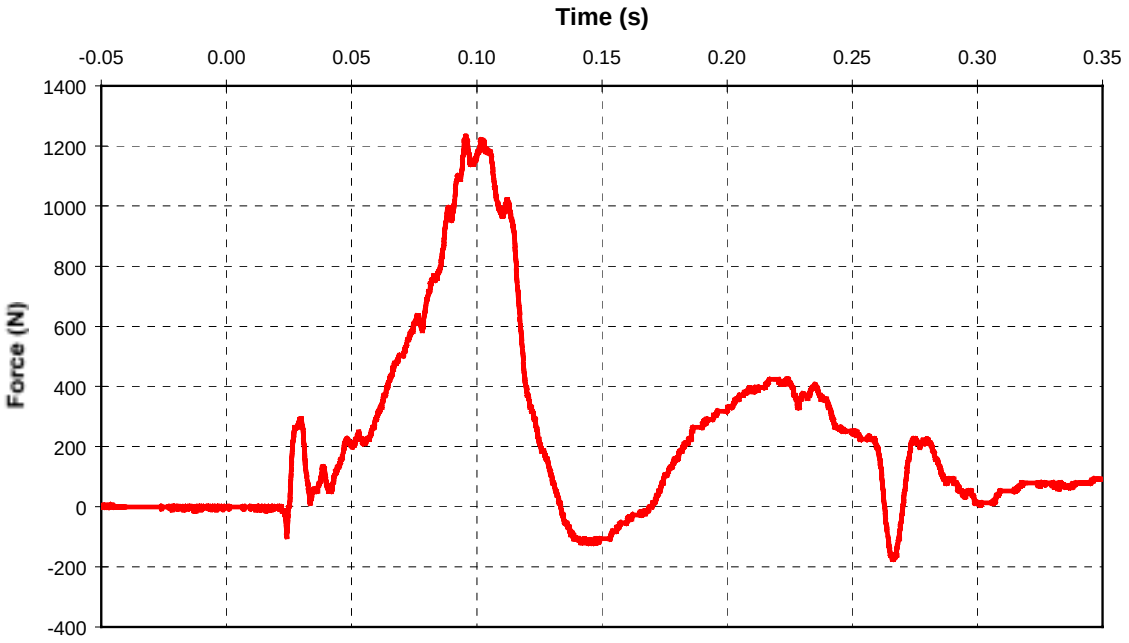
**A- 9 CF98021 1999 Saab 9-5 Head Vector Resultant Acceleration**



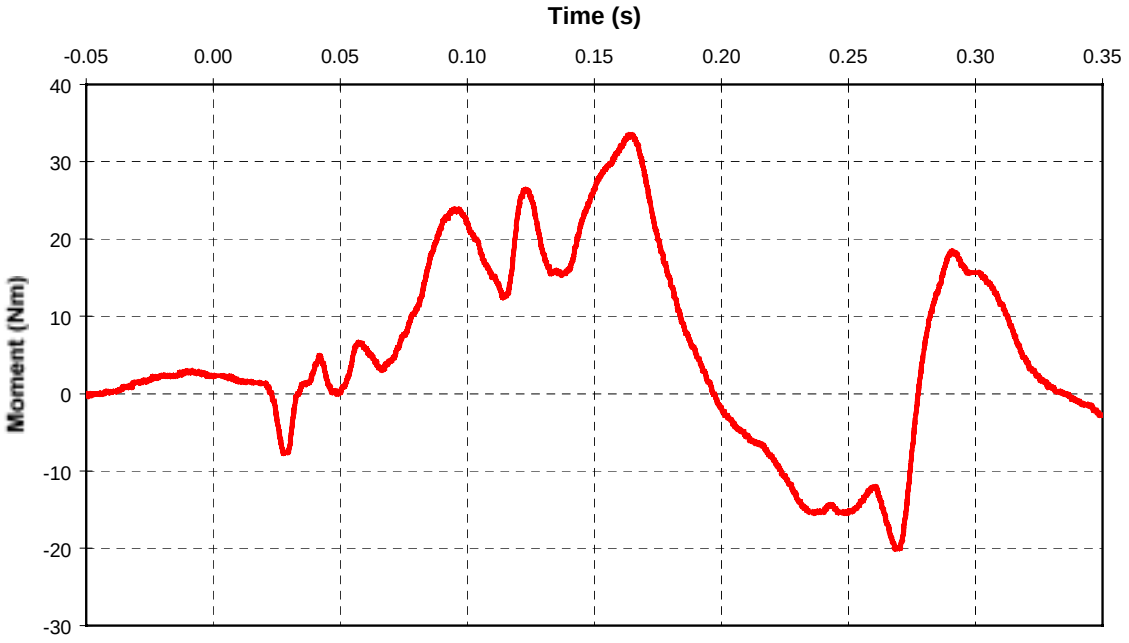

**A- 10 CF98021 1999 Saab 9-5 Neck A-P Shear Force**



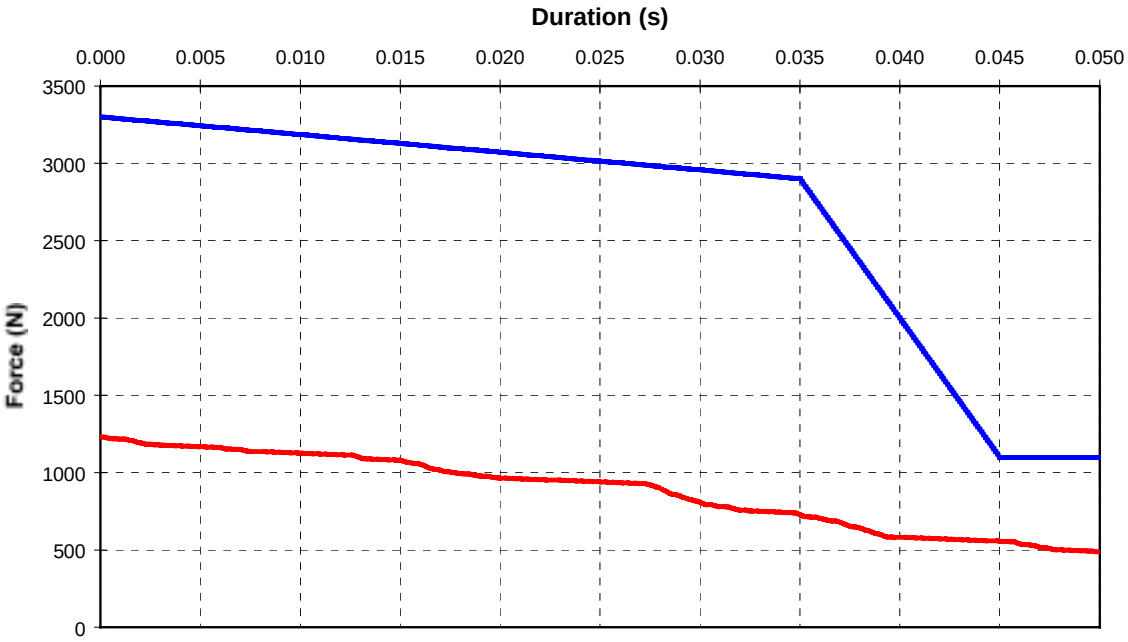
**A- 11 CF98021 1999 Saab 9-5 Neck Axial Force**



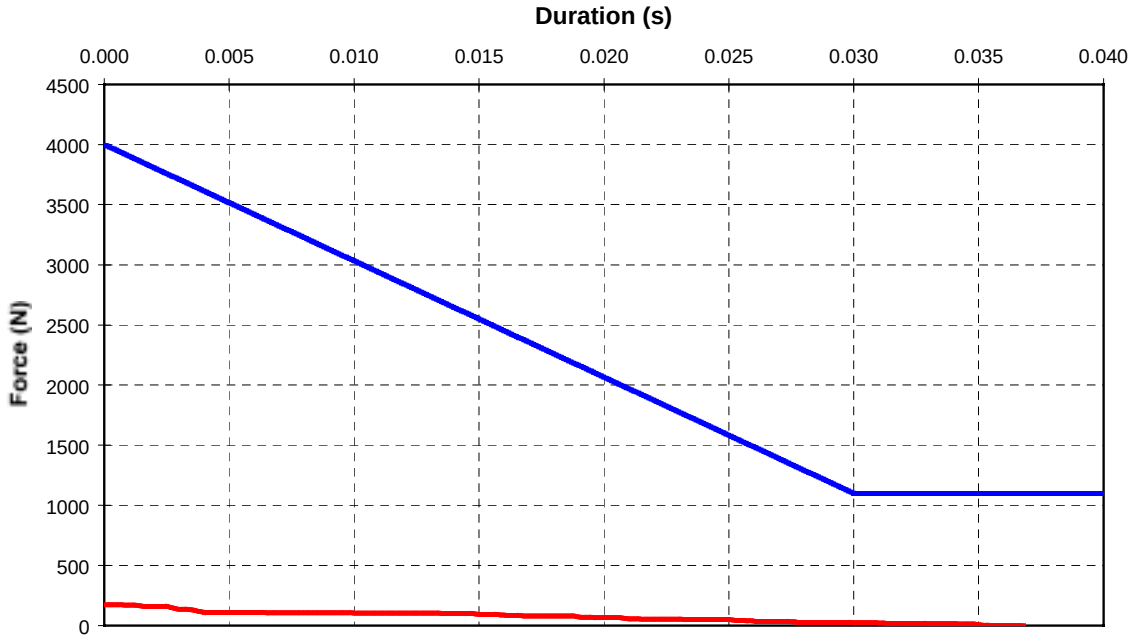

**A- 12 CF98021 1999 Saab 9-5 Neck Occipital A-P Moment**



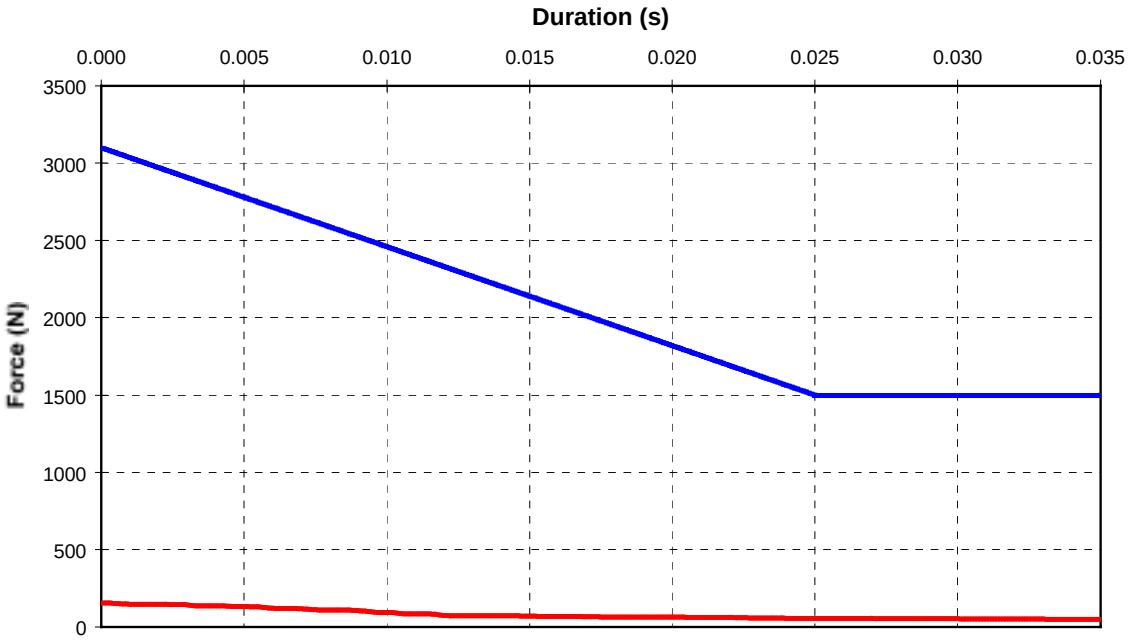
**A- 13 CF98021 1999 Saab 9-5 Neck Tension Analysis**



