

Insurance Institute for Highway Safety Crashworthiness Evaluation

Crash Test Report 1997 Dodge Neon (CF97019)

Vehicle identification number: 3B3ES47C0VT517690
Body style: Four-door sedan
Engine/transmission: Transverse 2.0-liter 4-cylinder, 3-speed automatic,
front-wheel drive

Standard crashworthiness features:

Driver and right front passenger front airbags
Shoulder belt upper anchorage height adjusters (front seating positions only)

Optional safety features:

Integrated rear center seat child restraint
Four-wheel antilock brakes

Vehicle specifications (provided by manufacturer):

Wheelbase: 264 cm
Overall length: 436 cm
Overall width: 171 cm
Curb weight: 1,143 kg

Vehicle specifications (measured):

Front bumper to firewall: 108 cm
Curb weight: 1,172 kg
Test weight: 1,308 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:

August 28, 1997

Preocrash — 1997 Dodge Neon



Postcrash — 1997 Dodge Neon



Summary

A 1997 Dodge Neon was crash tested on August 28, 1997 into a fixed deformable barrier at 40.0 mi/h (64.3 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 11-14 cm. Resultant intrusion in the driver footwell measured 24 cm in the area where a footrest typically would be located and 21-29 cm at other places on the toepan. The upper end of the steering column moved upward 2 cm and rearward 13 cm, and there was considerable lateral movement of the steering wheel (11 cm toward the passenger side). All doors remained closed during the crash. The driver and left rear doors were jammed shut after the crash and could not be opened without the use of tools. 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 with sliding latch plate and an airbag. During the crash, 7 cm of webbing spooled off the retractor. The airbag contacted the dummy's face during deployment. The dummy loaded the inflated airbag, continued forward, and rolled to the left. The dummy's head, neck, and shoulders turned back to face nearly forward and then moved rearward until the right rear side of the head contacted the head restraint. The dummy then settled back into the seat.

The maximum left upper tibia index was 0.90, and the maximum left lower tibia index was 1.13. The maximum right upper tibia index was 1.34, and the maximum right lower tibia index was 1.06.

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 at 5 mi/h (8 km/h) into a full-width rigid barrier and a rear center impact at 5 mi/h (8 km/h) into a pole. 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 toepan in the area where a footrest typically would be located.

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 68 cm behind its center of gravity (175 cm behind the front axle). The vehicle speed recorded just prior to impact was 40.0 mi/h (64.3 km/h), and the actual overlap was 41 percent.

Structural Performance

All doors remained closed during the crash. The driver door aperture shortened 24 cm as measured near the lower edge of the window. The rear of the driver door was pushed under the front edge of the left rear door after the crash. The driver door latch opened the door after the crash, but the shingled metal prevented the door from opening. The driver and left rear doors could not be opened without the use of tools. The right front and right rear doors opened with ease after the crash.

No fuel system leaks were observed after the crash. A small leak near the fuel pump at the right front corner of the tank was observed when the vehicle was rotated onto its right side to allow postcrash photography. Four to five drops of Stoddard fluid were collected while rolling the vehicle onto its side, and an additional four to five drops were collected during the first minute after the vehicle was rotated. There was no subsequent leakage of fluid.

