MS 568

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date Revised February November 1978 1979
Crash Tests of Rural Mailbox Installations	6. Performing Organization Code
7. Author(s) Ross, Hayes E., Jr., and Walker, Kenneth C.	8. Performing Organization Report No. 3254-6
9. Performing Organization Name and Address Texas A&M Research Foundation Texas Transportation Institute Texas A&M University College Station, Tx 77843	10. Work Unit No. 11. Contract or Grant No. DOT-FH-11-8821
12. Sponsoring Agency Name and Address Federal Highway Administration Office of Development Implementation Division Washington, D.C. 20590	13. Type of Report and Period Covered Interim July 1975 - January 1979 14. Sponsoring Agency Code

15. Supplementary Notes: Contract Technical Manager - W. J. Lindsay, FHWA Region 6
Contract Administrator - G. B. Trainer, FHWA, Washington, D.C.
Contract Liaison - J. R. Watson, Jr., and R. A. Richter, FHWA Washington, D.C.

16. Abstract

Five full-scale crash tests were conducted to evaluate the impact behavior of rural mailbox installations. Three of the five tests involved commonly used wood post supports, two of which were single box installations and the third was a four-box installation. The other two tests involved two promising new support concepts which utilized standard steel pipe. Both tests involved single box installations.

Results showed that installations with multiple boxes mounted on boards pose a serious hazard to motorists since the board can easily penetrate the windshield. The results also showed that a pipe support post performs in a more desirable manner than does a wood post. Careful attention must be given to the box-to-post attachment to prevent separation during impact and thus minimize the potential for windshield penetration by the mailbox.

17. Key Words	18. Distribution Statement
Mailbox(es), Crash Tests, Safety, Impact(s), Accidents, Impact Behavior, Rural, Highway(s)	

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

Form DOT F 1700.7 (8-69)

ACKNOWLEDGMENTS

W. J. Lindsay of the Federal Highway Administration (FHWA), Region 6, served as the technical contract manager. His guidance and cooperation throughout the study were very helpful. J. R. Watson, Jr., R. A. Richter, G. Trainer, H. L. Anderson, J. H. Hatton, and H. W. Taylor, all of FHWA, Washington, D.C., provided valuable assistance and timely suggestions. Other FHWA officials who provided input through an advisory committee to the project were W. H. Collins, N. Tuz, J. T. Brooks, D. B. Chisholm, and M. T. Browne.

Grateful acknowledgment is extended to all of the technical support personnel of the Texas Transportation Institute who assisted in the preparation, execution, and analysis of the full-scale crash tests. Special thanks go to Don Cangelose, Jim Bradley, Bill Ray, Dick Zimmer, Gordon Samuelson, and Eddie Denk for their attention to details and sincere interest in quality research. Thanks are also extended to Dr. Gene Buth for his cooperation in scheduling the tests. The efficient and accurate typing of this report by Sylvia Velasco is acknowledged. John Mulvahill, with assistance from Benito Jackson, did the drafting work.

FOREWORD

This report was prepared as a part of DOT Contract No. FH-11-8821, entitled "Cost Effectiveness of Small Highway Sign Supports".

The basic purpose of the contract was to develop objective criteria and methodologies to assist transportation agencies in the selection of a cost-effective sign support system. Results of this phase of the study can be obtained from the sponsoring agency (see item 12 of title page for address). Another phase of the study dealt with the impact behavior of rural mailbox installations, and this report presents results of that phase.

NOTICE

TABLE OF CONTENTS

		Page
I	INTRODUCTION	1
II	TEST CONDITIONS	11
	II-A Test Article Details	11
	II-B Test Vehicles	22
III	PERFORMANCE SPECIFICATIONS AND TEST RESULTS	28
	III-A Test No. 22	30
	III-B Test No. 23	30
	III-C Test No. 24	40
	III-D Test No. 25	40
	III-E Test No. 26	65
IV	SUMMARY AND CONCLUSIONS	76
V	RECOMMENDATIONS	79
APPENDIX A -	U. S. POSTAL SERVICE SPECIFICATIONS FOR RURAL MAILBOX INSTALLATIONS	80
APPENDIX B -	DATA ACQUISITION SYSTEMS	98
REFERENCES		104

LIST OF FIGURES

Figure		Page
1	Single box installations	3
2	Mailbox height in relation to vehicle windshield	5
3	Multiple box installation	9
4	Field installation with numerous boxes	10
5	Installation procedure, tests 22, 23, and 24	13
6	Installation details for wood post mailbox supports	14
7	Completed installation, test 22	15
8	Completed installation, test 23	17
9	Completed installation, test 24	18
10	Installation details, tests 25 and 26	19
11	Base and installation procedure, tests 25 and 26	20
12	Shear bolt and base assembly, test 25	21
13	Frangible coupling	23
14	Mailbox bracket-to-post connection	24
15	Test installations	25
16	1972 Chevrolet Vega	26
17	Typical dimensions of 1972-1973 Chevrolet Vega	27
18	Sequential photos, test 22	32
19	Deceleration versus time, test 22	34
20	Change in momentum versus time, test 22	35
21	Free missile travel versus time, test 22	36
22	Mailbox support damage, test 22	37
23	Damage to mailbox and timber cap	38
24	Vehicle damage, test 22	39
25	Sequential photos, test 23	42
26	Deceleration versus time, test 23	44
27	Change in momentum versus time, test 23	45
28	Free missile travel versus time, test 23	46
29	Mailbox support damage, test 23	47
30	Damage to mailbox, test 23	48

LIST OF FIGURES (continued)

Figure		Page
31	Vehicle damage, test 23	49
32	Sequential photos, test 24	51
33	Deceleration versus time, test 24	53
34	Change in momentum versus time, test 24	54
35	Free missile travel versus time, test 24	55
36	Damage to mailbox installation, test 24	56
37	Interior vehicle damage, test 24	57
38	Vehicle damage, test 24	58
39	Sequential photos, test 25	60
40	Deceleration versus time, test 25	62
41	Change in momentum versus time, test 25	63
42	Free missile travel versus time, test 25	64
43	Installation damage, test 25	66
44	Vehicle damage, test 25	67
45	Sequential photos, test 26	69
46	Deceleration versus time, test 26	71
47	Change in momentum versus time, test 26	72
48	Free missile travel versus time, test 26	73
49	Installation damage, test 26	74
50	Vehicle damage, test 26	75
51	Accelerometer positions	100
52	Camera positions	101
53	High-speed cameras	103

LIST OF TABLES

Table		Page
1	Mailbox accident data from four states, 1972	2
2	Summary of test conditions	12
3	Summary of results, test 3254-22	31
4	Time displacement event summary for test 3254-22	33
5	Summary of results, test 3254-23	41
6	Time displacement event summary for test 3254-23	43
7	Summary of results, test 3254-24	50
8	Time displacement event summary for test 3254-24	52
9	Summary of results, test 3254-25	59
10	Time displacement event summary for test 3254-25	61
11	Summary of results, test 3254-26	68
12	Time displacement event summary for test 3254-26	70
13	Summary of test results	77
14	Camera details	102

I. INTRODUCTION

Rural mailbox structures have received little attention with regard to their potential hazard to motorists. Although the incidence of impacts by errant motorists may be small in comparison to more formidable hazards, mailbox accidents are not statistically insignificant. Table 1 shows a summary of mailbox accident data from four states for 1972 (1).

Design specifications for the rural mailbox itself and its vertical position are promulgated by the United States Postal Service (USPS) (2). These specifications are given in Appendix A. However, the USPS has no specifications for mailbox supports. The American Association of State Highway Officials (AASHO) published guidelines for erecting mailboxes on highways in 1969, including suggested structural supports (9). It is noted that some of the recommended supports in reference 9 were found to be undesirable by testing reported herein. A cursory review of several state and county agencies revealed an almost total absence of any standards for mailbox supports. Only one state is known to have such standards. As a general rule, mailbox owners are limited only by their imagination. Steel tractor wheels, old-time stoves, water pumps, plow shares, milk cans filled with concrete, and massive I-beams, pipes, etc., are but a few of the "ingeneous" devices used to support mailboxes. Photographs of some of these are shown in Figure 1. While such supports may be artistic to some, most are serious roadside hazards.

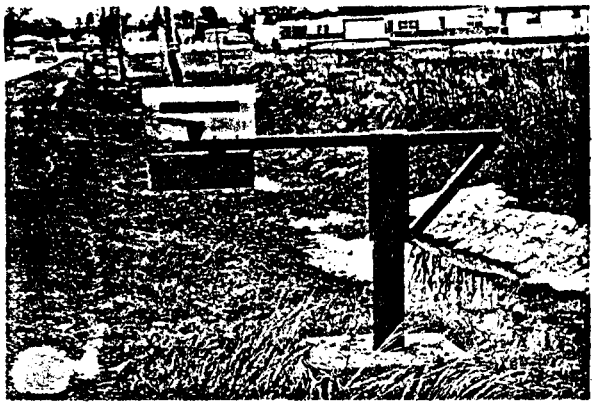
Mailboxes are hazardous primarily because of the mounting height of the box. Most boxes are mounted approximately 42 in. (106.7 cm) above ground to facilitate placement of mail in the box by the carrier. This height places the box(es) in direct line with the windshield on many vehicles. Photographs shown in Figure 2 illustrate this point for several contemporary vehicles.* The base of each of the three different sized boxes is approximately 42 in. (106.7 cm) above ground. Mounting of several boxes on a wood board compounds the problem since the board

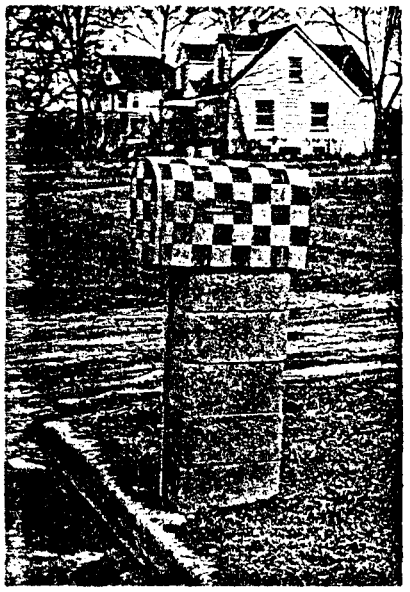
---

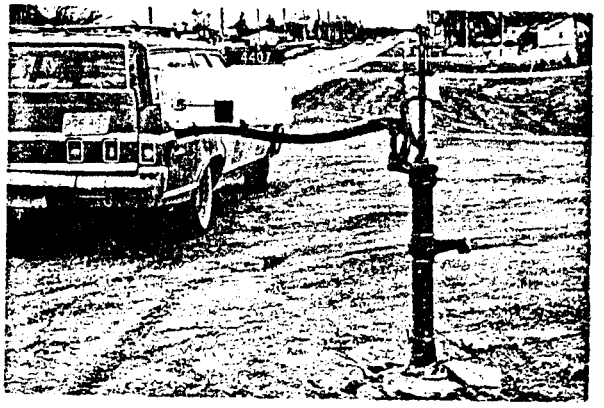
*The support systems shown in Figure 2 were used for illustrative purposes only and are not considered crashworthy systems.

Table 1. Mailbox accident data from four states, 1972. (from (1))

STATE	TOTAL ACCIDENTS	FATAL ACCIDENTS	PERSONAL INJURY ACCIDENTS	PROPERTY DAMAGE ACCIDENTS
Michigan	3,326	15	726	2,585
Missouri	272	7	93	172
Texas	1,053	12	225	816
Washington	254	0	77	177

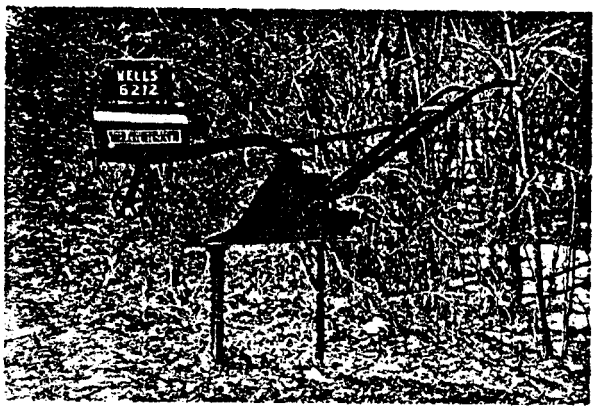


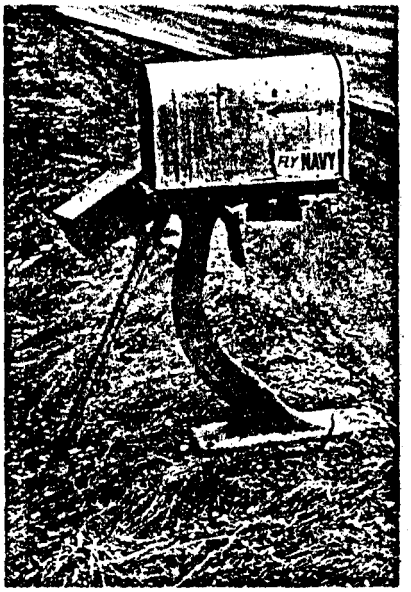


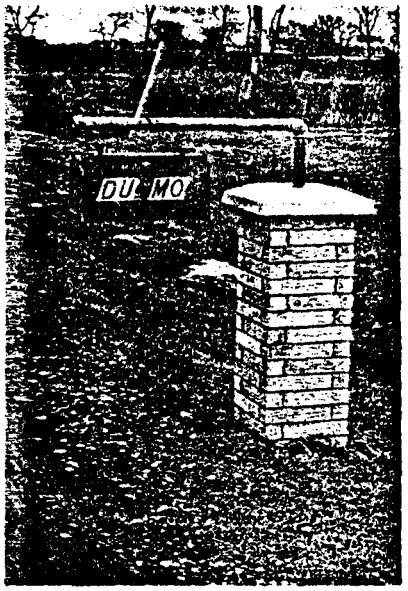


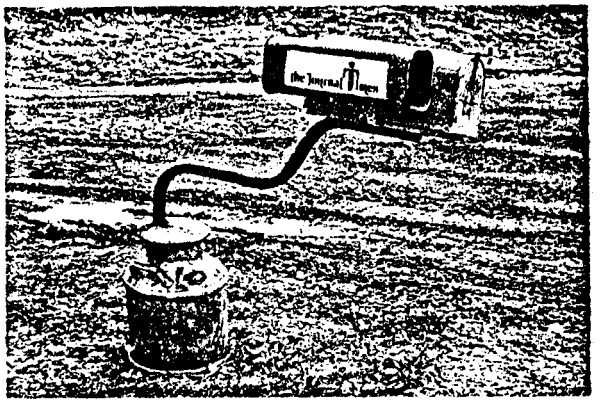
(Photos courtesy of Mr. Herbert Katt)

Figure 1. Single box installations.





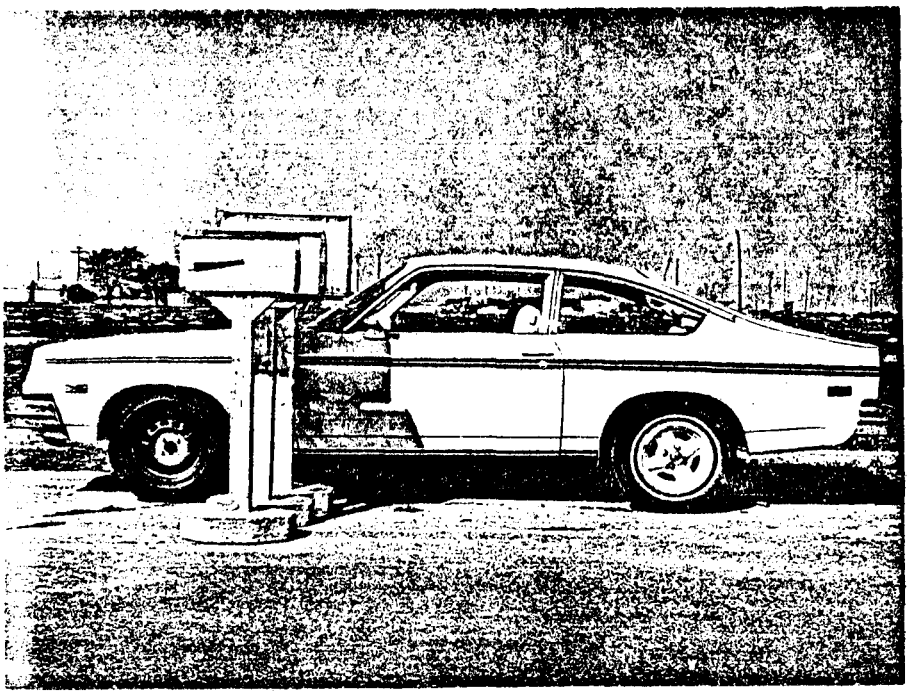




(Photos courtesy of Mr. Herbert Katt)

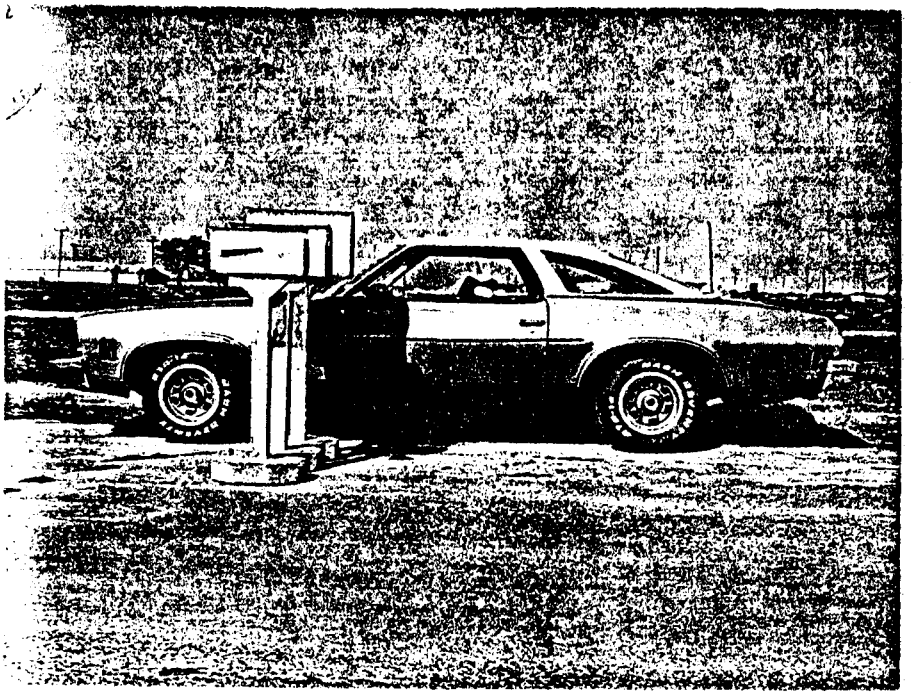
Figure 1. (continued)

a) Sub-compact

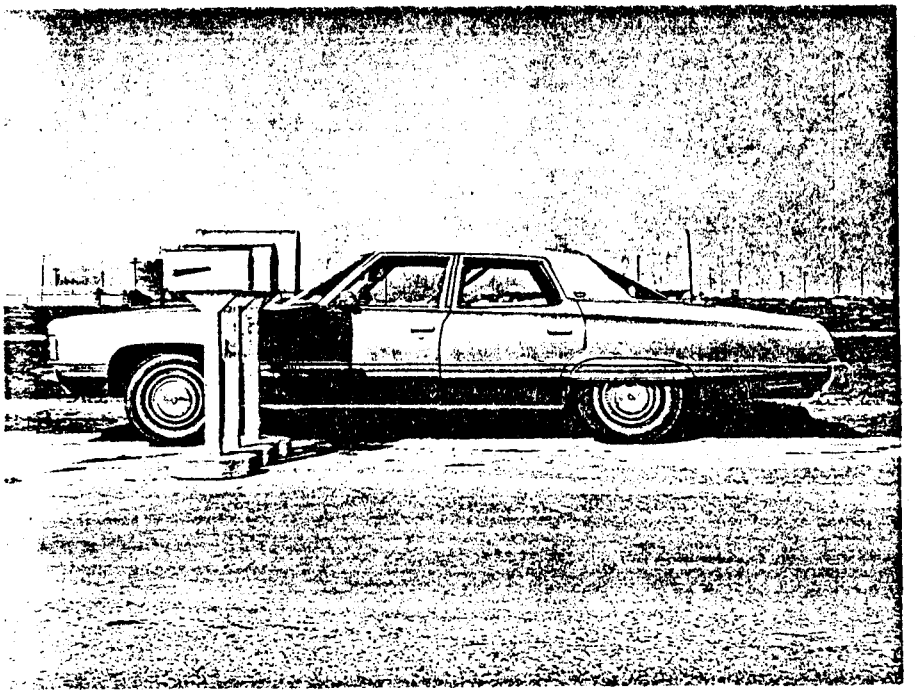


b) Compact

Figure 2. Mailbox height in relation to vehicle windshield.

