



PB94-186582

Publication No. FHWA-RD-93-107

July 1994

Testing of Small and Large Sign Support Systems FOIL Test Number: 92F019




U.S. Department of Transportation
Federal Highway Administration

Research and Development
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Approved by
U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161



1. Report No. FHWA-RD-93-107	2.  PB94-186582	3.	
4. Title and Subtitle TESTING OF SMALL AND LARGE SIGN SUPPORT SYSTEMS FOIL TEST NUMBER(S): 92F019		5. Report Date July 1994	6. Performing Organization Code
7. Author(s) Christopher M. Brown		8. Performing Organization Report No.	
9. Performing Organization Name and Address Advanced Technology & Research Corp. 14900 Sweitzer Lane Laurel, MD 20707		10. Work Unit No. (TRAIS) 3A5f3142	11. Contract or Grant No. DTFH61-91-Z-00002
12. Sponsoring Agency Name and Address Office of Safety and Traffic Operations R&D Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296		13. Type of Report and Period Covered Test Report, July 1992	
15. Supplementary Notes Contracting Officer's Technical Representative (COTR) - Richard King, HSR-20		14. Sponsoring Agency Code	
16. Abstract <p>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 92F019. The vehicle used for this test was a 1984 Honda Civic. The purpose of this test was to evaluate the low-speed safety performance of a triple legged steel 2 lb/ft (2.98 kg/m) 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. The test results indicate that the 2 lb/ft (2.98 kg/m) u-channel sign support system does not meet all of the applicable criteria for roadside safety appurtenances in weak soil specified by the FHWA.</p>			
17. Key Words Acceleration, occupant impact velocity, weak soil, u-channel, vehicle, FOIL.		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 19	22. Price

1989-08-01

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS					APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol	Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH									
in	inches	25.4	millimeters	mm	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	km	kilometers	0.621	miles	mi
AREA									
in ²	square inches	645.2	square millimeters	mm ²	mm ²	square millimeters	0.0016	square inches	in ²
ft ²	square feet	0.093	square meters	m ²	m ²	square meters	10.764	square feet	ft ²
yd ²	square yards	0.836	square meters	m ²	m ²	square meters	1.195	square yards	ac
ac	acres	0.405	hectares	ha	ha	hectares	2.47	acres	mi ²
mi ²	square miles	2.59	square kilometers	km ²	km ²	square kilometers	0.386	square miles	
VOLUME									
fl oz	fluid ounces	29.57	milliliters	ml	ml	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	l	l	liters	0.264	gallons	gal
ft ³	cubic feet	0.028	cubic meters	m ³	m ³	cubic meters	35.71	cubic feet	ft ³
yd ³	cubic yards	0.765	cubic meters	m ³	m ³	cubic meters	1.307	cubic yards	yd ³
NOTE: Volumes greater than 1000 l shall be shown in m ³ .									
MASS									
oz	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
lb	pounds	0.454	kilograms	kg	kg	kilograms	2.202	pounds	lb
T	short tons (2000 lb)	0.907	megagrams	Mg	Mg	megagrams	1.103	short tons (2000 lb)	T
TEMPERATURE (exact)									
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C	°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
ILLUMINATION									
fc	foot-candles	10.76	lux	l	lx	lux	0.0929	foot-candles	fc
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²	cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS									
lbf	poundforce	4.45	newtons	N	N	newtons	0.225	poundforce	lbf
psi	poundforce per square inch	6.89	kilopascals	kPa	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.

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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 92F019. 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 triple legged steel 2 lb/ft (2.98 kg/m) 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.

Test Number	Test Date	Test Vehicle	Test Weight (lb)	Test Speed (mi/h)	Test Article Description	Impact Location
92F019	7-16-92	'85 Honda Civic	1860	20	3 leg steel 2 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 lb (839 kg). The actual weight of the test vehicle was 1860 lb (844 kg). After ballasting, the vehicles' inertial properties were remeasured.

4. SIGN SUPPORT

The sign support system consisted of three 2 lb/ft (2.98 kg/m) steel u-channel legs 15 ft (4.6 m) long. Three ft (0.9 m) of each leg was buried in NCHRP Report 230 S-2 weak soil (sand). Attached to the 3 legs was a 4-ft high by 5-ft 8-in (1.2-m by 1.7-m) wide aluminum sign panel. The panel was a 0.125-in (3.2-mm) thick aluminum sheet and was installed 7 ft (2.1 m) above ground. The three legs were installed 1.7 ft (0.5 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 (152.4-mm) lifts and compacted until the final grade was reached. Figure 1 is a drawing of the sign support system.

5. TEST RESULTS - TEST 92F019

The test vehicle was accelerated to 18.4 mi/h (27 ft/s (8.2 m/s)) prior to impacting the sign support. The centerline of the test vehicle was aligned with the center sign post.

The bumper made contact with all three sign legs and began to collapse. The sign posts made contact with the bumper to the outside edge of each bumper support and at the bumper center. The u-channel legs began to bow away from the vehicle and wrap around the front end of 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 flattening or breakaway force required still could not be obtained because too much energy was consumed plowing through the weak soil. The u-channel bent backwards but never flattened. The u-channel legs pushed through the sand approximately 18 in (457.2 mm). The u-channel began pushing through the weak soil upon impact and continued to push through the weak until the vehicle had come to a stop. The sign system remained in the weak soil leaning back 60 degrees. The u-channel was later pulled from the ground and a bend in each u-channel post was recorded 12 in (304.8 mm) below the ground line.

Damage to the vehicle consisted of minor damage to the bumper and grill. The majority of the damage occurred in the center of the bumper. The occupant compartment was intact after the test.