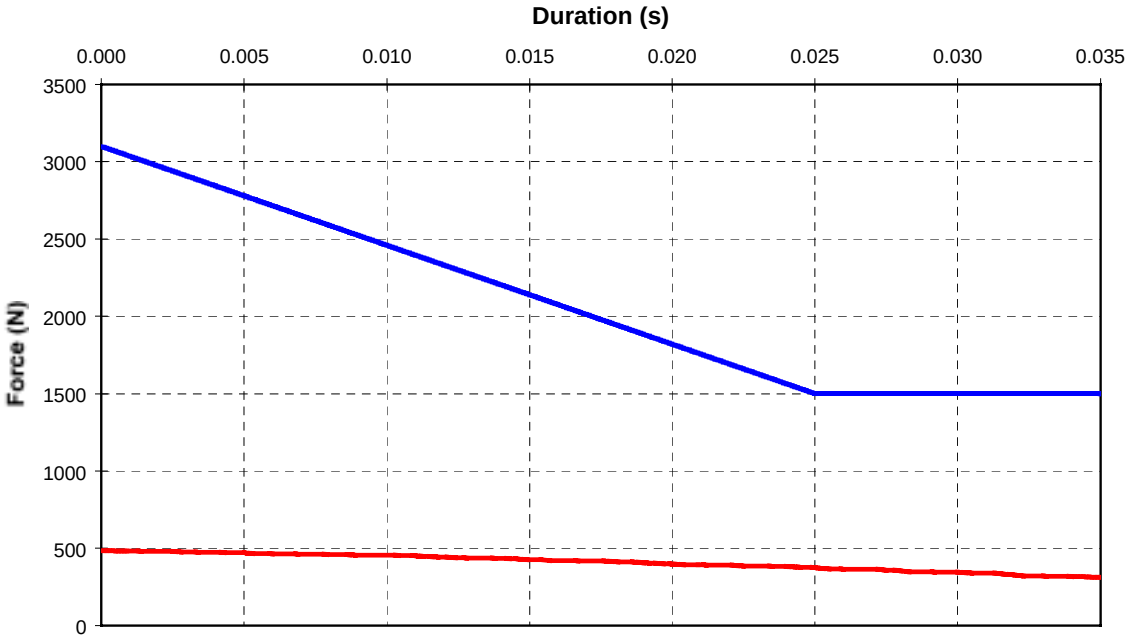

**A- 14 CF98021 1999 Saab 9-5 Neck Compression Analysis**



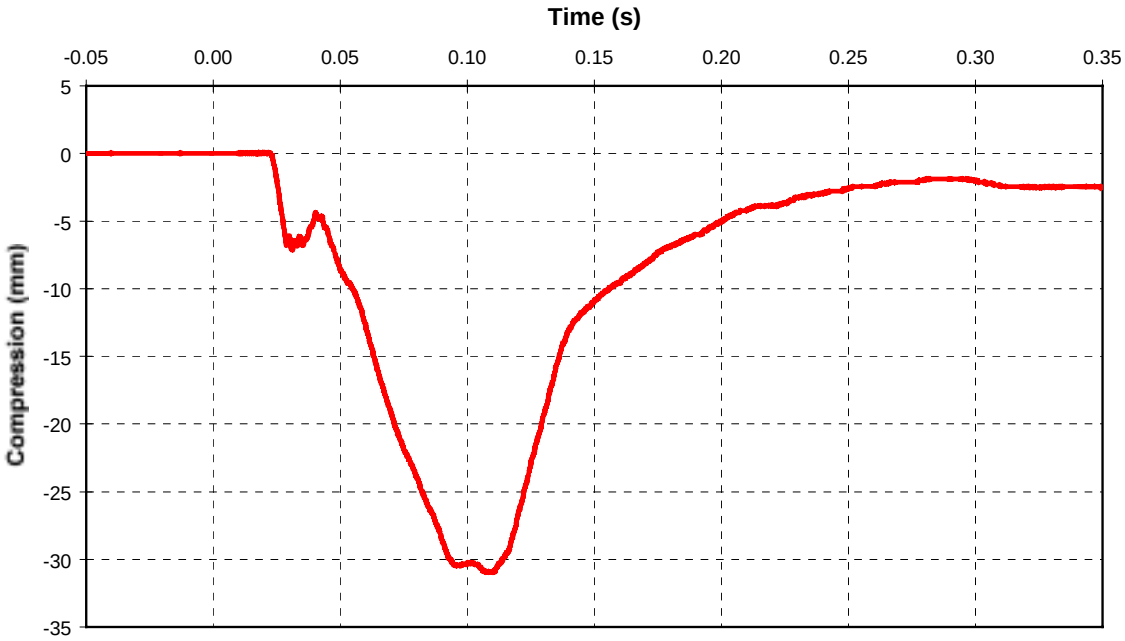
**A- 15 CF98021 1999 Saab 9-5 Neck A-P Shear (Positive) Analysis**



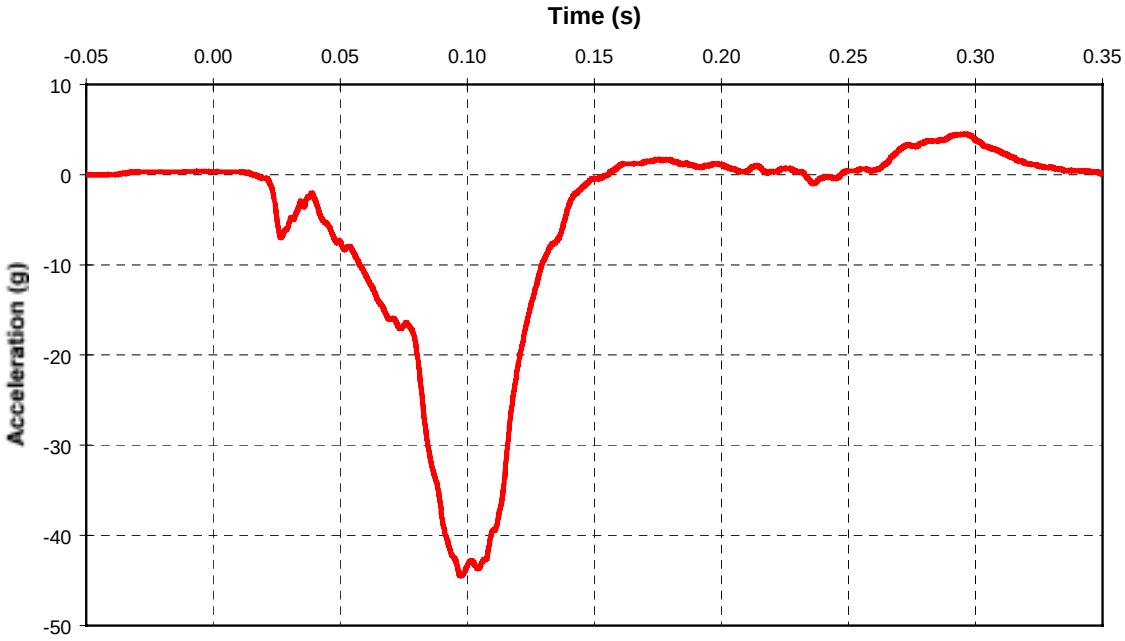

**A- 16 CF98021 1999 Saab 9-5 Neck A-P Shear (Negative) Analysis**



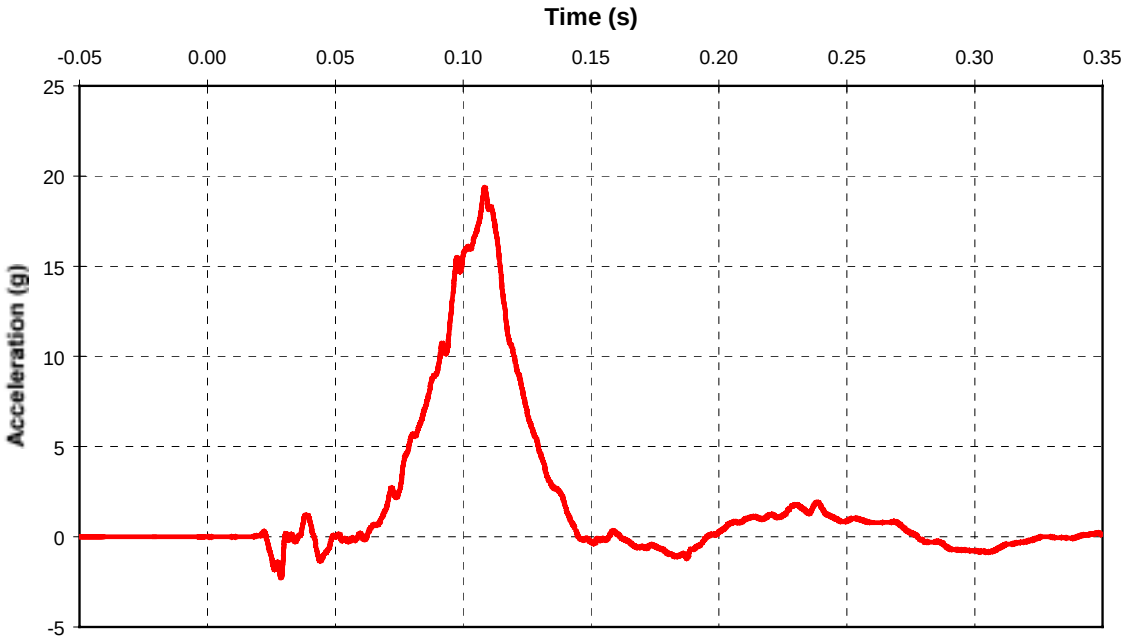
**A- 17 CF98021 1999 Saab 9-5 Chest Compression**