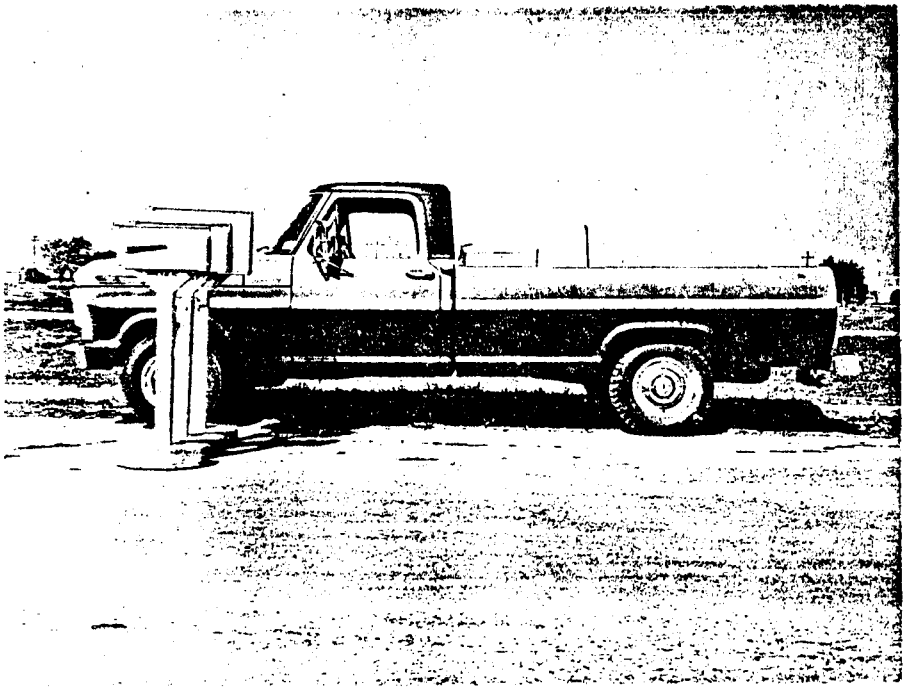


c) Medium Size



d) Full Size

Figure 2. (continued)

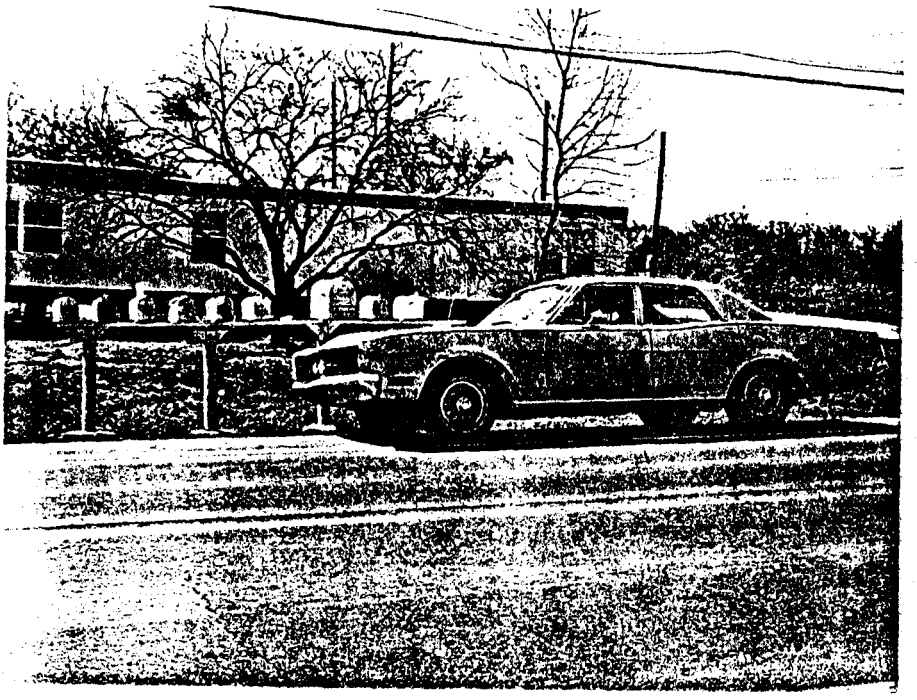


e) Pickup Truck

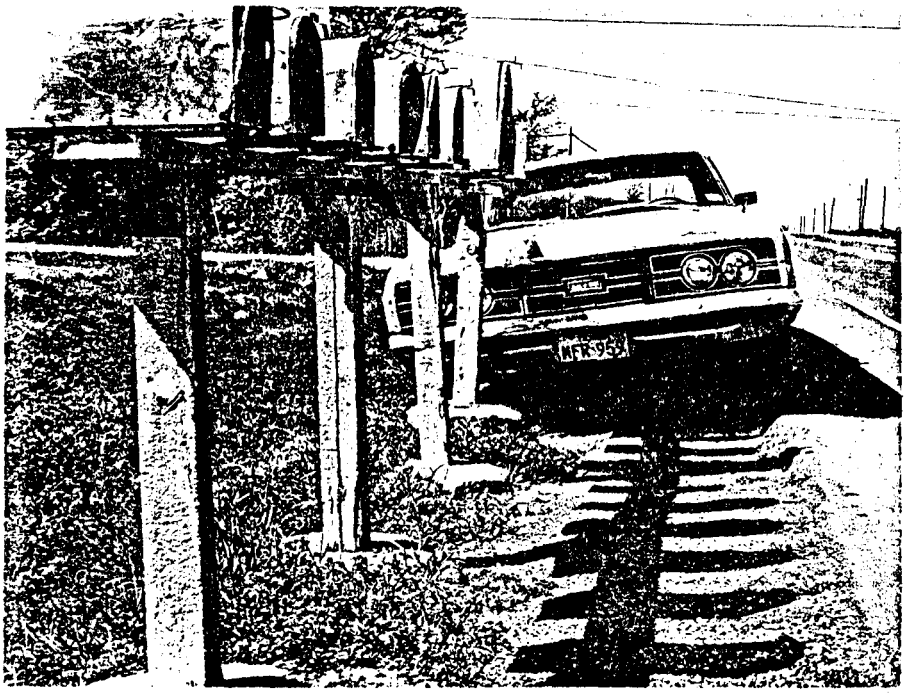
Figure 2. (continued)

can spear through the windshield. Field installations of multiple boxes are shown in Figure 3. Figure 4 shows what may be a record for the number of boxes (in excess of 200) mounted on one continuous support.

To gain insight into the hazard of mailbox installations the Federal Highway Administration (FHWA) elected to conduct a limited full-scale crash test program. Tests were conducted on widely used wood post supports and two promising new support concepts utilizing standard steel pipe. This report describes those tests and results obtained therefrom.



a) Side View



b) Head-on View

Figure 3. Multiple box installation.

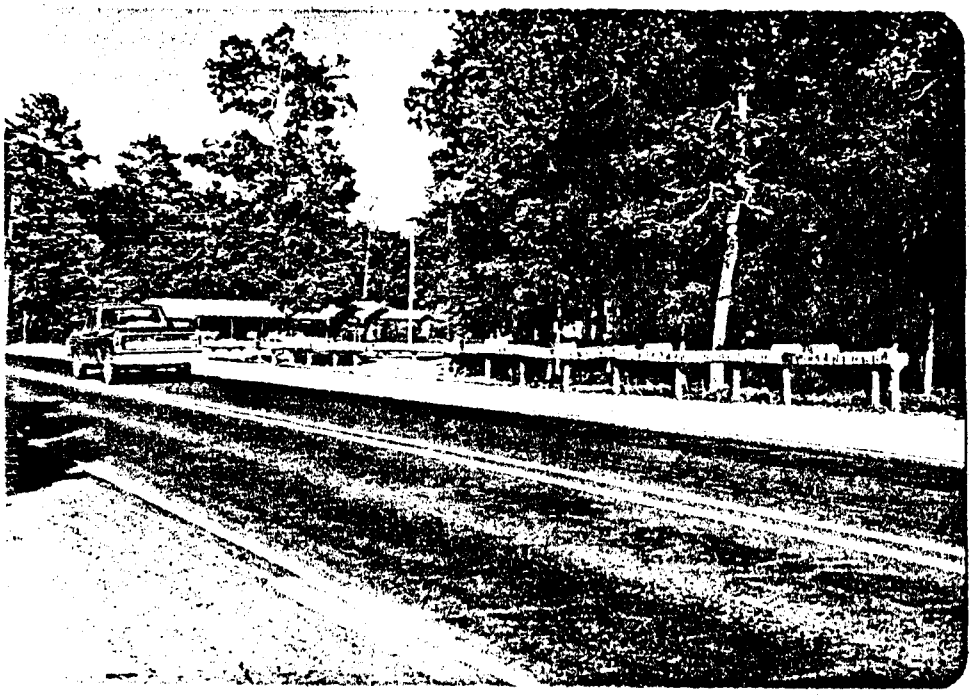


Figure 4. Field installation with numerous boxes.

II. TEST CONDITIONS

A total of five full-scale tests were conducted, three involving wood posts and two with pipe post designs. Table 2 contains a summary of the test conditions. Further design details are given in subsequent sections.

It was clear from previous tests of sign posts (4) that high-speed impacts would be more hazardous than low-speed impacts for the mailbox installations to be evaluated. Hence the impact speed in each test was approximately 60 mph (26.8 m/s). Test data were recorded and analyzed in accordance with recommended guidelines for testing roadside appurtenances (5). Soil at the test site conformed to recommended standards (5).

II-A. Test Article Details

II-A-1. Wood Posts

Tests 22, 23 and 24 involved a single 4 in. by 4 in. (10.2 cm by 10.2 cm) wood post support. In each of these three tests the post was set 2 ft into an 18 in. (45.7 cm) diameter drilled hole, backfilled and then tamped into position. The drilling and tamping are pictured in Figure 5. The base of the mailbox was 42 in. (106.7 cm) above ground level for all tests.

Figure 6 shows installation details. Although the post was similar in these tests, the mailbox arrangement, size, and attachment differed.

Single Mailbox. Test 22 consisted of a single No. 1-A (see Appendix A) mailbox mounted on 1.625 in. by 8 in. by 19.5 in. (4.13 cm by 20.3 cm by 49.5 cm) yellow pine timber cap. The mailbox was held to the cap by six 1.5 in. (3.81 cm) long composition roofing nails. Three 16 penny nails were used to attach the cap to the post. Two triangular braces secured the timber cap to the post, with four 8 penny nails in each brace. Figure 7 shows the installation from direction of impact and the mailbox height with respect to the test vehicle.

Single Mailbox with Strap Attachment. Installation details in test 23 were identical to the previous test with the exception of two straps added to increase the mailbox-to-post connection strength.

Table 2. Summary of test conditions.

TEST NO.	VEHICLE WEIGHT (lb)	IMPACT SPEED (mph)	TYPE AND SIZE OF SUPPORT POST	CAP AND SUPPORT ARM DETAILS	POST EMBEDMENT DEPTH (ft)	NUMBER OF MAILBOXES ON POST	TYPE OF MAILBOX(ES)[a]
22	2270	58.2	Wood 4 in. x 4 in. Nominal Dimensions	(b)	2.0	1	No. 1-A
23	2270	62.6	Wood 4 in. x 4 in. Nominal Dimensions	(b) with Ranger strap see Fig 8	2.0	1	No. 1-A
24	2440	58.8	Wood 4 in. x 4 in. Nominal Dimensions	(b)	2.0	4	One No. 1 Two No. 1-A One No. 2
25	2260	58.8	Std. Steel Pipe[d] 1½ in. I.D.	(c)	2.3	1	No. 1-A
26	2260	60.9	Std. Steel Pipe[e] 1½ in. I.D.	(c)	2.3	1	No. 1

[a]Type I, Standard Rural Mailboxes, as per U.S. Postal Service (see Appendix A).

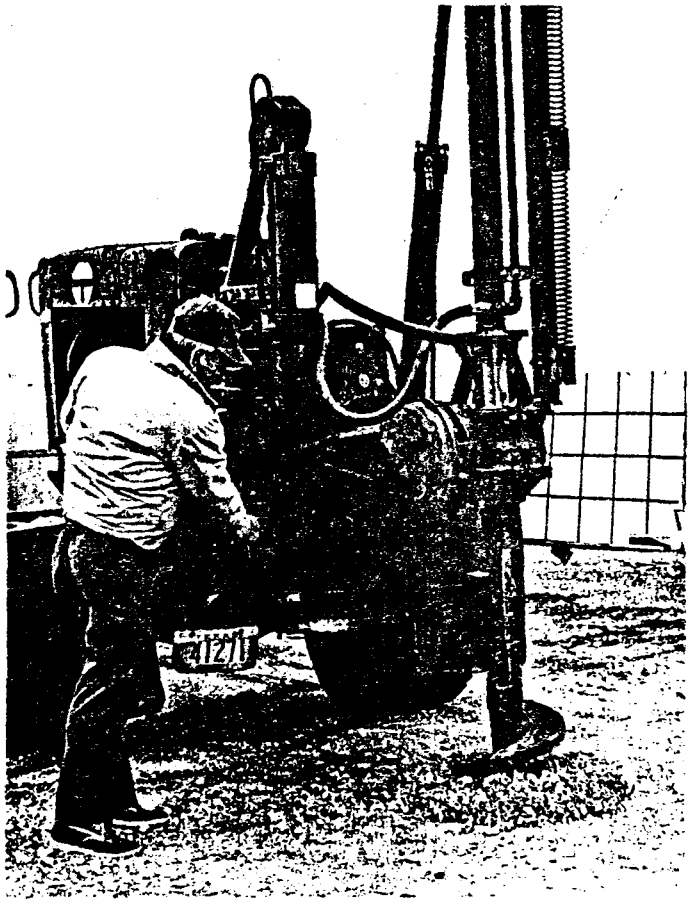
[b]See Figure 6.

[c]See Figure 10.

[d]Lap splice design with bolted shear connection (see Figure 10).

[e]Frangible cast iron coupling with retainer straps (see Figure 10).

Metric Conversions:
1 lb = 4.45 N
1 mph = 0.447 m/s
1 in. = 2.54 cm
1 ft = 0.305 m



a) Drilling

b) Tamping

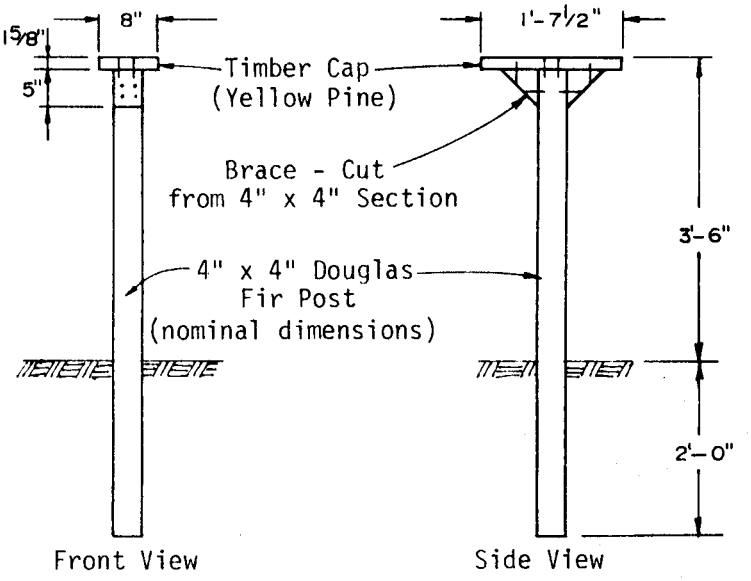
Figure 5. Installation procedure, tests 22, 23, and 24.

Connections:

1) Cap-to-post: Three 16 penny nails
2) Brace-to-cap and post: Four ea. 8 penny nails
3) Mailbox-to-cap: Six 1½ in. composition roofing nails

Metric Conversions:

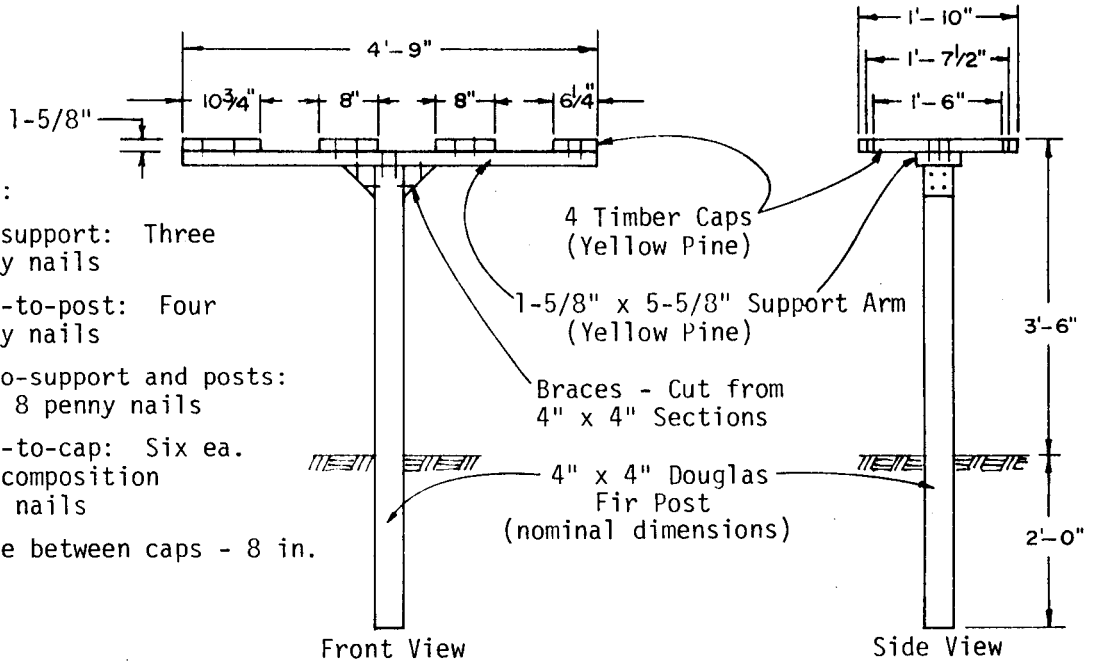
1 in. = 2.54 cm
1 ft = 0.305 m



SINGLE SUPPORT FOR #1-A MAILBOX (Tests 22 and 23)

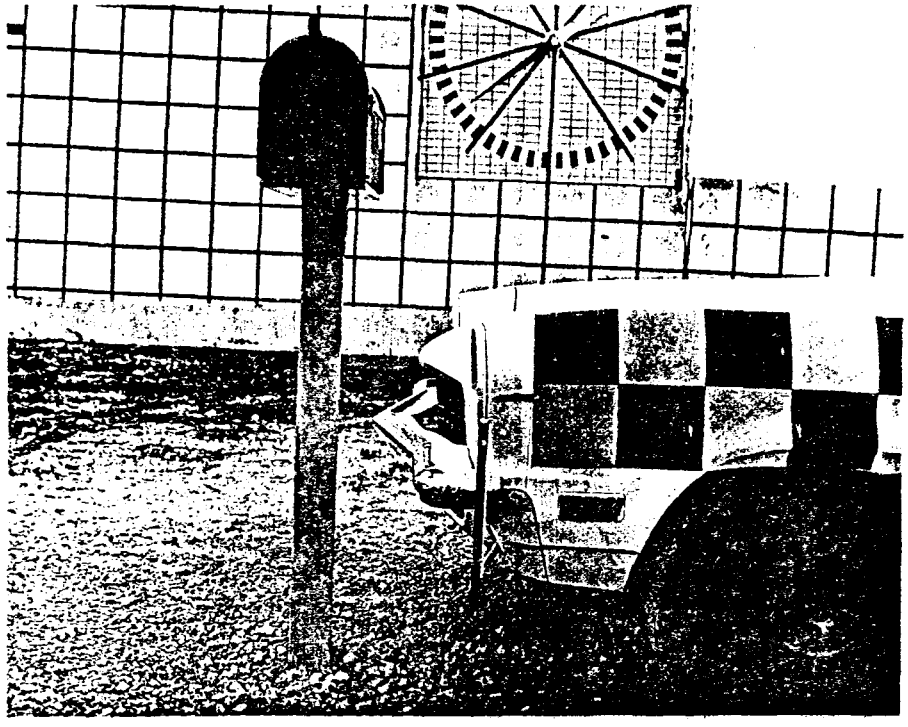
Connections:

1) Cap-to-support: Three 16 penny nails
2) Support-to-post: Four 16 penny nails
3) Brace-to-support and posts: Four ea 8 penny nails
4) Mailbox-to-cap: Six ea. 1½ in. composition roofing nails
5) Distance between caps - 8 in.