Damage to the sign system consisted of three bent and twisted u-channel posts. The sign posts were removed from the ground after the test and a bend was recorded 12 in (304.8 mm) below the ground-line. The panel was in good condition after the test. No sign components impaled the occupant compartment.

The occupant impact velocity using the 2-ft (0.6-m) flail space model outlined in NCHRP Report Number 230, was determined to be 17.8 ft/s (5.4 m/s). The occupant impact velocity was reached 0.2015 s into the crash event. The ridedown acceleration was 1.4 g's. The peak force (300 Hz data) for the impact event was 5.3 g's (9.8 kips (43.5 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 20.0 ft/s (6.1 m/s).

Photographs 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 17.8 ft/s (5.4 m/s) which is not less than or equal to the 16 ft/s (4.9 m/s) limit specified by the FHWA.

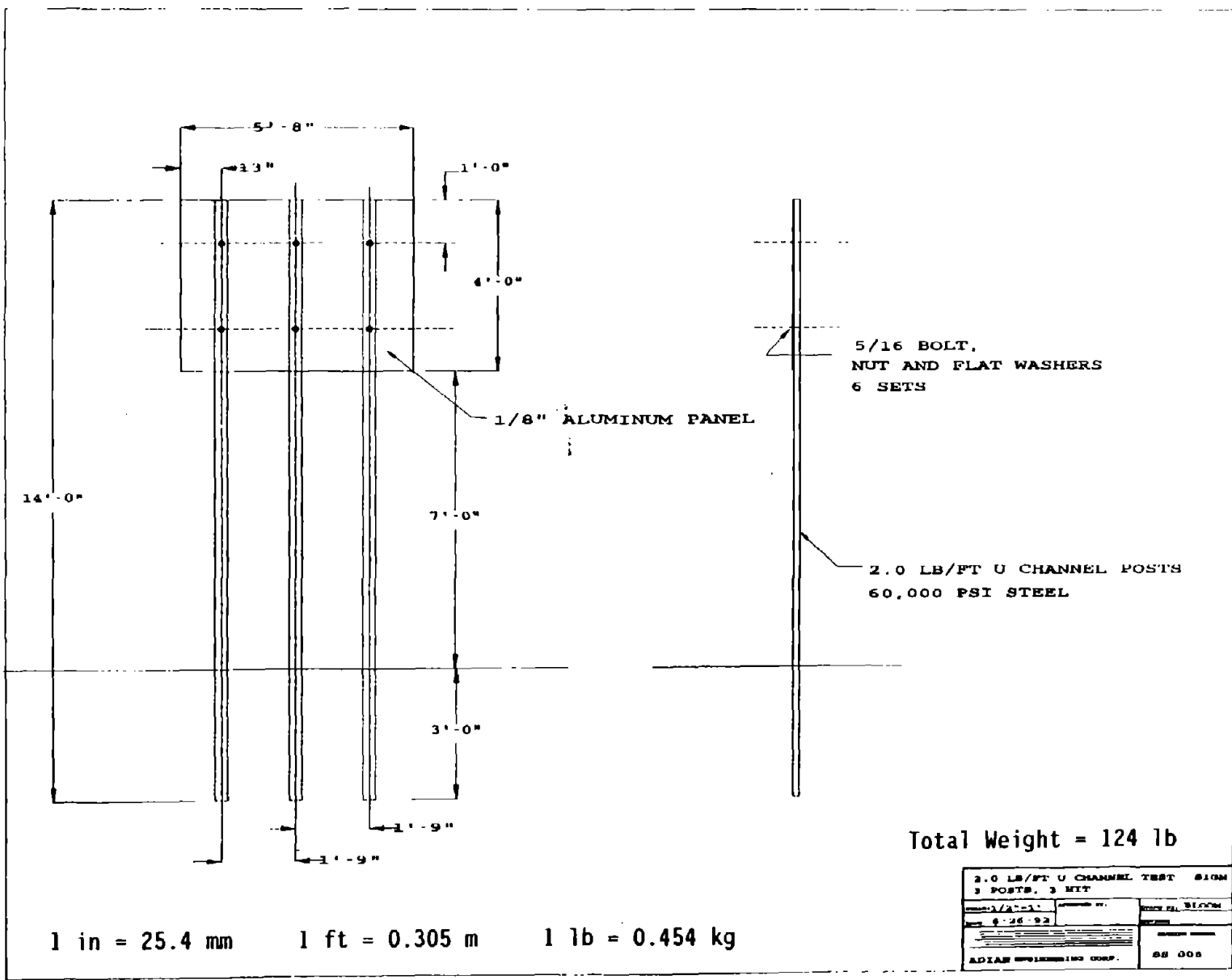
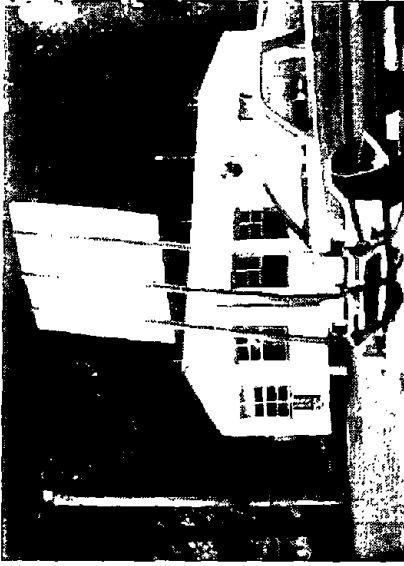
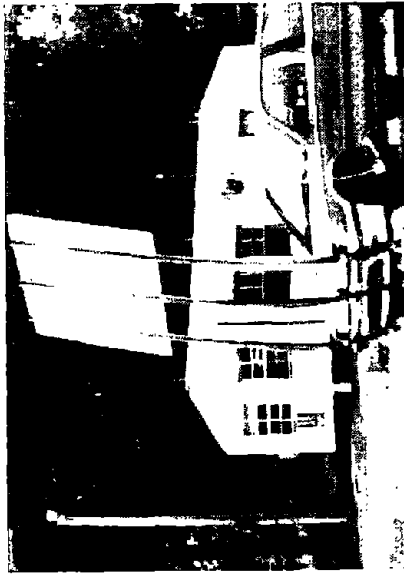


Figure 1. Sketch of small sign support.