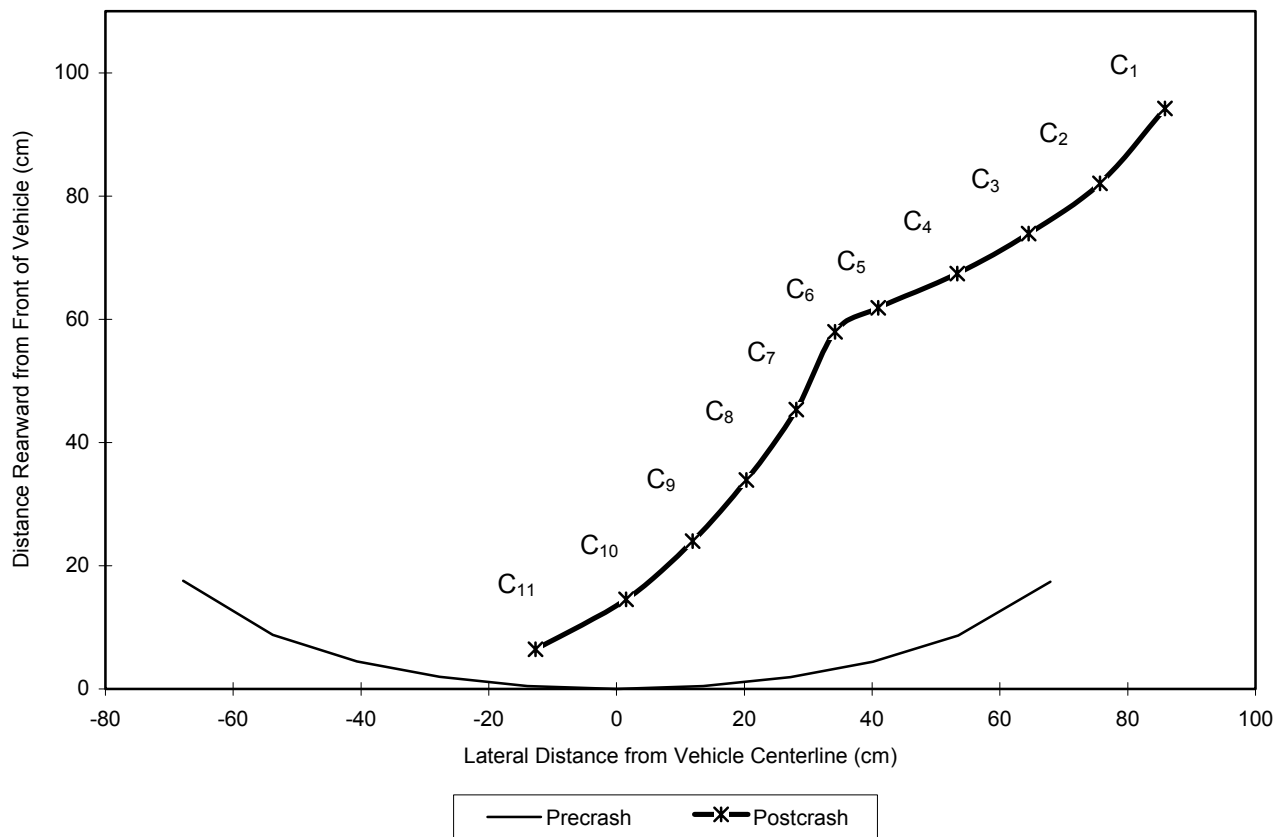
Figure 1 shows the overhead view of the crash deformation. Figure 2A illustrates the precrash and postcrash contour measures of the front bumper cover profile and the resulting permanent crush. Figure 2B illustrates the corresponding measures of both the front bumper reinforcement bar and the upper crossmember 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 crossmembers, which are visible in Figure 3.

Figure 1
Overhead View of Crash Deformation — 1997 Dodge Neon



Figure 2
Crush Contour Measurements — 1997 Dodge Neon

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)	94	82	74	67	62	58	45	34	24	15	6
Precrash Contour (cm)	17	9	4	2	0	0	0	2	4	9	18
Resulting Crush (cm)	77	73	70	65	62	58	45	32	20	6	-12

The length of the reference line was 136 cm precrash and 99 cm postcrash.