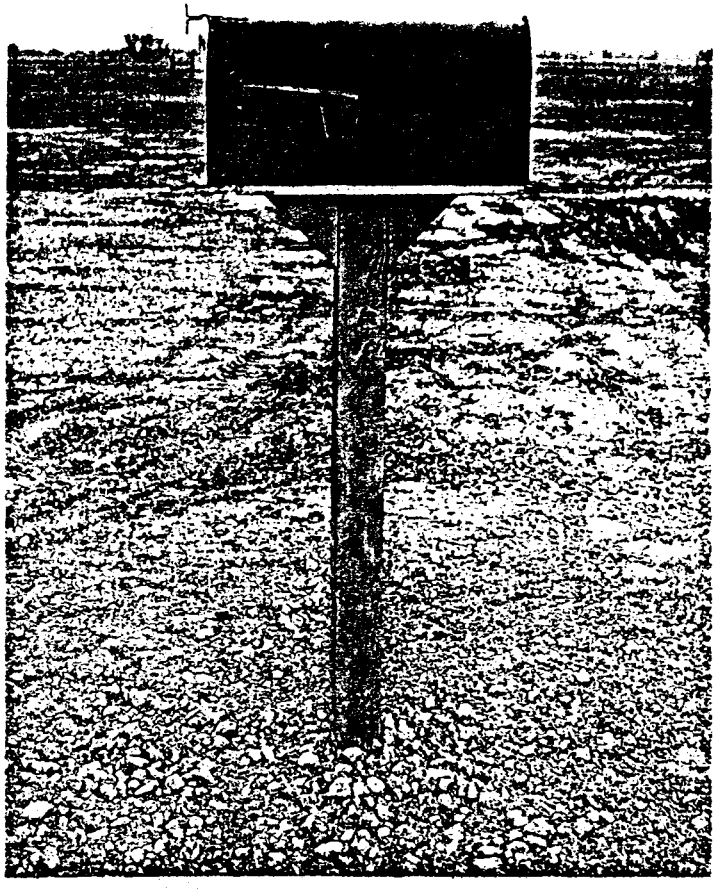


SINGLE SUPPORT FOR MULTIPLE MAILBOXES (Test 24)

Figure 6. Installation details for wood post mailbox supports.



a) Side View



b) Front View

Figure 7. Completed installation, test 22.

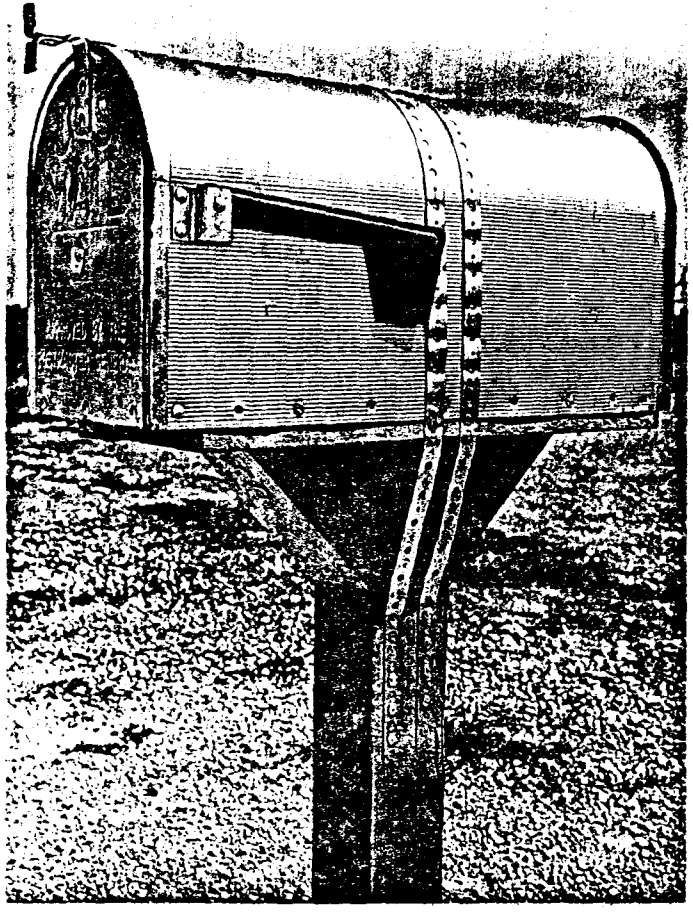
Commercially available hanger straps were used. Static load tests of the strap showed it had a tensile strength of approximately 500 lb (2224 N). Width of the 24 gauge strap was 0.75 in. (1.91 cm) with 0.25 in. (0.64 cm) diameter holes on 1 in. (2.54 cm) centers. Each strap was attached to the post with ten 1.5 in. (3.81 cm) composition roofing nails, five on each side, beginning 6 in. (15.24 cm) from the bottom of the timber cap and continuing on 1 in. (2.54 cm) centers. Connection to the timber cap was made with one 1.5 in. (3.81 cm) roofing nail on each side of the mailbox. Details of the installed strap and the direction of impact can be seen in Figure 8.

Multiple Mailboxes. Test 24 involved four mailboxes: one No. 1, two No. 1-A's, and one No. 2 sizes (see Appendix A). Each mailbox was attached to a yellow pine timber cap with six 1.5 in. (3.81 cm) composition roofing nails. A 1.625 in. by 5.625 in. by 57 in. (4.13 cm by 14.3 cm by 144.8 cm) support arm held the timber caps, each with three 16 penny nails. The support arm was connected to the 4 in. by 4 in. (10.2 cm by 10.2 cm) post with four 16 penny nails and two triangular braces, each held by four 8 penny nails. The complete installation is shown in Figure 9.

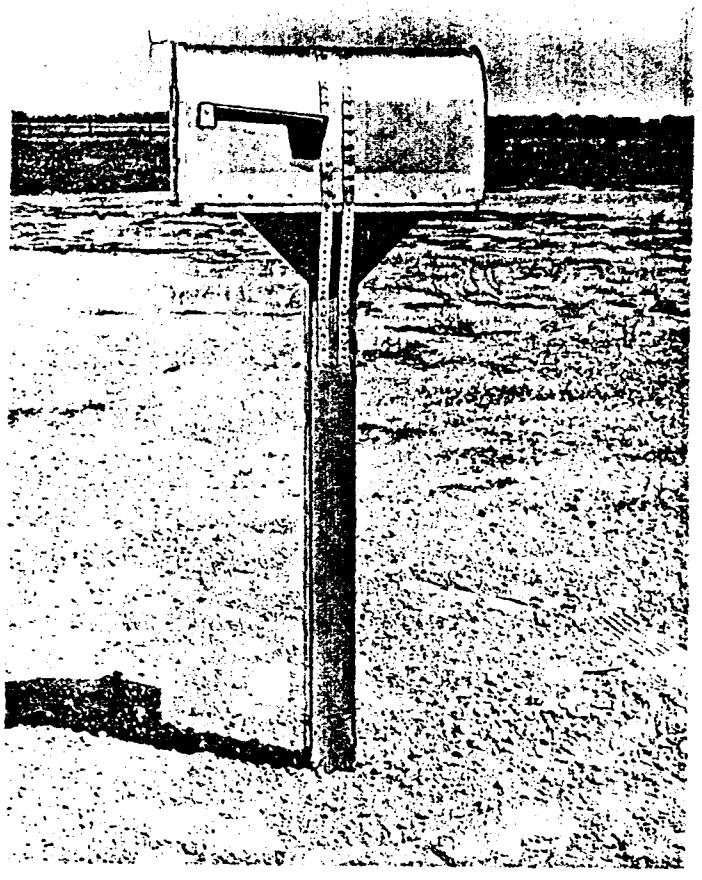
II-A-2. Standard Steel Pipe Posts

In tests 25 and 26, 1.5 in. (3.81 cm) inside diameter standard steel pipe with two post-base combinations were evaluated. Both are commercially available support systems (6). Installation details are given in Figure 10. The base in both cases was a 1.5 in. (3.81 cm) standard steel pipe 30 in. (76.2 cm) long with a 5 in. (12.7 cm) auger on one end to facilitate installment. By digging a small hole and then turning the augered pipe with a pipe wrench, the base was readily installed. The base and installation procedure are pictured in Figure 11.

In test 25, a lap-spliced steel pipe with bolted shear connection, described in Figure 10, was evaluated. The lower bolt was a 0.375 in. by 4.5 in. (0.95 cm by 11.4 cm) retainer bolt, and the other was a 0.3125 in. by 4.5 in. (0.79 cm by 11.4 cm) shear bolt with a short section machined down to the minor thread diameter of 0.2524 in. (0.64 cm). The shear bolt and the bolted assembly are pictured in Figure 12.

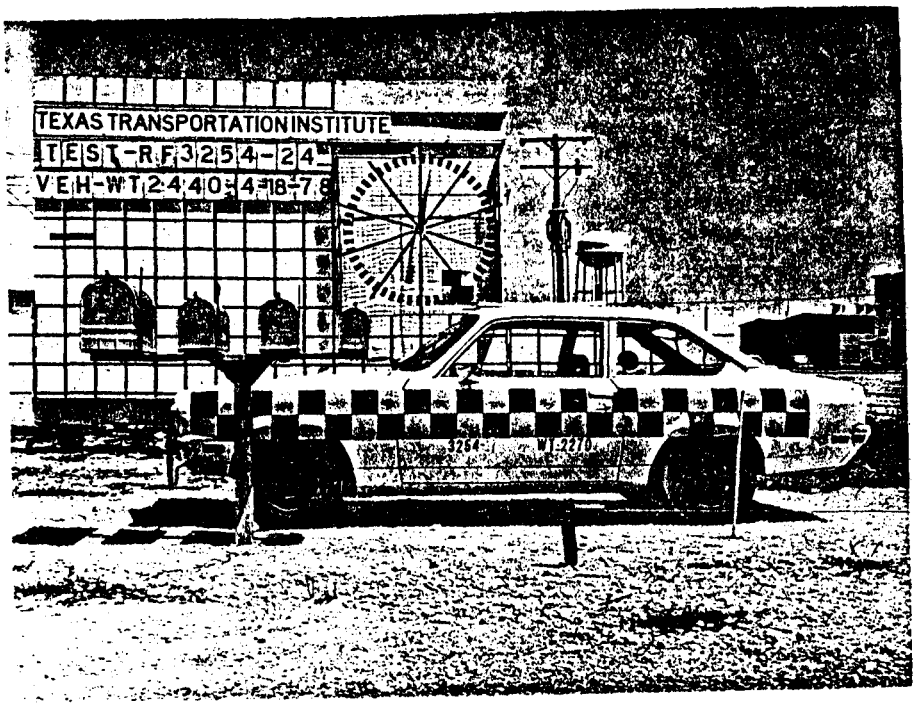


a) Closeup of Strap

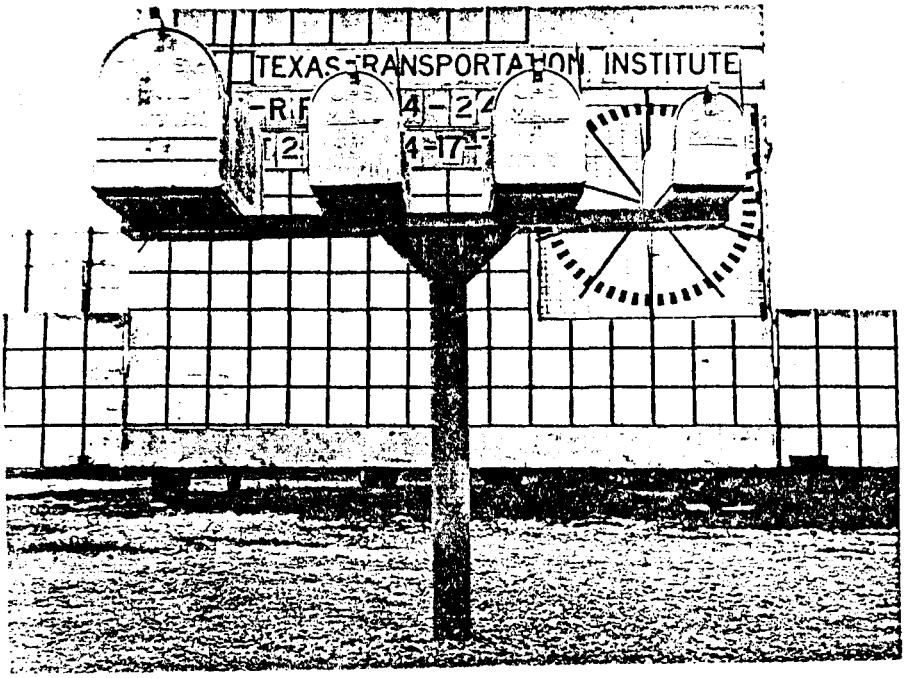


b) Direction of Impact

Figure 8. Completed installation, test 23.

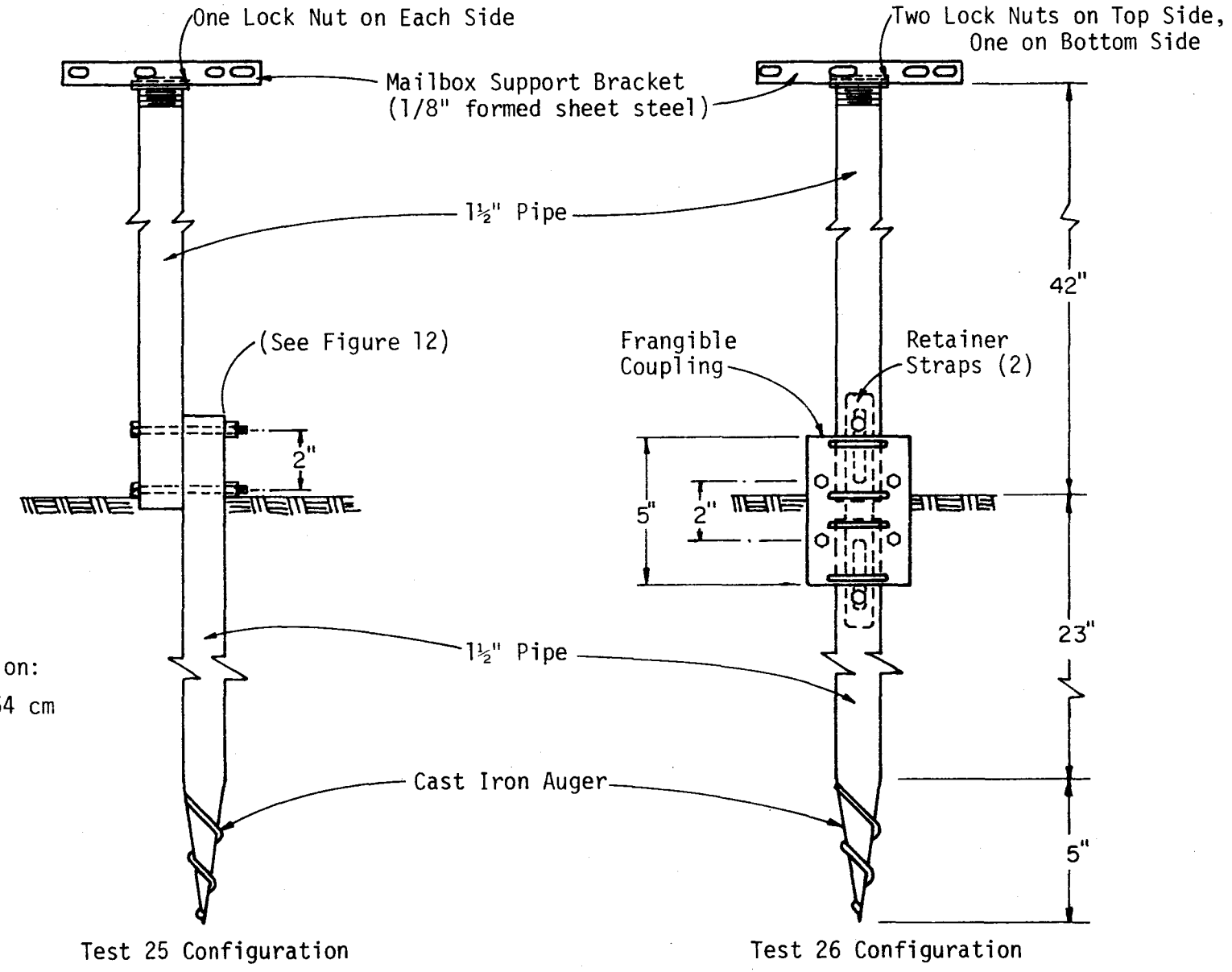


a) Support in Relation to Vehicle Size



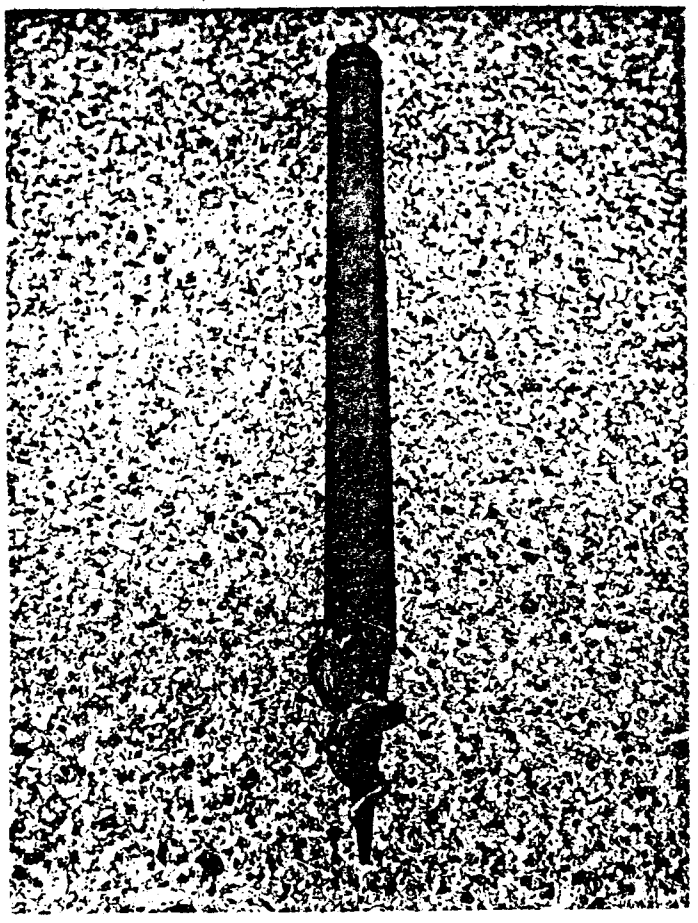
b) Side View

Figure 9. Completed installation, test 24.



Metric Conversion:
1 in. = 2.54 cm

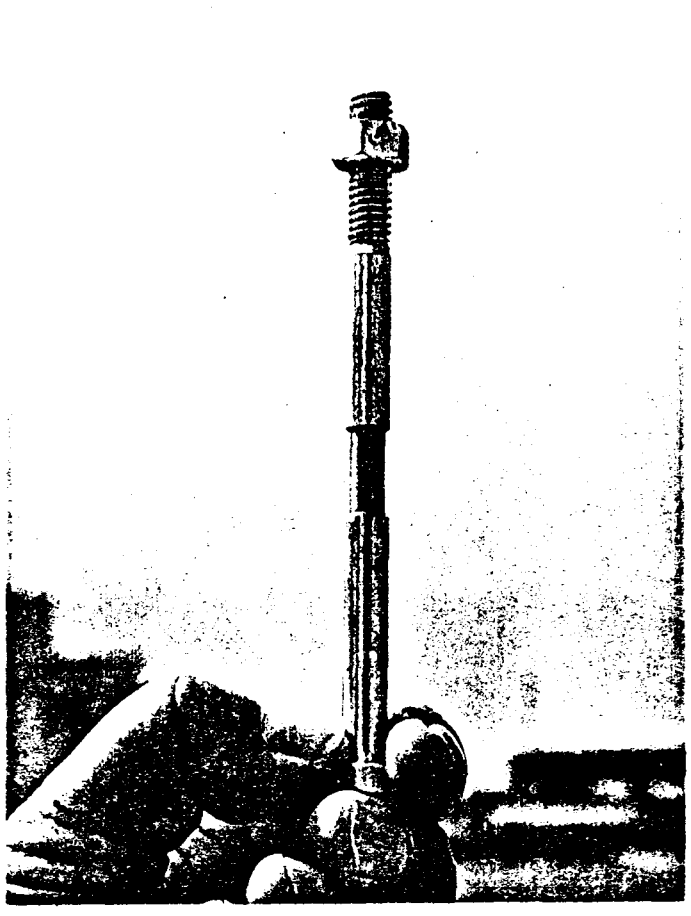
Figure 10. Installation details, tests 25 and 26.