0.074 s



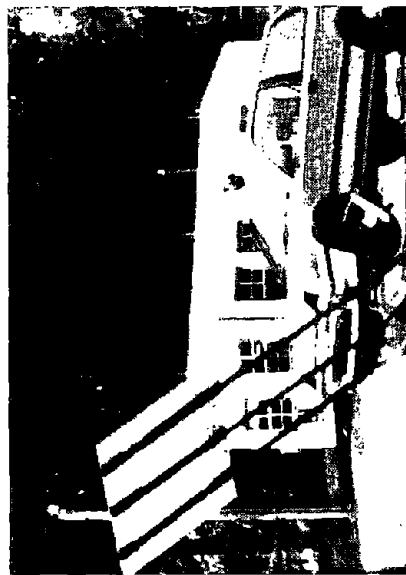
0.050 s



0.020 s



0.644 s

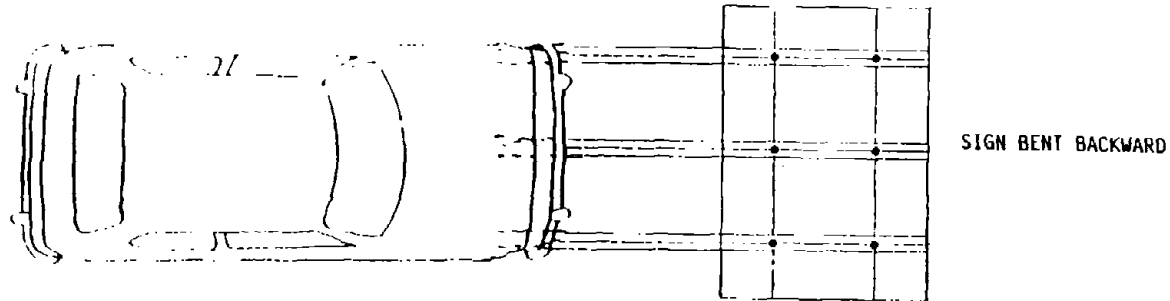


0.290 s



0.130 s

Figure 2. Test photographs during impact, test 92F019.



VEHICLE ROLLED UP SIGN

5

Test number..... 92F019
 Date..... July 16, 1992
 Test vehicle.....1985 Honda Civic
 Vehicle weight.....1860 lb (844 kg)
 Test article.....Small Sign Support
 Material.....2 lb/ft u-channel
 3-Leg, 3-Hit
 Embedment depth......3 feet
 Panel type.....4 ft by 5 ft 8 in aluminum sheet
 Height......11 ft
 Foundation......S-2 Weak Soil
 Impact speed......27 ft/s (8.2 m/s)
 Impact angle......0 degrees
 Impact location.....Head-on, centerline

Vehicle analysis:	<u>Observed</u>	<u>Design/Limit</u>
Longitudinal:		
Occupant Delta V at 2 ft.....	17.8 ft/s	≤16 ft/s
Ridedown Acceleration.....	1.4 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.....		3.7 g's
Lateral.....		NA
Vehicle Damage (TAD).....12-FC-1		
(VDI).....12FDEN1		
Vehicle crush......2 in		
Vehicle velocity change......20.0 ft/s		
Exit angle.....no exit		

1 in = 25.4 mm 1 ft = 0.305 m 1 lb = 0.454 kg

Figure 3. Summary of test 92F019.