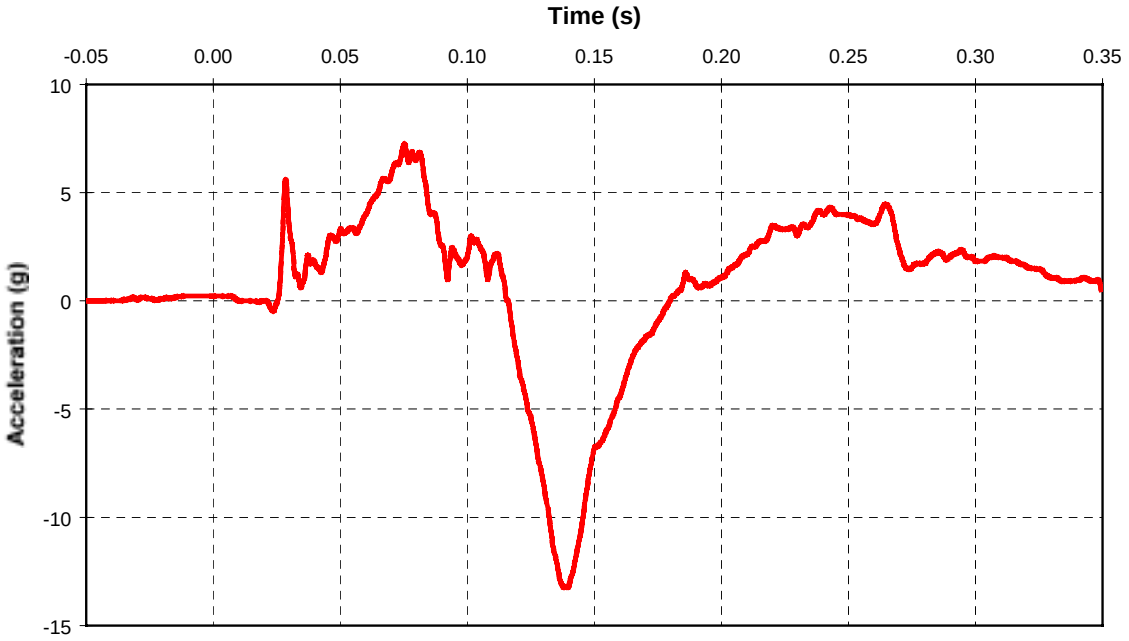

**A- 18 CF98021 1999 Saab 9-5 Chest A-P Acceleration**



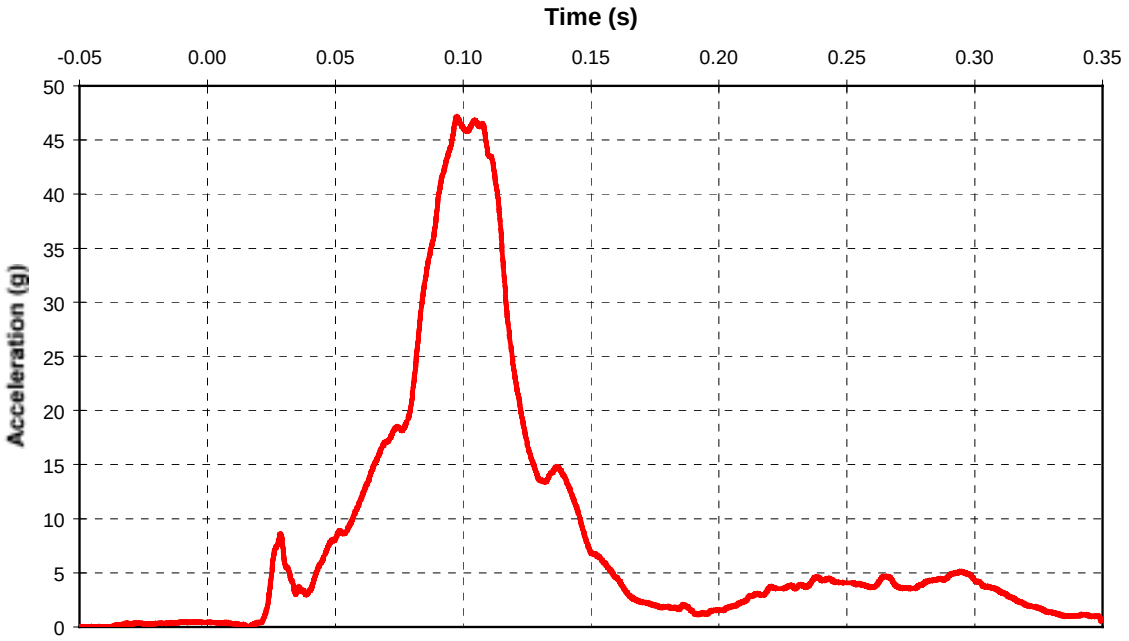
**A- 19 CF98021 1999 Saab 9-5 Chest L-M Acceleration**



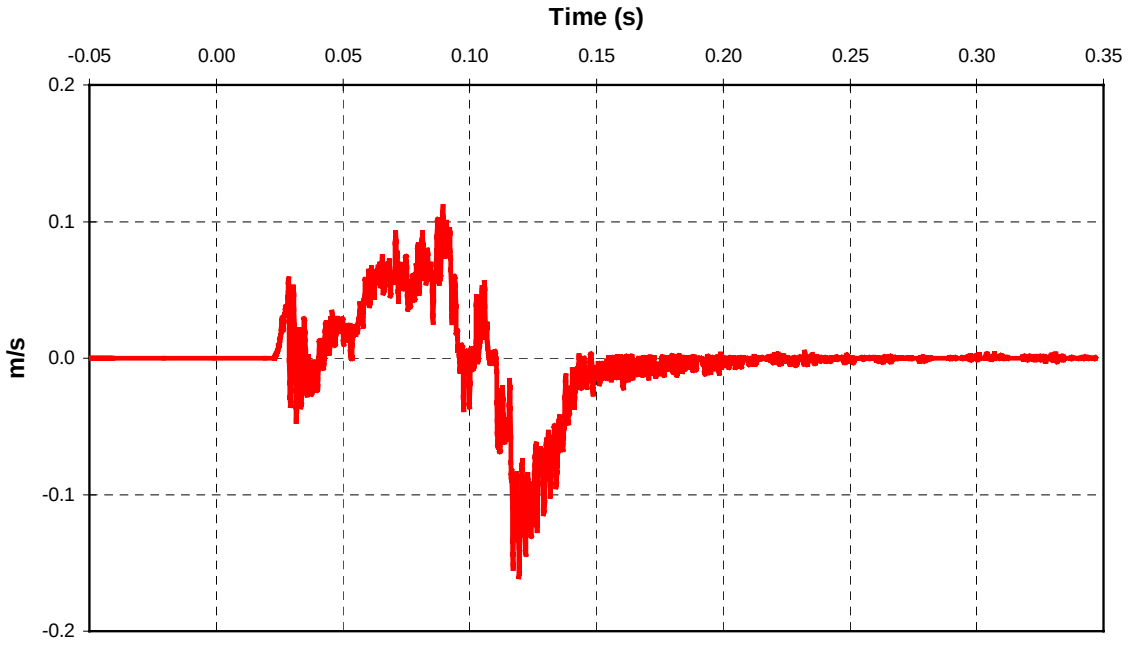

**A- 20 CF98021 1999 Saab 9-5 Chest I-S Acceleration**



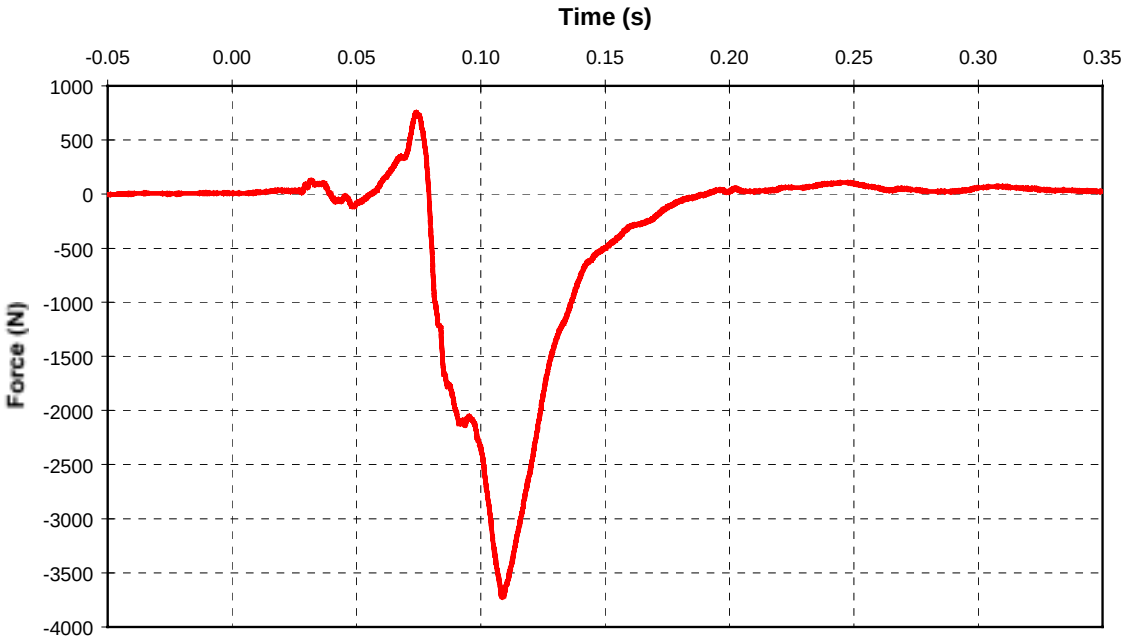
**A- 21 CF98021 1999 Saab 9-5 Chest Vector Resultant Acceleration**



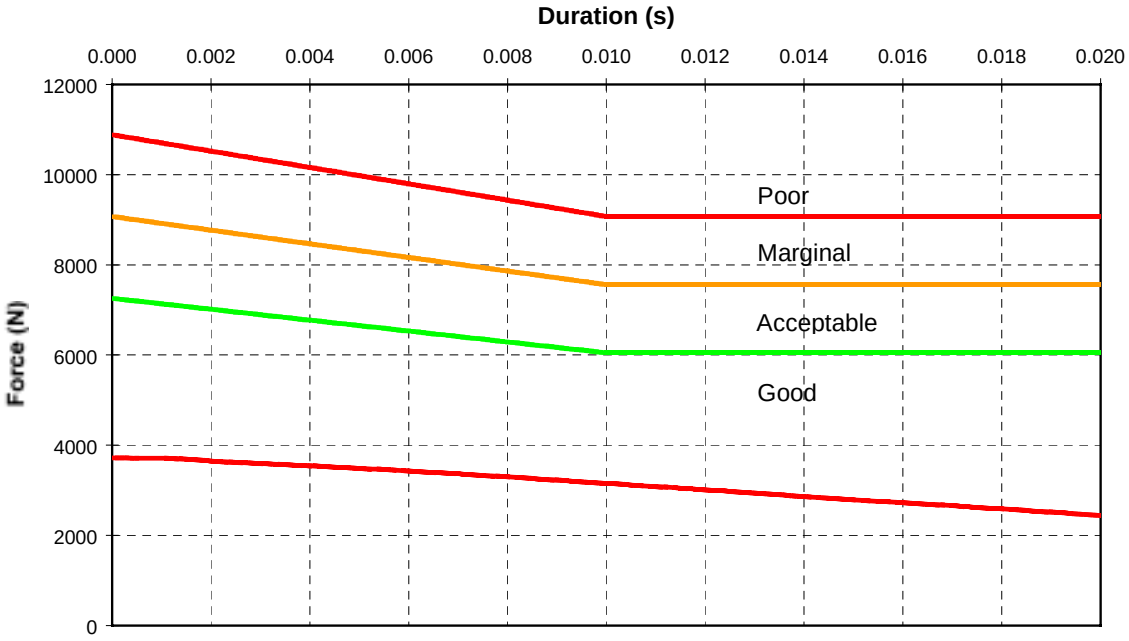

**A- 22 CF98021 1999 Saab 9-5 Viscous Criterion**



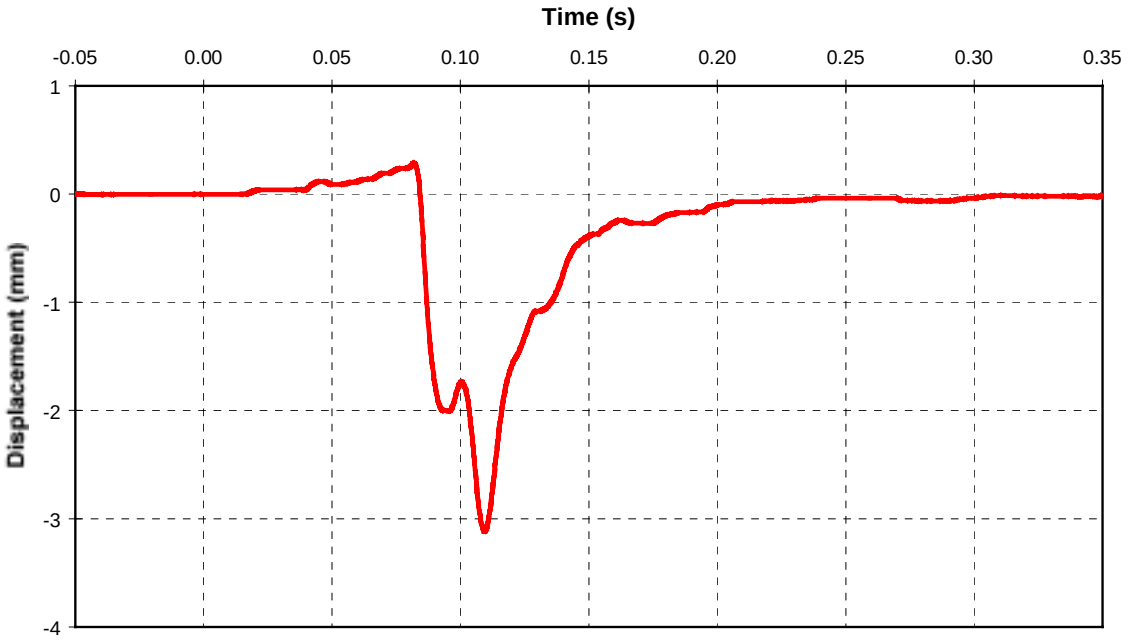
**A- 23 CF98021 1999 Saab 9-5 Left Femur Axial Force**