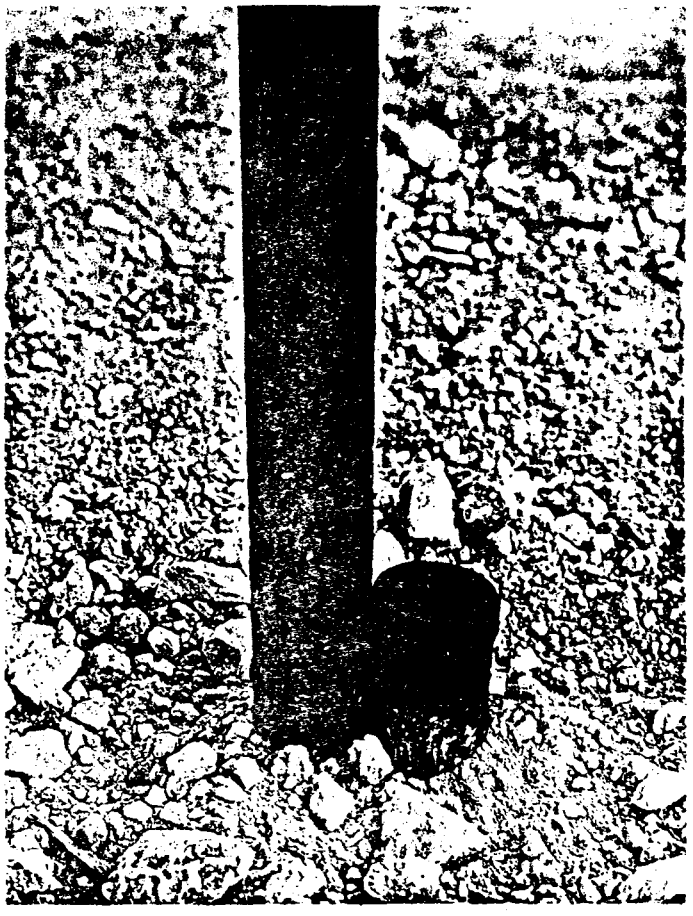
a) Auger Base

b) Base Installation

Figure 11. Base and installation procedure, tests 25 and 26.



a) Shear Bolt



b) Bolted Assembly

Figure 12. Shear bolt and base assembly, test 25.

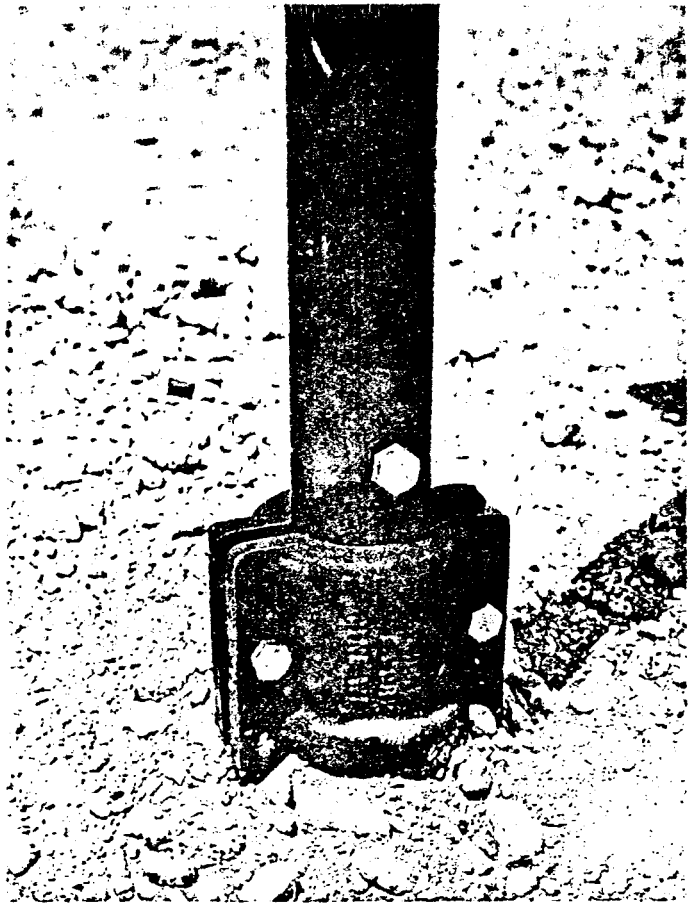
In test 26 the post-to-base assembly consisted of a frangible coupling. It incorporated two retainer straps attached with two 0.375 in. by 2.5 in. (0.95 cm by 6.35 cm) bolts, with four 0.3125 in. by 1.5 in. (0.79 cm by 3.81 cm) bolts connecting the coupling to the base and post. All bolts were grade 2. Closeup views of the coupling are given in Figure 13. Note that the coupling has been partially embedded in the soil.

The mailbox bracket-to-support post attachment was made with lock nuts. One lock nut was set below the mailbox bracket. In test 25 one lock nut was used to hold the bracket down while in test 26 two nuts were used. The installation and completed bracket assembly can be seen in Figure 14. Also, an ornamental S-brace connecting the bracket and support post was used in test 25. For both pipe tests, six 0.1875 in. by 0.75 in. (0.48 cm by 1.91 cm) bolts with lock washers were used to attach the mailbox to the bracket. A No. 1-A mailbox was used in test 25 and a No. 1 mailbox was used in test 26. (See Appendix for mailbox size description.) The completed installations can be seen in Figure 15.

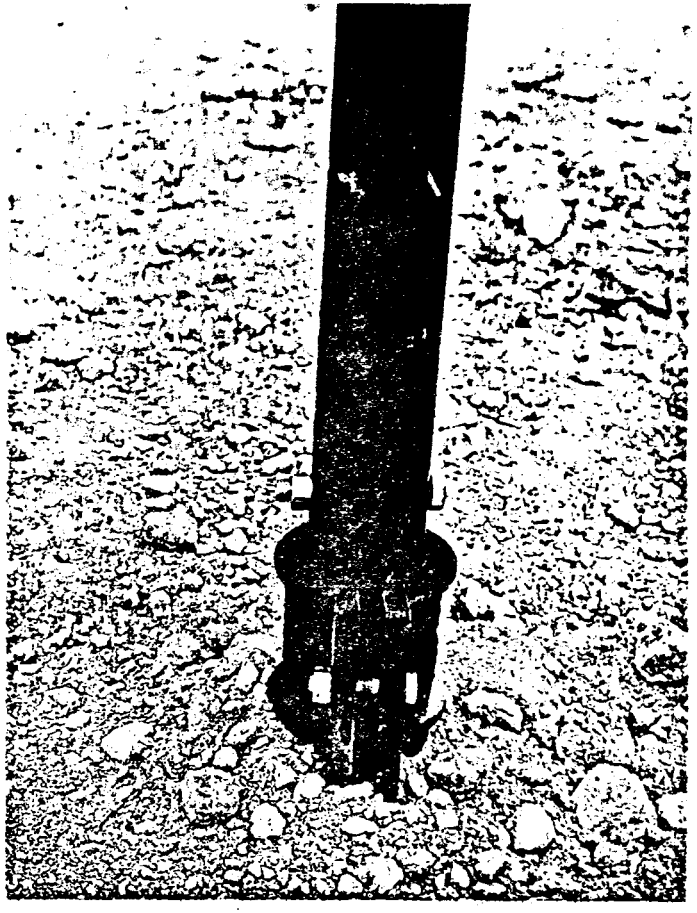
II-B. Test Vehicles

Test vehicles consisted of 1972 and 1973 Chevrolet Vegas weighing approximately 2,250 lb (1022 kg). Figure 16 contains photographs of a 1972 Vega. Design differences between the 1972 and 1973 models were very minor. Figure 17 contains typical dimensions of the 1972-1973 Vegas used in the crash tests.

Data acquisition systems, consisting of high-speed cine and on-board instrumentation, are described in Appendix B.



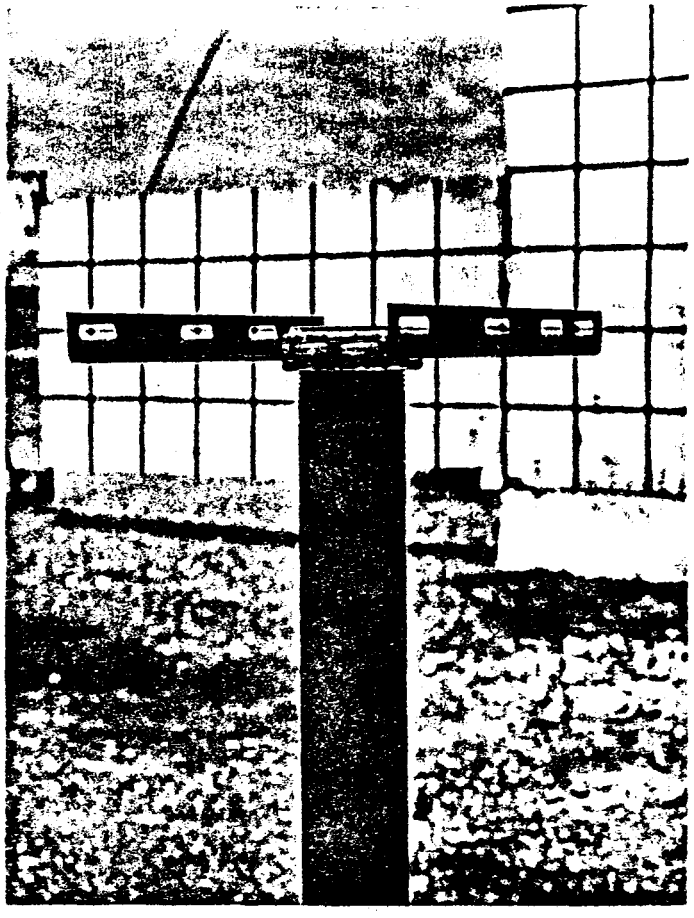
a) Front View



b) Side View

Figure 13. Frangible coupling.

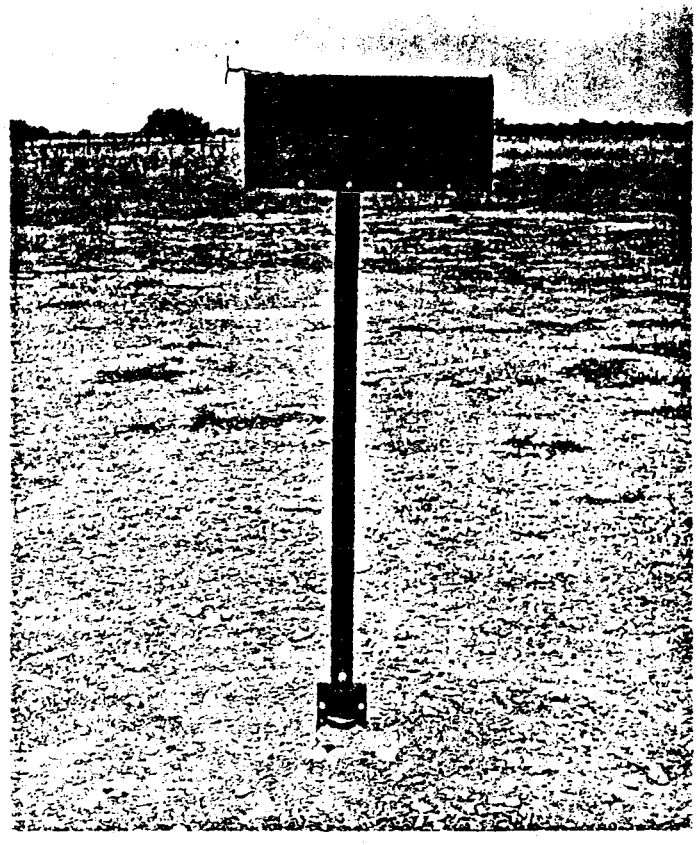
a) Assembly



b) Final Assembly, Test 26

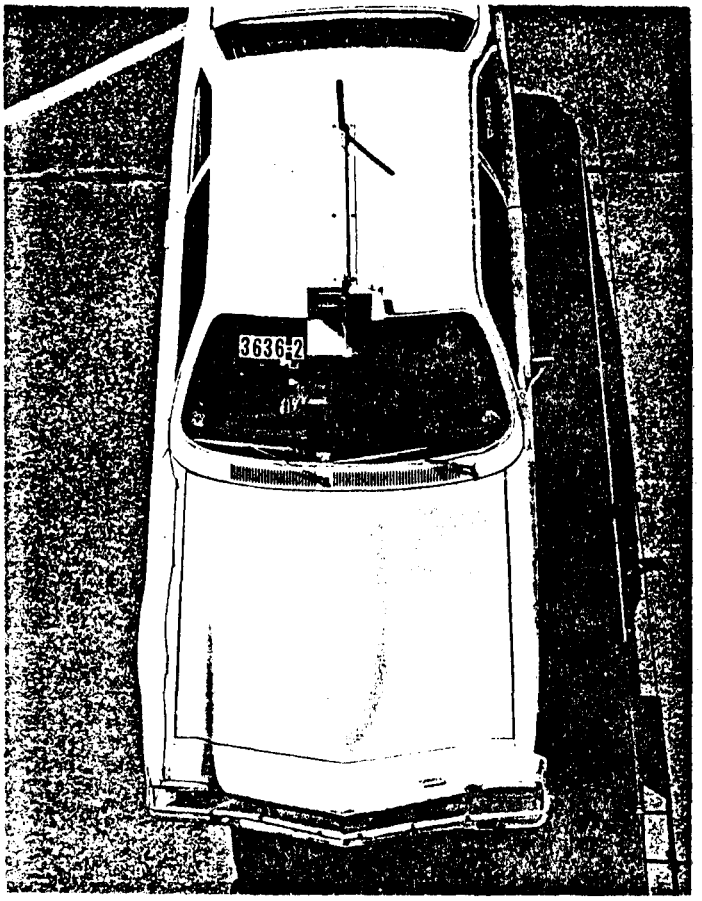
Figure 14. Mailbox bracket-to-post connection.

a) Test 25



b) Test 26

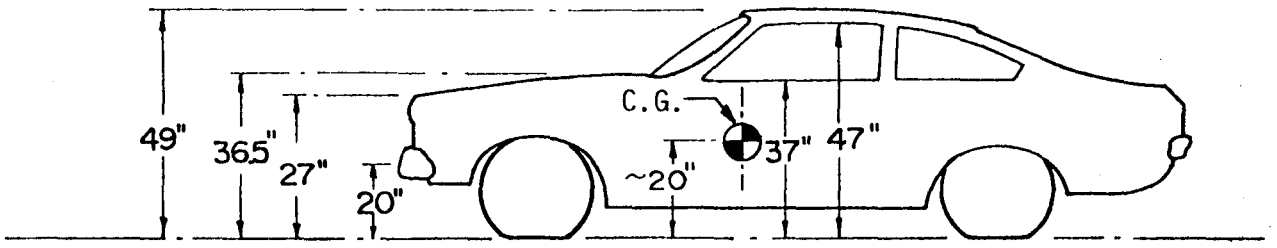
Figure 15. Test installations.



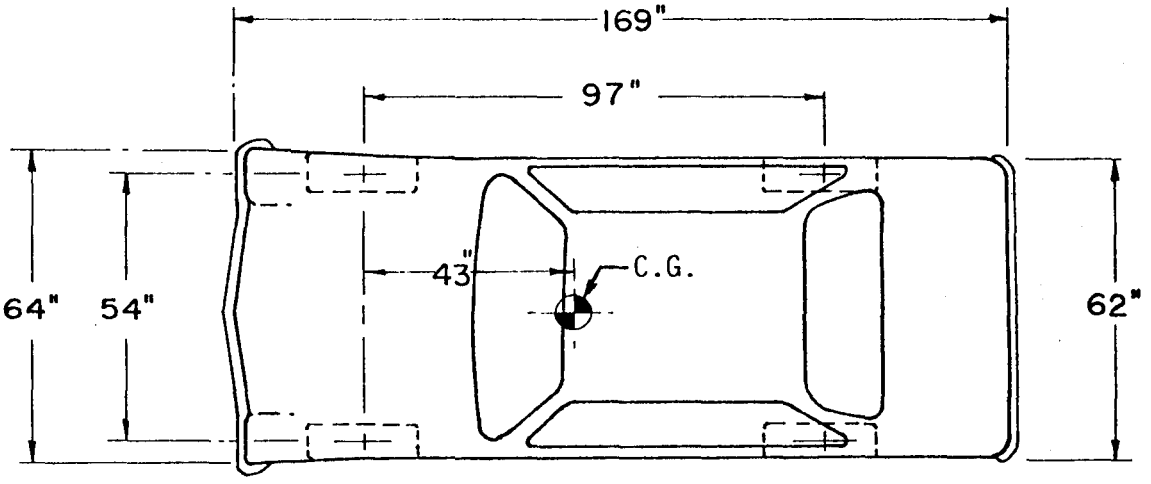
a) Top View

b) Side View

Figure 16. 1972 Chevrolet Vega.



ELEVATION



PLAN

Figure 17. Typical dimensions of 1972-1973 Chevrolet Vega.

III. PERFORMANCE SPECIFICATIONS AND TEST RESULTS

This chapter contains a detailed description of each test and results obtained therefrom. For each test a summary is presented that includes data on the test article and test vehicle, data derived from the accelerometer readings and various classifications of test vehicle damage. Photos of installation damage and vehicle damage are given, as well as sequential photos showing vehicle interaction with the test article. A time displacement event table that corresponds to the sequential photos is also included.

Although there are no performance specifications per se for mailbox supports, it seems logical that such appurtenances should comply with recognized safety standards for sign posts, light poles, and traffic signals as published by the American Association of State Highway and Transportation Officials (AASHTO) (3). According to AASHTO, "Satisfactory dynamic performance is indicated when the maximum change in momentum for a standard 2250 lb (1020 kg) vehicle, or its equivalent, striking a breakaway support at speeds from 20 mph to 60 mph (32 kmph to 97 kmph) does not exceed 1100 pound-seconds (4893 N-sec), but desirably does not exceed 750 pound-seconds (336 N-sec)."

As used in the Specification, "breakaway supports" is a generic term meant to include all types of sign supports whether the release mechanism is a slip plane, plastic hinges, fracture elements, or a combination of these. The Specification states that "Breakaway structures should also be designed to prevent the structure or its parts from penetrating the vehicle occupant compartment." The Specification also alludes to the unacceptability of vehicle rollover following impact with the sign post.

Data derived from accelerometer readings include change in momentum, peak acceleration, highest 50 msec (note: 1 msec = 0.001 sec) average acceleration, and duration of event. Peak acceleration is found directly from the accelerometer readings, and the 50 msec acceleration is derived by averaging the readings over all 50 ms intervals and then

selecting the largest value. Change in momentum is found by first integrating the acceleration versus time plot given by the accelerometer signals. This is the change in vehicle velocity, which, when multiplied by the vehicle mass, gives the momentum change. Length of time the integration is performed over must be specified since change in momentum is time dependent.

Because of this time dependency, guidelines have been established to determine the duration for computation (5). It is referred to as the "duration of event" defined as follows:

> "For yielding supports (such as base-bending signs) change in vehicle momentum to be used in the acceptance criteria of this section shall be computed on the basis of time integration of the vehicle deceleration signal over a 'duration of the event'. This duration shall be defined as the lesser of the following: (1) time between incipient contact and loss of contact between the vehicle and the yielding support, or (2) the time for a free missile to travel a distance of 24 in. (60.9 cm) starting from rest with the same magnitude of vehicle deceleration."

Free missile travel is explicitly determined from measured accelerometer data. However, "time between incipient contact and loss of contact between the vehicle and the yielding support" is not so simply determined. Time at which "loss of contact" occurs may at times be difficult to define with precision. Use of high-speed film would seem to be the most logical solution to this problem, but there are shortcomings. In some tests, the vehicle moved over the mailbox and support. In this situation it can be seen that "apparent contact" can take place over a long period of time without appreciable contact forces over some of that time.

Because of these problems, a simple, consistent method of determining the duration of event was selected. Analysis of the accelerometer readout was made, and the time at which accelerations returned to and essentially remained at zero was used as time of contact. Deceleration cannot remain at zero unless the vehicle reaches a constant velocity or it has come to a stop. However, in each test contact was followed by a

period when wind drag and rolling resistance were the only forces on the vehicle. Decelerations associated with these forces are small in comparison to those caused by contact forces. Film data were used to check accelerometer results to insure accuracy of results.

Damage to the vehicle was assessed in terms of two nationally recognized rating scales. These were the Vehicle Damage Scale published by the Traffic Accident Data Project (TAD) (7) and the Collision Deformation Classification recommended by the Society of Automotive Engineers (SAE) (8).

III-A. Test No. 22

Results of test 22 are summarized in Table 3. Figure 18 shows the sequential photos, and the corresponding time displacement event summary is given in Table 4. Figures 19, 20, and 21 show deceleration, change in momentum, and free missile travel versus time data.

Almost immediately after impact the mailbox, mailbox base, and base braces separated from the post. Shortly thereafter the post broke away at ground level. Because of its inertia, the mailbox and timber cap remained almost stationary as the post broke away, until striking the top of the hood and rolling into the windshield. The box broke and dished the windshield and bent the moulding above the windshield. However, the box did not penetrate through into the passenger compartment. Figures 22 and 23 show the damage to the post, base, and mailbox. Other than a broken windshield, the vehicle sustained only minor damage as can be seen in Figure 24.

III-B. Test No. 23

Analysis of mailbox and support response in test 22 indicated a stronger connection was needed to keep the mailbox attached to the post. The design was modified to include two galvanized hanger straps to secure the mailbox to the support. This design was developed to keep the breakaway features of the wood post, without allowing the post and mailbox to separate upon impact. See section III-A-1 for more complete installation details.