TEST NO. 92F019

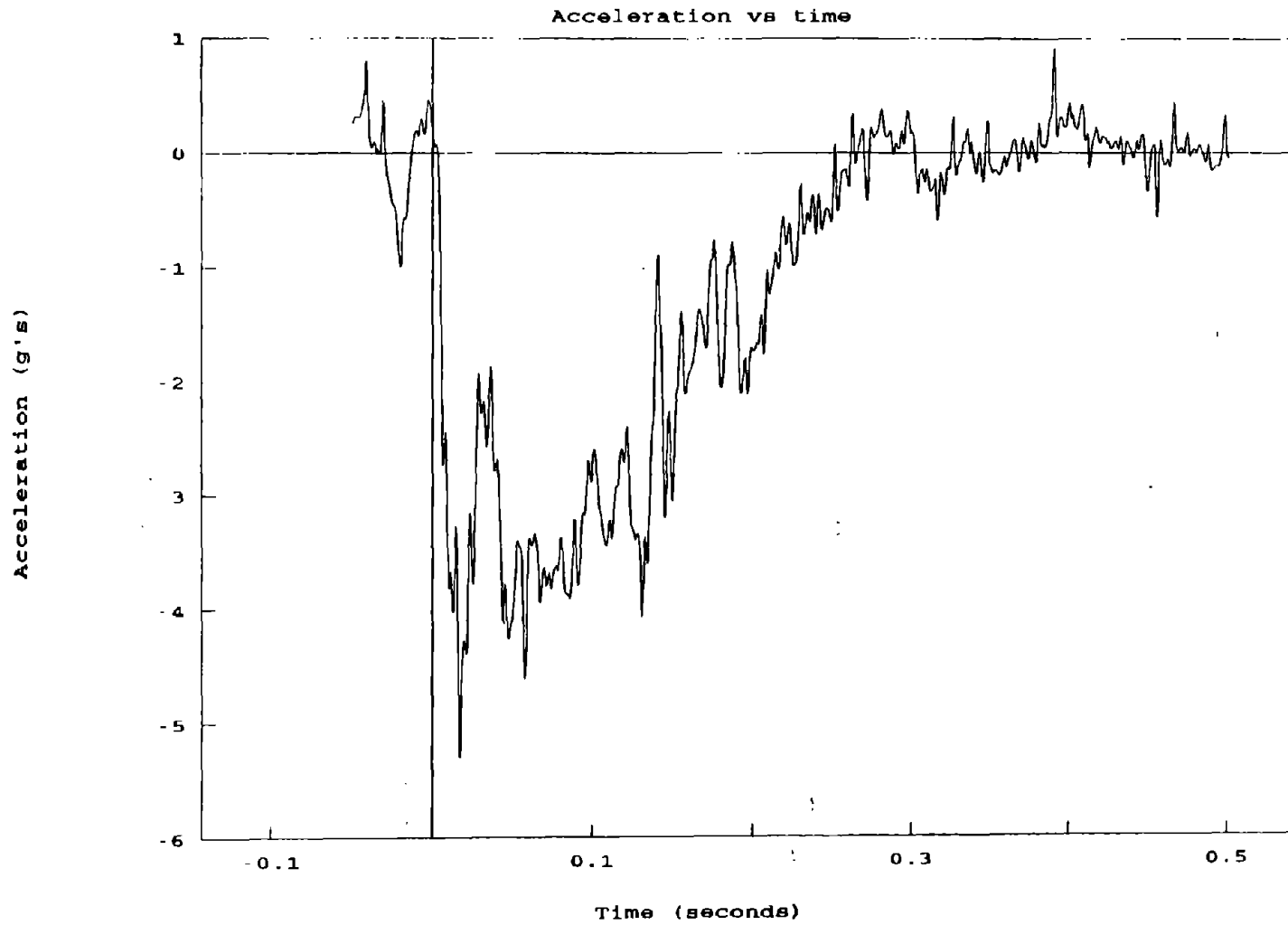
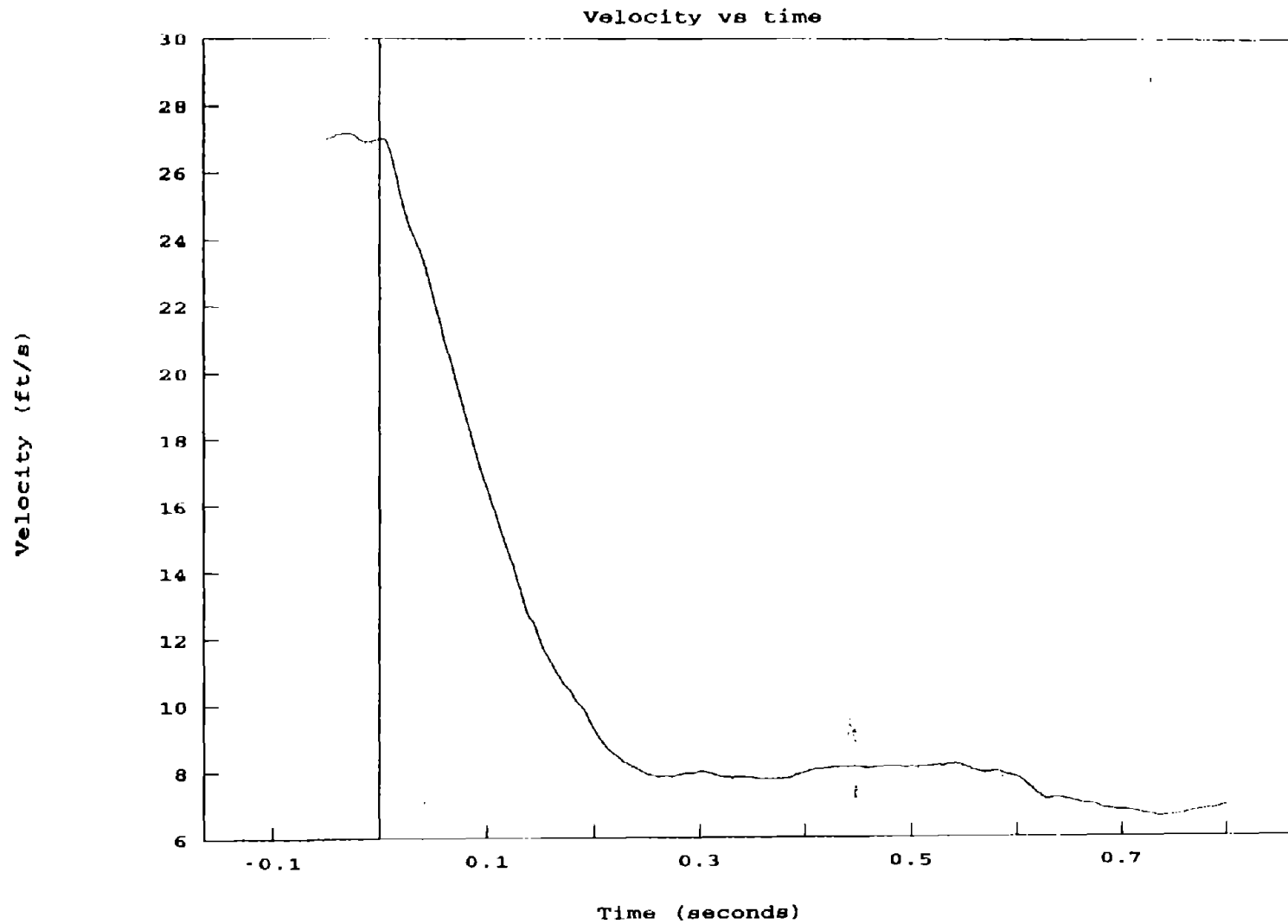


Figure 4. Acceleration versus time, X-axis, test 92F019.