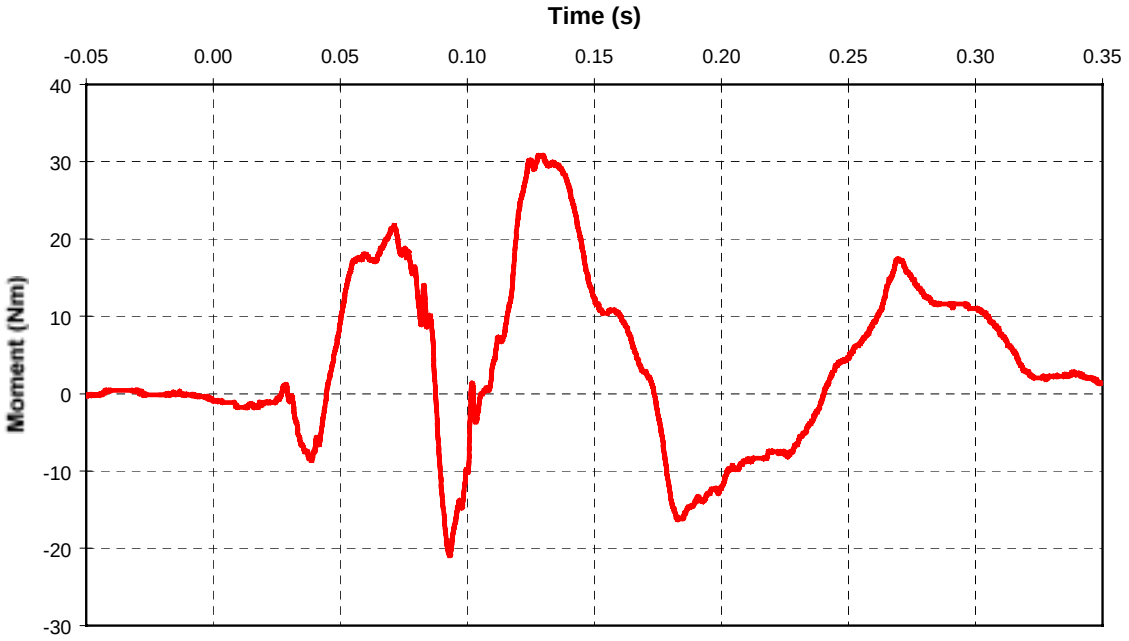

**A- 24 CF98021 1999 Saab 9-5 Left Femur Axial Force Analysis**



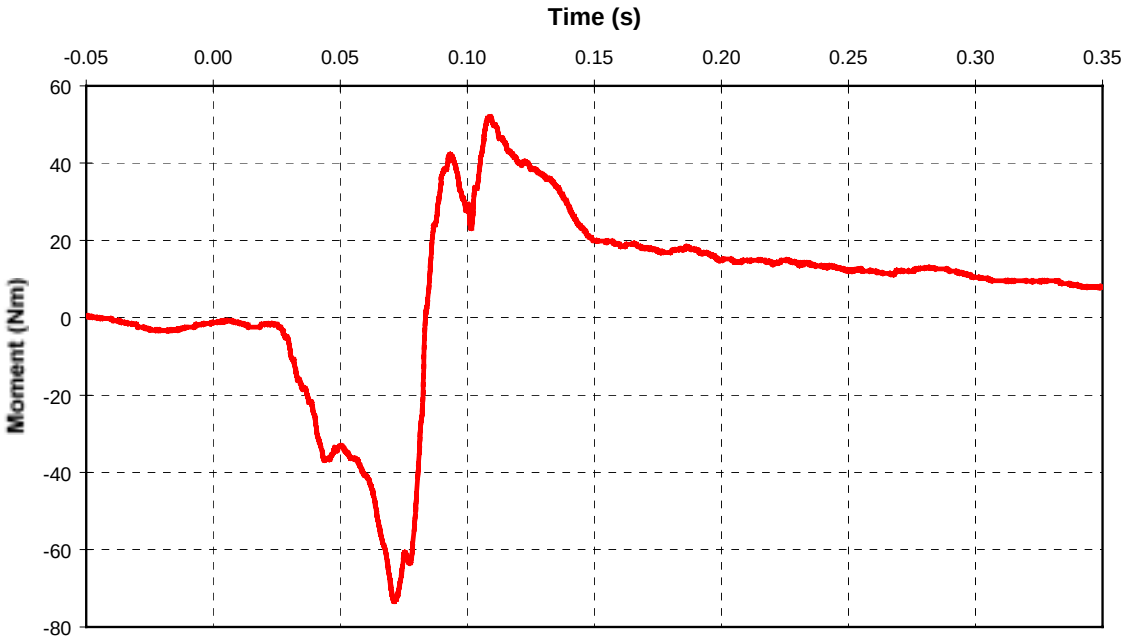
**A- 25 CF98021 1999 Saab 9-5 Left Tibia-Femur Displacement**



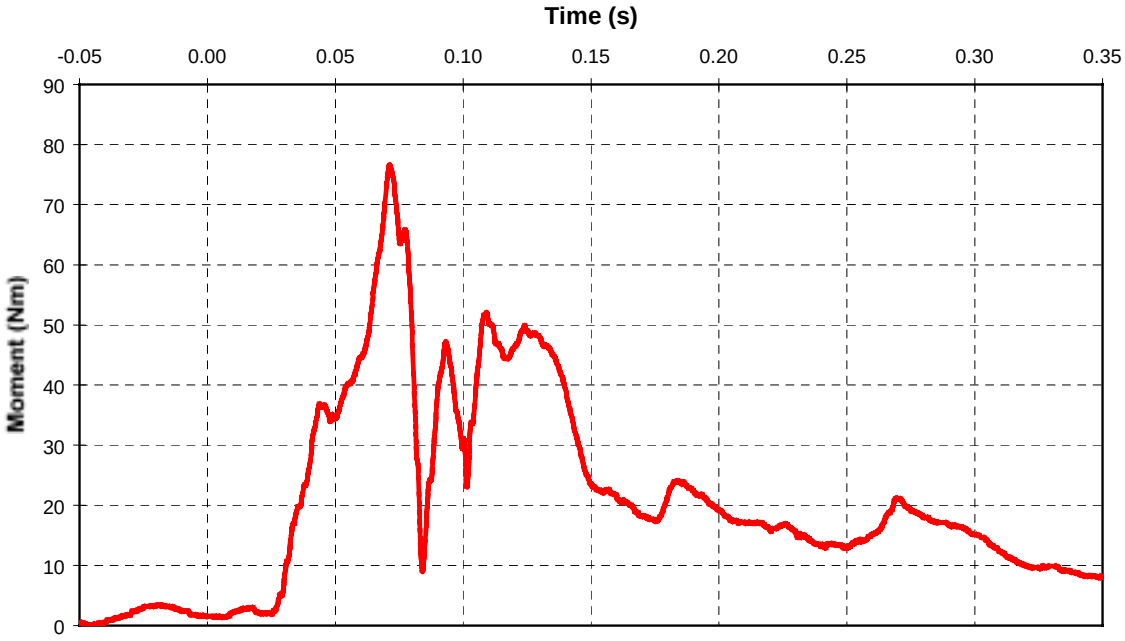

**A- 26 CF98021 1999 Saab 9-5 Left Upper Tibia L-M Moment**



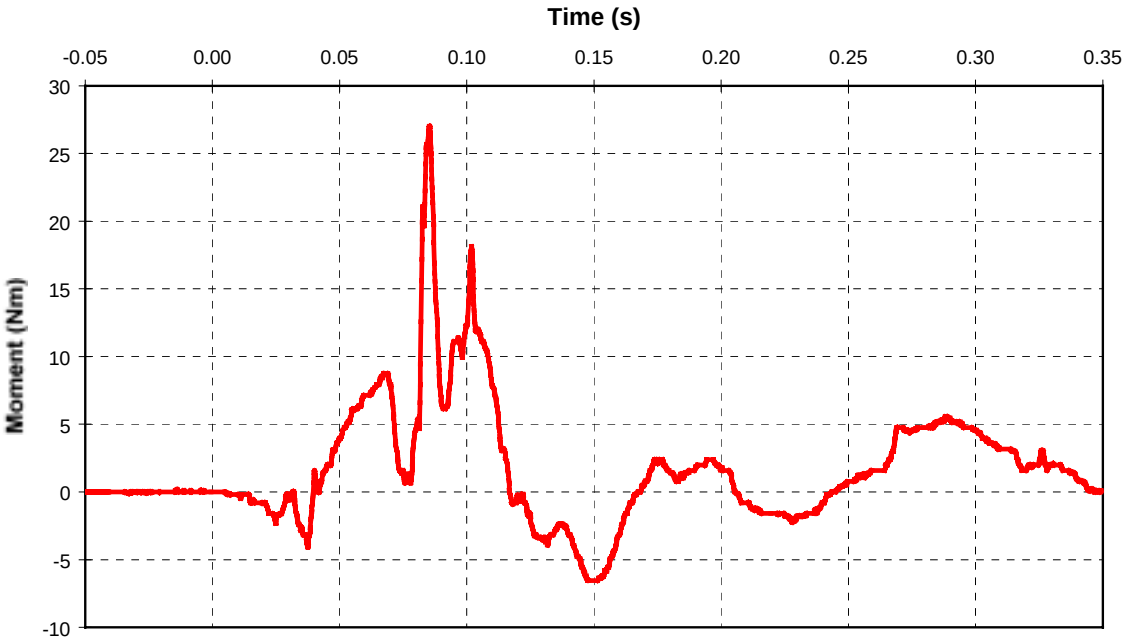
**A- 27 CF98021 1999 Saab 9-5 Left Upper Tibia A-P Moment**