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

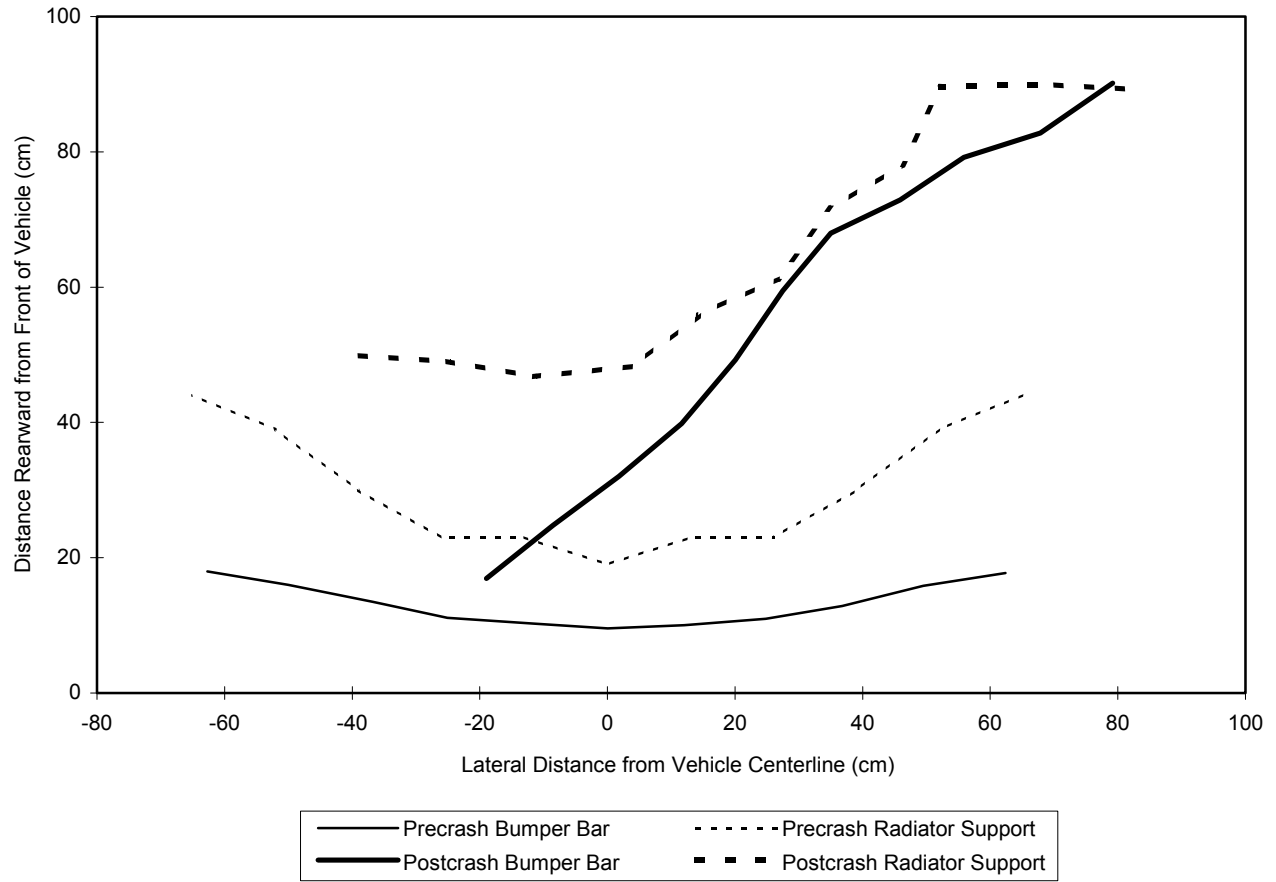


Figure 3
Preocrash View from Below — 1997 Dodge Neon

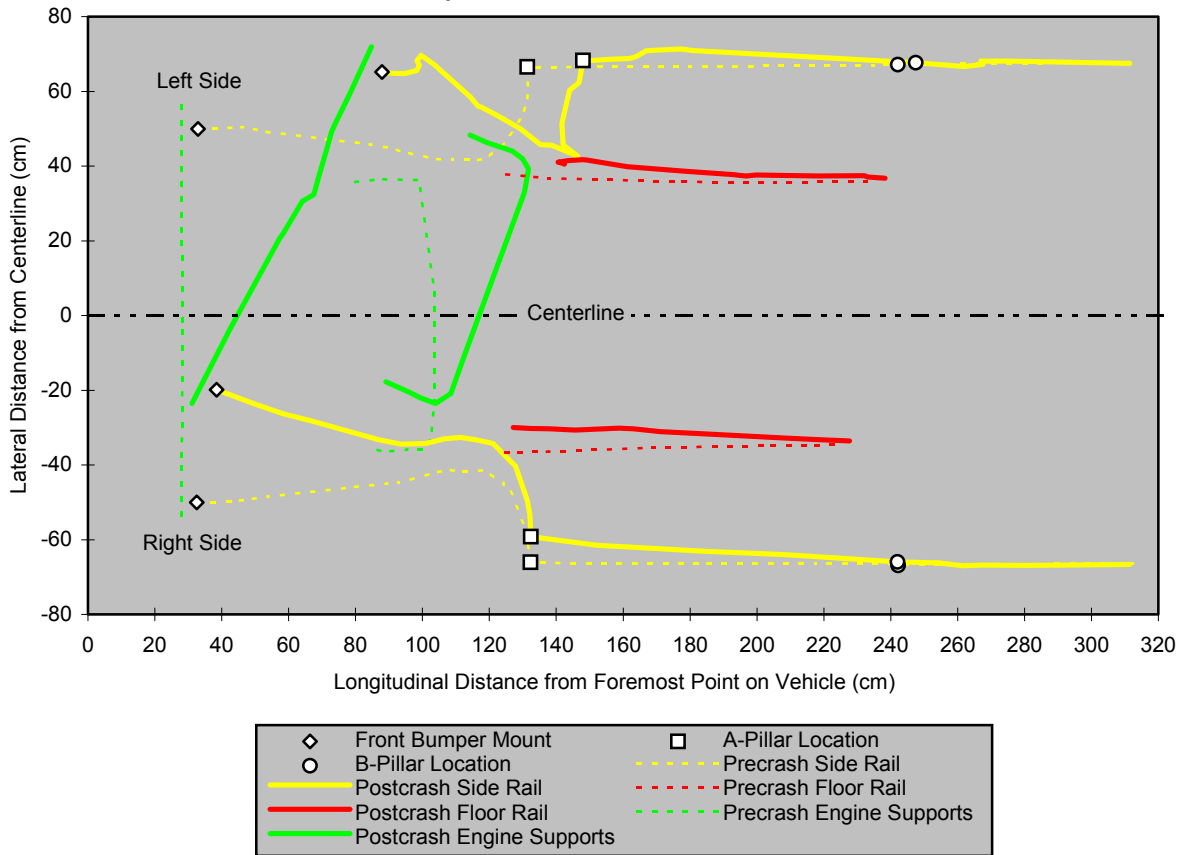


Postcrash View from Below — 1997 Dodge Neon

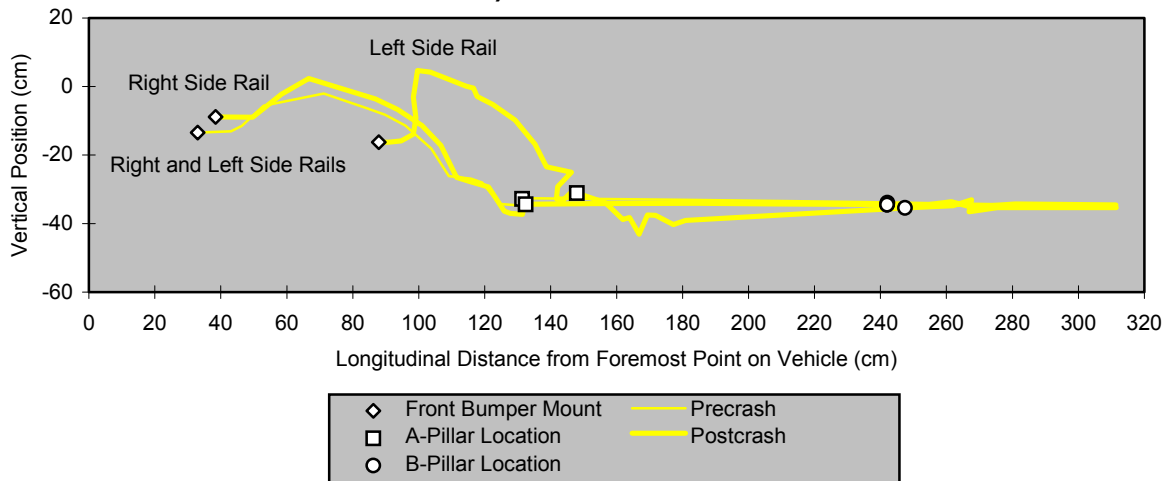


Figure 4
Frame Rail Deformation — 1997 Dodge Neon

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 Dodge Neon				
Selected Locations*	Longitudinal	Lateral	Vertical	Resultant
Steering column (cm)	-13	-11	2	17
Left lower instrument panel (cm)	-14	-5	6	16
Right lower instrument panel (cm)	-11	-4	1	11
Brake pedal (cm)	-24	1	13	27
Left toepan (cm)	-28	2	7	29
Center toepan (cm)	-26	2	7	27
Right toepan (cm)	-19	3	7	21
Footrest (cm)	-23	2	8	24
Average displacement of the four seat attachment bolts from primary reference system (cm)	-4	1	-3	—

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

Restraint System Performance

Airbags

Driver: The uninflated driver airbag was 64 cm in diameter, and the excursion of its center when inflated was limited by two 22 cm-long tethers. The airbag was vented by two 25 mm-diameter holes at positions corresponding to 11 and 1 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 42 ms into the crash and appeared to be fully inflated at 58 ms.