Table 3. Summary of results, test 3254-22.

Impact Velocity = 58.2 mph

POST DATA

Type	Wood
Size	4 in. x 4 in. (Nominal Dimensions)
Embedment Method	Drill and Backfill
Embedment Depth (ft)	2

VEHICLE DATA

Make	Chevrolet
Model	Vega
Year	1973
Weight (lb)	2270
Impact Point	15 in. to left of center

ACCELEROMETER DATA	Left	Right
Change in Momentum (lb-sec)	77	53
Duration of Event (sec)*	0.187	
Peak Deceleration (G's)	5.73	4.43
Maximum 0.050 Sec Average Deceleration (G's)	0.82	0.48

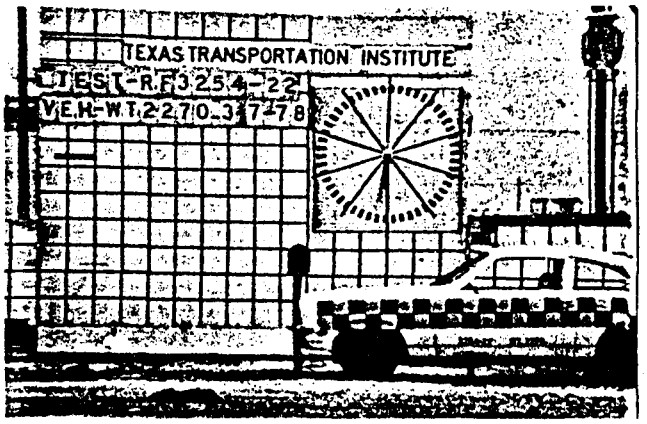
VEHICLE DAMAGE CLASSIFICATION

TAD	FL-1
SAE	12FLAN1
Did test article penetrate the passenger compartment?	No
Was windshield broken?	Yes, by Mailbox

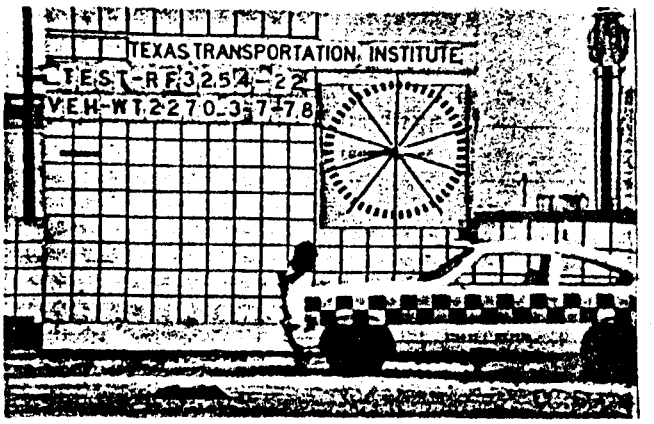
*Time of contact

Metric Conversions:

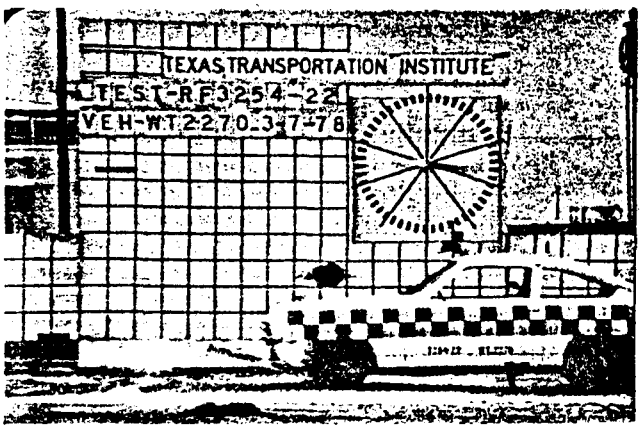
1 in. = 2.54 cm
1 ft = 0.305 m
1 lb_m = 0.454 kg
1 lb_m-sec = 0.454 kg-s
1 mph = 0.447 m/s



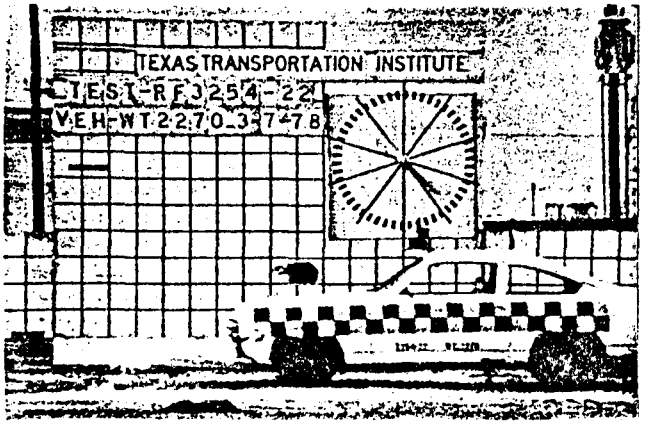
0.000 sec



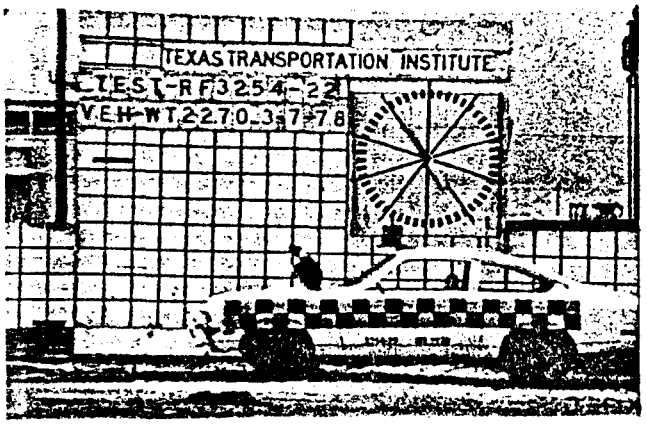
0.008 sec



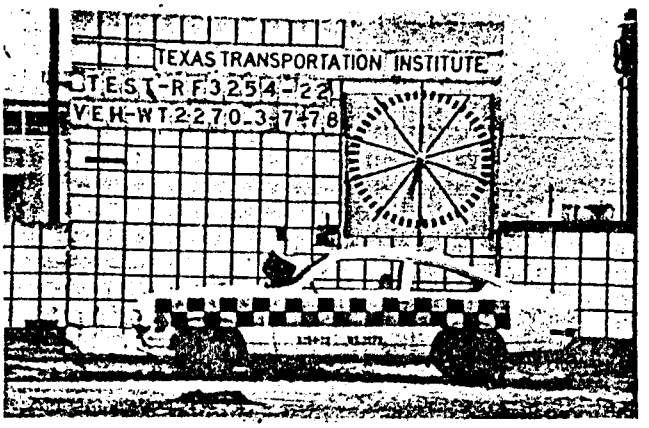
0.028 sec



0.032 sec



0.052 sec



0.075 sec

Figure 18. Sequential photos, test 22.

Table 4. Time displacement event summary for test 3254-22.

TIME (sec)	NOMINAL VEHICLE DISPLACEMENT (ft)	EVENT
0.000	0.00	Impact
0.008	0.92	Mailbox separates from post
0.028	2.17	Post breaks
0.032	4.00	Mailbox is in air
0.052	5.85	Mailbox hits hood
0.075	8.64	Mailbox hits windshield

Metric Conversions:

1 ft = 0.305 m

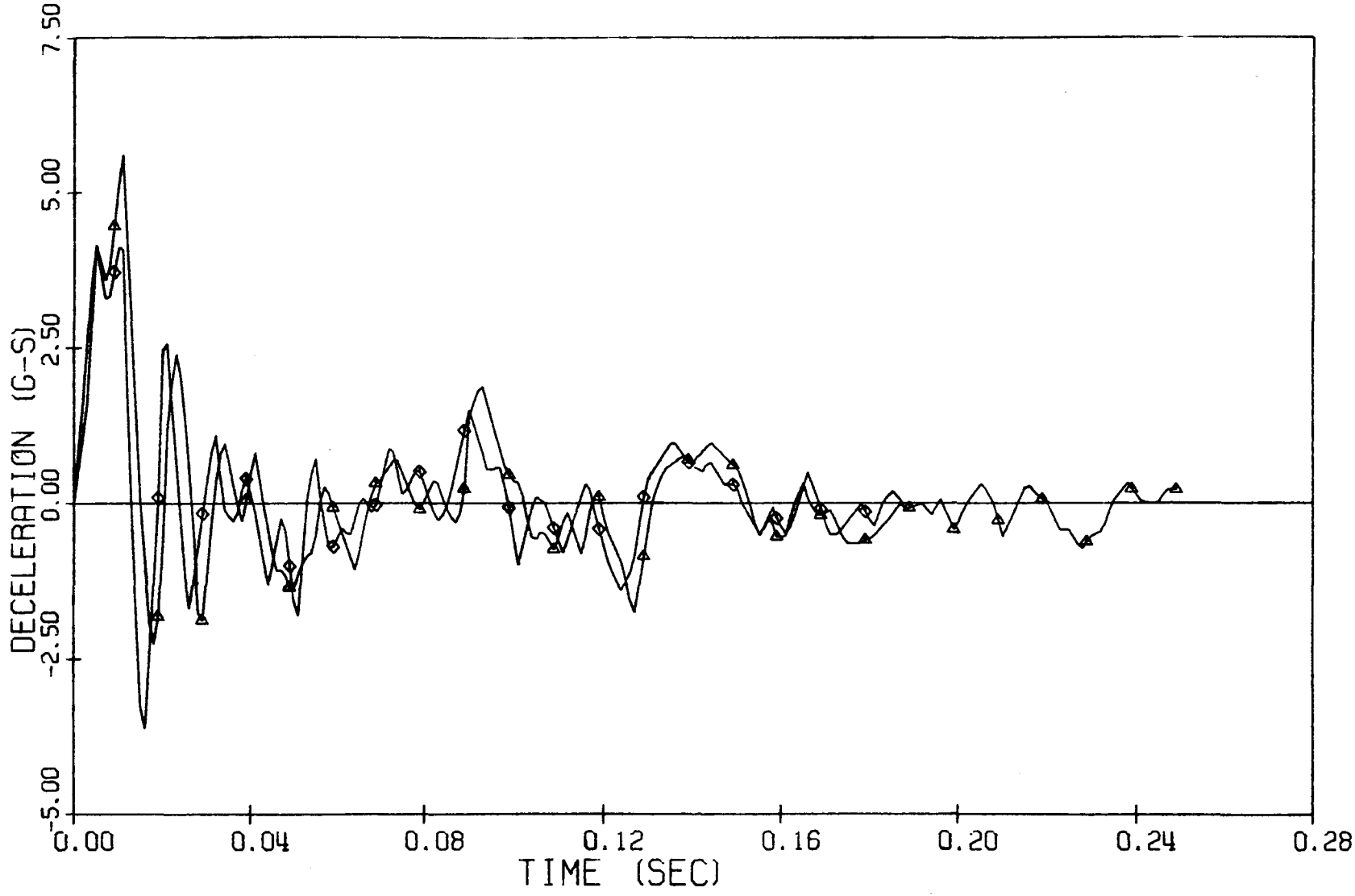


Figure 19. Deceleration versus time, test 22.

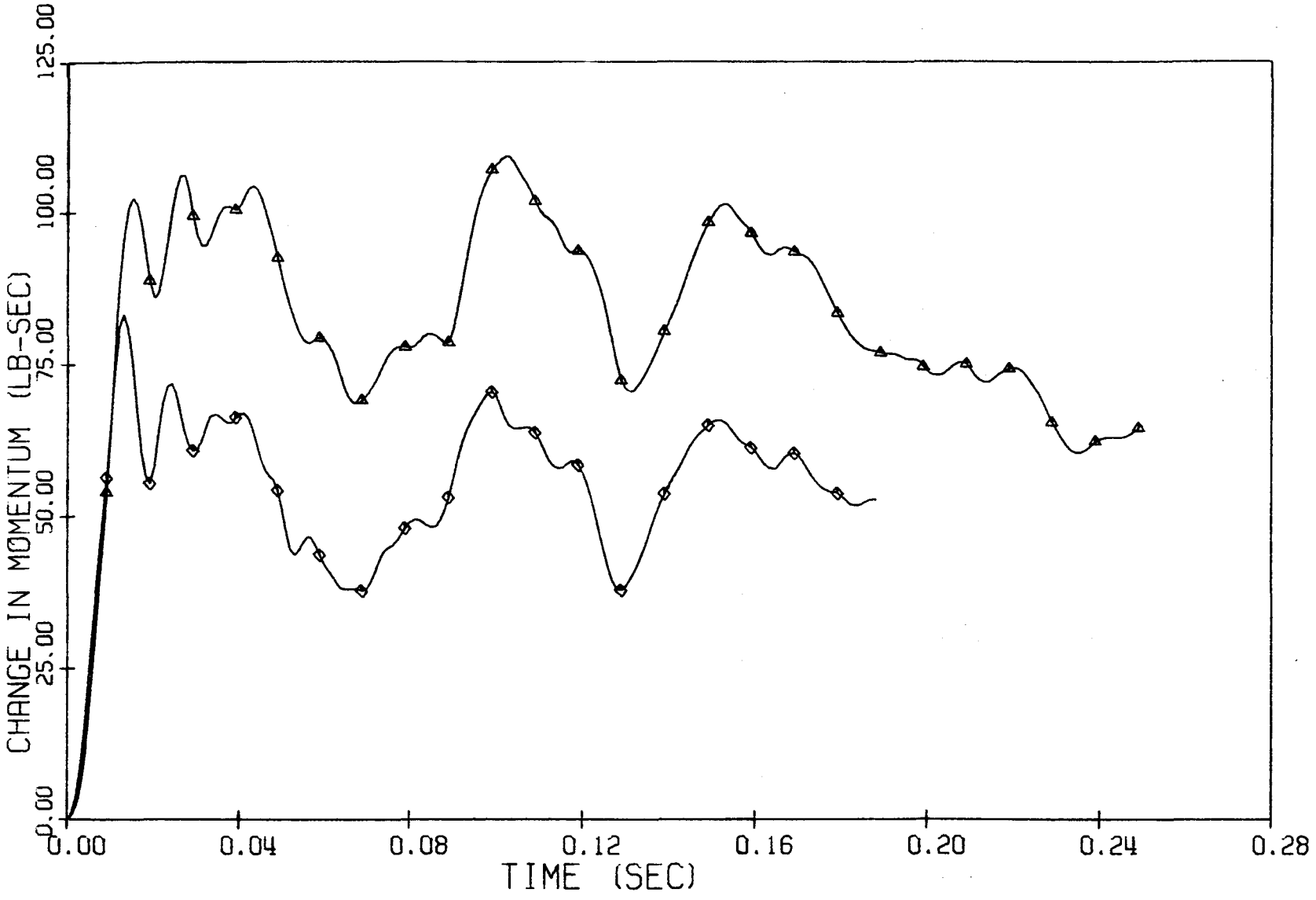


Figure 20. Change in momentum versus time, test 22.

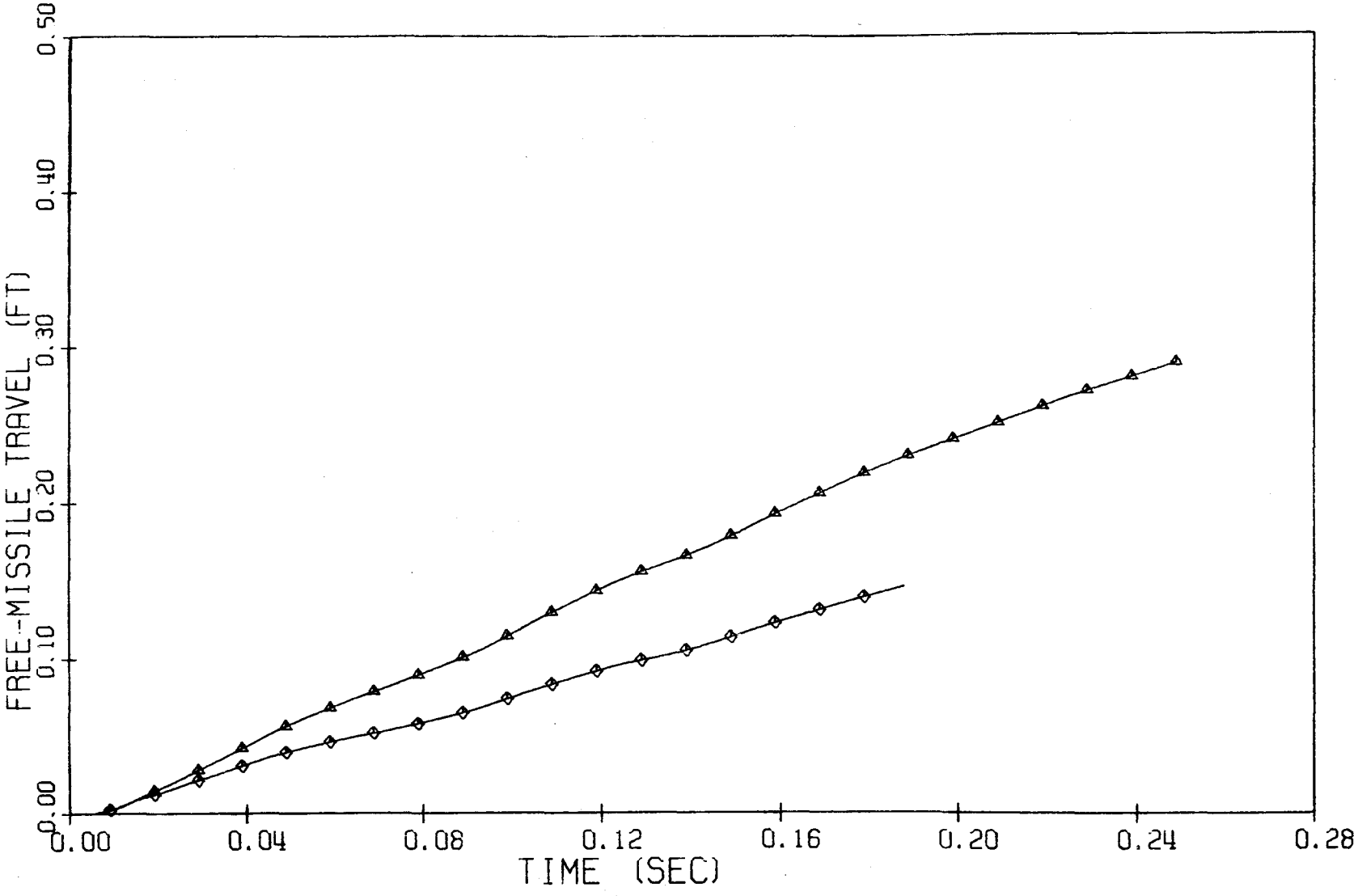
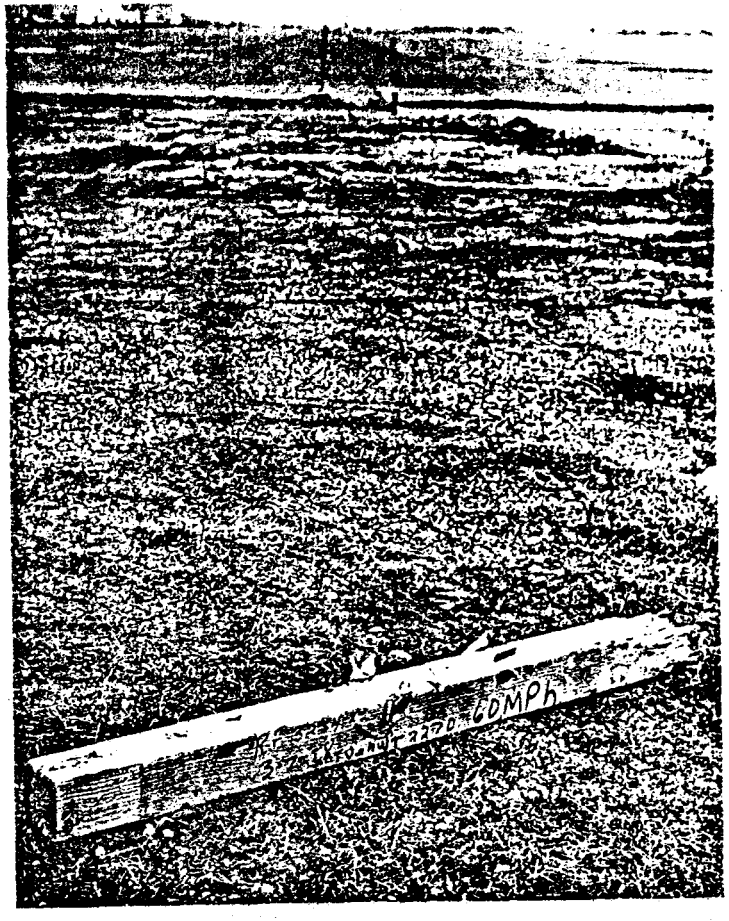


Figure 21. Free missile travel versus time, test 22.

a) Base



b) Mailbox Post

Figure 22. Mailbox support damage, test 22.

