

Insurance Institute for Highway Safety Crashworthiness Evaluation

Crash Test Report 1997 Honda Civic (CF97009)

Vehicle identification number: 2HGEJ6673VH542157
Body style: Four-door sedan
Engine/transmission: Transverse 1.6-liter 4-cylinder, 4-speed automatic,
front-wheel drive

Standard crashworthiness features:

- Driver and right front passenger front airbags
- Dual-locking shoulder belts (front and rear outboard seating positions)
- Shoulder belt upper anchorage height adjusters (front seating positions only)
- Shoulder belt webbing grabbers (front seating positions only)
- Right front and both rear shoulder belt retractors are convertible from emergency to automatic locking for ease of child restraint use

Optional safety features:

- Four-wheel antilock brakes

Vehicle specifications (provided by manufacturer):

Wheelbase:	262 cm
Overall length:	445 cm
Overall width:	170 cm
Curb weight:	1,058 kg

Vehicle specifications (measured):

Front bumper to firewall:	100 cm
Curb weight:	1,096 kg
Test weight:	1,244 kg
Overall width:	172 cm

Nominal test parameters:

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

Crash test date:

June 4, 1997

Preocrash — 1997 Honda Civic



Postcrash — 1997 Honda Civic



Summary

A 1997 Honda Civic was crash tested on June 4, 1997 into a fixed deformable barrier at 39.9 mi/h (64.2 km/h) and a 39 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 5-7 cm. A U-shaped steel knee bolster underlying the left instrument panel was compressed forward 10 cm, mitigating the effect of the instrument panel intrusion on the left knee. Resultant intrusion in the driver footwell measured 19 cm at the footrest and 18-24 cm at other places on the toepan. The upper end of the steering column moved upward 6 cm and rearward 6 cm. All doors remained closed during the crash. The driver and left rear doors required tools to open, but the right front and right rear doors opened with ease after the crash.

The driver dummy was restrained by a three-point lap/shoulder belt and an airbag. During the crash, 2 cm of webbing spooled off the retractor, and an additional 4 cm of slack webbing was added to the belt loop by tearing of the force-limiting stitching. The airbag briefly contacted the dummy's head during deployment. During rebound, the dummy's head, neck, and shoulders moved toward the B-pillar. The head then contacted the B-pillar before the dummy settled into the seat.

The dummy's head contact against the B-pillar produced a peak resultant head acceleration of 14 g. The dummy's chest had a maximum compression of 54 mm. The left tibia-femur had a maximum displacement of 12 mm. The left lower tibia had a maximum index of 0.85. The right lower tibia had a maximum resultant bending moment of 168 Nm.

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 IV). 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 64 cm behind its center of gravity (178 cm behind the front axle). The vehicle speed recorded just prior to impact was 39.9 mi/h (64.2 km/h), and the actual overlap was 39 percent.

Structural Performance

All doors remained closed during the crash. The driver door aperture shortened 5 cm as measured at the lower edge of the window. The driver and left rear doors required tools to open, but the right front and right rear doors opened with ease after 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.

The windshield along the left A-pillar separated from the car structure.

