Publication No. FHWA-RD-93-099
July 1994

Testing of Small and Large Sign Support Systems FOIL Test Number: 92F012

U.S. Department of Transportation
Federal Highway Administration

Research and Development
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101-2296

Technical Report Documentation Page

1. Report No.	2.	3. Recipie
FHWA-RD-93-099	PB94-186301	

4. Title and Subtitle	5. Report Date
TESTING OF SMALL AND LARGE SIGN SUPPORT SYSTEMS FOIL TEST NUMBER(S): 92F012	July 1994 6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Christopher M. Brown	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Advanced Technology & Research Corp. 15210 Dino Drive Burtonsville, MD 20866	3A5f3142 11. Contract or Grant No. DTFH61-91-Z-00002

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Office of Safety and Traffic Operations R&D Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296	Test Report, May 1992 14. Sponsoring Agency Code

15. Supplementary Notes

Contracting Officer's Technical Representative (COTR) - Richard King, HSR-20

16. Abstract

This test report contains the results of a crash test performed at the Federal Outdoor Impact Laboratory (FOIL) in McLean, Virginia. The test was performed on a small sign support system at 20 mi/h (8.9 m/s), test 92F012. The vehicle used for these test was a 1985 Honda Civic. The purpose of this test was to evaluate the low-speed safety performance of a dual 3-lb/ft (4.5-kg/m) u-channel sign support in weak soil. The posts were spaced 2 ft 4 in (0.7 m) apart. The performance evaluation was based on the latest requirements for breakaway supports as specified in Volume 54, Number 3 of the Federal Register dated January 5, 1989. These criteria specify, in part, that the occupant change in velocity must be 16 ft/s (4.9 m/s) or less, that the significant test article stub height remaining after impact be no more than 4 in (102 mm), and that there can be no occupant compartment intrusion. The test results indicate that the dual 3-lb/ft (4.5-kg/m) u-channel sign support with 2-ft 4-in (0.7-m) spacing does not meet all of the applicable performance criteria for roadside safety appurtenances in weak soil specified by the FHWA.

17. Key Words	18. Distribution Statement
Acceleration, occupant impact velocity, weak soil, u-channel, vehicle, FOIL.	No restrictions. This document is available to the public through the National Technical Information Service Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	19	

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0 093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0 405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3 785	liters	l
ft^3	cubic feet	0 028	cubic meters	m^3
yd^3	cubic yards	0 765	cubic meters	m^3

NOTE: Volumes greater than 1000 l shall be shown in m^3

		MASS		
oz	ounces	28 35	grams	g
lb	pounds	0 454	kilograms	kg
T	short tons (2000 lb)	0 907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1 8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10 76	lux	l
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4 45	newtons	N
psi	poundforce per square inch	6 89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0 039	inches	in
m	meters	3 28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1 195	square yards	ac
ha	hectares	2.47	acres	mi^2
km^2	square kilometers	0.386	square miles	
		VOLUME		
ml	milliliters	0 034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m^3	cubic meters	35 71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2 202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0 0929	foot candles	fc
cd/m^2	candela/m^2	0 2919	foot Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0 225	poundforce	lbf
kPa	kilopascals	0 145	poundforce per square inch	psi

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised August 1992)

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1. SCOPE

This test report contains the results of a crash test performed at the Federal Outdoor Impact Laboratory (FOIL) in McLean, Virginia. The test was performed on a small sign support system at 20 mi/h (8.9 m/s), test 92F012. The vehicle used for this test was a 1985 Honda Civic. The purpose of this test was to evaluate the low speed safety performance of a dual legged steel 3 lb/ft u-channel sign support. The performance evaluation was based on the latest requirements for breakaway supports as specified in Volume 54, Number 3 of the Federal Register dated January 5, 1989. These criteria specify, in part, that the occupant change in velocity must be 16 ft/s (4.9 m/s) or less, that the significant test article stub height remaining after impact be no more than 4 in (102 mm), and that there can be no occupant compartment intrusion.

2. TEST MATRIX

The test was performed on a small sign support system. The test speed was 20 mi/h (8.9 m/s). The sign was buried in NCHRP Report Number 230, S-2 weak soil[1]. A summary of the test conditions is presented in table 1.

Table 1. Test matrix.

Test Number	Test Vehicle	Test Weight (lb)	Test Speed (mi/h)	Test Article Description	Impact Location
92F012	'85 Honda Civic	1850	20	2 leg steel 3 lb/ft	center

3. VEHICLE

The test vehicle was a 1985 Honda Civic two door hatchback with a manual transmission. Prior to the test, the vehicles' fluids were drained and its inertial properties measured. The vehicle was stripped of certain components which made space for the installation of test equipment. The vehicle was ballasted with a data acquisitions system, transducers, a brake system and weight plates (if necessary) to bring its inertial weight to approximately 1850 pounds (839 kg). The actual weight of the test vehicle was 1850 pounds (839 kg). After ballasting, the vehicles' inertial properties were remeasured.

4. SIGN SUPPORT

The sign support system consisted of two 3 lb/ft (4.47 kg/m) steel u-channel legs 15 ft (4.6 m) long. Three feet (0.9 m) of each leg was buried in NCHRP Report 230 S-2 weak soil (sand). Attached to the 2 legs was a 5-ft high by 4-ft (1.5-m by 1.2-m) wide aluminum sign panel. The panel was a 0.125-in (3-mm) thick aluminum sheet and was installed 7 ft (2.1 m) above ground. The two legs were installed 2.3 ft (0.7 m) apart. The whole sign support system was assembled and inserted in a hole in the weak soil. The hole was backfilled in 6-in (0.152-m) lifts and compacted until the final grade was reached. Figure 1 is a drawing of the sign support system.

5. TEST RESULTS - 20 MI/H (8.9 M/S), TEST 92F012

The test vehicle was accelerated to 20.6 mi/h (30.3 ft/s (9.2 m/s)) prior to impacting the sign support. The centerline of the test vehicle was aligned with the mid point between the two sign legs.

The bumper made contact with both sign legs and began to collapse. The brunt of the impact occurred to the inside edge of the left bumper support and on the right bumper support. The u-channel legs began to bow away from the vehicle. The vehicle continued forward, pushing the u-channel legs through the weak soil. The required force to break or flatten the u-channel was higher than the resisting force of the weak soil therefore the weak soil gave way before the u-channel and the vehicle forced the u-channel to plow through the sand. Once the u-channel had pushed through the sand as far as possible the force required still could not be obtained because to much more energy was consumed plowing through the weak soil. The u-channel bent backwards but never flattened and the vehicle climbed the u-channel legs of the sign, pitching upward approximately 15 degrees. The vehicle then rolled back down the legs and came to rest in front of the leaning sign system. The sign system remained in the weak soil leaning back 60 degrees. The u-channel legs pushed through the sand approximately 18 in (0.457 m). The u-channel was pulled from the ground and a bend was recorded 12 in (0.305 m) below the ground line.