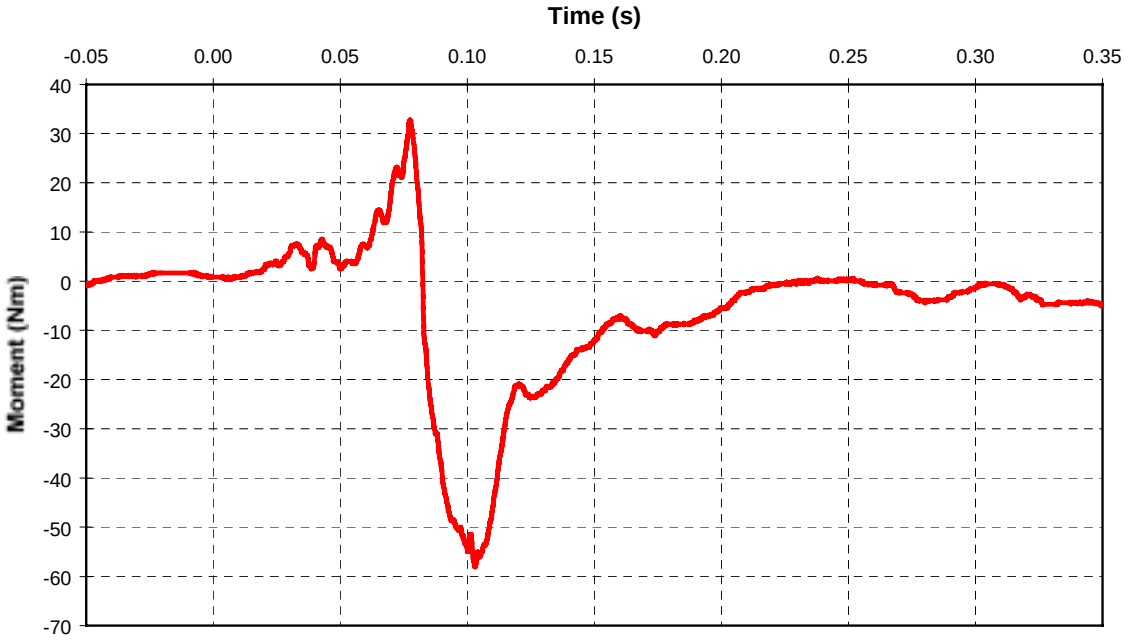

**A- 28 CF98021 1999 Saab 9-5 Left Upper Tibia Vector Resultant Moment**



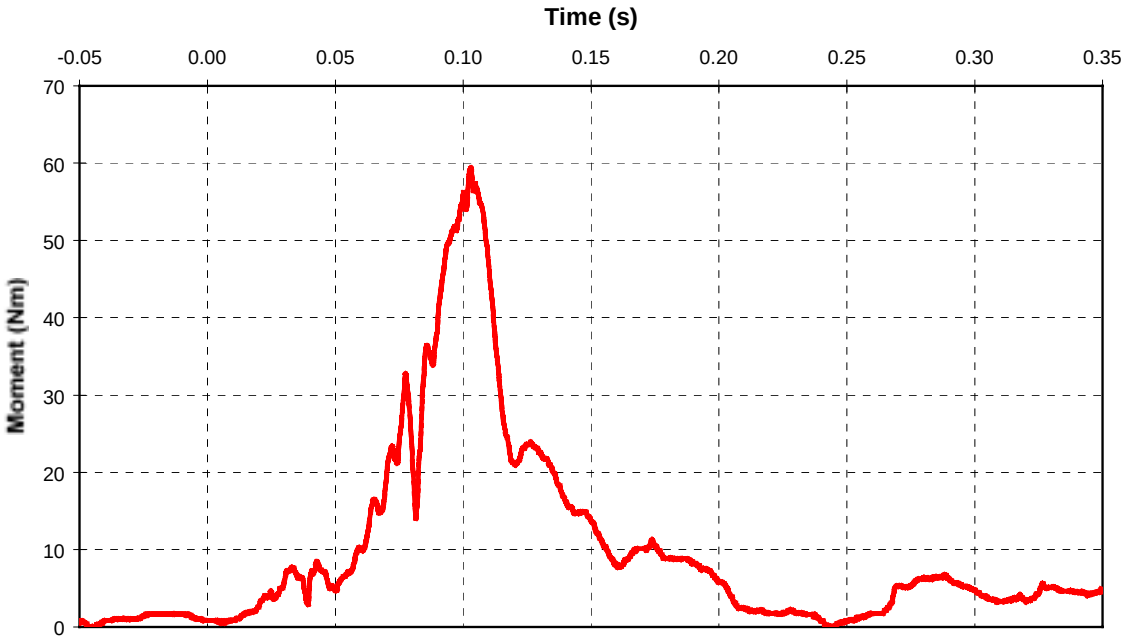
**A- 29 CF98021 1999 Saab 9-5 Left Lower Tibia L-M Moment**



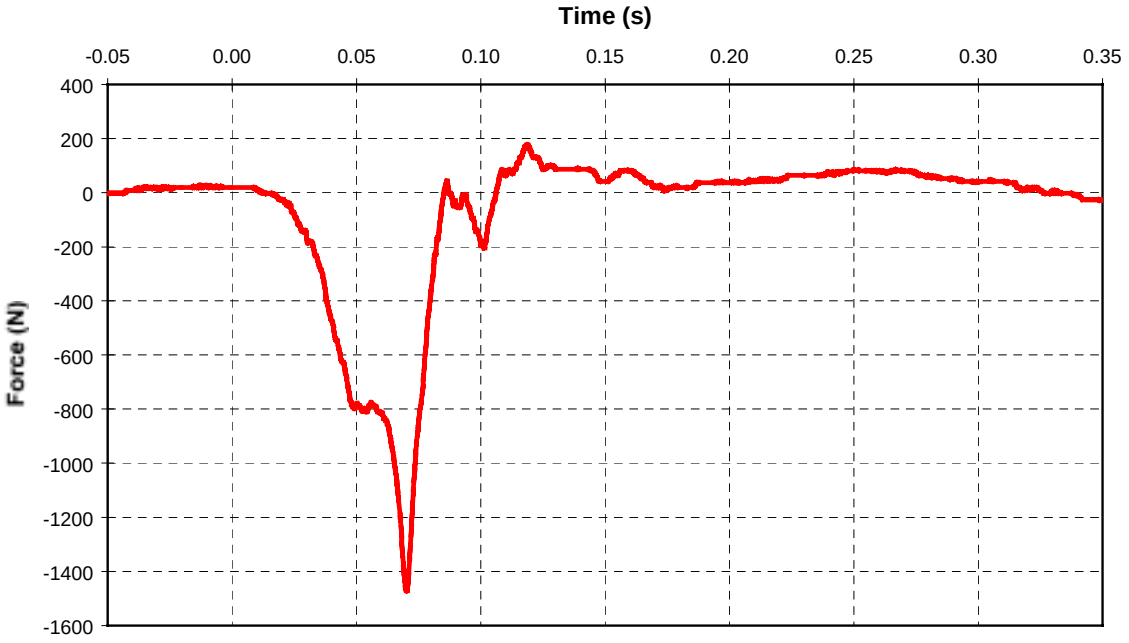

**A- 30 CF98021 1999 Saab 9-5 Left Lower Tibia A-P Moment**



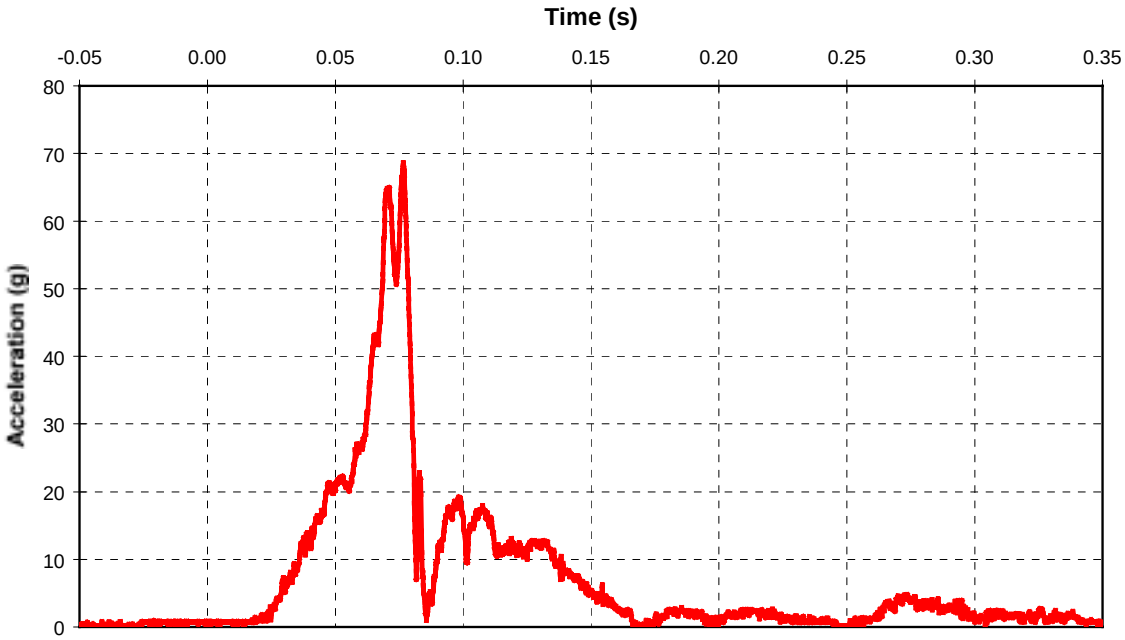
**A- 31 CF98021 1999 Saab 9-5 Left Lower Tibia Vector Resultant Moment**



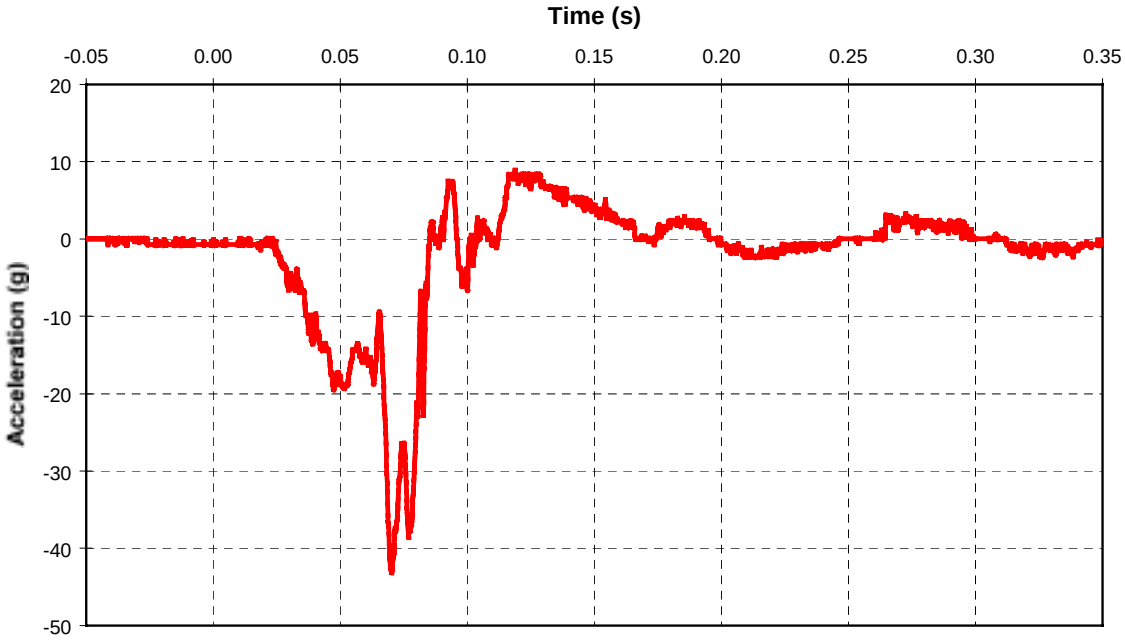

**A- 32 CF98021 1999 Saab 9-5 Left Lower Tibia Axial Force**



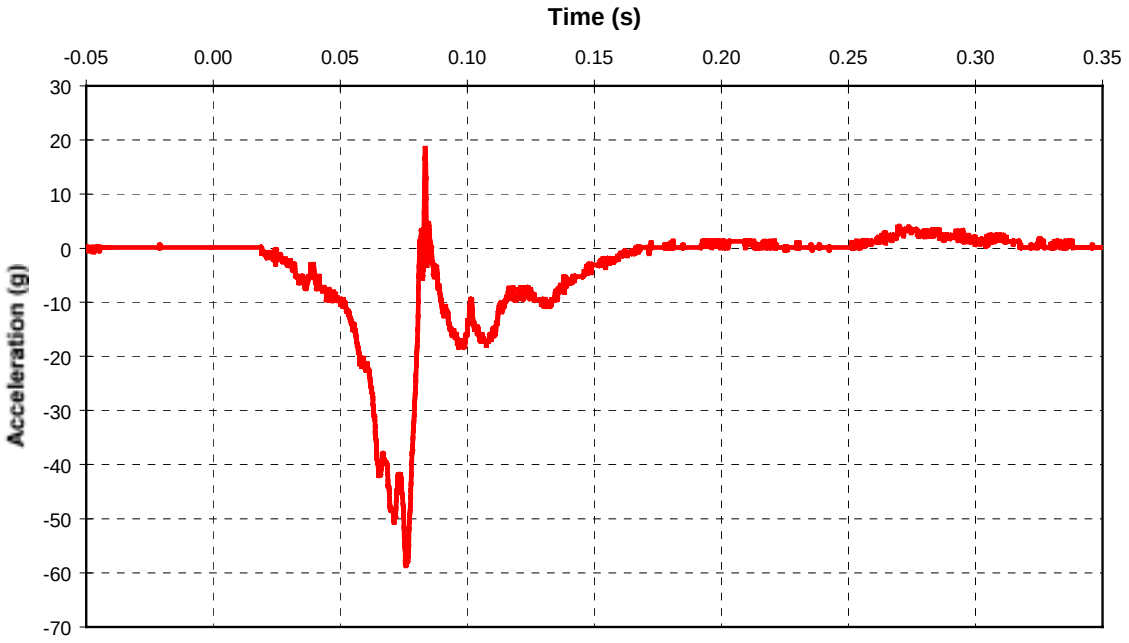
**A- 33 CF98021 1999 Saab 9-5 Left Foot Vector Resultant Acceleration**