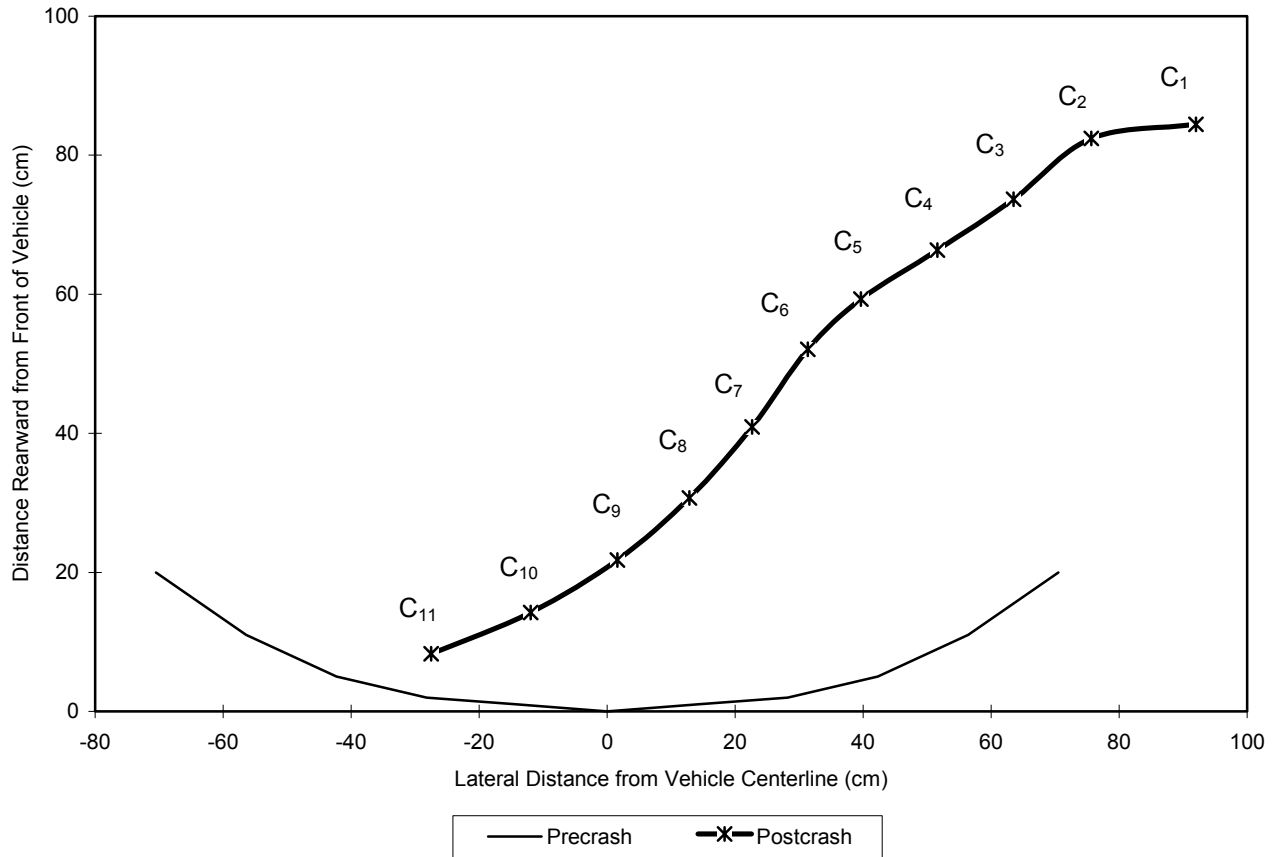
Figure 1 shows the overhead view of the crash deformation. Figure 2A illustrates the precrash and postcrash contour measures of the front bumper cover profile and the resulting permanent crush. Figure 2B illustrates the corresponding measures of both the front bumper reinforcement bar and the upper crossmember of the radiator support. Figure 3 shows the precrash and postcrash views from below. Figure 4 illustrates the deformation of the side rails, floor rails, and crossmember, which are visible in Figure 3.

Figure 1
Overhead View of Crash Deformation — 1997 Honda Civic



Figure 2
Crush Contour Measurements — 1997 Honda Civic

a) Exterior Crush Contour at Bumper Height



	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)	84	82	74	66	59	52	41	31	22	14	8
Precrash Contour (cm)	20	11	5	2	1	0	1	2	5	11	20
Resulting Crush (cm)	64	71	69	64	58	52	40	29	17	3	-12

The length of the reference line was 141 cm precrash and 120 cm postcrash.