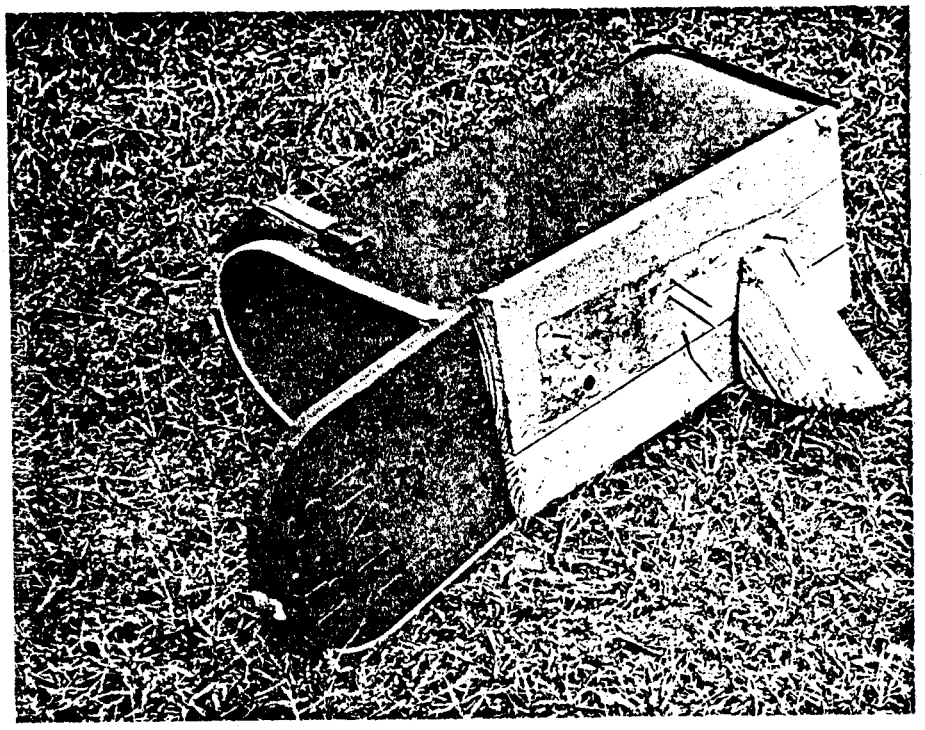
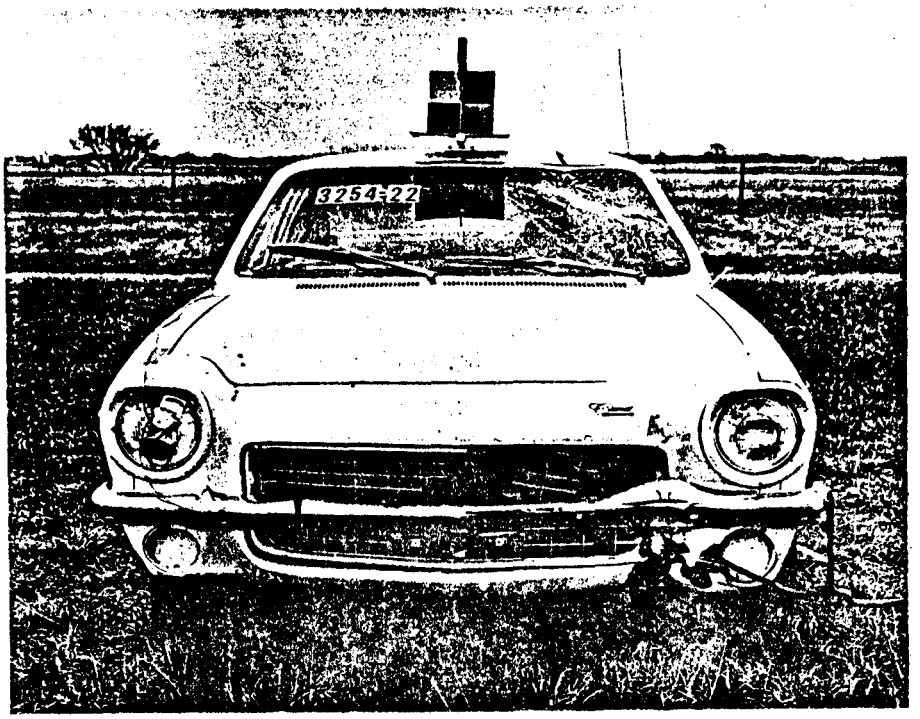
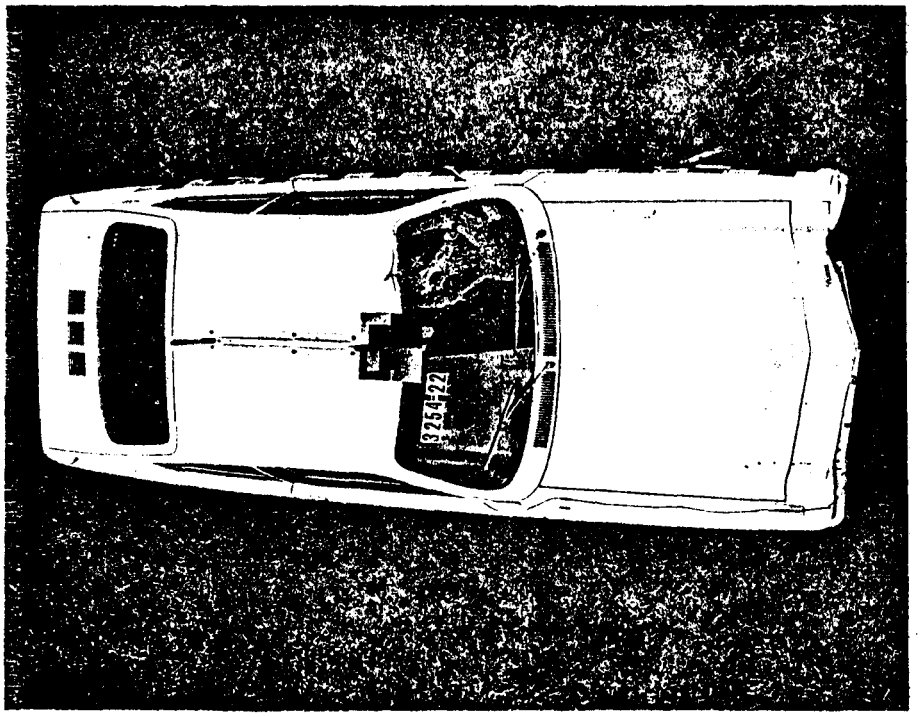


Figure 23. Damage to mailbox and timber cap.



a) Front View



b) Top View

Figure 24. Vehicle damage, test 22.

Results of test 23 are summarized in Table 5. Sequential photos are shown in Figure 25, and the time displacement event summary follows in Table 6. Deceleration, change in momentum, and free missile travel versus time data are shown in Figures 26, 27, and 28.

Upon impact the post split at the top where the connecting straps were attached to the post, then broke on the side away from impact. The mailbox and timber cap gained little velocity during the initial impact. After the support broke at ground level, the vehicle continued moving forward, and the mailbox impacted and broke the windshield. However, the box did not penetrate through to the passenger compartment. Damage to the support and mailbox is shown in Figures 29 and 30, and Figure 31 shows vehicle damage after test 23.

III-C. Test No. 24

Results for test 24 are summarized in Table 7. Figure 32 shows the sequential photos, and the time displacement event summary is given in Table 8. Figures 33, 34, and 35 contain deceleration, change in momentum, and free missile travel versus time data.

Upon impact the support post broke at ground level and at bumper height (20 in.) (50.8 cm). The support arm also separated from the post soon after impact without gaining any significant velocity. As a result, the support arm and four mailboxes hung in mid-air as the vehicle drove into it. When the support arm hit the windshield, three mailboxes entered the passenger compartment along with 75 percent of the support arm. The dummy was struck on the chin by the support arm, which almost decapitated the dummy. The impact also forced the seat back. Damage to the installation is pictured in Figure 36. Damage to the dummy and vehicle interior is shown in Figure 37, and exterior vehicle damage is given in Figure 38.

III-D. Test No. 25

Table 9 summarizes the results of test 25. Sequential photos are shown in Figure 39, and the time displacement event summary is given in Table 10. Figures 40, 41, and 42 contain deceleration, change in momentum, and free missile travel versus time data.

Table 5. Summary of results, test 3254-23.

Impact Velocity = 62.6 mph

POST DATA

Type	Wood
Size	4 in. x 4 in. (Nominal Dimensions)
Embedment Method	Drill and Backfill
Embedment Depth (ft)	2

VEHICLE DATA

Make	Chevrolet
Model	Vega
Year	1973
Weight (lb)	2270
Impact Point	15 in. to right of center

ACCELEROMETER DATA	Left	Right
Change in Momentum (lb-sec)	14	83
Duration of Event (sec)*	0.135	
Peak Deceleration (G's)	8.40	9.05
Maximum 0.050 Sec Average Deceleration (G's)	0.51	0.59

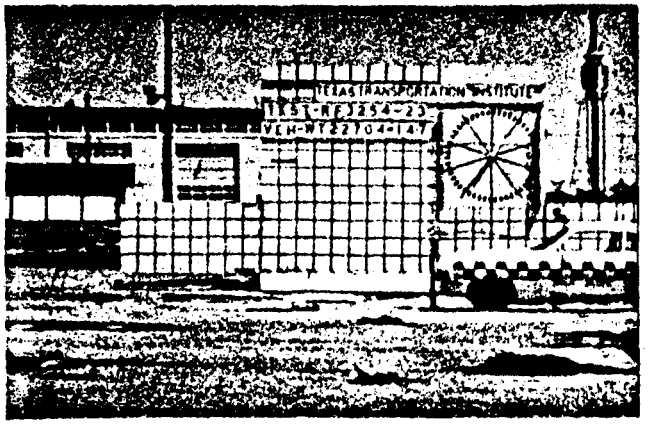
VEHICLE DAMAGE CLASSIFICATION

TAD	FR-1
SAE	12FRAN1
Did test article penetrate the passenger compartment?	No
Was windshield broken?	Yes, by Mailbox

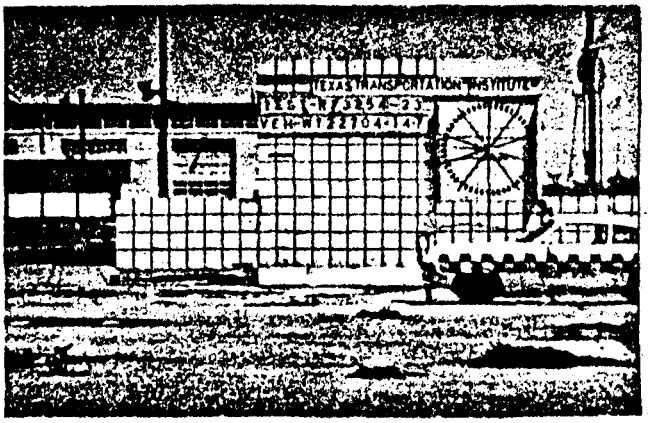
*Time of contact

Metric Conversions:

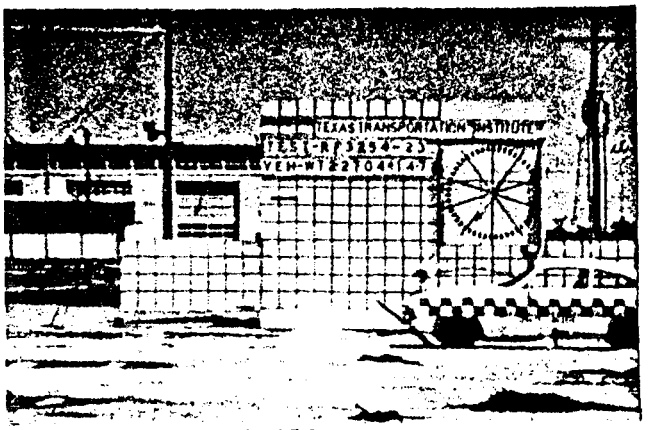
1 in. = 2.54 cm
1 ft = 0.305 m
1 lb_m = 0.454 kg
1 lb_m-sec = 0.454 kg-s
1 mph = 0.447 m/s



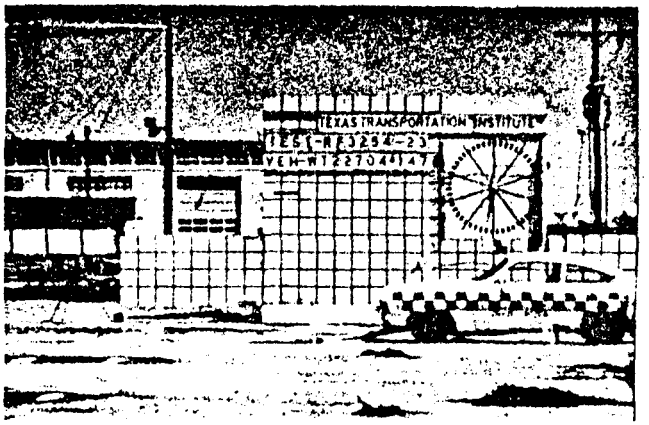
0.000 sec



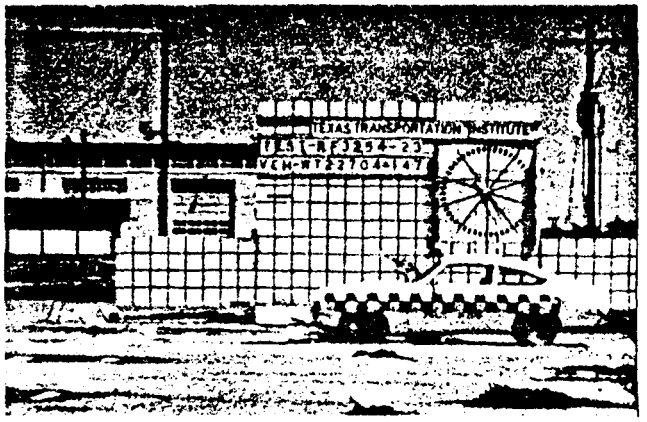
0.006 sec



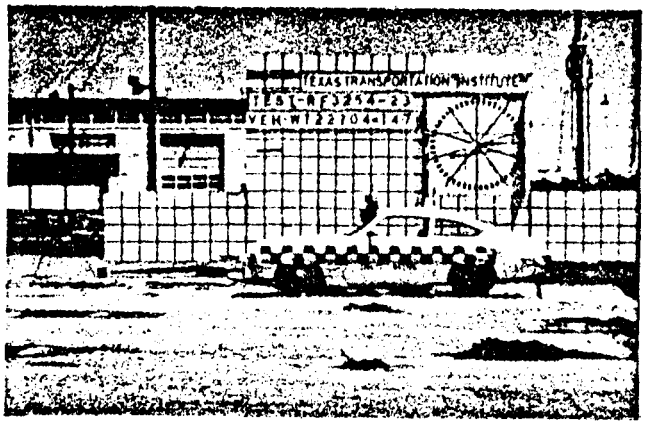
0.018 sec



0.033 sec



0.065 sec



0.093 sec

Figure 25. Sequential photos, test 23.

Table 6. Time displacement event summary for test 3254-23.

TIME (sec)	NOMINAL VEHICLE DISPLACEMENT (ft)	EVENT
0.000	0.00	Impact
0.006	0.62	Support splits at top
0.018	1.73	Post breaks at ground
0.033	2.44	Post hits ground
0.065	5.91	Mailbox strikes windshield
0.093	8.35	Mailbox rolls up windshield

Metric Conversions:

1 ft = 0.305 m

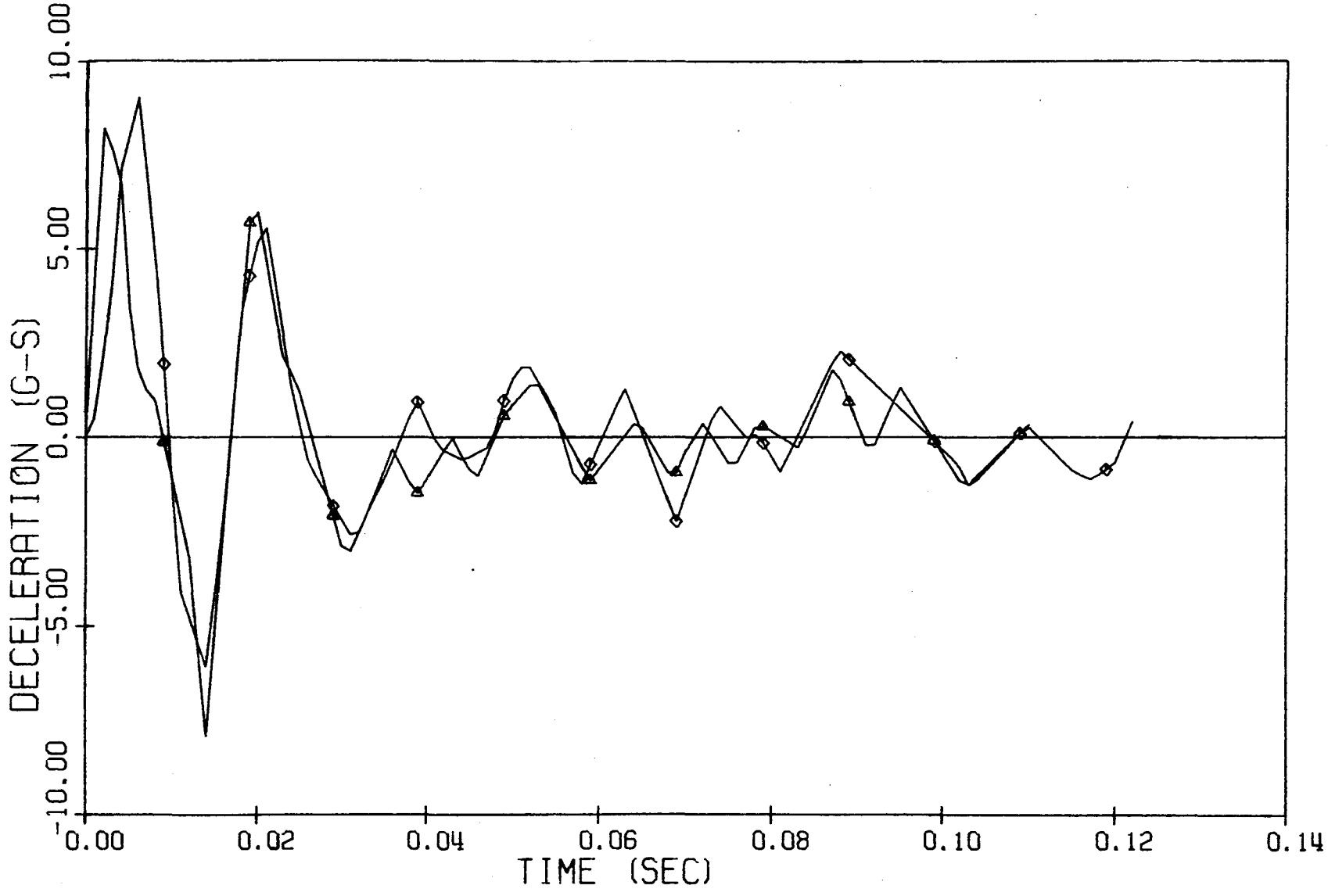


Figure 26. Deceleration versus time, test 23.