Damage to the vehicle consisted of minor damage to the bumper and grill. The majority of the damage occurred on the left side of the vehicle where the sign made contact with the inside of the bumper support rather than on the bumper support. None of the sign components impaled the occupant compartment.

Damage to the sign system consisted of two bent and twisted u-channel legs. Significant bends were recorded 12 in (0.3 m) below ground level. The panel was in good condition after the test. None of the sign system components impaled the vehicle during the crash event.

The occupant impact velocity using the 2-ft (0.6-m) flail space model outlined in NCHRP Report Number 230, was determined to be 20.3 ft/s (6.2 m/s). The occupant impact velocity was reached 0.194 s into the crash event. The ridedown acceleration was 1.9 g's. The peak force (300 Hz data) for the impact event was 6.9 g's (12.7 kips (56.4 kN)). Because the sign system stopped the vehicle, the vehicle change in velocity is equal to the impact velocity. The actual vehicle velocity change calculated by integration of the on-board accelerometers was 26.4 ft/s (8.1 m/s).

Photographs taken during the impact event are presented in figure 2. A summary of the impact conditions and the test results is presented in figure 3. Figures 4 through 7 are plots of data collected during the test. Pre- and post-test photographs of the vehicle and sign support system are presented in figures 8 through 11. Figure 12 depicts a sketch of the measured vehicle crush.

6. CONCLUSION

The test results indicate that the small sign support system does not meet all of the applicable criteria for the low-speed test in weak soil. There was no occupant compartment intrusion and no significant stub remaining after the test, however the occupant impact velocity was 20.3 ft/s (6.2 m/s) which is not less than or equal to the 16 ft/s (4.9 m/s) limit specified by the FHWA.

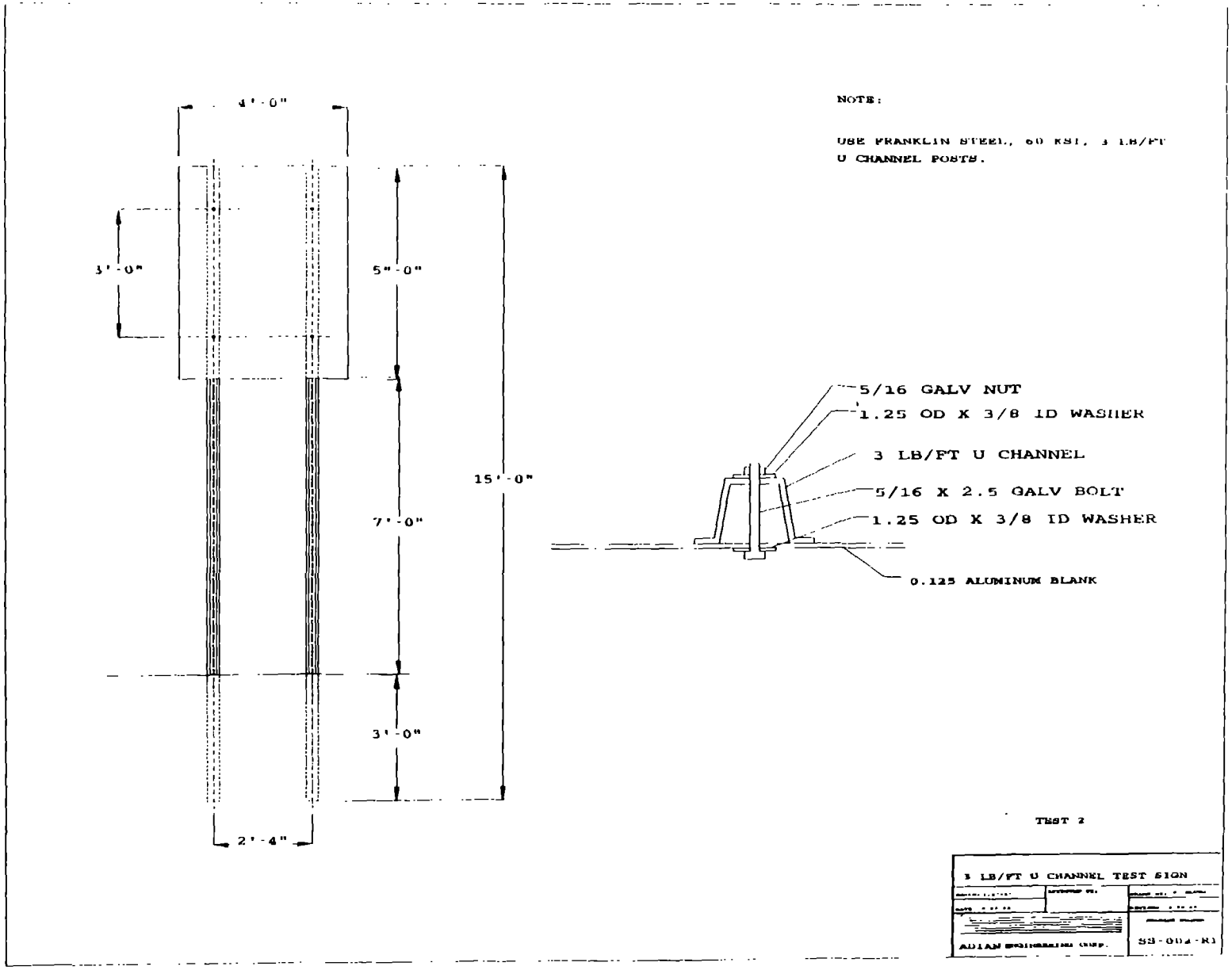


Figure 1. Sketch of small sign support.