b) Front Bumper Bar and Upper Radiator Support Crossmember Crush Contour

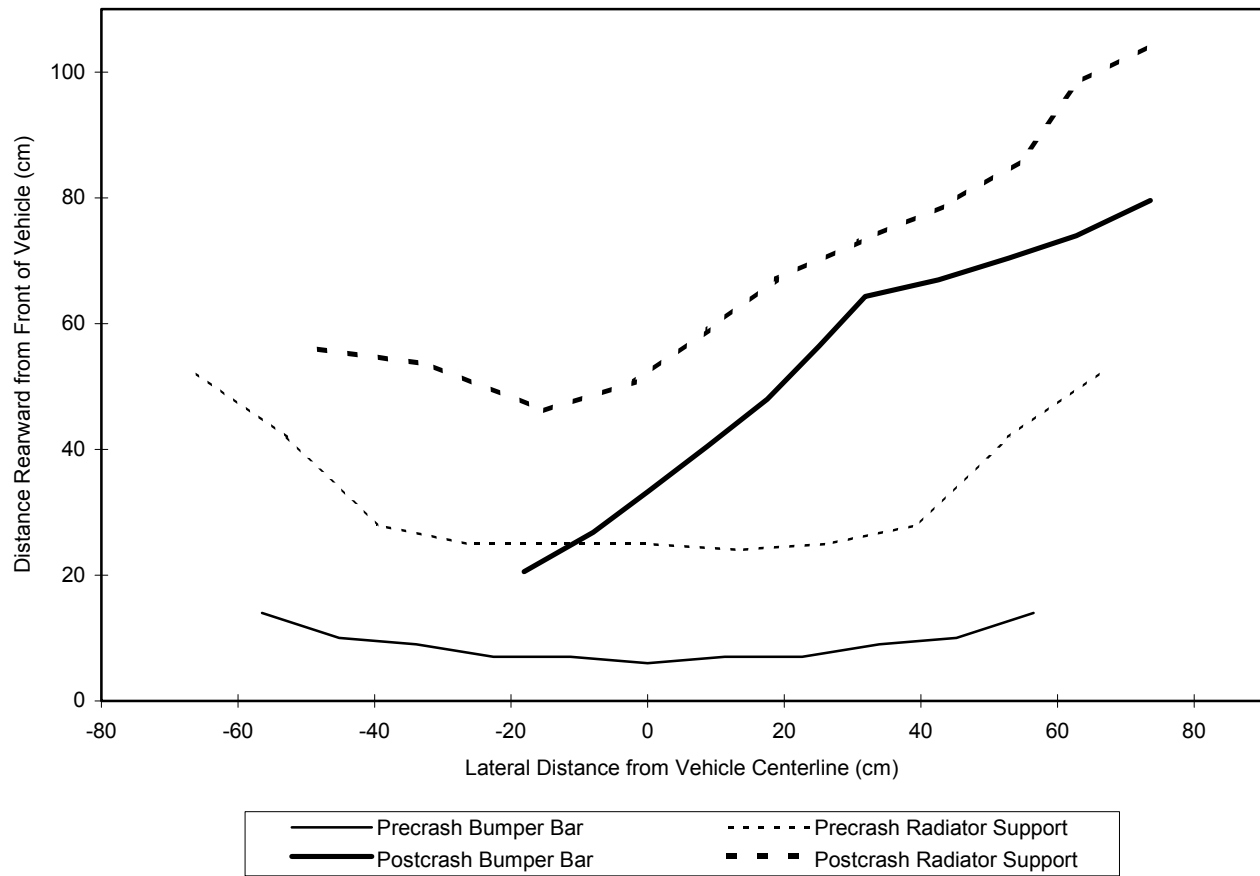
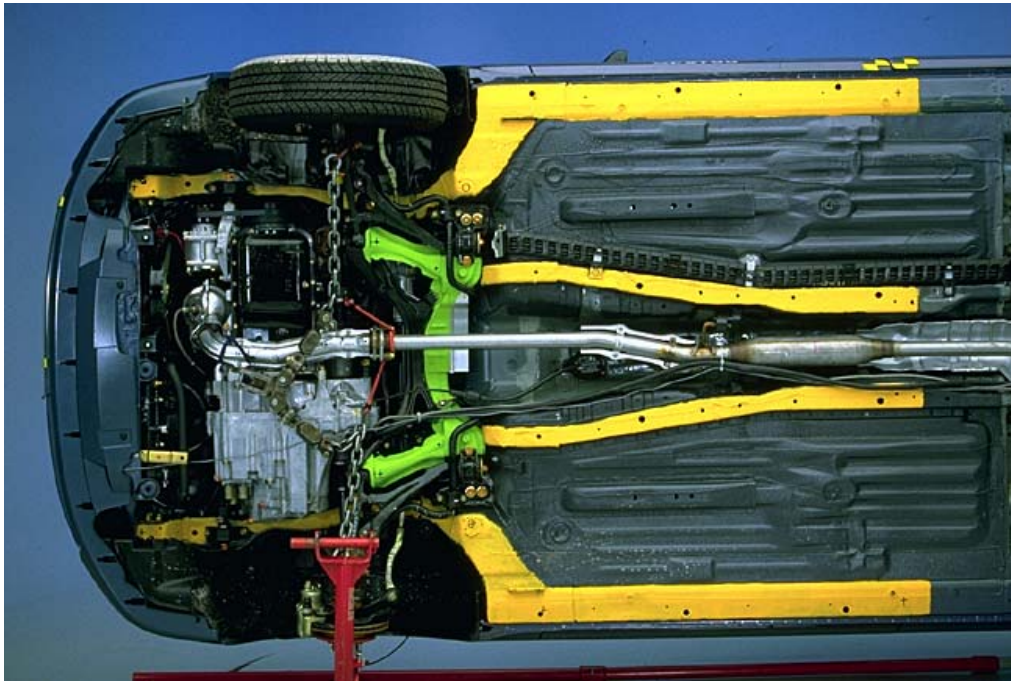