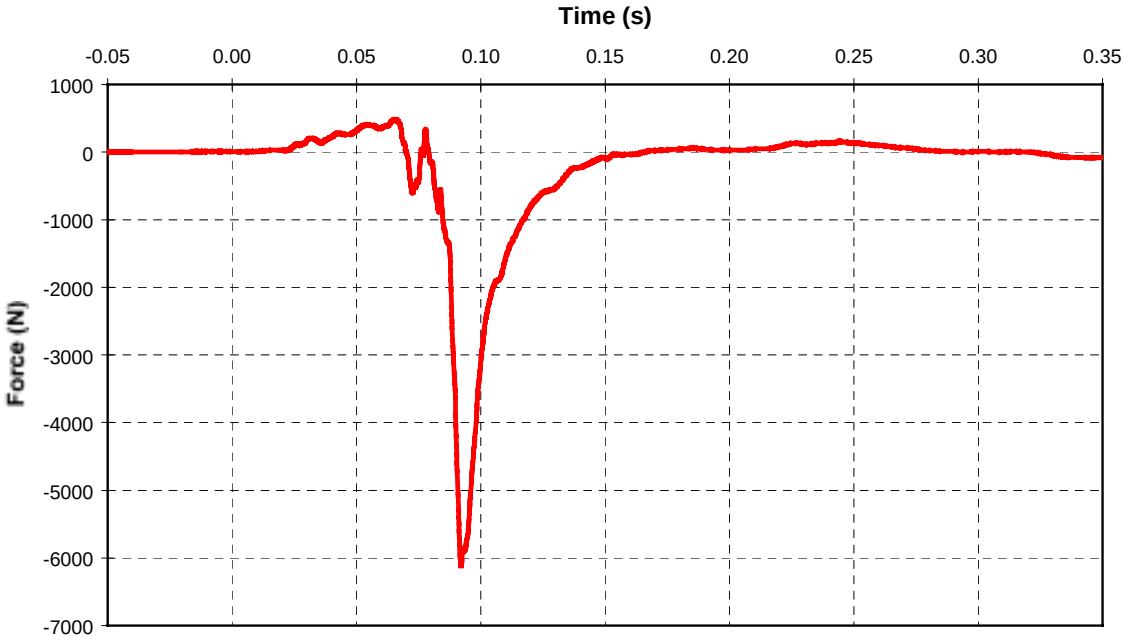

**A- 34 CF98021 1999 Saab 9-5 Left Foot A-P Acceleration**



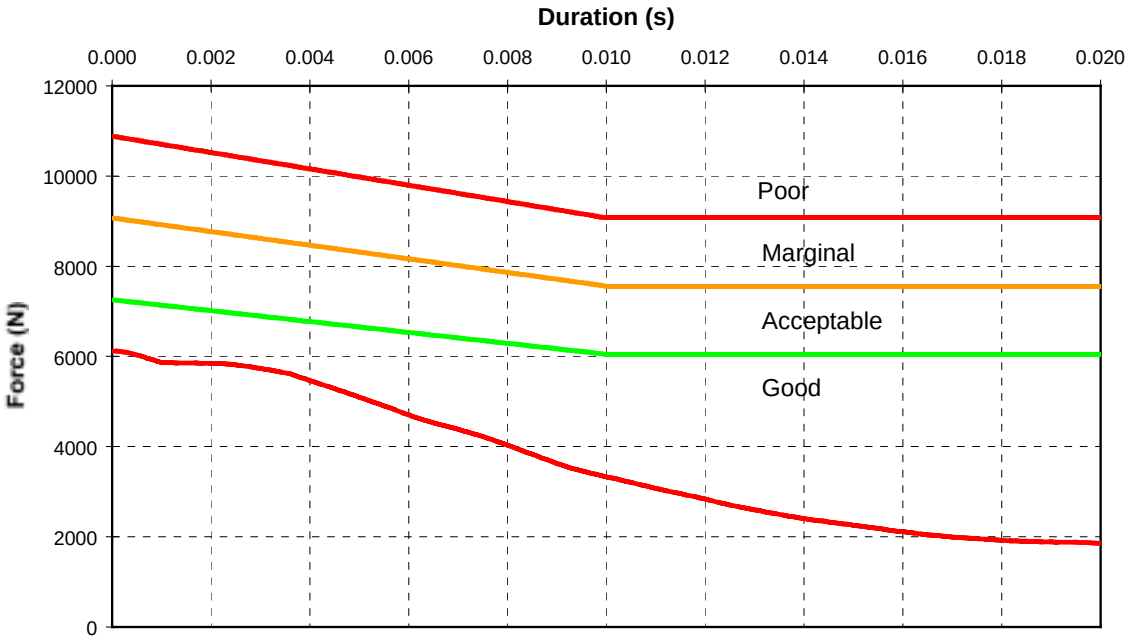
**A- 35 CF98021 1999 Saab 9-5 Left Foot I-S Acceleration**



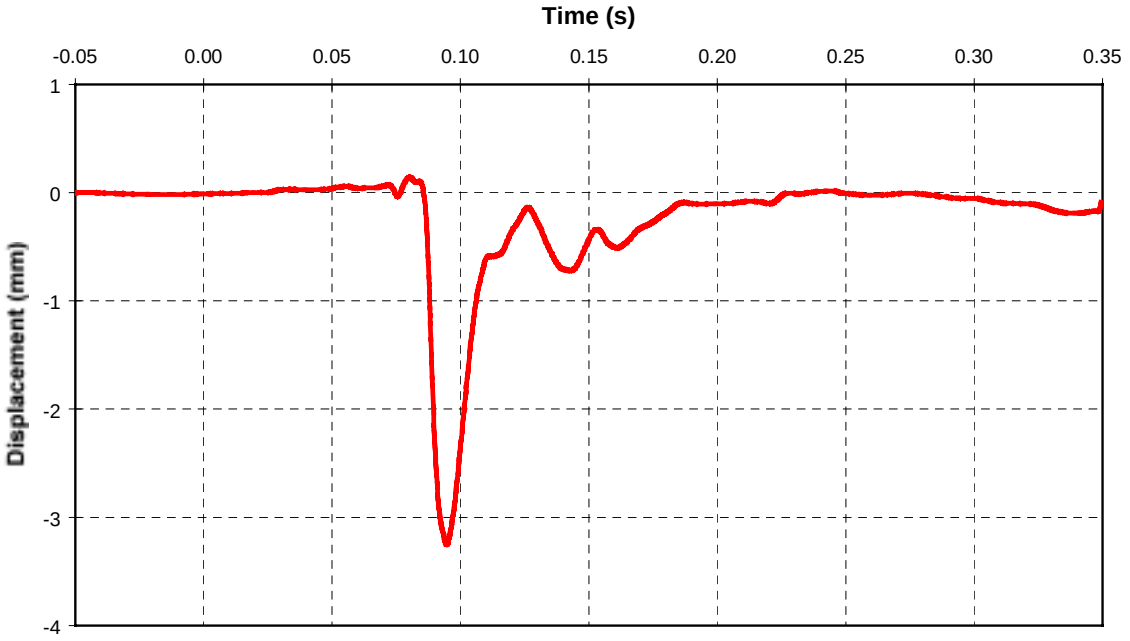

**A- 36 CF98021 1999 Saab 9-5 Right Femur Axial Force**



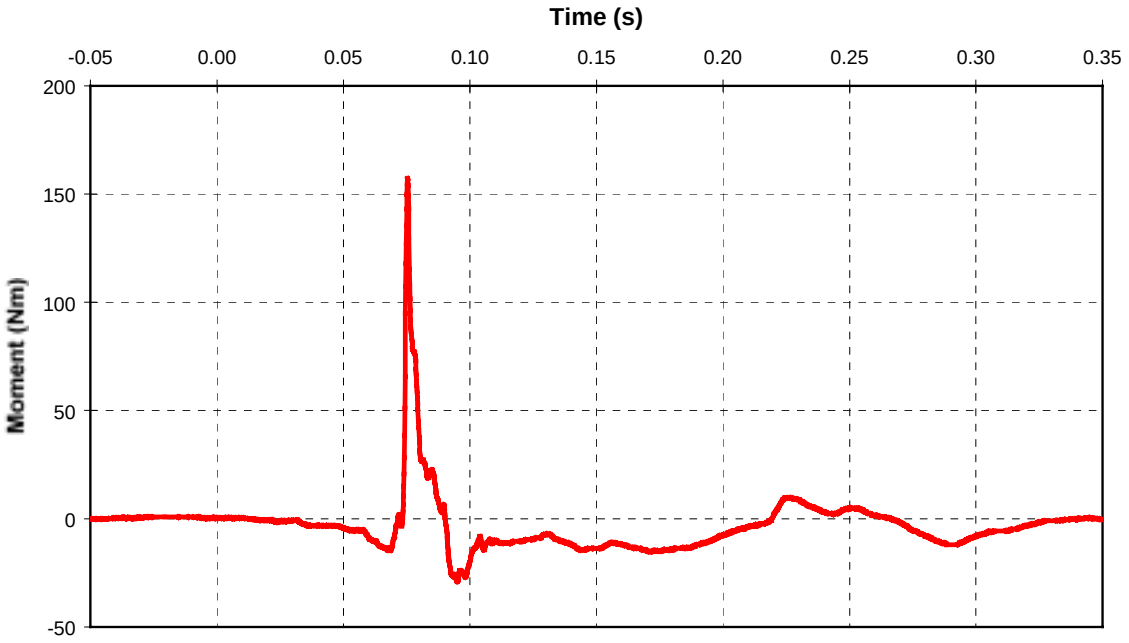
**A- 37 CF98021 1999 Saab 9-5 Right Femur Axial Force Analysis**



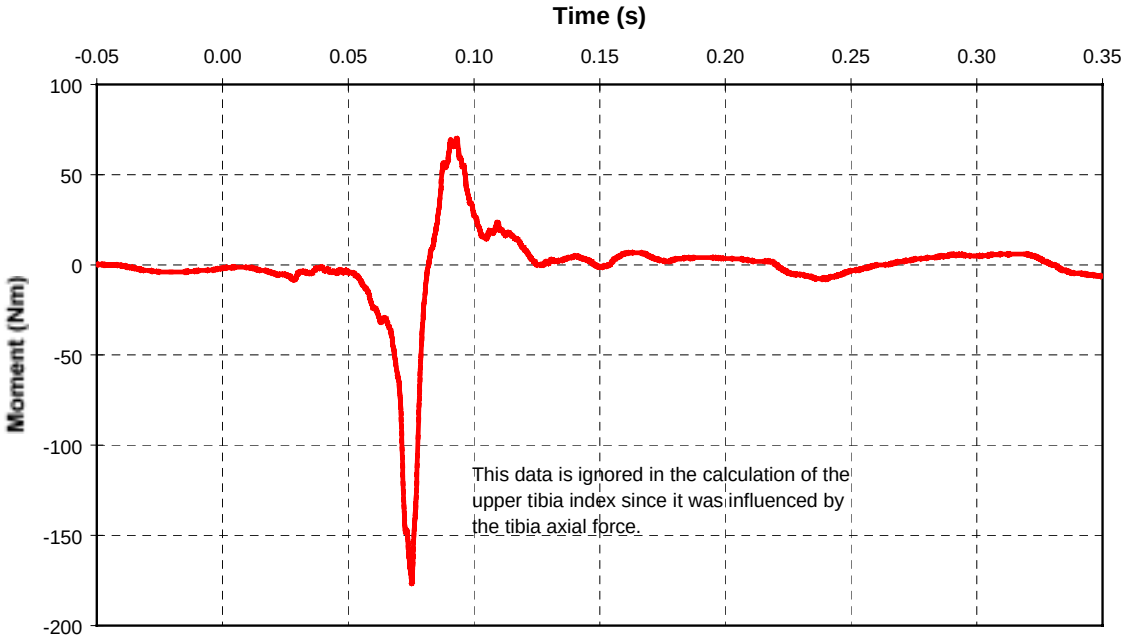

**A- 38 CF98021 1999 Saab 9-5 Right Tibia-Femur Displacement**



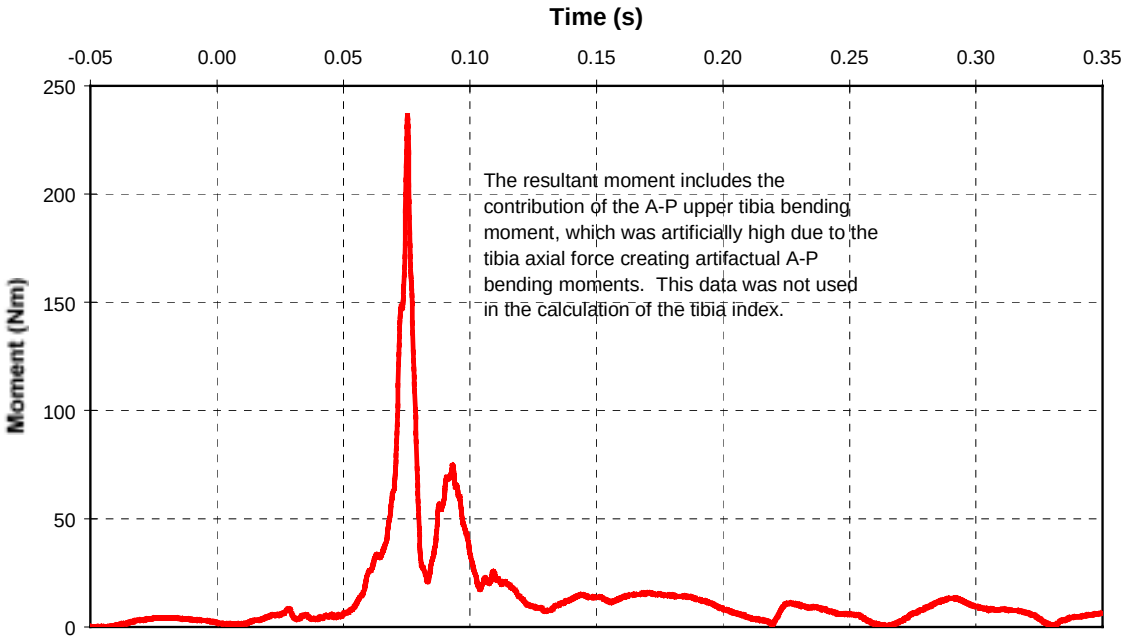
**A- 39 CF98021 1999 Saab 9-5 Right Upper Tibia L-M Moment**