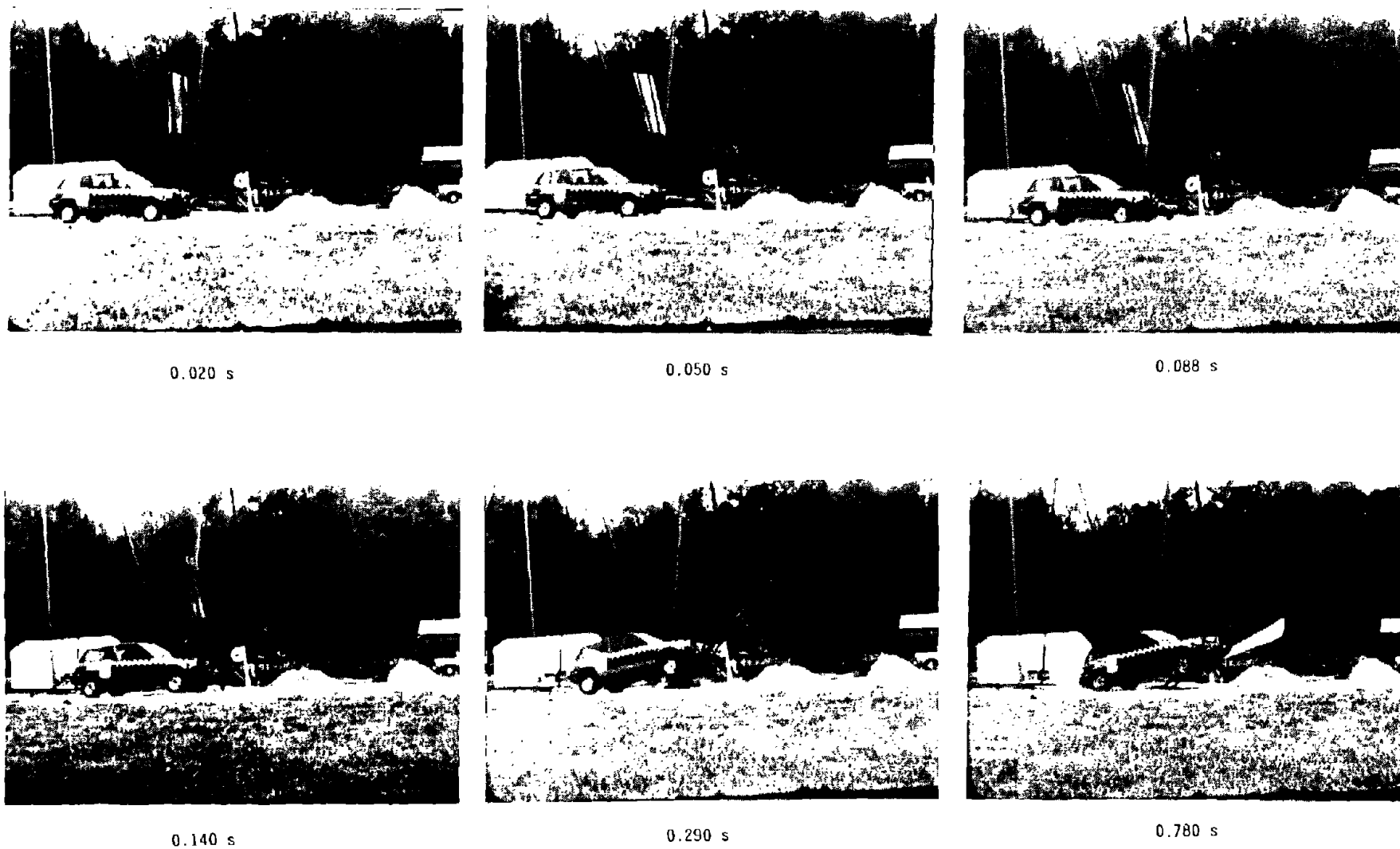
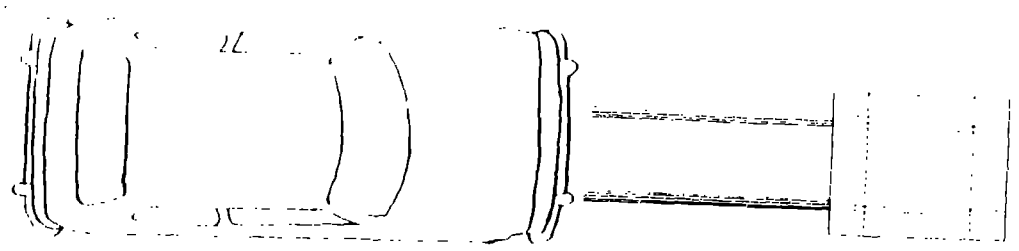


Figure 2. Test photographs during impact, test 92F012.



Test number..... 92F012

Date..... May 28, 1992

Test vehicle.....1985 Honda Civic

Vehicle weight... .....1850 lb (839 kg)

Test article.....Small Sign Support

Material.....3 lb/ft u-channel
2-Leg, 2-Hit

Embedment depth.....3 feet

Panel type.....5 foot by 4 foot by 0.125 thick aluminum sheet

Height.....12 feet

Foundation.....S-2 Weak Soil

Impact speed.....30.3 ft/s (9.2 m/s)

Impact angle .....0 degrees

Impact location.....Head on, centerline

Vehicle analysis:	Observed	Design/Limit
Longitudinal:		
Occupant Delta V at 2 ft	20.3 ft/s	≤16 ft/s
Ridedown Acceleration	1.9 g's	15/20 g's
Lateral:		
Occupant Delta V at 1 ft	no contact	no spec
Ridedown Acceleration	no contact	no spec
Peak 50 msec acceleration		
Longitudinal	4.5 g's	
Lateral	NA	

Vehicle Damage (TAD).....12-FC-2
(VDI).....12FDEN1

Vehicle crush.....3.0 inches

Vehicle velocity change.....26.4 ft/s

Exit angle.....no exit

Figure 3. Summary of test 92F012.