Figure 3
Preocrash View from Below — 1997 Honda Civic

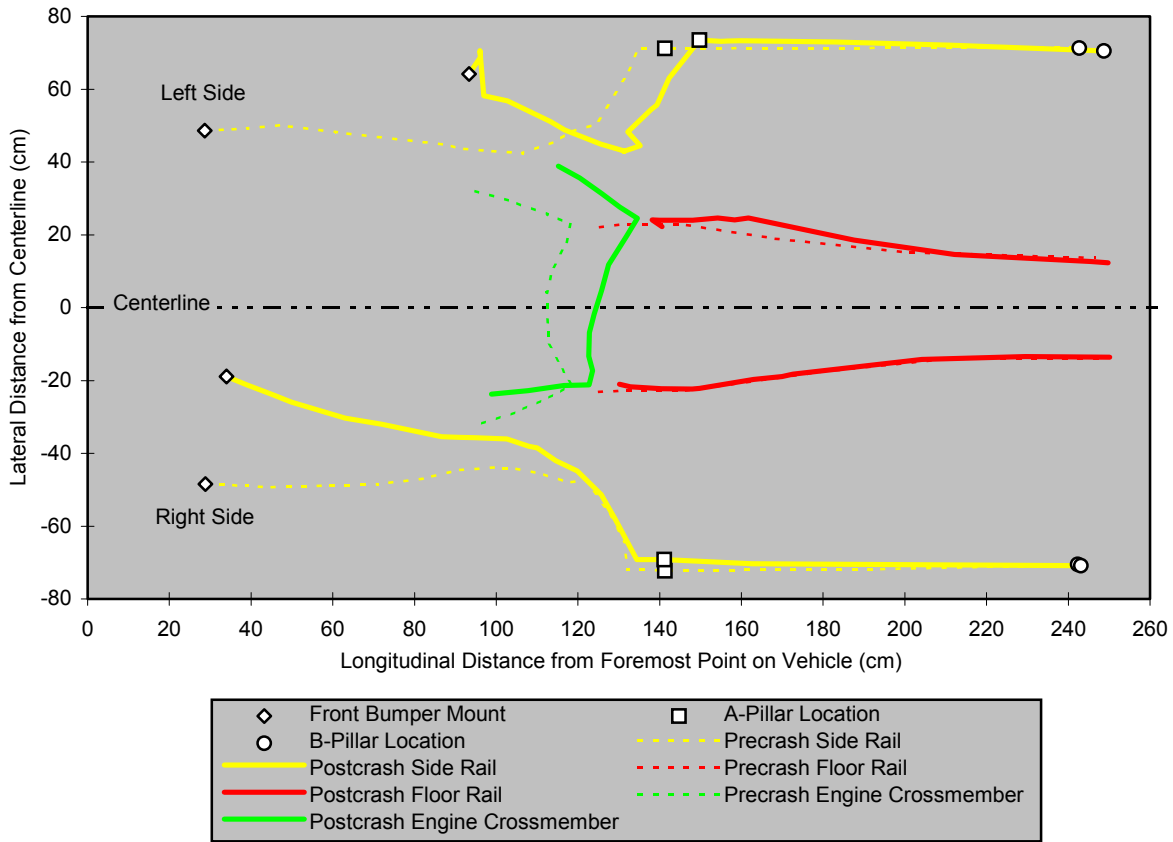


Postcrash View from Below — 1997 Honda Civic

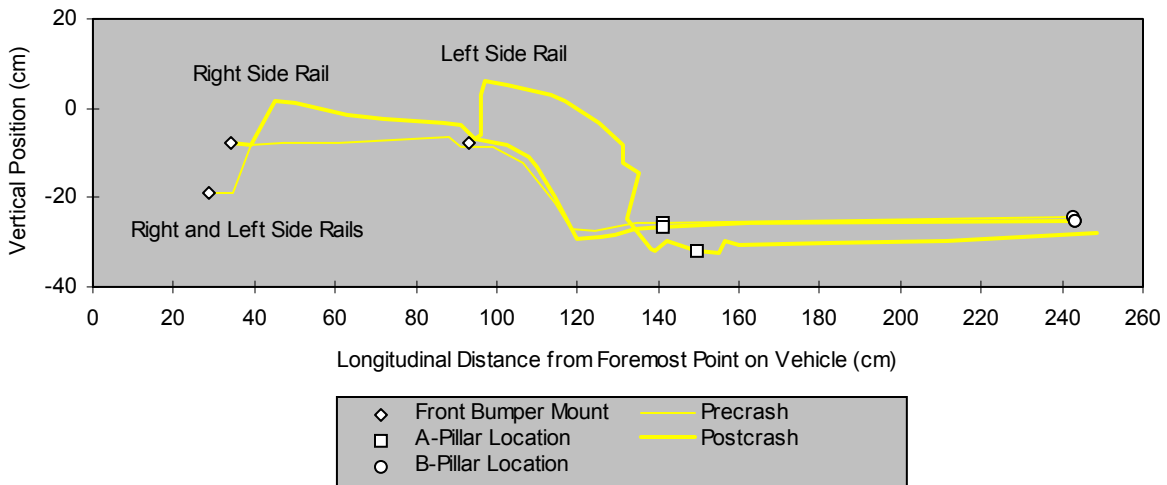


Figure 4
Frame Rail Deformation — 1997 Honda Civic

a) View from Below



b) Side View



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 IV). 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 — 1997 Honda Civic				
Selected Locations*	Longitudinal	Lateral	Vertical	Resultant
Steering column (cm)	-6	3	6	9
Left lower instrument panel (cm)**	-7	-1	1	7
Right lower instrument panel (cm)**	-5	-2	-1	6
Brake pedal (cm)	-17	3	3	17
Left toepan (cm)	-24	-3	3	24
Center toepan (cm)	-22	-2	2	22
Right toepan (cm)	-18	-1	1	18
Footrest (cm)	-18	0	-3	19
Average displacement of the four seat attachment bolts from primary reference system (cm)	-2	1	0	—

* All measurements taken on the driver side. From the driver's position, positive is forward, left, and up.

** Two U-shaped steel knee bolsters underlay the lower instrument panel on either side of the steering column. The left knee bolster was compressed forward 10 cm mitigating the left instrument panel intrusion's effect on the left tibia, knee, femur, and hip. The right knee bolster was less deformed.