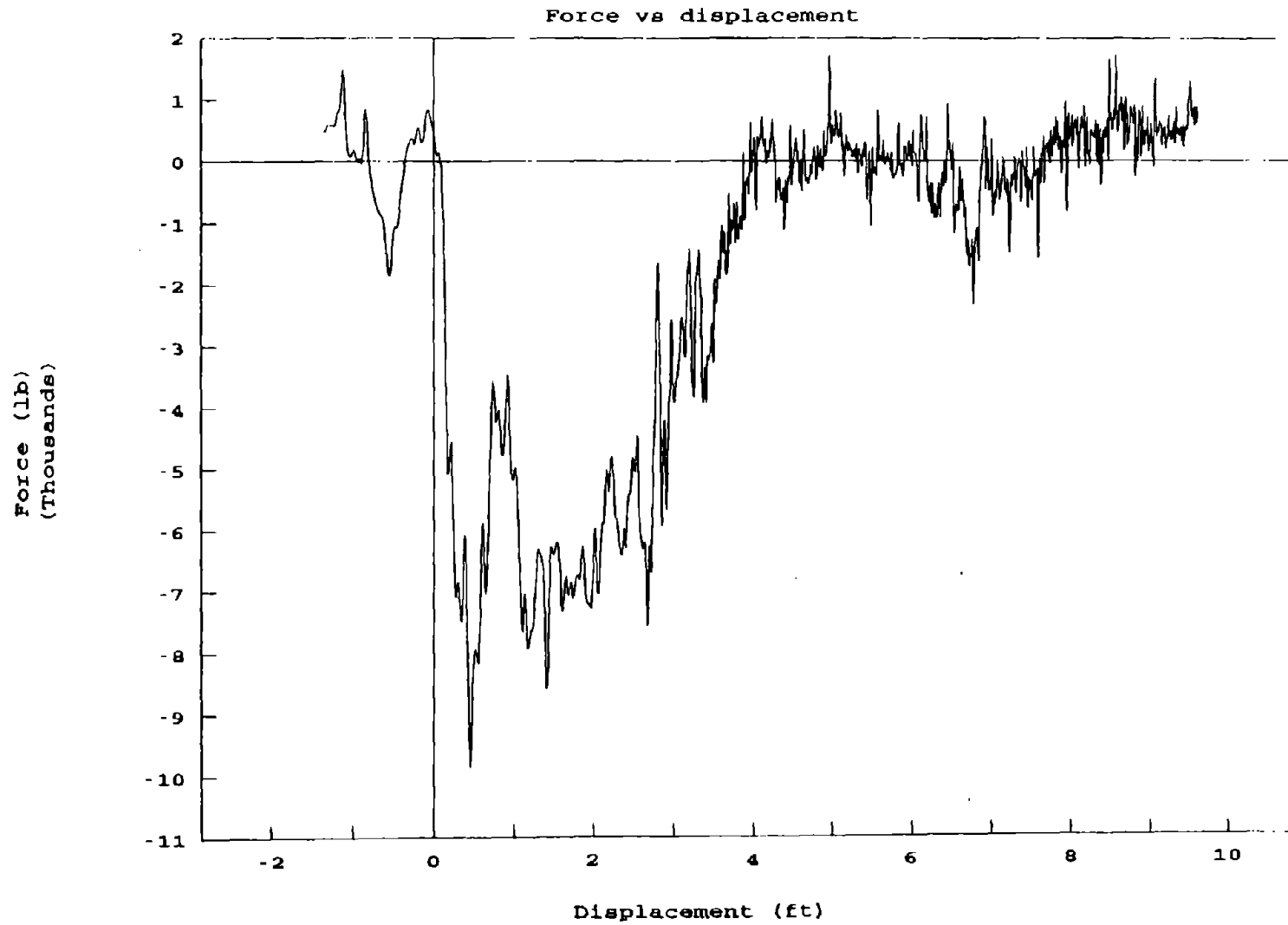
TEST NO. 92F019



1 ft = 0.305 m

Figure 5. Velocity versus time, X-axis, test 92F019.