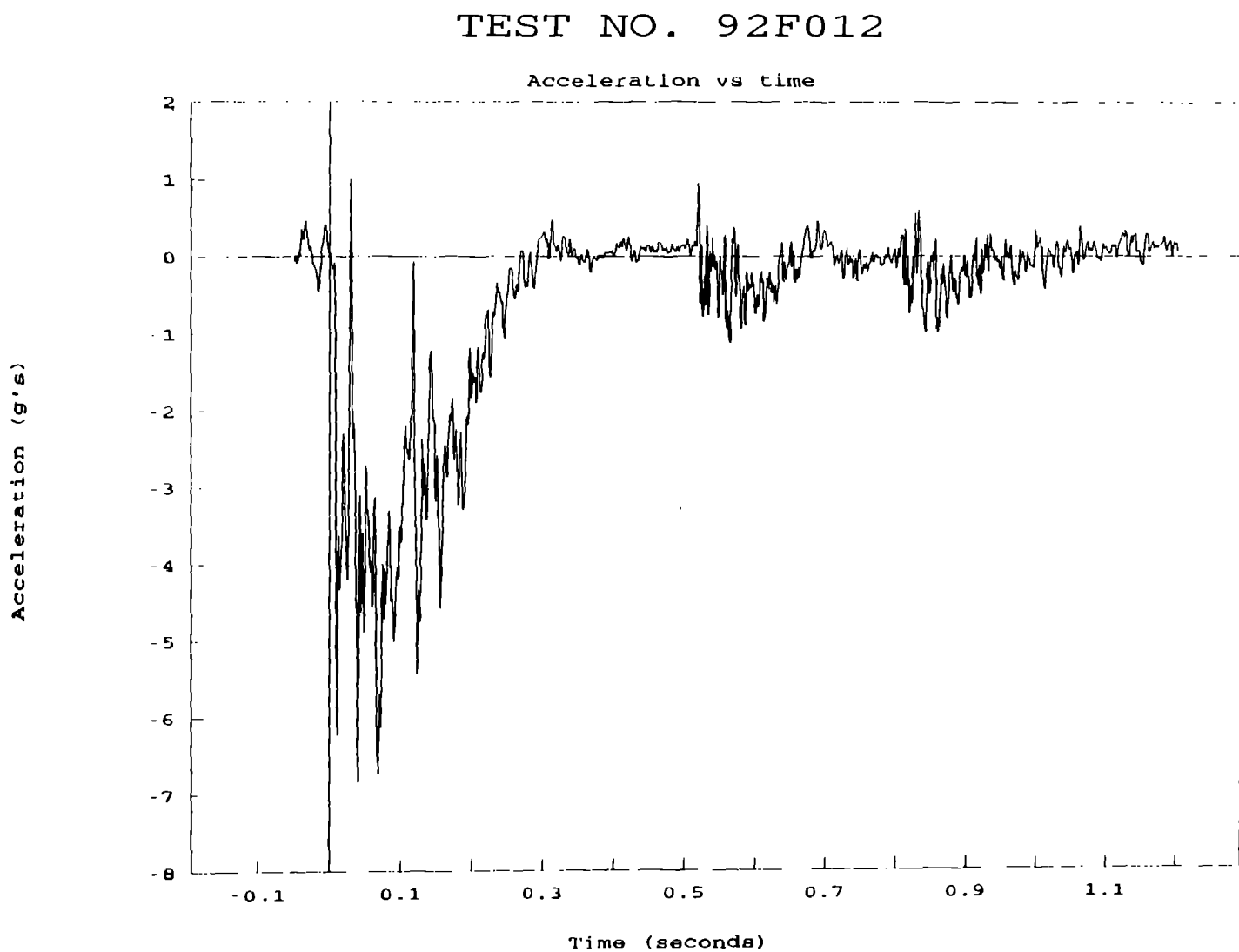


Figure 4. Acceleration versus time, X-axis, test 92F012.

TEST NO. 92F012

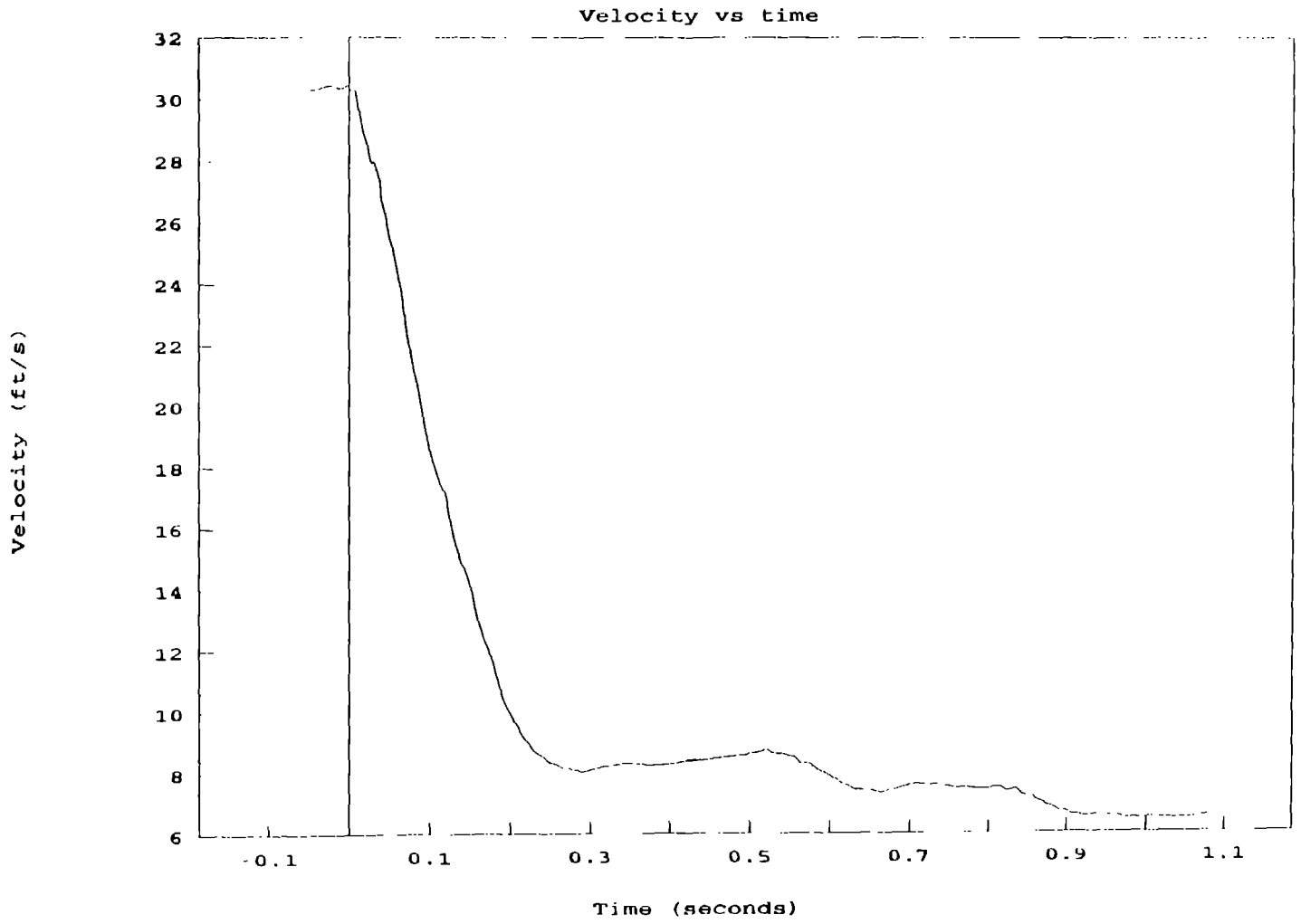


Figure 5. Velocity versus time, X-axis, test 92F012.