Restraint System Performance

Airbags

Driver: The uninflated driver airbag was 60 cm in diameter, and the excursion of its center when inflated was limited by two 24 cm-long tethers. The airbag was vented by two 35 mm-diameter holes 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 position D indicated the airbag deployed at

14 ms into the crash and appeared to be fully inflated at 37 ms.

Passenger: The top-mounted passenger airbag deployed vertically and was untethered. The cylinder-shaped airbag was vented by two 55 mm-diameter holes located at the lateral ends. The airbag contributed to windshield damage during deployment.

Seat Belts

This vehicle is equipped with dual-locking lap/shoulder belts with sliding latch plates at the outboard seating positions and adjustable upper anchorage points at both front seating positions. The front inboard lower anchorage points are attached to and move with the seats. The front outboard lower anchorage points are bolted to the floor. During the crash, 2 cm of webbing was pulled from the retractor through the D-ring as measured by a pull-string mounted between the retractor housing and the webbing just beyond the retractor. In addition, the force-limiting stitching tore, adding 4 cm of additional slack webbing to the belt loop.

Seat

Postcrash examination of the driver seat rails indicated no discernible movement of the seat in its tracks during the crash. Analysis of the high-speed film taken from camera position D indicated the driver seat back movement was minimal. Deformation of the floor under the driver seat caused the seat to tip outboard slightly.

Steering Column

The upper end of the steering column moved upward 6 cm and rearward 6 cm relative to the driver seat. The lower portion of the steering column inside the occupant compartment uses a tube-in-tube design, and a residual collapse of 8 cm was measured. Both the right and left shear modules compressed 1 cm. The metal spokes of the steering wheel deformed so that the face of the wheel was skewed 10 degrees to the left about an axis passing through the 6 and 12 o'clock positions of the wheel.

Dummy Kinematics

Head, Neck, and Torso

Analysis of the high-speed film taken from camera position D indicated the deploying airbag briefly contacted the dummy's face at 29 ms into the crash (the airbag appeared to be in contact with the dummy's face in one frame of the film taken at this position). The dummy's face began to load the airbag at 51 ms into the crash (14 ms after the airbag was fully inflated). Paint transferred from the dummy's face onto the airbag indicated the dummy's nose loaded the airbag 5 cm above its center. As the dummy's head continued forward, it moved to the left side of the airbag and pushed deep into the airbag. During rebound, the dummy's head, neck, and shoulders moved rearward toward the B-pillar. The back of the head then contacted the B-pillar and shoulder belt D-ring at 292 ms, as indicated by film analysis and recorded head acceleration measures and confirmed by paint transfer. The dummy then settled back into the seat. Table 2 provides the timing and duration of these events.

Table 2 Analysis of Restraint System Performance and Dummy Kinematics — 1997 Honda Civic	
Event	Time (ms)
Deployment of airbag	14
Airbag contacts head during deployment	29
Airbag fully inflated	37
Head begins to load airbag	51
Head contacts B-pillar and shoulder belt D-ring	292

Legs and Feet

Left leg and foot: Paint transferred from the dummy's left knee indicated the knee contacted the knee bolster at the left instrument panel intrusion measurement point. The left knee also contacted the instrument panel padding just above the bolster and settled against the lower left corner of the steering column trim. Paint transferred from the dummy's left shin indicated the shin contacted the knee bolster directly below the left knee impact location; the bolster's plastic face partially broke away, and the left shin contacted the underlying steel U-shaped bolster and compressed it forward 10 cm. The left foot was found with its heel pressed against the floorpan and the left edge of its sole close to the inboard edge of the footrest. The top right of left toe was against the underside of the brake pedal. The foot was dorsiflexed and slightly everted.