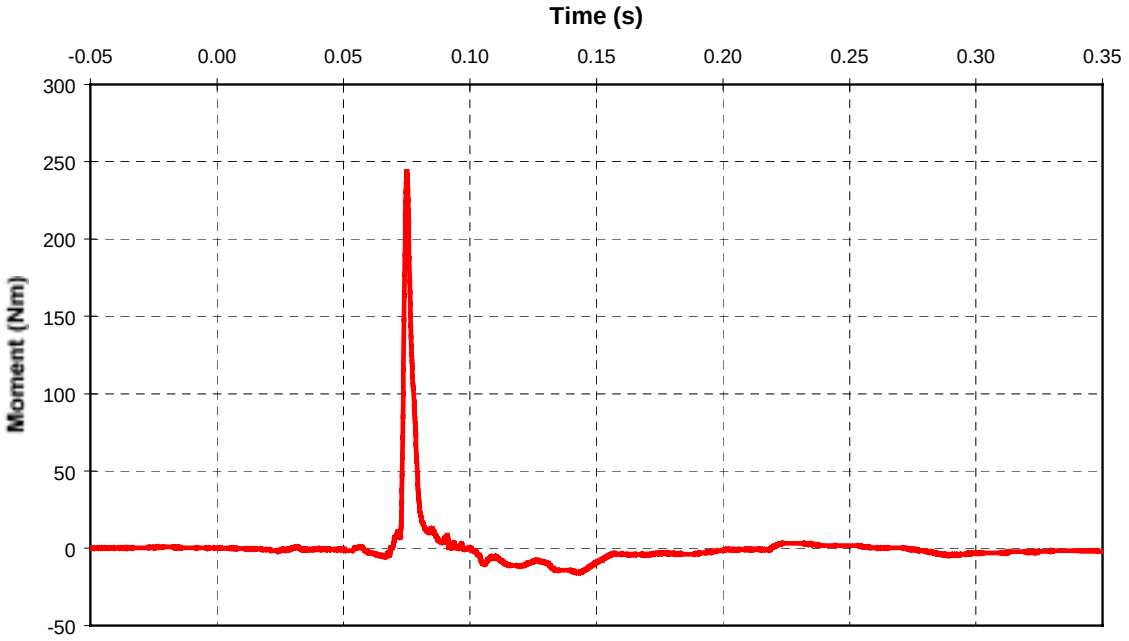

**A- 40 CF98021 1999 Saab 9-5 Right Upper Tibia A-P Moment**



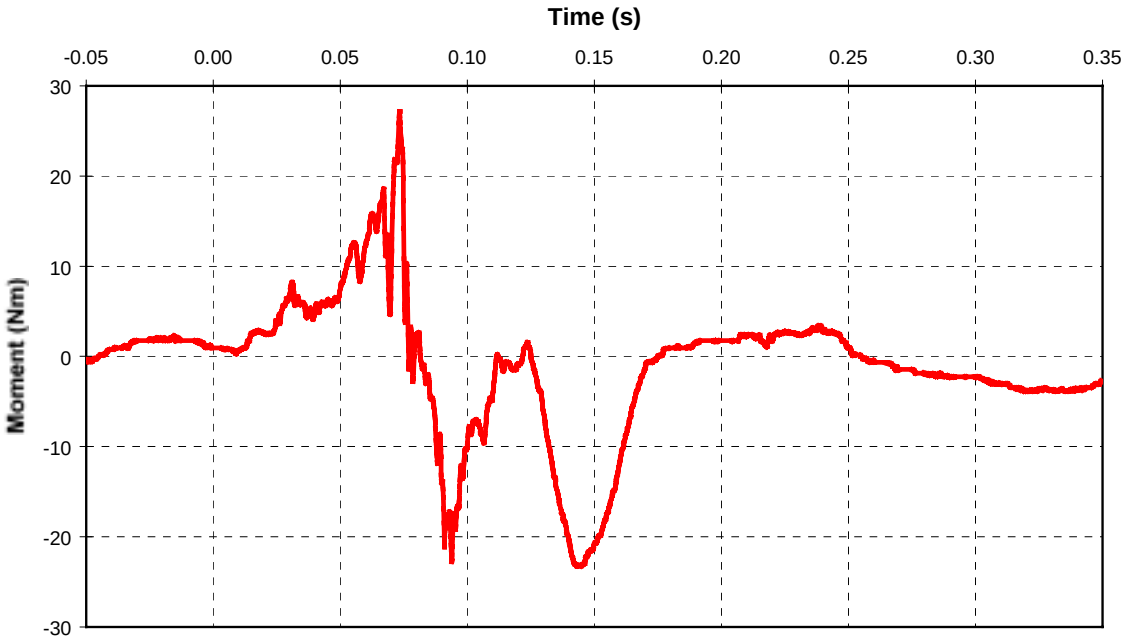
**A- 41 CF98021 1999 Saab 9-5 Right Upper Tibia Vector Resultant Moment**



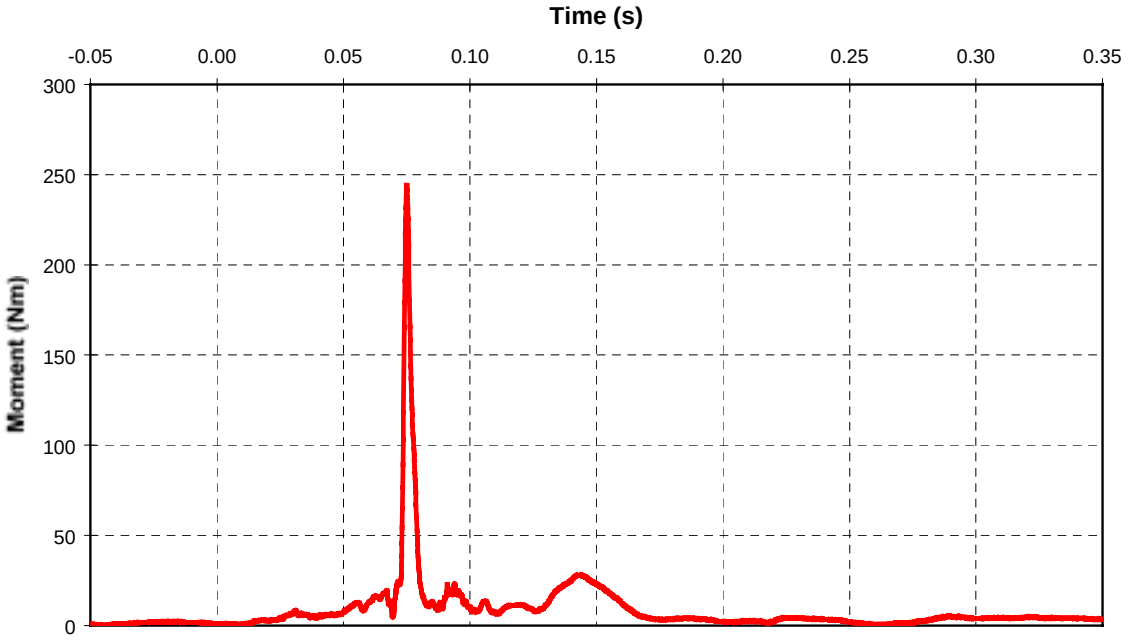

**A- 42 CF98021 1999 Saab 9-5 Right Lower Tibia L-M Moment**



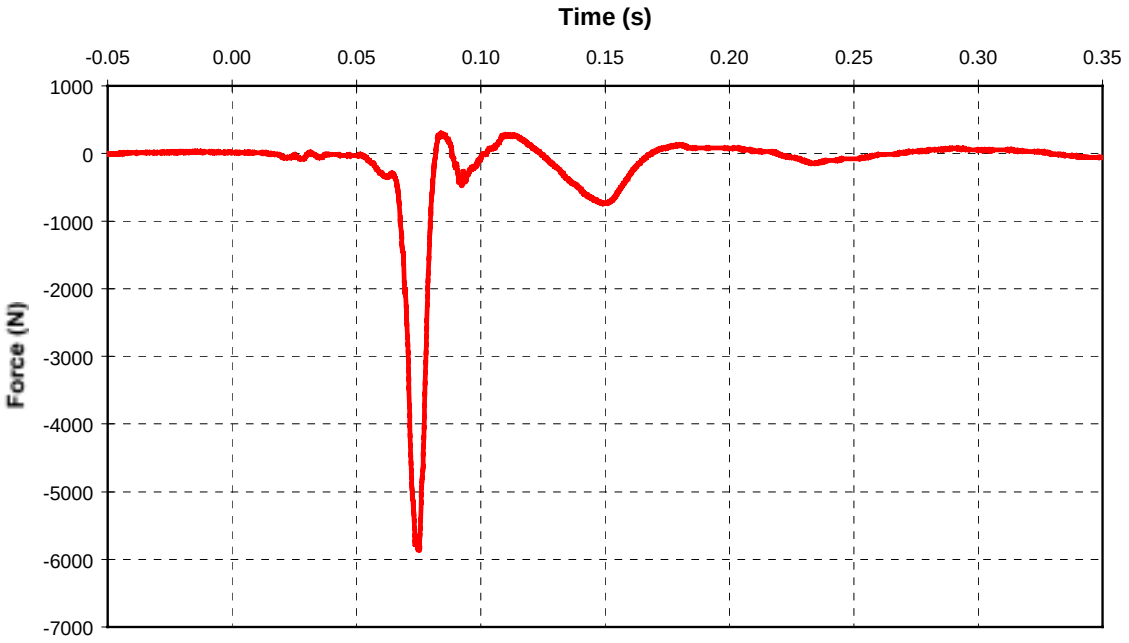
**A- 43 CF98021 1999 Saab 9-5 Right Lower Tibia A-P Moment**