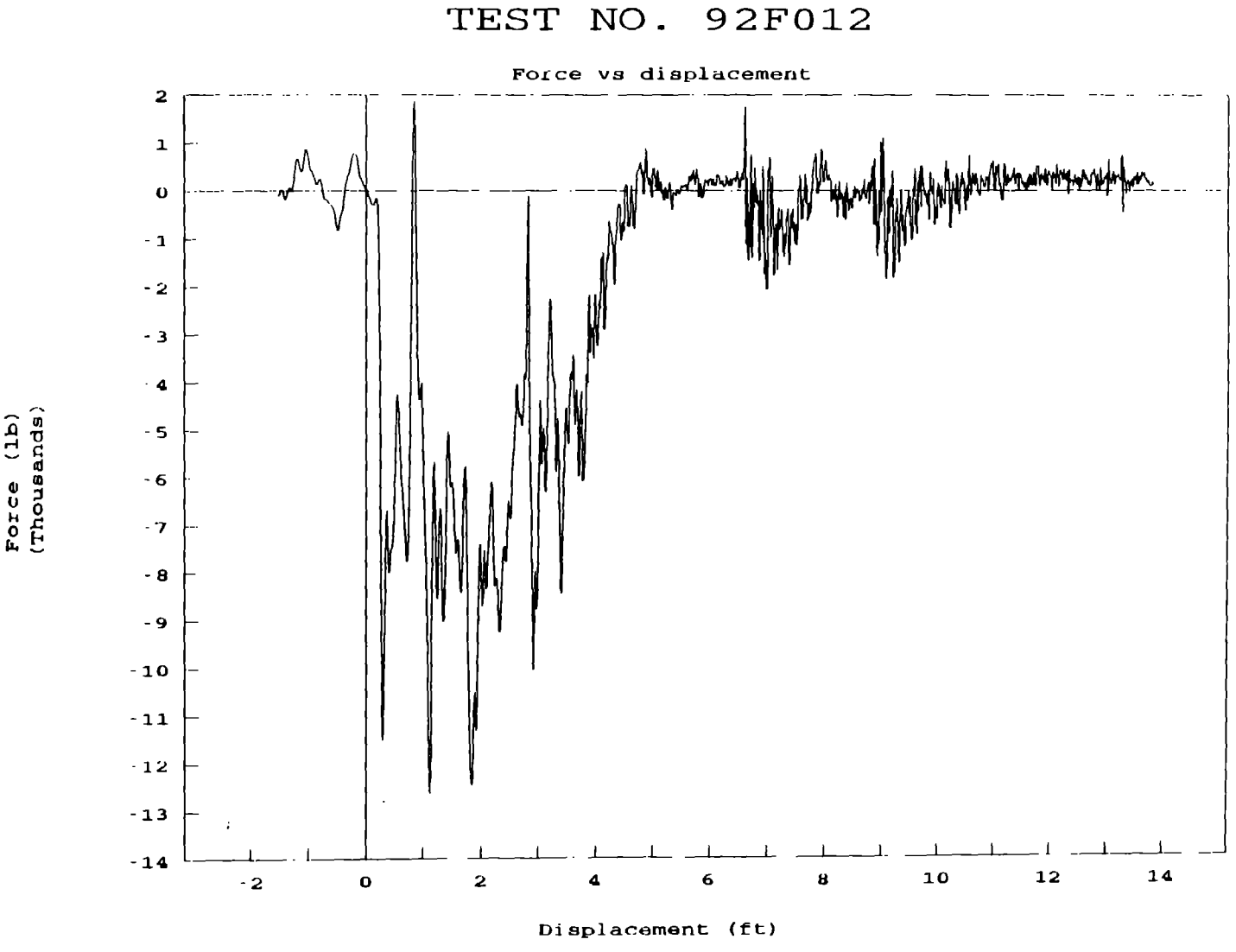


Figure 6. Force versus displacement, X-axis, test 92F012.