Passenger: The top-mounted passenger airbag deployed at an angle, and its excursion was limited by four 48 cm-long tethers. The cylinder-shaped airbag was vented by one 60 mm-diameter hole located at the top center surface of the airbag. The airbag's vinyl compartment cover was not reinforced and neither it nor the airbag appeared to contribute to windshield damage during deployment.

Seat Belts

This vehicle is equipped with three-point 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 B-pillars. During the crash, 7 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.

Seat

Postcrash examination of the driver seat rails indicated about 1 cm of rearward movement on the left side of the seat in its tracks during the crash and no discernible movement on the right side of the seat. 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 2 cm and rearward 13 cm relative to the driver seat, and there was significant lateral movement of the steering wheel (11 cm toward the passenger side). The lower steering wheel rim and the left and right lower spokes were bent forward. The steering column is divided into three segments by a universal joint and a corrugated section. After the crash, these joints were bent to 90 degree angles. The shear module compressed about 1 cm on the left side and 2 cm on the right.

Dummy Kinematics

Head, Neck, and Torso

Analysis of the high-speed film taken from camera position D indicated the airbag contacted the dummy's face at 50 ms into the crash (8 ms before the airbag was fully inflated). The dummy's face began to load the inflated airbag at 58 ms into the crash. Paint transferred from the dummy's face onto the airbag indicated the dummy's nose loaded the airbag 10 cm above and 5 cm to the left of its center. The dummy's head, neck, and shoulders continued forward into the airbag and then rolled to the left. The head, neck, and shoulders turned back to face nearly forward and then moved rearward until the right rear side of the head contacted the head restraint. The dummy then settled back into the seat. Table 2 provides the timing and duration of these events.