TEST NO. 92F019

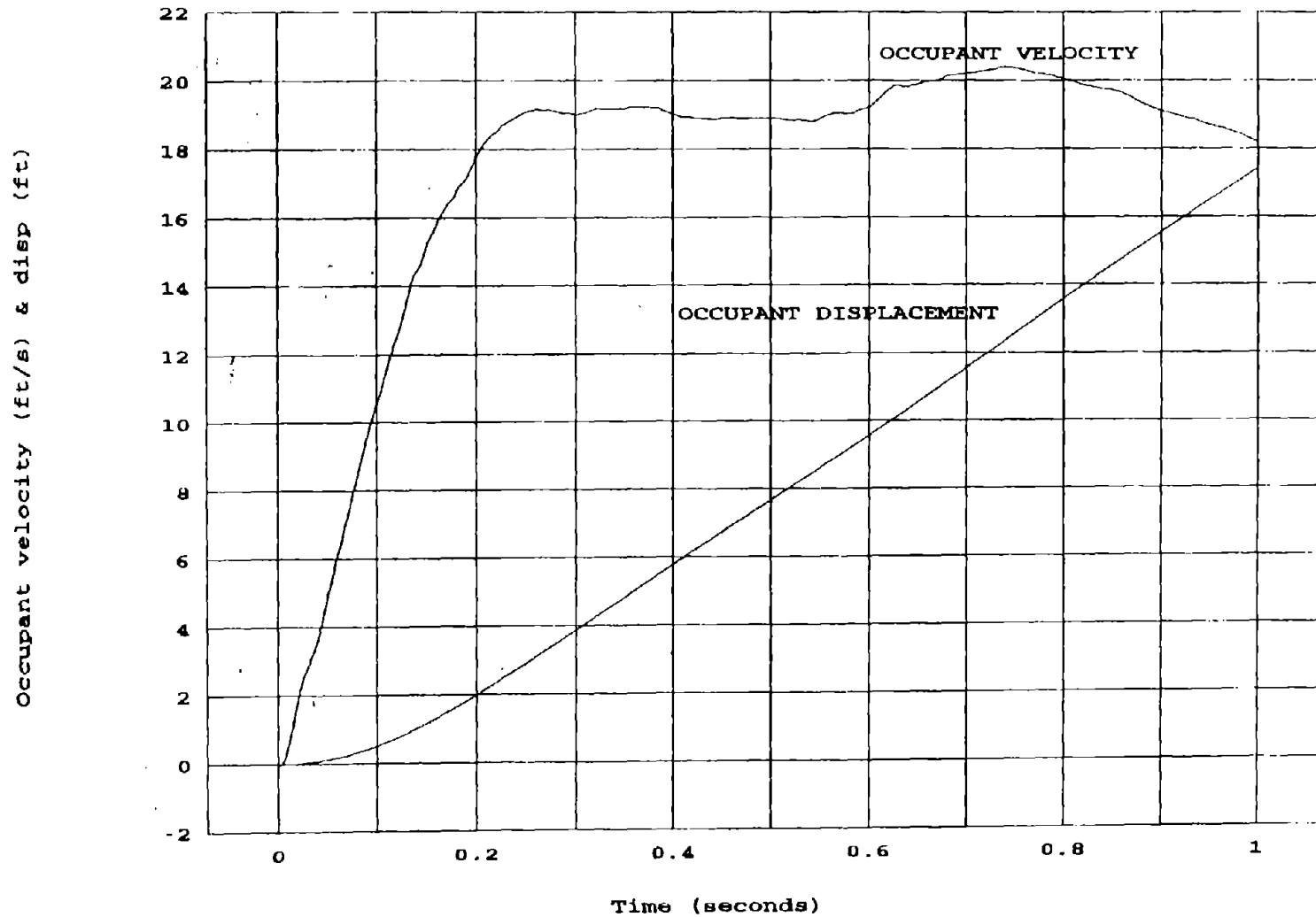


1 lbf = 4.45 N 1 ft = 0.305 m

Figure 6. Force versus displacement, X-axis, test 92F019.

TEST NO. 92F019

Occupant velocity & disp vs time



1 ft = 0.305 m

Figure 7. Occupant velocity and relative displacement versus time, X-axis, test 92F019.