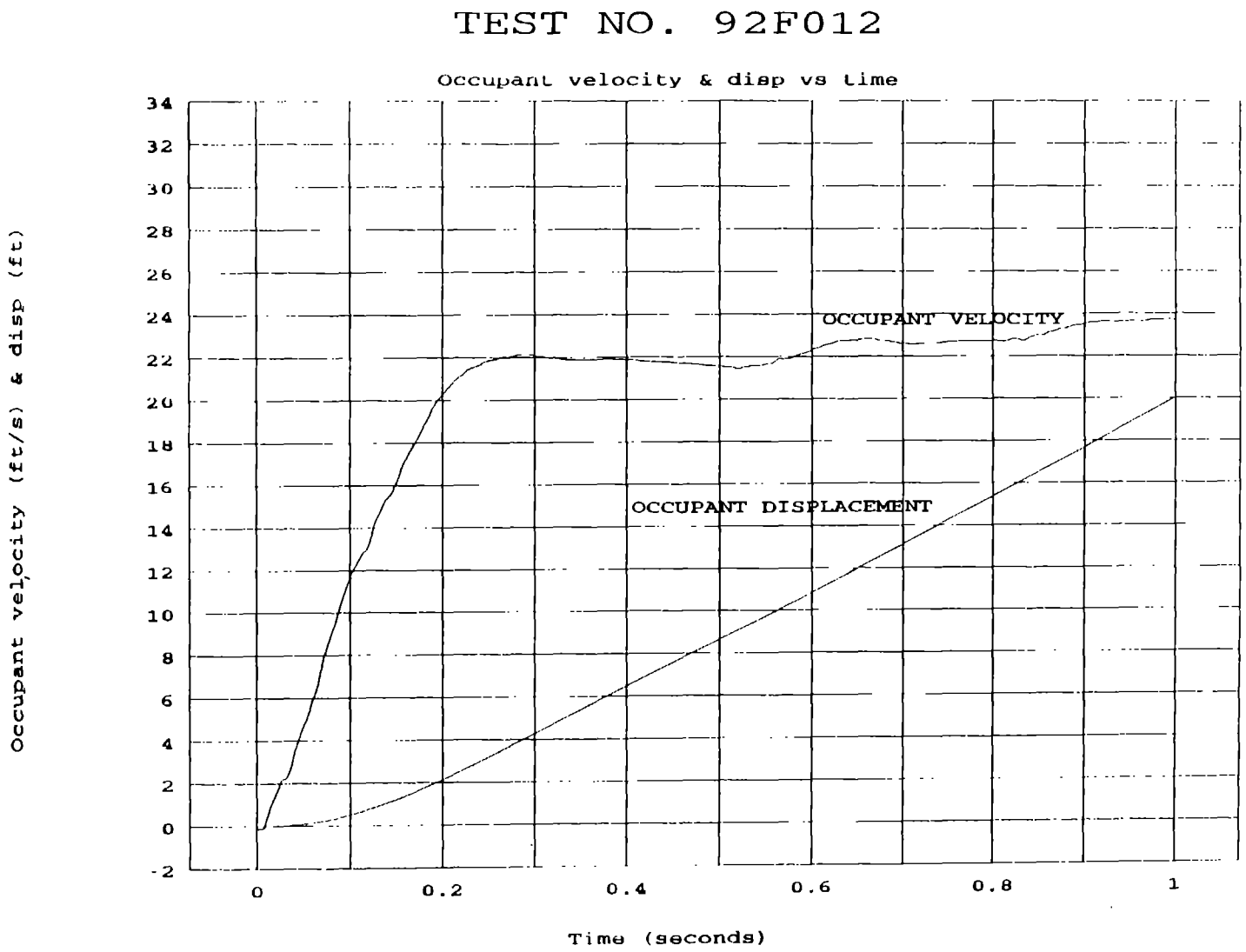


Figure 7. Occupant velocity and relative displacement versus time, X-axis, test 92F012.

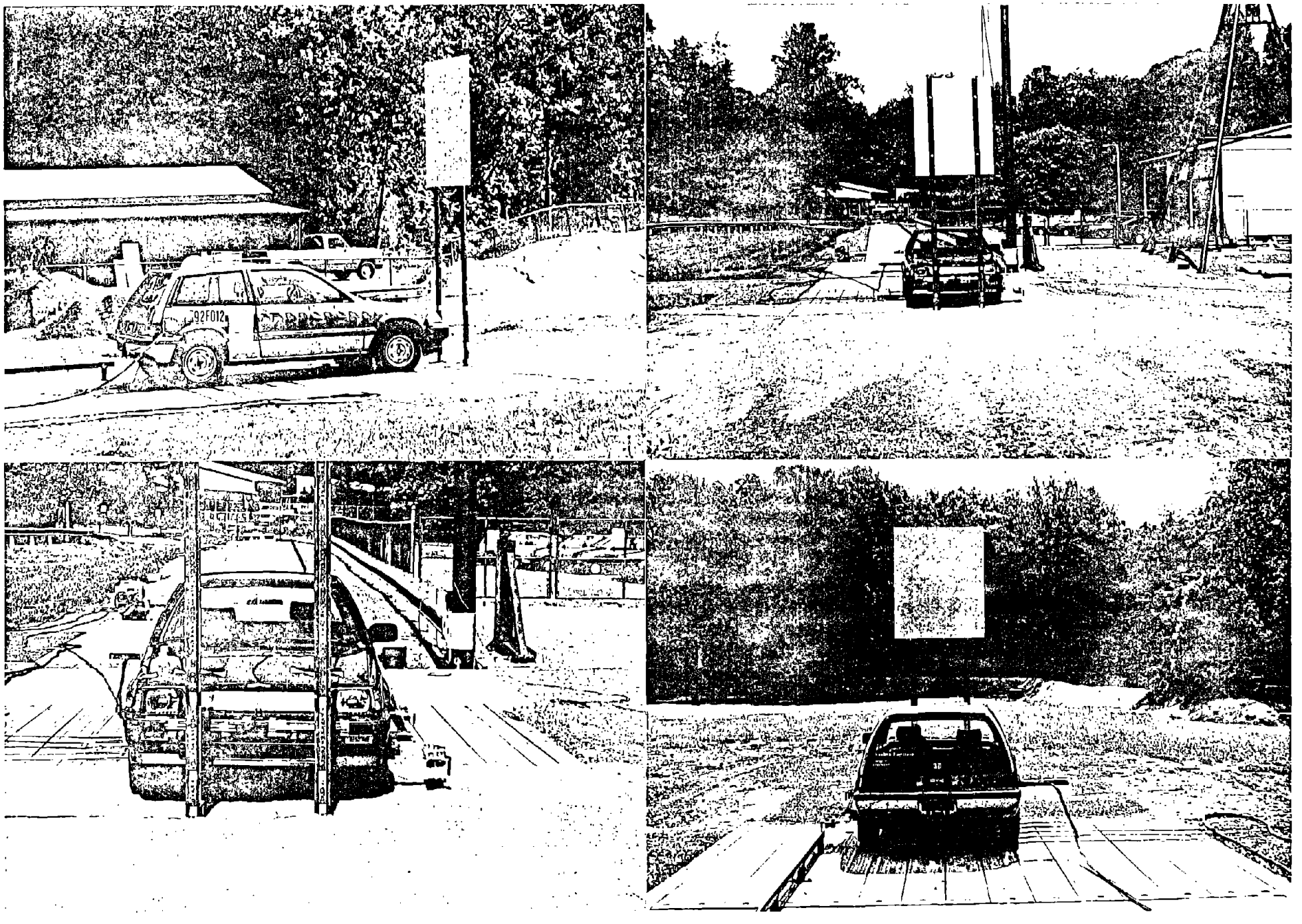


Figure 8. Pretest photographs of test 92F012.