Right leg and foot: Paint transferred from the dummy's right knee indicated the knee contacted the knee bolster 3 cm to the left of the right instrument panel intrusion measurement point. The right knee also contacted the steering column trim just below the ignition switch, and the left side of the knee contacted the underside of the steering column trim. Paint transferred from the dummy's right shin indicated the shin contacted the knee bolster directly below the right knee impact location. The right knee and shin deformed the steel bracket underneath the knee bolster. The right foot was found with its back pushed against the floorpan. The foot was pointed sharply to the right, and the base of its heel was against the intruded toe pan. The foot was dorsiflexed and everted.

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 dummy's head contact against the B-pillar produced a peak resultant head acceleration of 14 g at 301 ms. Table 3 provides a summary of the maximum head injury measurements recorded during the crash.

Table 3 Head Injury Measurements — 1997 Honda Civic			
Measure	Published Tolerance Threshold	Result	Time (ms)
Vector resultant acceleration (g)	80	52	93
Vector resultant acceleration — 3 ms clip (g)	80	51	92-95
Head Injury Criterion (HIC)	1000	374	76-112
Head Injury Criterion — 15 ms interval (HIC-15)*	700	241	87-102

* A proposed amendment to the Canadian Motor Vehicle Safety Regulations suggests calculating HIC during a 15 ms interval rather than the 36 ms interval specified by the U.S. standard. The Canadian proposal includes an injury threshold of 700 for front-seat occupants protected by airbags.

Neck

Table 4 provides a summary of the maximum neck injury measurements recorded during the crash.

Table 4 Neck Injury Measurements — 1997 Honda Civic			
Measure	Published Tolerance Threshold	Result	Time (ms)
A-P shear force (kN)	±3.1*	0.7	142
Axial compression force (kN)	4.0*	0.0	—
Axial tension force (kN)	3.3*	2.0	93
Flexion bending moment (Nm)	190**	30	148
Extension bending moment (Nm)	57**	15	308

* These values are for instantaneous loading. Neck loads are compared with magnitude-duration injury criteria in Figures A-12 to A-15.

** These published thresholds are recommended injury assessment reference values from Backaitis and Mertz (1994), but significant neck injury may occur at lower bending moments. Mertz and Patrick (1971) report that bending moments of 47 Nm in extension and 88 Nm in flexion would be non-injurious for occupants represented by the Hybrid III 50th percentile adult male dummy.

Chest

The dummy's chest had a maximum rib compression of 54 mm at 105 ms while the dummy was loading the airbag and seat belt. Table 5 provides a summary of the maximum chest injury measurements recorded during the crash.

Table 5 Chest Injury Measurements — 1997 Honda Civic			
Measure	Published Tolerance Threshold	Result	Time (ms)
Vector resultant spine acceleration — 3 ms clip (g)	60	42	97-100
Rib compression (mm)	50	54	105
Viscous criterion (m/s)	1.0	0.5	96

Legs and Feet

Left leg and foot: The left knee had a maximum displacement of 12 mm. The left lower tibia had a maximum resultant bending moment of 185 Nm and a maximum index of 0.85.

Right leg and foot: None of the injury measures approached the reference values.

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

Table 6 Leg and Foot Measurements — 1997 Honda Civic					
Measure	Published Tolerance Threshold	Left Leg		Right Leg	
		Result	Time (ms)	Result	Time (ms)
Axial femur force (kN)	9.1*	3.3	78	3.4	83
Tibia-femur displacement (mm)	15	12	81	2	82
Upper Tibia					
L-M moment (Nm)	±225	-36	103	112	67
A-P moment (Nm)	±225	-160	80	97	59
Vector resultant moment (Nm)	225	160	80	136	66
Index	1.00	0.71	80	0.64	66
Lower Tibia					
L-M moment (Nm)	±225**	-63	106	163	76
A-P moment (Nm)	±225**	175	105	45	75
Vector resultant moment (Nm)	225**	185	105	168	76
Axial force (kN)	8.0**	0.9	106	2.3	59
Index	1.00	0.85	105	0.79	76
Foot					
A-P foot acceleration (g)	±150	54	96	-79	56
I-S foot acceleration (g)	±150	56	61	82	59
Vector resultant foot acceleration (g)	150	71	61	107	58

* This critical value is for instantaneous loading. Femur loads are compared with magnitude-duration injury criteria in Figures A-23 and A-34.