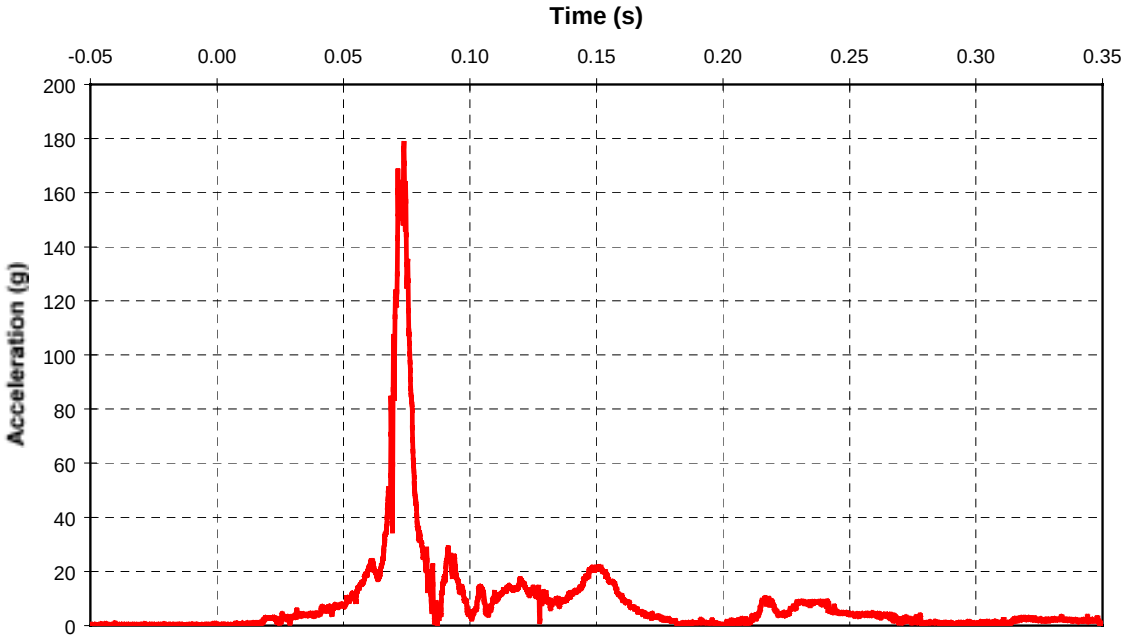

**A- 44 CF98021 1999 Saab 9-5 Right Lower Tibia Vector Resultant Moment**



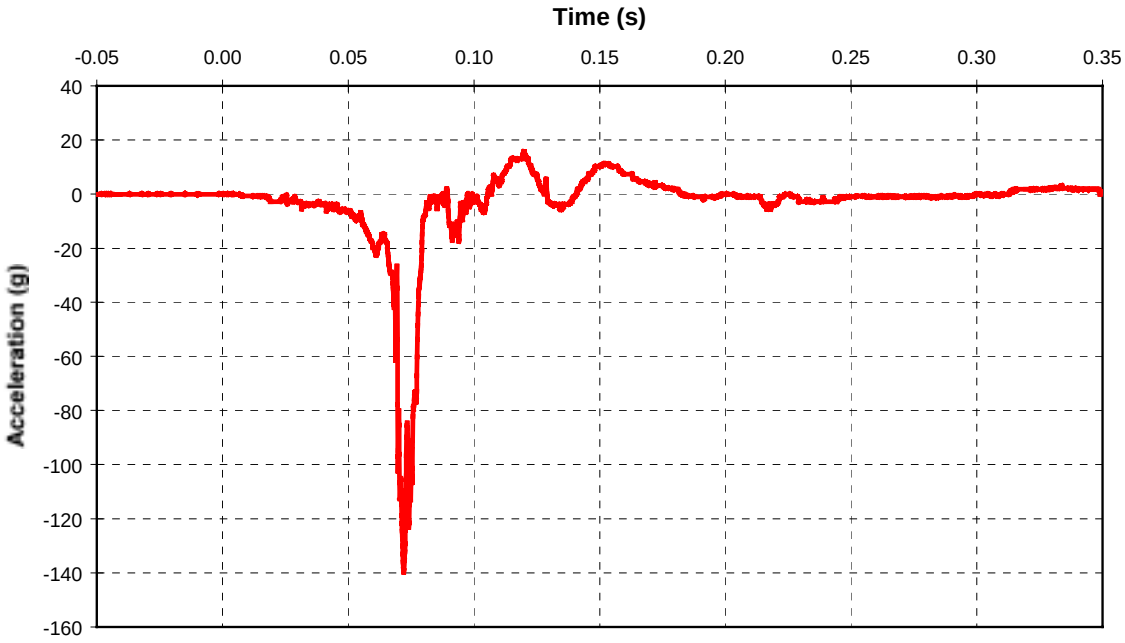
**A- 45 CF98021 1999 Saab 9-5 Right Lower Tibia Axial Force**



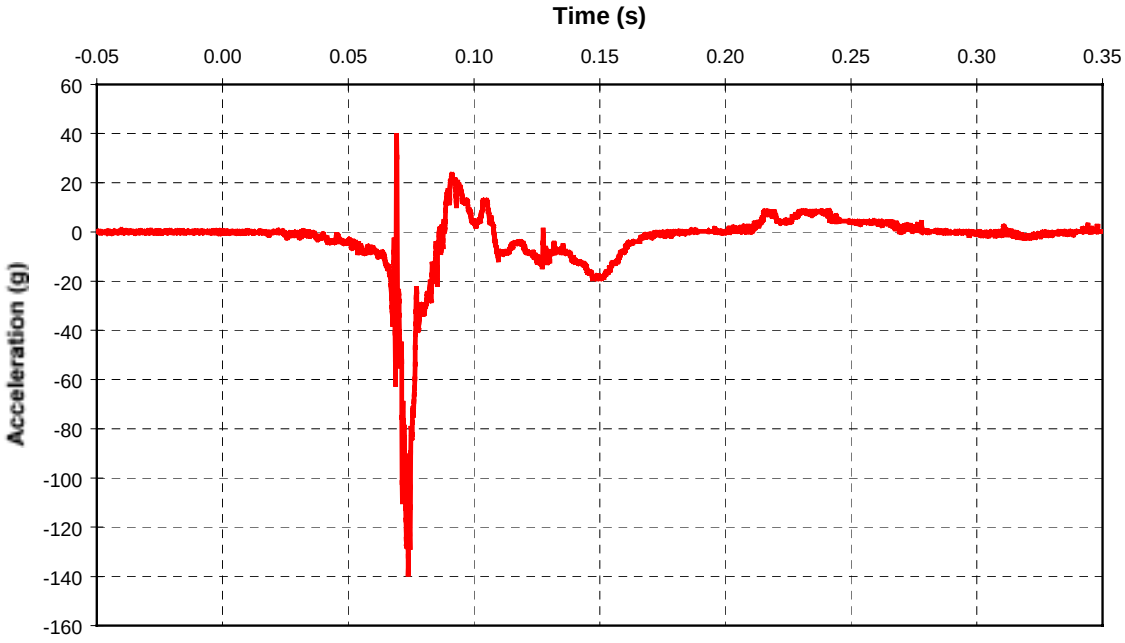

**A- 46 CF98021 1999 Saab 9-5 Right Foot Vector Resultant Acceleration**



**A- 47 CF98021 1999 Saab 9-5 Right Foot A-P Acceleration**




**A- 48 CF98021 1999 Saab 9-5 Right Foot I-S Acceleration**



SAAB

SAAB CARS USA, INC

# 1999 SAAB 9-5 SE 4DR /514ASR

YS3EF48E9X3006053

Cayenne Red Mica Paint/Wayne Beige

## STANDARD EQUIPMENT

**ENGINEERING & PERFORMANCE:**

* 2.3 Liter, 4 Cylinder, 16 Valve DOHC
* 5-Speed Manual Transmission Turbo Engine
* 215/55 VR-16 Steel Belt Radials
* 16 Inch Alloy Wheels
* Front Wheel Drive
* 4-Wheel Power Assist Disc Brakes
* Power Assist Rack & Pinion Steering
* Multi Link Independent Rear Suspension

**SAFETY & SECURITY:**

* Next Generation Driver & Passenger Front Airbags
* Front Seat Side Air Bags
* Saab Active Head Restraints
* 3-Point Seat Belts For All Occupants
* Anti-Lock Braking System (ABS)
* Front Seat Belt Fit Adjustments
* Front Seat Belt Pre-Tensioners
* Safety Cage, Front & Rear Crumple Zones
* 5-mph Self Restoring Bumpers
* Child Safety Rear Door Locks & Windows
* Anti-Theft Alarm w/Remote
* Power Central Locking System
* Daytime Running Lights w/Auto Shut Off
* Headlamp Washer/Wiper
* Front Fog Lights & Rear Fog Light
* Rear Side & Rear Window Electric Demisters
* Wide Angle Passenger Side Mirror

**COMFORT & CONVENIENCE:**

* Power Tilt/Slide Tinted Glass Sunroof
* Power Windows, w/"One Touch" Opening
* Dual Control Automatic Climate Control Electro Static and Charcoal Air Filter
* 8 Way Power Reclining Front Seats
* Instrument Night Panel Feature
* Head Restraints, Front & Rear Outboard Seats
* Leather Seat Surfaces & Steering Wheel
* Steering Wheel Adjustable For Reach and Rake
* Cruise Control
* Front & Rear Floor Mats
* Burled Walnut Dash
* Illuminated Vanity Mirrors
* Interior Courtesy Light Delay
* Power & Heated Rearview Mirrors
* Heat-Absorbent Tinted Glass
* Center Storage Console
* Front Seat Storage Pockets
* Front & Rear Cupholders
* 60/40 Split Fold Down Rear Seat
* Cargo Area Light & Tool Kit
* Multi-Function Saab Car Computer
* Harman/Kardon AM/FM Stereo, In Dash CD, Cassette, 9 speakers, Anti-Theft and Weatherband
* Refrigerated Glove Box
* Adjustable Front Armrest

The above information is affixed pursuant to Federal Automobile Information Disclosure Act. Importer's suggested retail price does not include license and title fees and state and local taxes. Dealer installed options and accessories are not included. Where transportation charge is not shown, this has been paid by dealer directly to transporter. SAAB CARS USA, INC. IS THE SOLE FACTORY AUTHORIZED IMPORTER OF THESE VEHICLES AND A SUBSIDIARY OF THE MANUFACTURER–SAAB AUTOMOBILE AB, TROLLHÄTTAN, SWEDEN.

| MANUFACTURER'S SUGGESTED RETAIL PRICE: | $33,495.00 |
|---|---|
| **OPTIONS AND ADDITIONAL CHARGES:** | |
| 4-Spd Auto Transmission | 1,110.00 |
| Cayenne Red Mica Paint | No Charge |
| * 1,000 Mile First Service & Saab Roadside Assistance | Included |
| * 5 Year Seat Belt Warranty & 6 Year Perforation Warranty | Included |
| * 4 Year/50,000 Mile New Vehicle Limited Warranty | Included |
| ~~Destination Charge~~ | ~~575.00~~ |
| | ~~$35,180.00~~ |

AUTHORIZED DEALER

VIRGINIA'S FIRST FAMILY
BROWN'S SAAB
1590 SEMINOLE TRAIL
CHARLOTTESVILLE VA USA 22901

**SHIP TO DEALER**

VIRGINIA'S FIRST FAMILY
BROWN'S SAAB
1590 SEMINOLE TRAIL
CHARLOTTESVILLE VA USA 22901

**METHOD OF TRANSPORT**

0980 M/S OTELLO
TRUCK I.D. 53499

**PORT OF ENTRY** BRUNSWICK

## PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 0%
MAJOR SOURCES OF FOREIGN PARTS CONTENT: SWEDEN: 30%, GERMANY: 20%

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: TROLLHATTAN, SWEDEN
COUNTRY OF ORIGIN: ENGINE PARTS: SWEDEN
TRANSMISSION PARTS: JAPAN

NOTE: Parts content does not include final assembly, distribution or other non-parts costs.

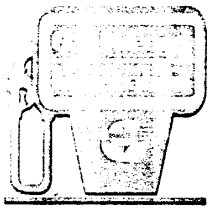
Compare this vehicle to others in the **FREE GAS MILEAGE GUIDE** available at the dealer

CITY MPG

**19**

ACTUAL MILEAGE will vary with options, driving conditions, driving habits and vehicle's condition. Results reported to EPA indicate that the majority of vehicles with these estimates will achieve between

16 and 22 mpg city
22 and 30 mpg on the highway.



**1999 SAAB 9-5, 2.3L-16V, 4-CYLINDER ENGINE, ELECTRONIC FUEL INJECTION, TURBOCHARGER, 4-SPEED AUTOMATIC TRANSMISSION**

ESTIMATED ANNUAL FUEL COST:

**$893.00**

HIGHWAY MPG

**26**

FOR COMPARISON SHOPPING, all vehicles classified as

**MID SIZE**

have been issued mileage ratings ranging from

17 to 39 mpg city and
23 to 50 mpg highway.