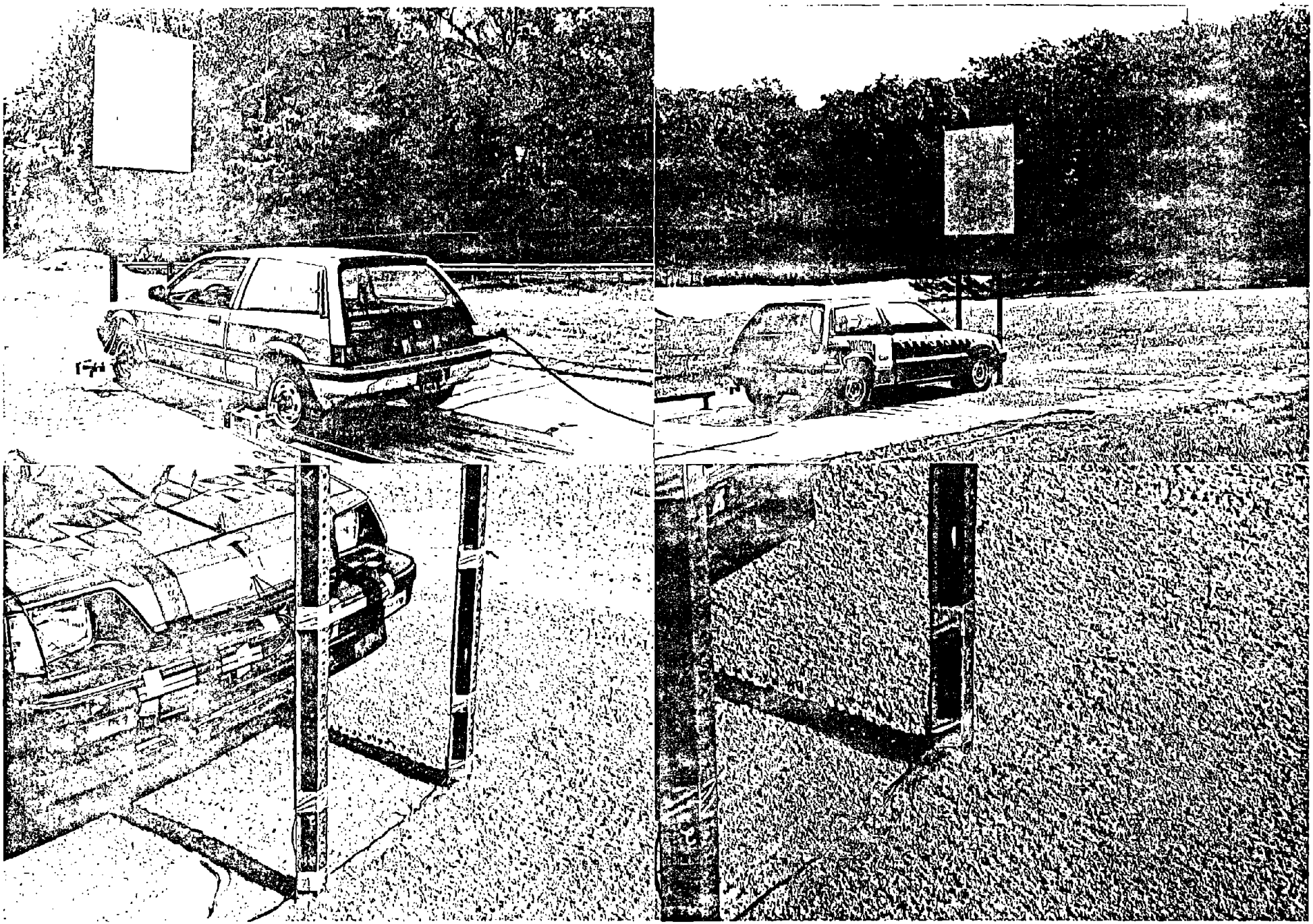


Figure 9. Additional pretest photographs of test 92FO12.

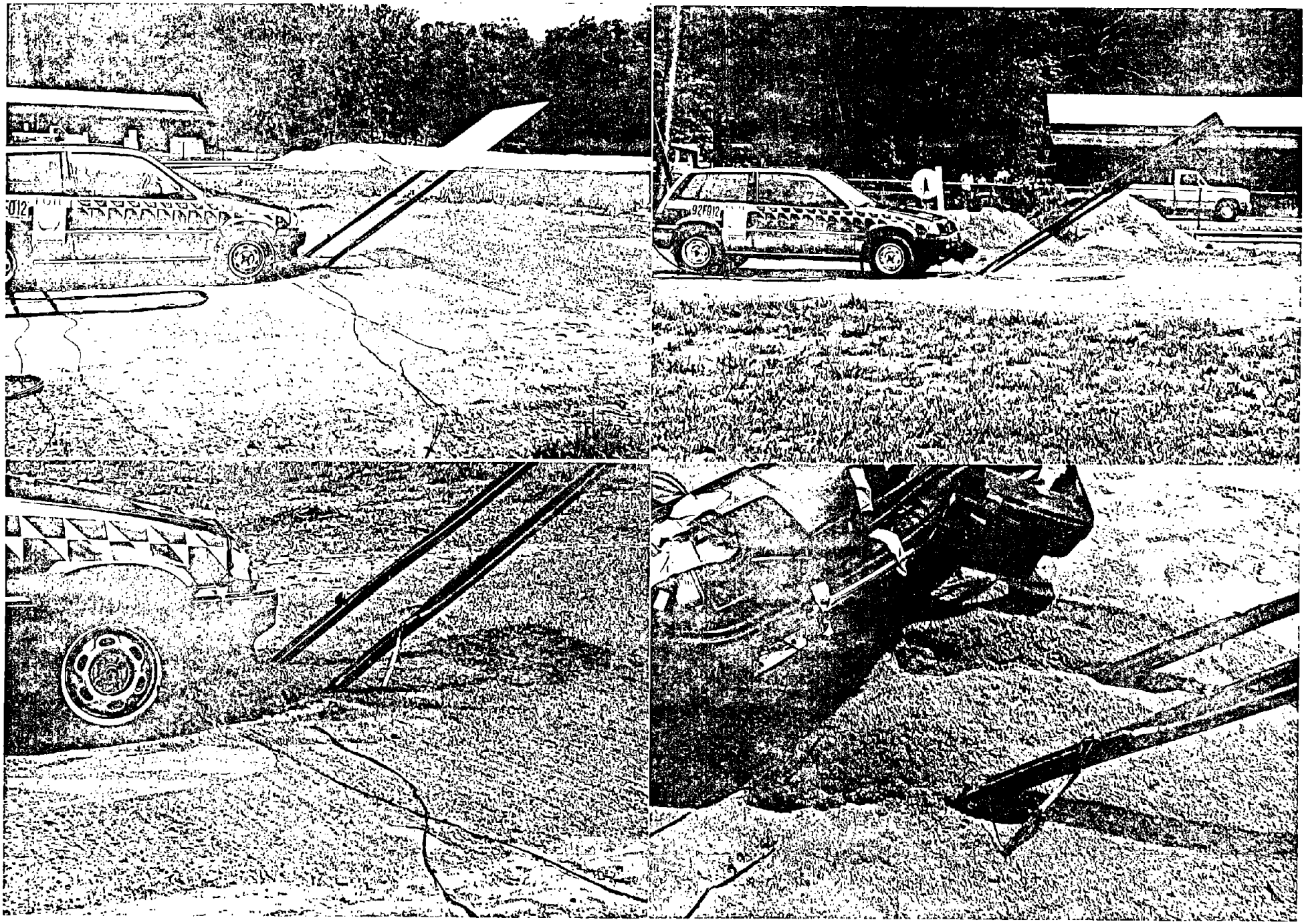


Figure 10. Post-test photographs of test 92F012.