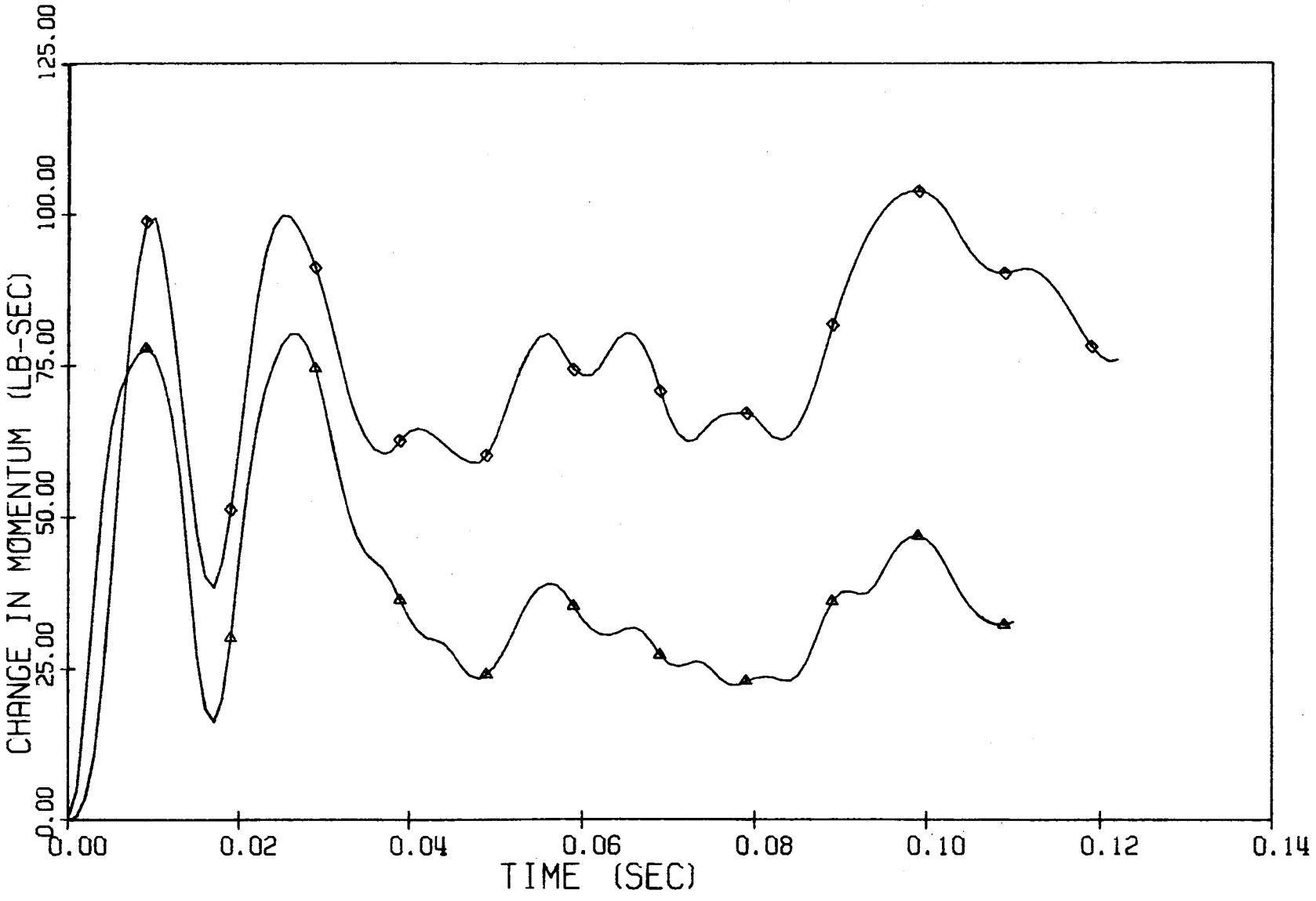


Figure 27. Change in momentum versus time, test 23.

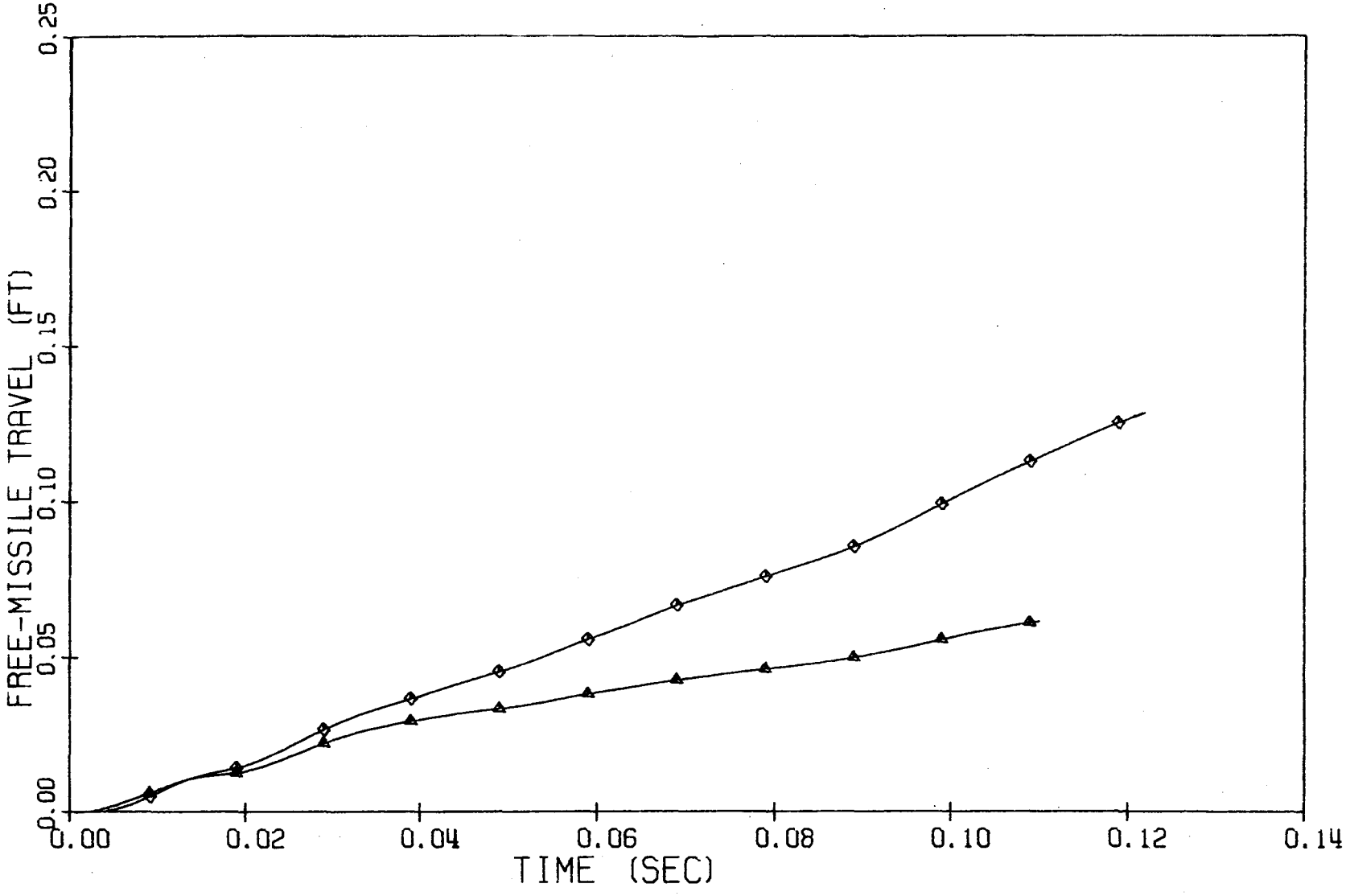
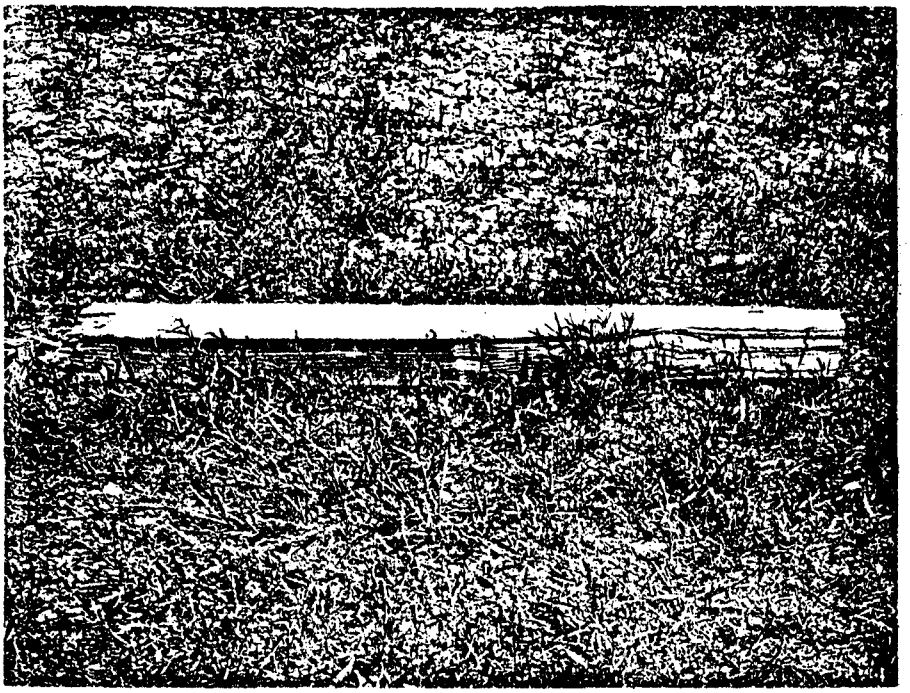
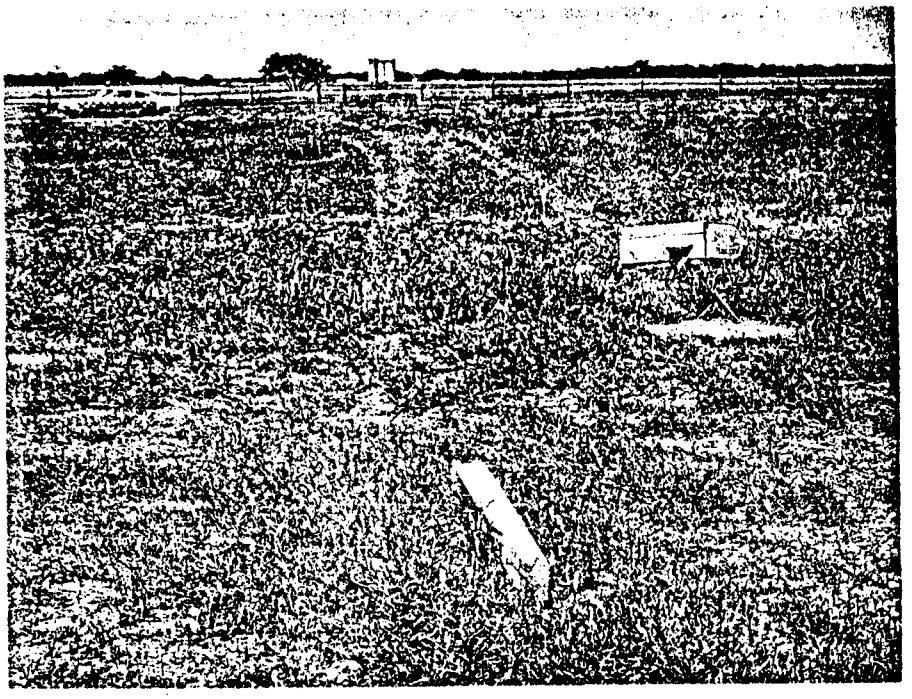


Figure 28. Free missile travel versus time, test 23.

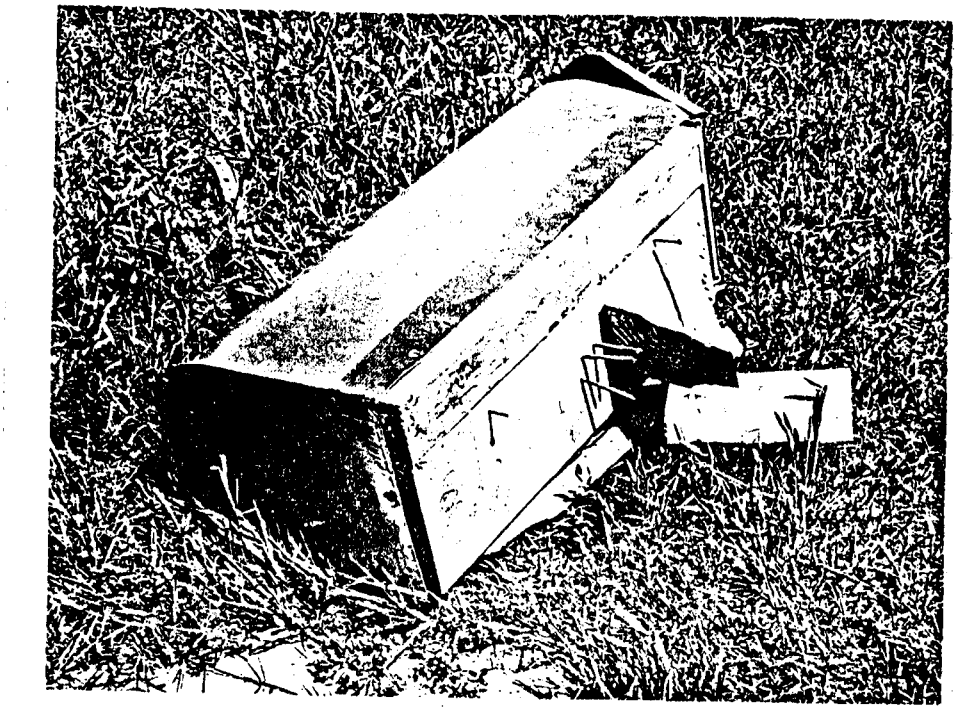


a) Post

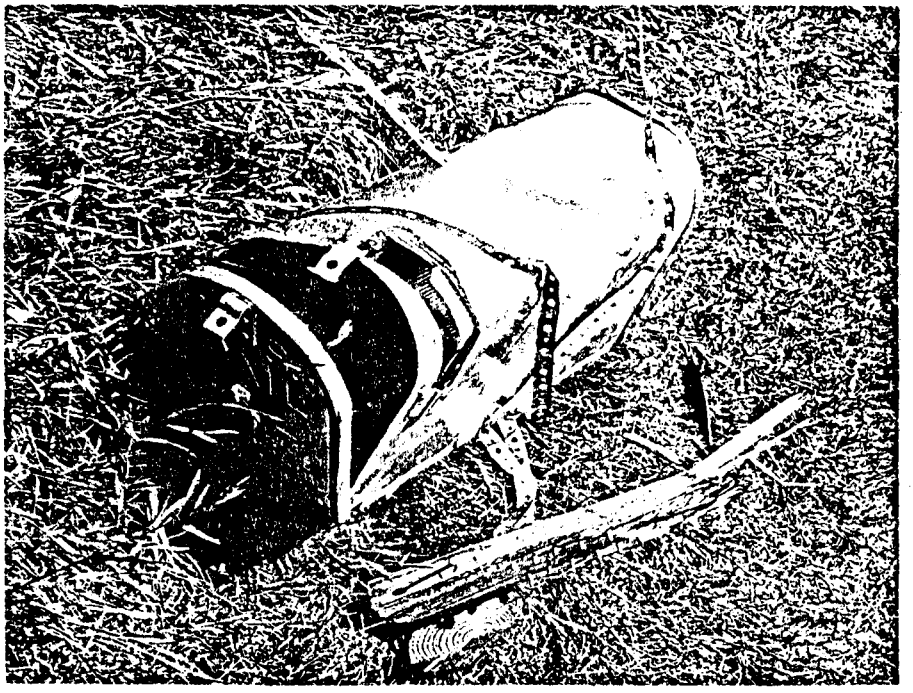


b) Post in Relation to Mailbox

Figure 29. Mailbox support damage, test 23.

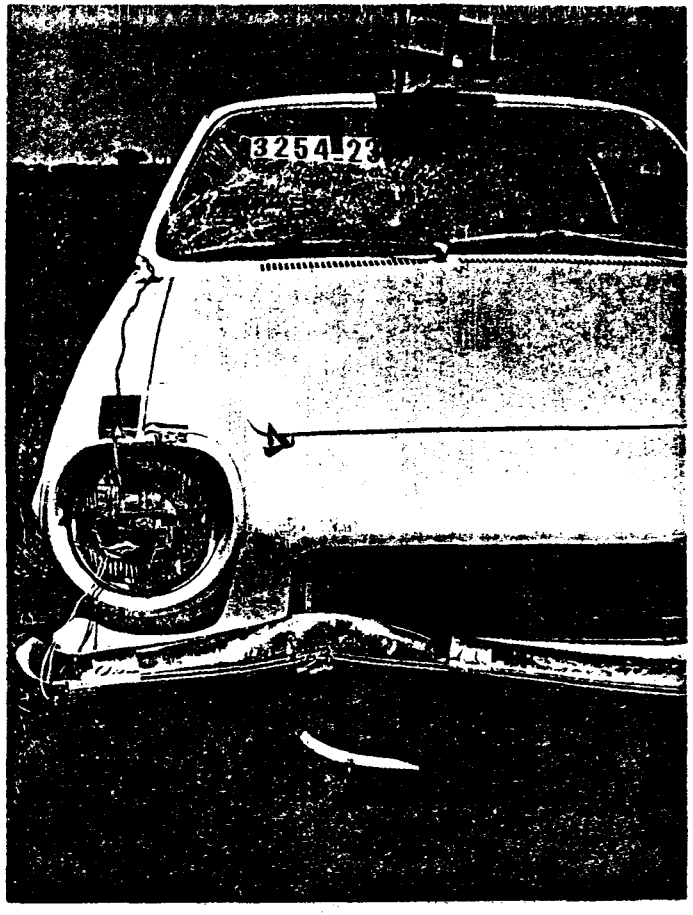


a) Bottom View

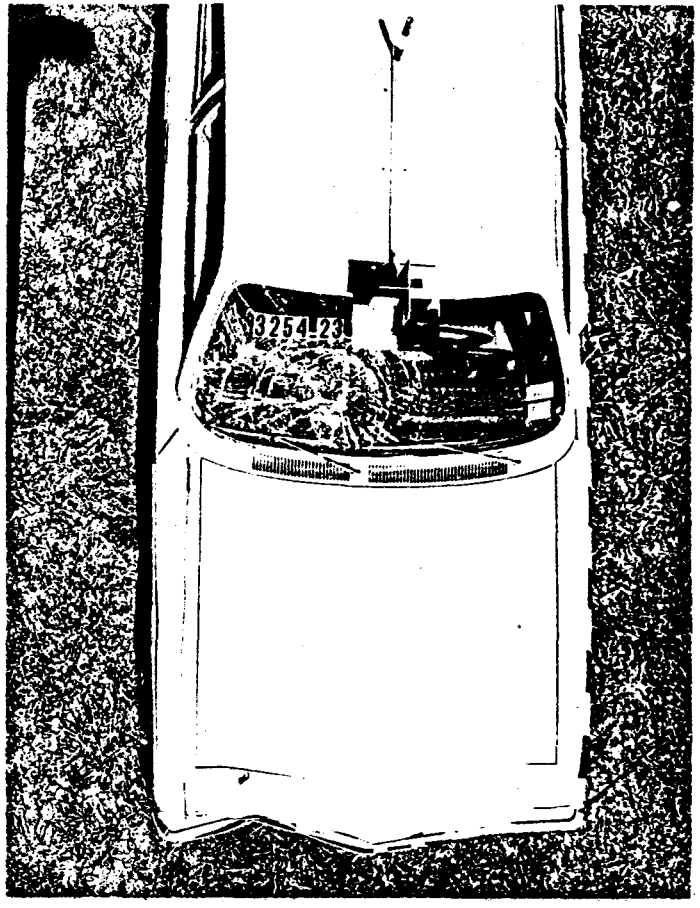


b) Top View

Figure 30. Damage to mailbox, test 23.



a) Front View



b) Top View

Figure 31. Vehicle damage, test 23.

Table 7. Summary of results, test 3254-24.