** 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.

References

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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

1997 Honda Civic Four-Door Sedan: 5 mi/h Front into Angle Barrier

Test Number: LA97003

VIN: 2HGEJ6673VH542157

Mileage: 205

Features: Driver and passenger airbags, air conditioning, automatic transmission, power steering, power mirrors, power door locks, power windows, heated back glass, tilt steering wheel, two-stage paint.

Description	Part		Labor	
	Mfg. No	Price	Operation	Hours
Bumper reinforcement, front	71130S01A00ZZ	\$119.93	Replace*	1.5
Bumper reinforcement, front			Refinish	0.5
Bumper cover, front			Repair/align	0.5
Bumper reinforcement, right front	71142S01A00ZZ	9.70	Replace*	
Bumper absorber, front	71170S00A00	61.68	Replace	
Headlamp assembly, right	33101S01A01	162.80	Replace	0.7
Headlamps			Aim	0.5
Radiator support			Repair/align*	1.5
Radiator support			Refinish	0.5
Fender, right front			Repair/align*	3.5
Fender, right front			Refinish	3.4
Paint and materials		70.40		
Total Parts		\$424.51		
Total Labor		390.60		12.6
Grand Total		\$815.11		

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

Dummy Clearance Measurements

Test Number: CF97009
Vehicle Make: Honda Civic
Vehicle Model Year: 1997
Seat Type: Manual adjustment

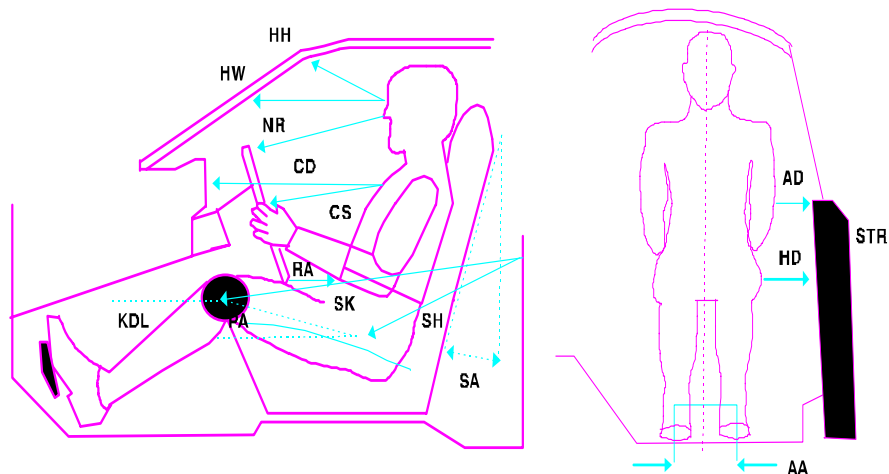
Manufacturer's Specifications

Seat Back Information: Reclined to fourth latch rearward from first locking position
Upper Belt Anchorage: Adjusted to uppermost position
Steering Column Adjustment: Midpoint

Location	Code	Measurement	Location	Code	Measurement
Head to header	HH	285	Torso angle	TA	15.4°
Head to windshield	HW	510	Striker to knee*	SK	605
Nose to rim	NR	390	Striker to knee angle*	SKA	4.3°
Chest to dash	CD	580	Striker to H-point	SHH	195
Chest to steering wheel	CS	360	horizontal		
Rim to abdomen	RA	200	Striker to H-point	SHV	-145
Pelvic angle	PA	22.8°	vertical		
Knee to dash left	KDL	180	Arm to door	AD	80
Knee to dash right	KDR	140	H-point to door	HD	115
			Seat back angle	SA	23°
			Ankle to ankle	AA	290
			Knee to knee	KK	325

All distance measurements are in mm.

* These measurements are made in a vertical plane containing the striker and parallel to the driver door sill.



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