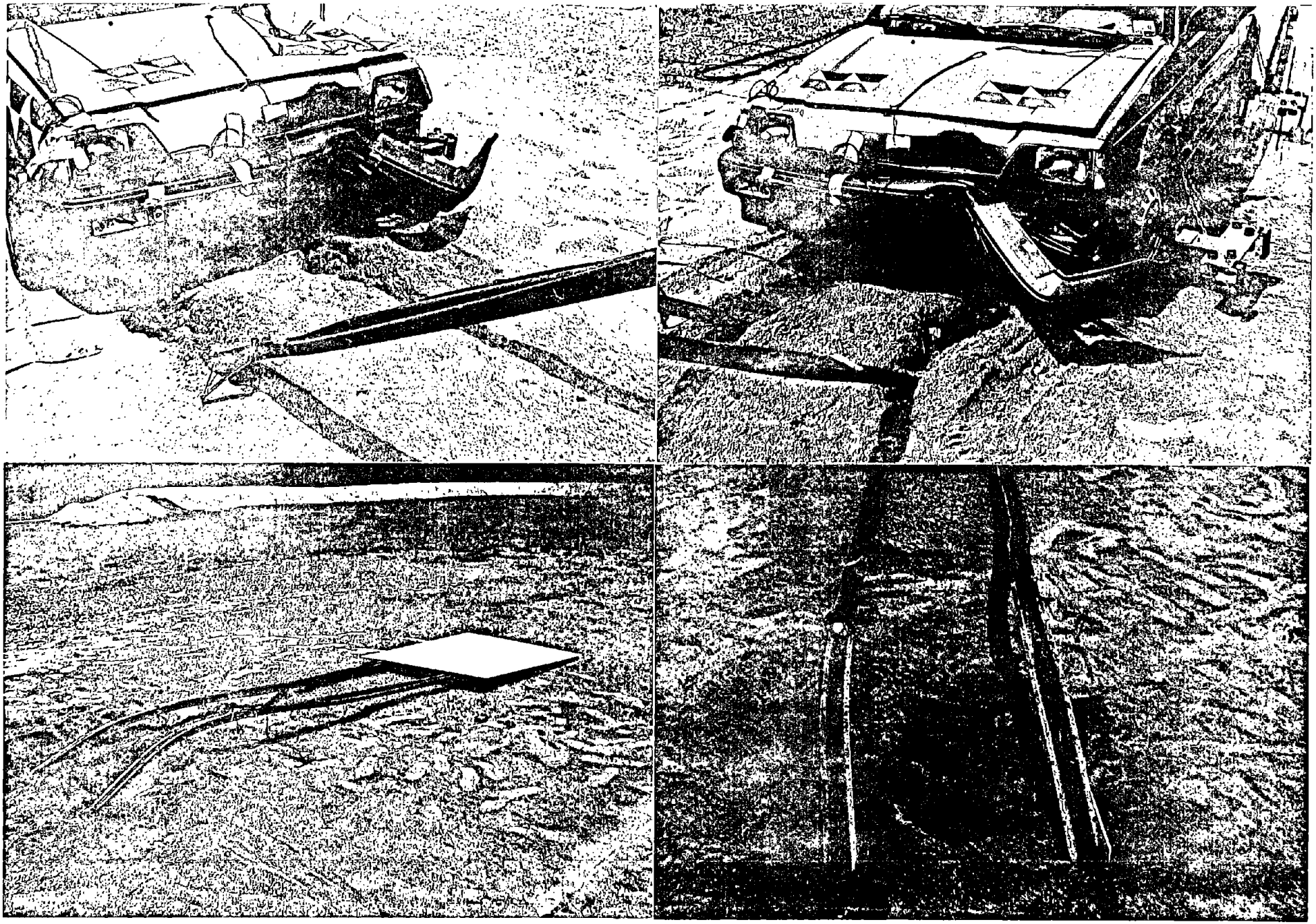
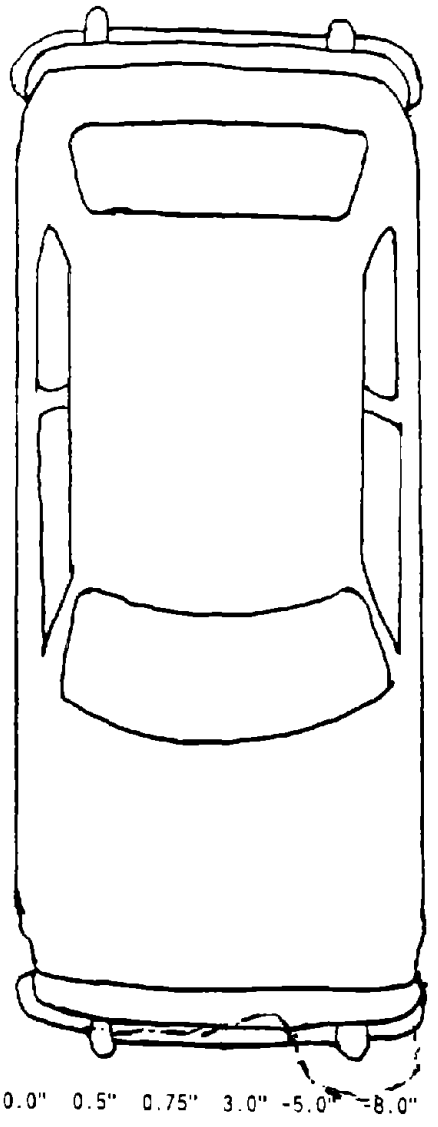


Figure 11. Additional post-test photographs of test 92F012.



------- Post test

1 in = 2.54 cm

Figure 12. Sketch of vehicle crush, test 92F012.

8. REFERENCES

(1) Michie, Jarvis D., "Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances," National Cooperative Highway Research Program Report Number 230, March 1981.