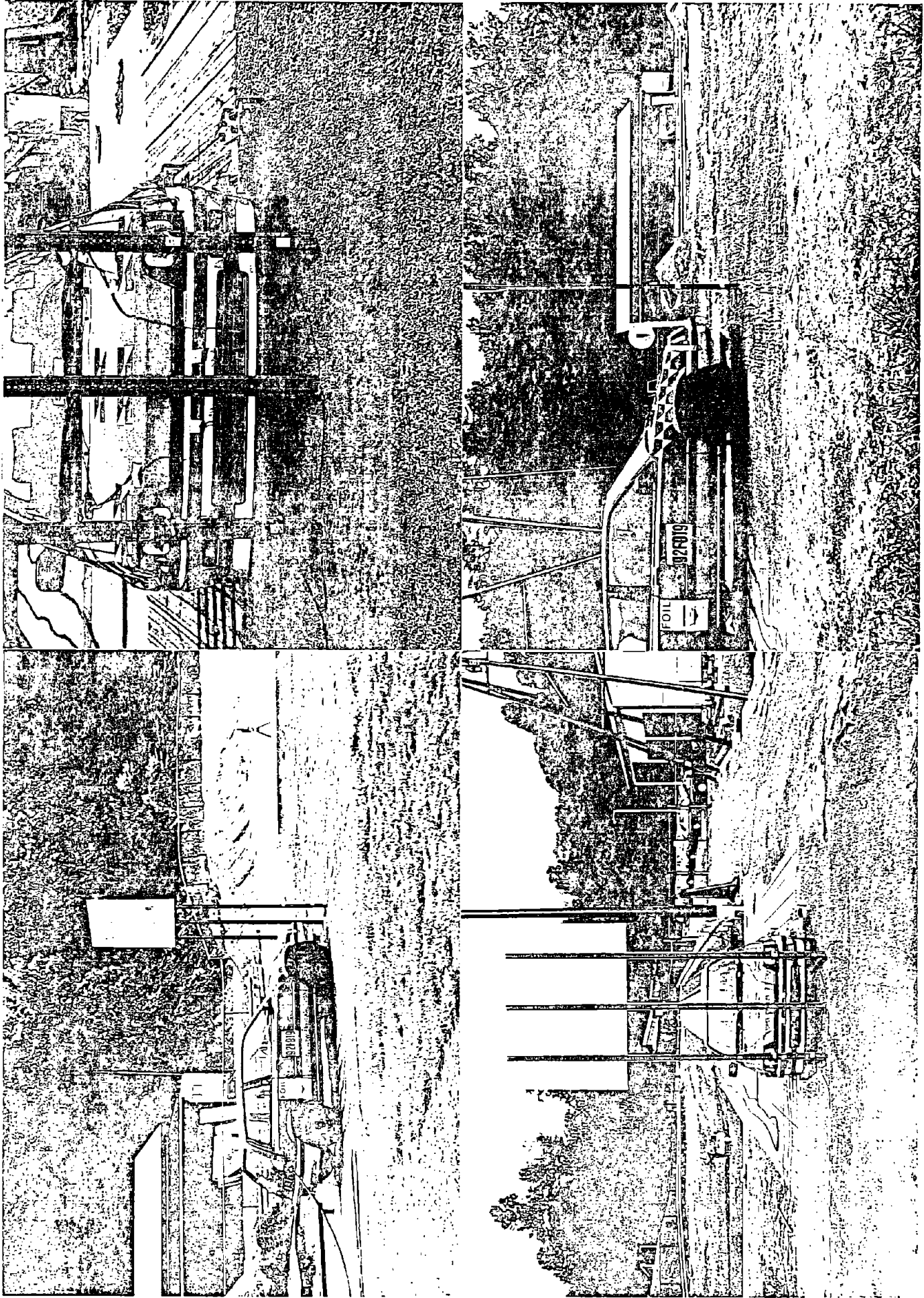


Figure 8. Pretest photographs of test 92F019.

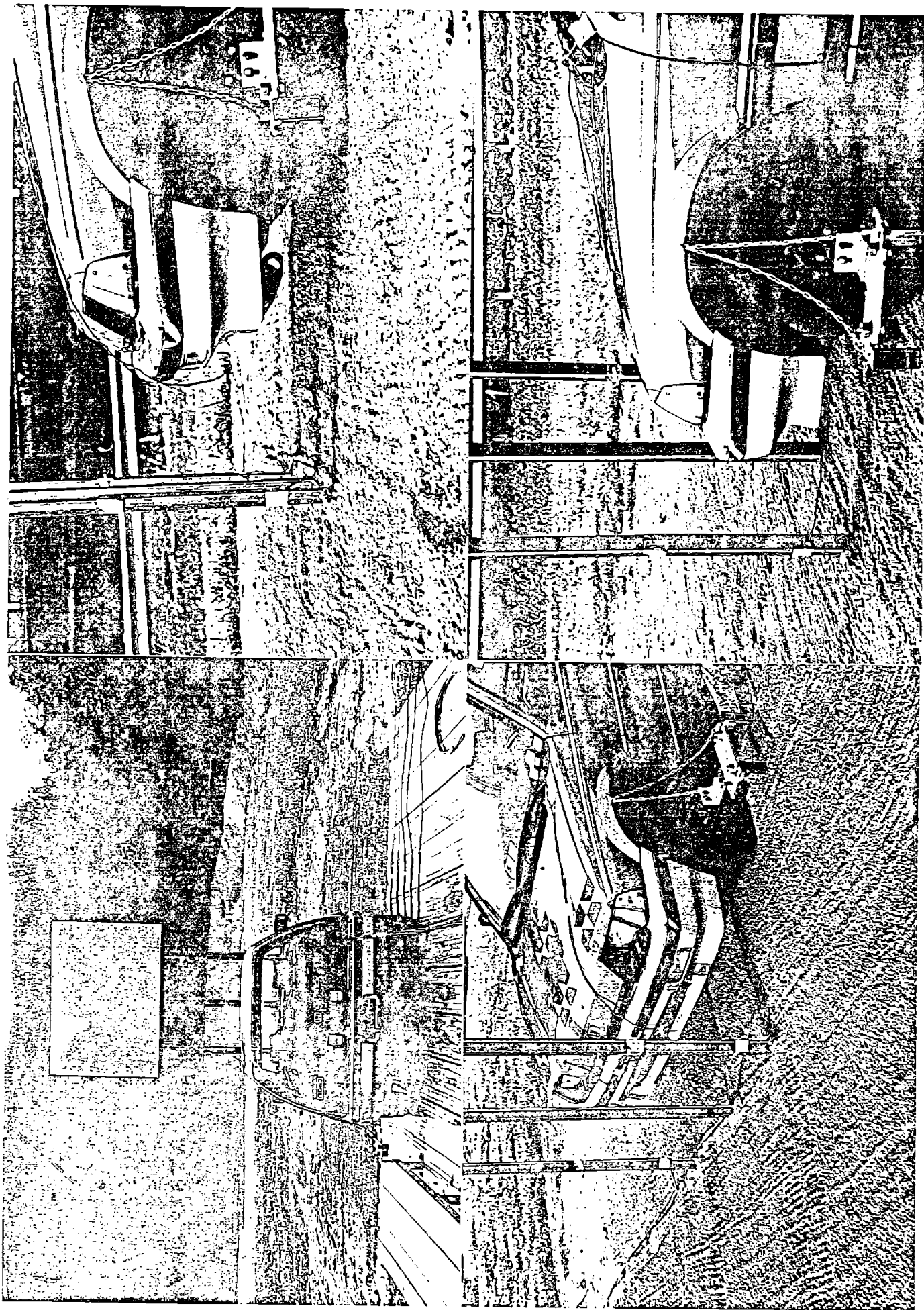


Figure 9. Additional pretest photographs of test 92F019.



Figure 10. Post-test photographs of test 92F019.