Table 2 Film Analysis of Restraint System Performance and Dummy Kinematics — 1997 Dodge Neon	
Event	Time (ms)
Deployment of airbag	42
Airbag contacts head during deployment	50
Airbag fully inflated	58
Head begins to load airbag	58
Back of head contacts head restraint	318-364
Dummy settles back into seat	900

Legs and Feet

Left leg and foot: Paint transferred from the dummy's left knee indicated the knee contacted the knee bolster about 1 cm above and 2 cm to the right of the left instrument panel intrusion measurement point. The left knee also transferred paint to the left side of the steering column and the instrument panel above the bolster. The plastic bolster trim and its underlying steel plate both were dented by the knee impact. Paint transferred from the dummy's left shin indicated the shin contacted the knee bolster below and to the left of the left knee impact location. The left foot was found fully dorsiflexed and slightly inverted. The back of the heel was pressed into a downward buckle of the floormat. The toes were against the intruded toepan, but the heel and instep were not touching the toepan.

Right leg and foot: Paint transferred from the dummy's right knee indicated the knee contacted the knee bolster 4 cm below and 4 cm to the left of the right instrument panel intrusion measurement point. The right knee also transferred paint to the lower right steering column trim below the ignition switch. The plastic bolster trim and its underlying steel plate both were dented by the knee impact. Paint transferred from the dummy's right shin indicated the top of the shin contacted the knee bolster directly below the right knee impact location. The right foot was found fully dorsiflexed and slightly everted. The left side of the foot was pressed against the accelerator pedal and toepan. The back of the heel was suspended above the floorpan. The console/tunnel and side trim were pushed against the right side of the foot.

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. Table 3 provides a summary of the maximum head injury measurements recorded during the crash.

Table 3 Head Injury Measurements — 1997 Dodge Neon			
Measure	Published Tolerance Threshold	Result	Time (ms)
Vector resultant acceleration (g)	80	52	84
Vector resultant acceleration — 3 ms clip (g)	80	52	83-86
Head Injury Criterion (HIC)	1000	394	68-104
Head Injury Criterion — 15 ms interval (HIC-15)*	700	265	80-95

* 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 Dodge Neon			
Measure	Published Tolerance Threshold	Result	Time (ms)
A-P shear force (kN)	±3.1*	-0.5	77
Axial compression force (kN)	4.0*	0.8	115
Axial tension force (kN)	3.3*	2.1	84
Flexion bending moment (Nm)	190**	38	75
Extension bending moment (Nm)	57**	23	177

* 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

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

Table 5 Chest Injury Measurements — 1997 Dodge Neon			
Measure	Published Tolerance Threshold	Result	Time (ms)
Vector resultant spine acceleration — 3 ms clip (g)	60	46	87-90
Rib compression (mm)	50	39	87
Viscous criterion (m/s)	1.0	0.4	65

Legs and Feet

Left leg and foot: The left tibia-femur displacement sensor failed, preventing measurements from being recorded during the crash. The maximum left upper tibia index was 0.90. The maximum left lower tibia resultant bending moment was 244 Nm. The maximum left lower tibia axial force was 5.2 kN. The maximum left lower tibia index was 1.13.

Right leg and foot: The maximum right upper tibia resultant bending moment was 268 Nm. The maximum upper tibia index was 1.34. The maximum right lower tibia resultant bending moment was 216 Nm. The maximum right lower tibia axial force was 5.6 kN. The right lower tibia index was 1.06.

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

Table 6 Leg and Foot Measurements — 1997 Dodge Neon					
Measure	Published Tolerance Threshold	Left Leg		Right Leg	
		Result	Time (ms)	Result	Time (ms)
Axial femur force (kN)	9.1*	4.7	63	3.9	83
Tibia-femur displacement (mm)	15	—	—	0	n/a
Upper Tibia					
L-M moment (Nm)	±225	-145	125	143	69
A-P moment (Nm)	±225	167	62	227	69
Vector resultant moment (Nm)	225	170	62	268	69
Index	1.00	0.90	65	1.34	69
Lower Tibia					
L-M moment (Nm)	±225**	-128	64	202	69
A-P moment (Nm)	±225**	240	92	159	86
Vector resultant moment (Nm)	225**	244	92	216	86
Axial force (kN)	8.0**	5.2	65	5.6	68
Index	1.00	1.13	92	1.06	69
Foot					
A-P foot acceleration (g)	±150	-31	61	-62	63
I-S foot acceleration (g)	±150	70	63	67	60
Vector resultant foot acceleration (g)	150	74	63	75	63

* 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 Dodge Neon Four-Door Sedan: 5 mi/h Front into Barrier

Test Number: LF97006

VIN: 3B3ES47C0VT517690

Mileage: 73

Features: Driver and passenger airbags, air conditioning, automatic transmission, power steering, tinted glass, heated back glass, two-stage paint.

Description	Part		Labor	
	Mfg. No	Price	Operation	Hours
Bumper reinforcement, front			Remove/reinstall	2.0
Bumper reinforcement, front			Repair/align*	1.0
Radiator support			Repair/align**	1.0
Radiator support			Refinish	0.5
Paint and materials		\$8.00		
Total Parts		\$8.00		
Total Labor		139.50		4.5
Grand Total		\$147.50		

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

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

Dummy Clearance Measurements

Test Number: CF97019
Vehicle Make: Dodge Neon
Vehicle Model Year: 1997
Seat Type: Manual adjustment

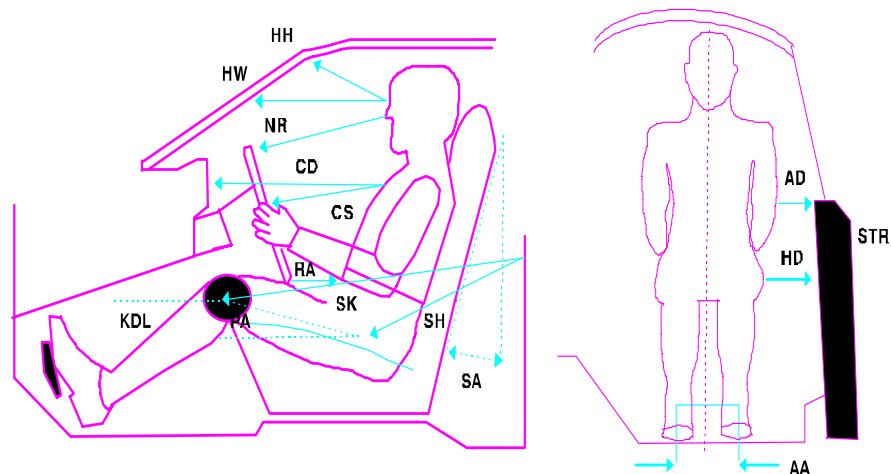
Manufacturer's Specifications

Seat Back Information: Reclined 18 degrees rearward
Upper Belt Anchorage: Adjusted to fourth notch with uppermost notch as first
Steering Column Adjustment: This car not equipped with adjustable column

Location	Code	Measurement	Location	Code	Measurement
Head to header	HH	310	Torso angle	TA	15.0°
Head to windshield	HW	495	Striker to knee*	SK	620
Nose to rim	NR	355	Striker to knee angle*	SKA	0.2°
Chest to dash	CD	560	Striker to H-point	SHH	188
			horizontal		
Chest to steering wheel	CS	340	Striker to H-point	SHV	110
			vertical		
Chest to airbag module	ABM	225	Arm to door	AD	0
Rim to abdomen	RA	155	H-point to door	HD	185
Pelvic angle	PA	24.3°	Seat back angle	SA	18°
Knee to dash left	KDL	170	Ankle to ankle	AA	315
Knee to dash right	KDR	175	Knee to knee	KK	315

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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