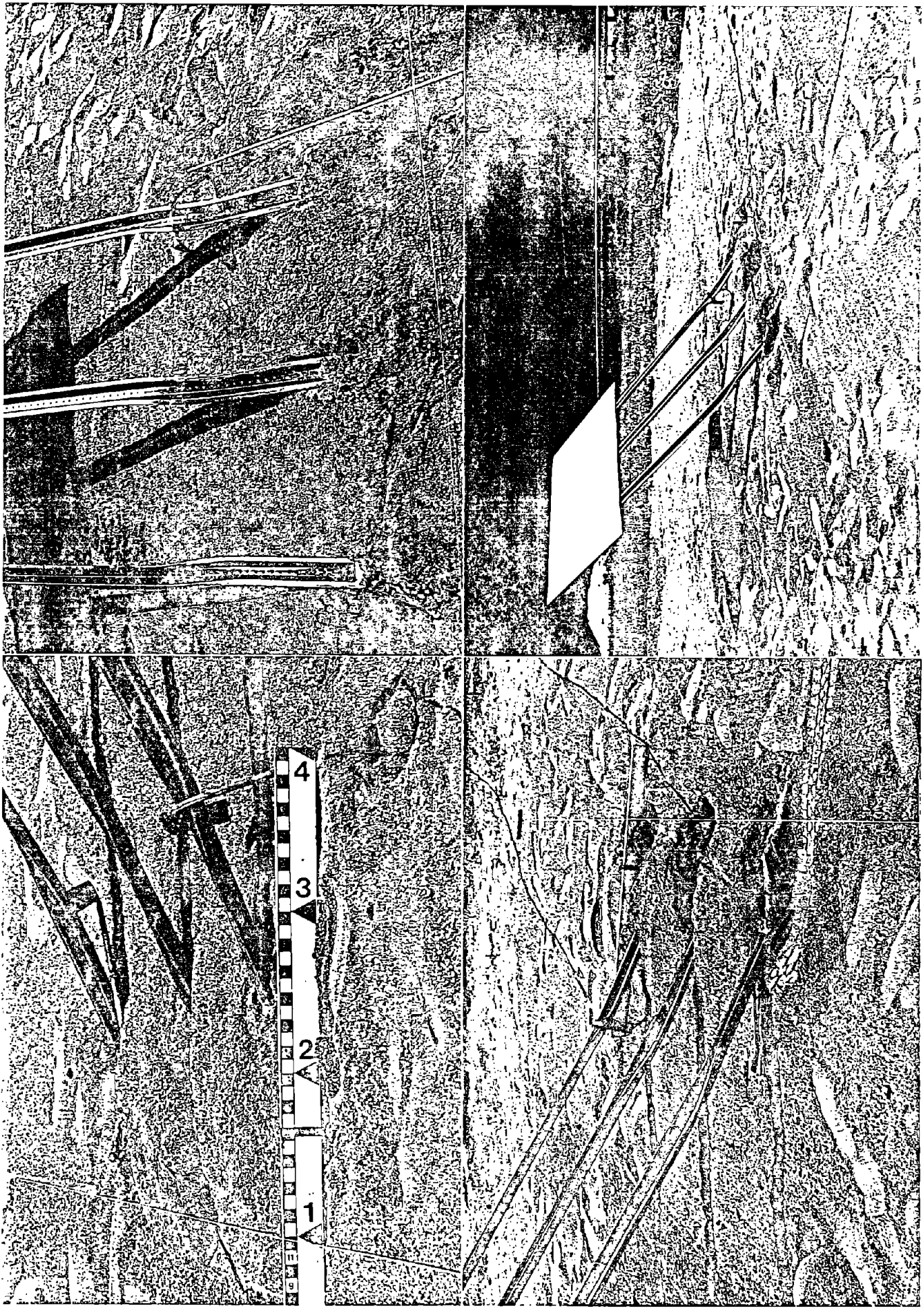
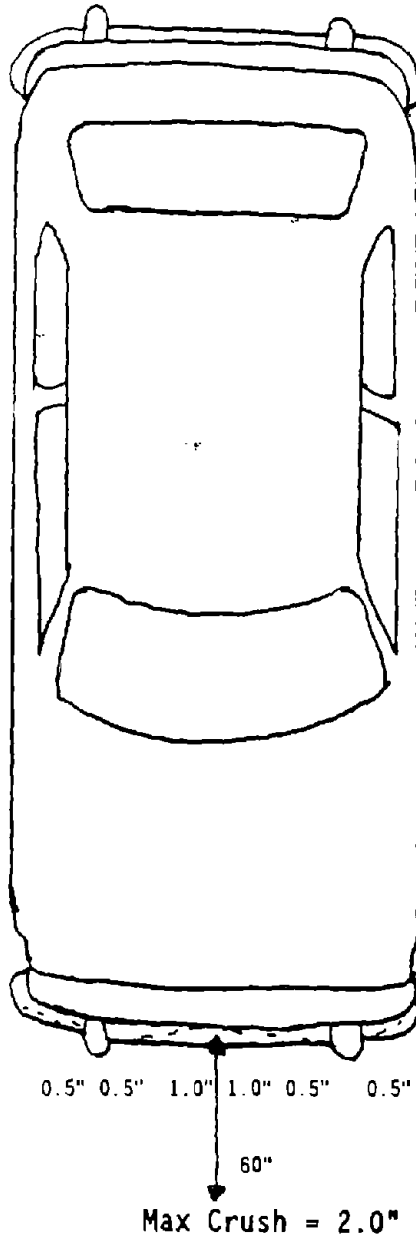


Figure 11. Additional post-test photographs of test 92F019.



0.5" 0.5" 1.0" 1.0" 0.5" 0.5"

60"

Max Crush = 2.0"

----- Post test

1 in = 2.54 cm

Figure 12. Sketch of vehicle crush, test 92F019.

8. REFERENCES

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