Impact Velocity = 58.8 mph

POST DATA

Type	Wood
Size	4 in. x 4 in. (Nominal Dimensions)
Embedment Method	Drill and Backfill
Embedment Depth (ft)	2

VEHICLE DATA

Make	Chevrolet
Model	Vega
Year	1973
Weight (lb)	2440
Impact Point	15 in. to left of center

ACCELEROMETER DATA	Left	Right
Change in Momentum (lb-sec)	162	140
Duration of Event (sec)*	0.125	
Peak Deceleration (G's)	9.44	8.68
Maximum 0.050 Sec Average Deceleration (G's)	0.71	0.61

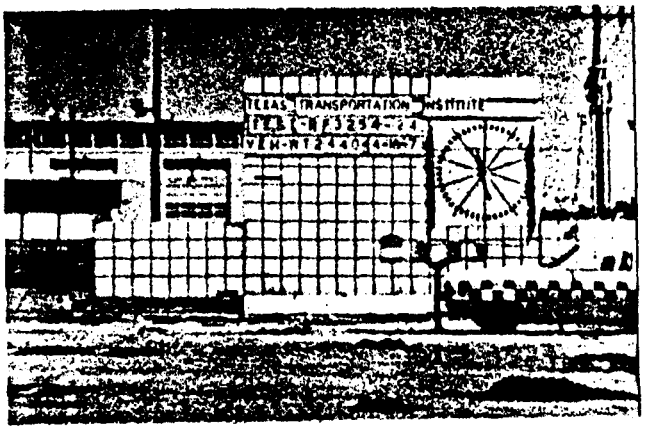
VEHICLE DAMAGE CLASSIFICATION

TAD	FL-0
SAE	12FLAN1
Did test article penetrate the passenger compartment?	Yes
Was windshield broken?	Yes, by Mailboxes and Support Arm

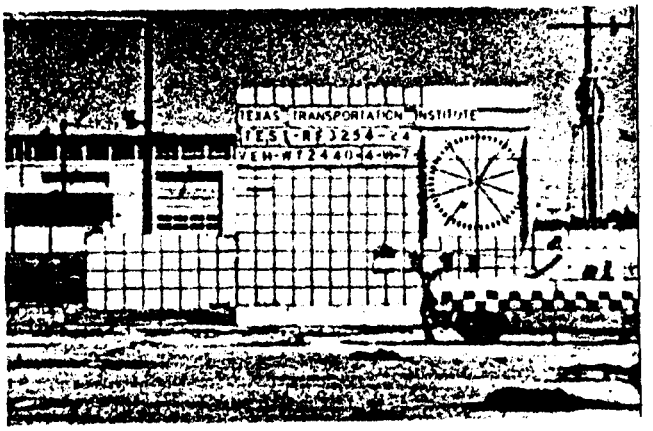
*Time of contact

Metric Conversions:

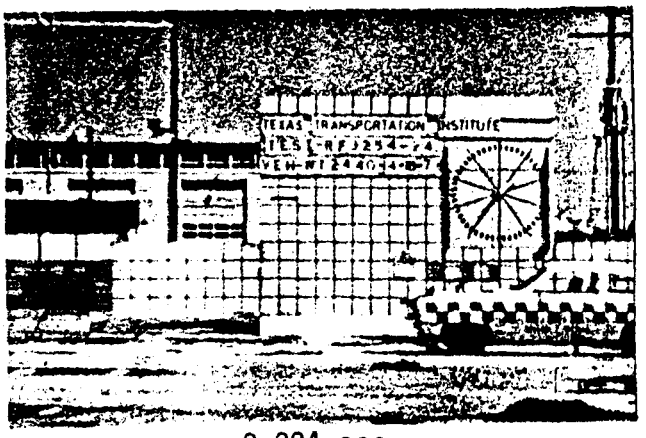
1 in.	= 2.54 cm
1 ft	= 0.305 m
1 lb_m	= 0.454 kg
1 lb_m-sec	= 0.454 kg-s
1 mph	= 0.447 m/s



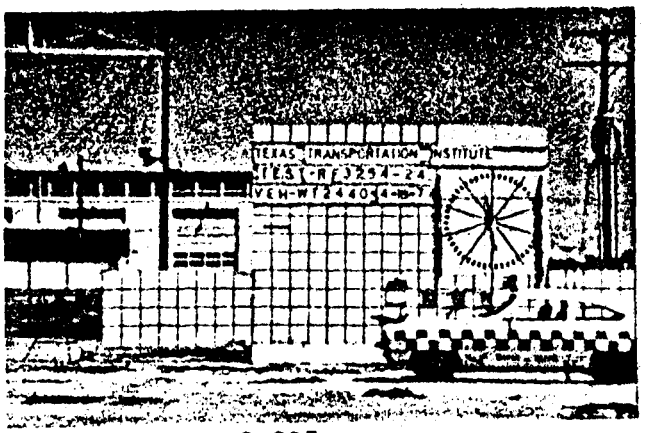
0.000 sec



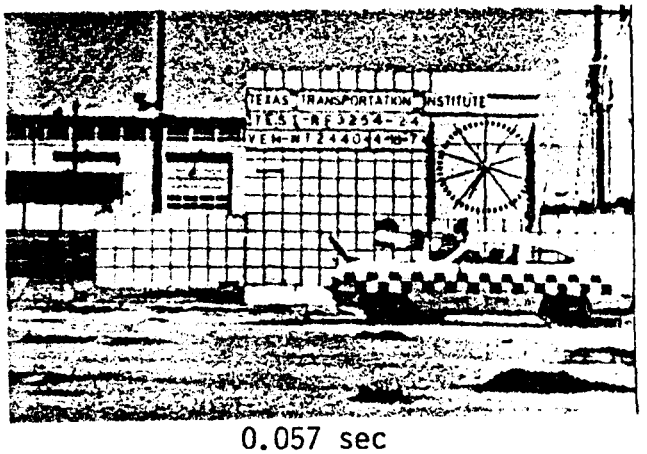
0.005 sec



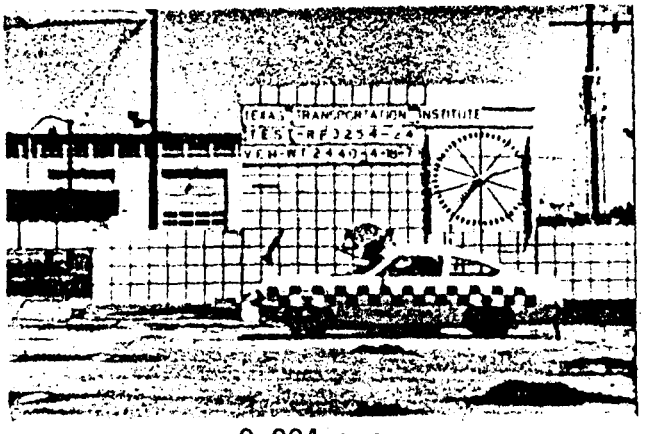
0.024 sec



0.035 sec



0.057 sec



0.094 sec

Figure 32. Sequential photos, test 24.

Table 8. Time displacement event summary for test 3254-24.

TIME (sec)	NOMINAL VEHICLE DISPLACEMENT (ft)	EVENT
0.000	0.00	Impact
0.005	0.45	Post breaks at bumper
0.024	2.14	Post loses contact with bumper
0.035	3.18	First mailbox hits windshield
0.057	5.06	Dummy hit by first mailbox
0.094	8.35	Fourth mailbox separates from support arm

Metric conversions:

1 ft = 0.305 m

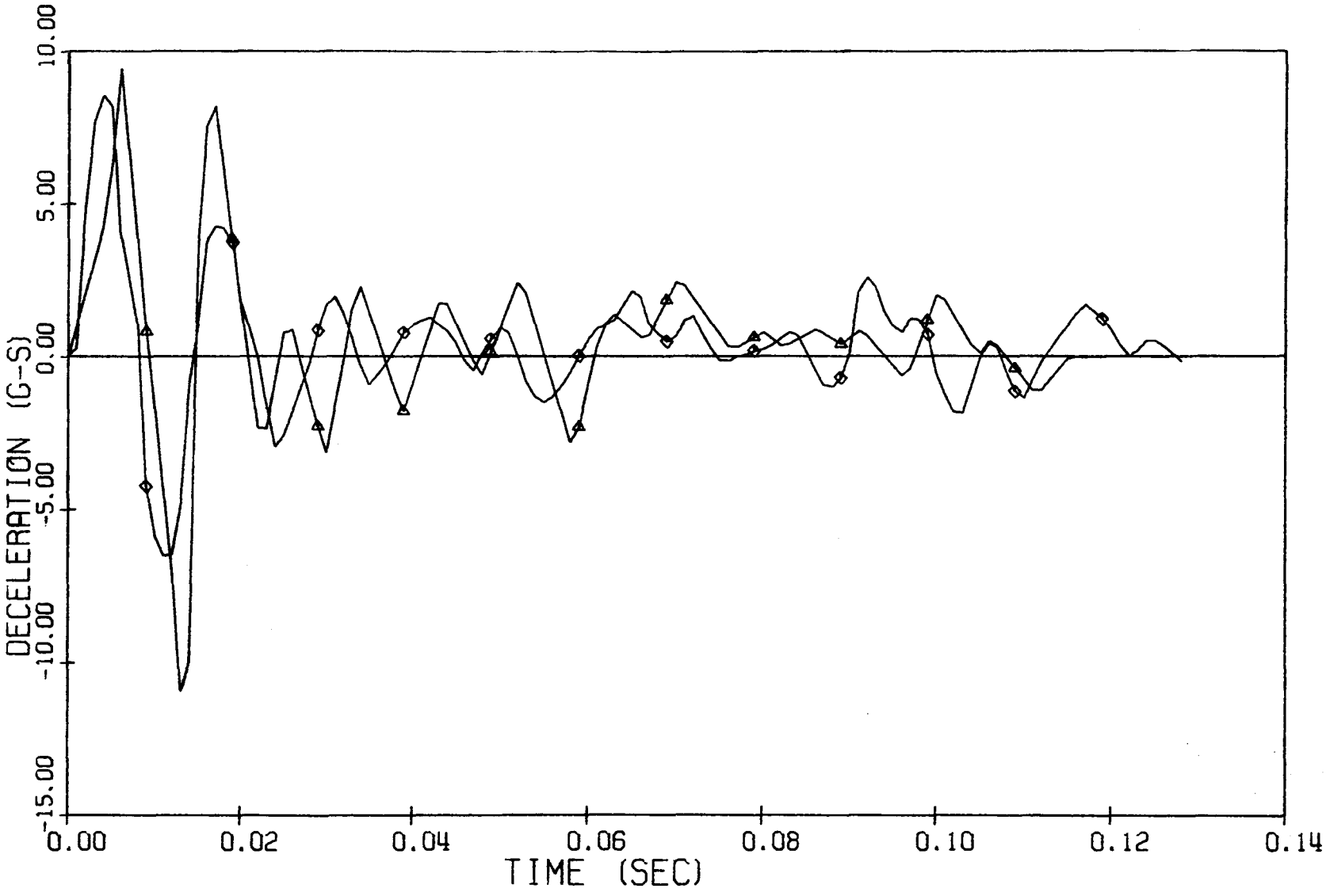


Figure 33. Deceleration versus time, test 24.

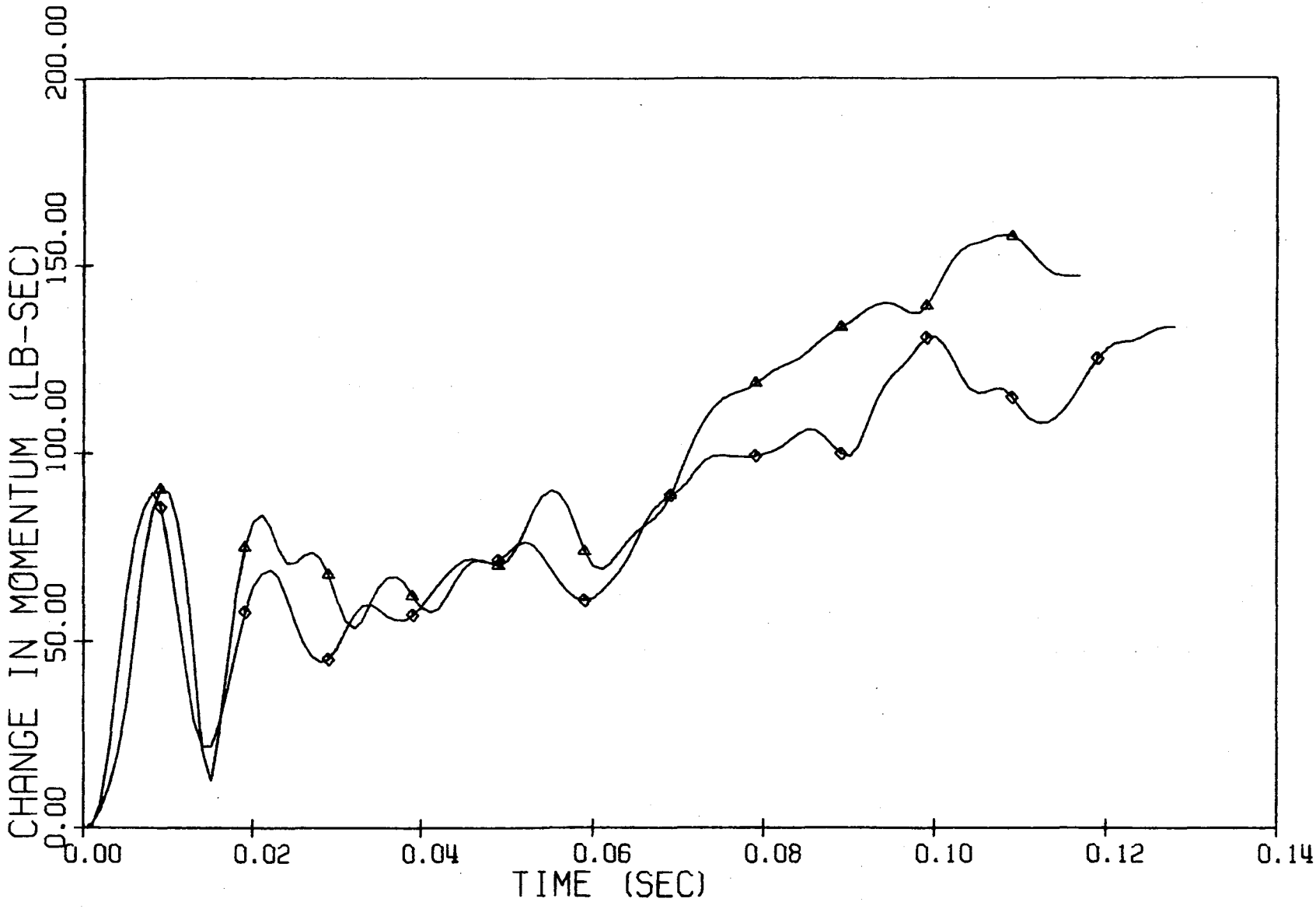


Figure 34. Change in momentum versus time, test 24.

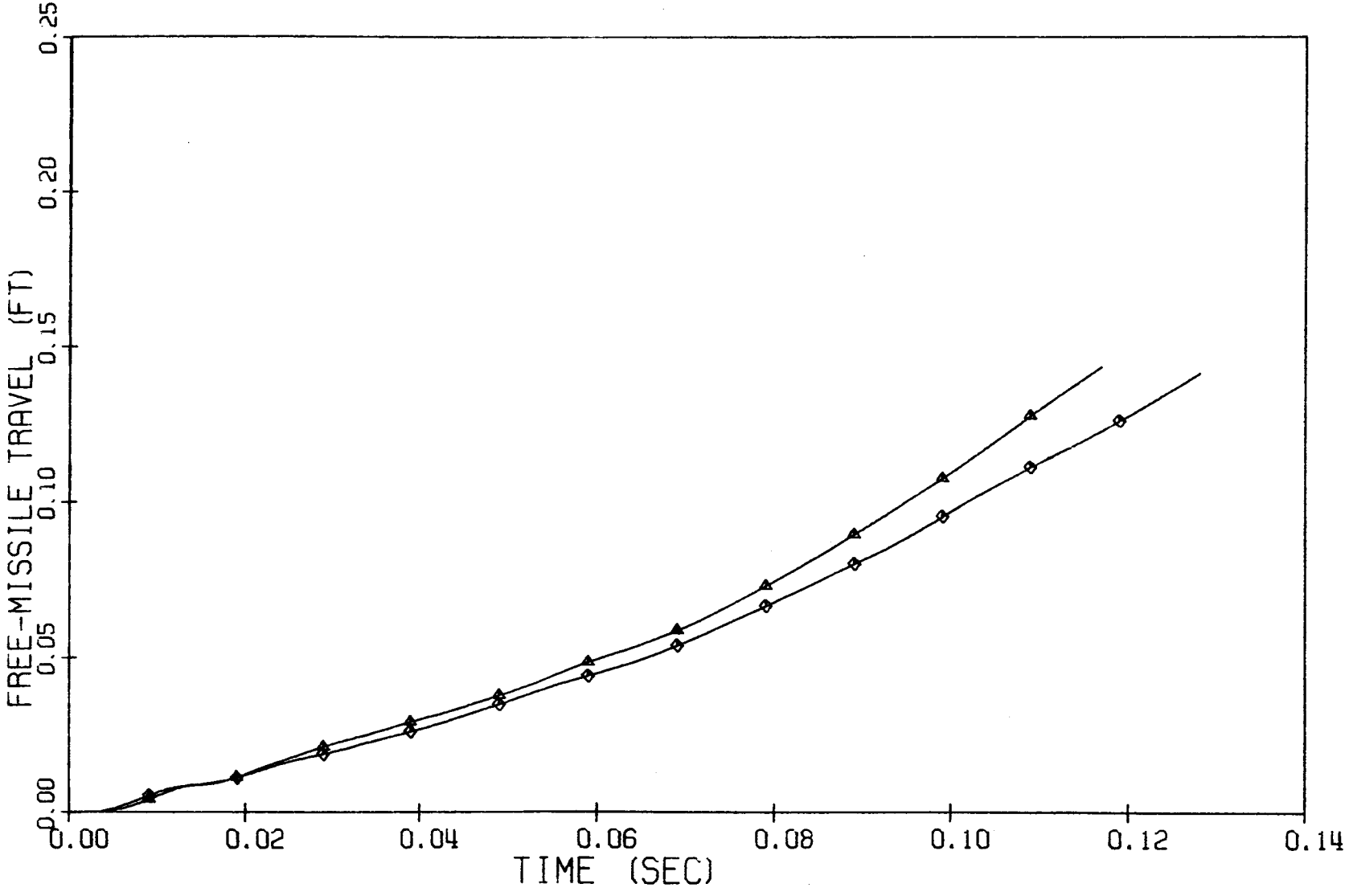
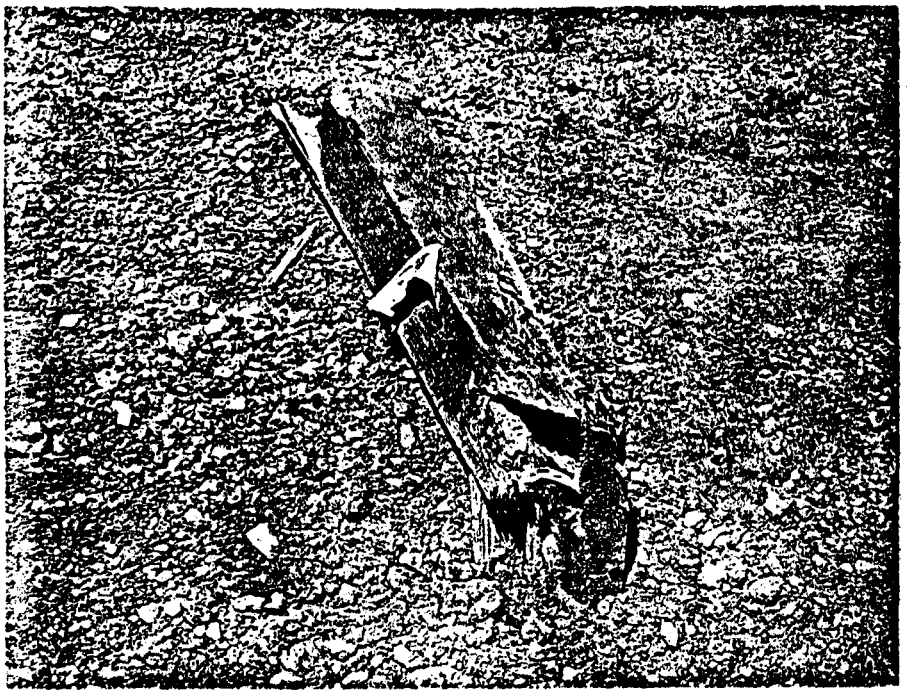


Figure 35. Free missile travel versus time, test 24.

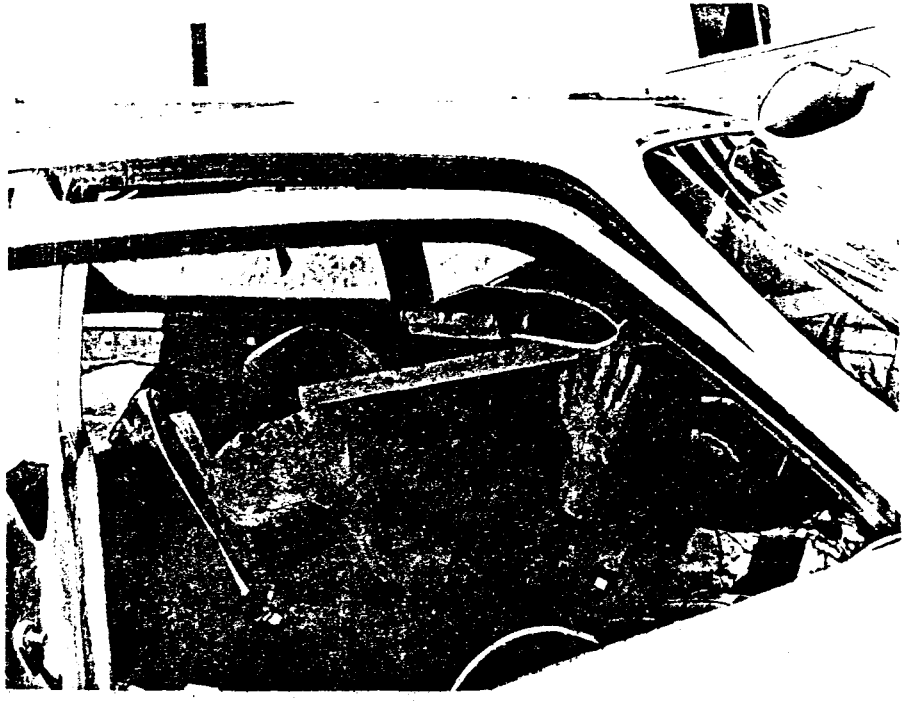


a) Post Damage

b) Mailbox and Support Damage

Figure 36. Damage to mailbox installation, test 24.

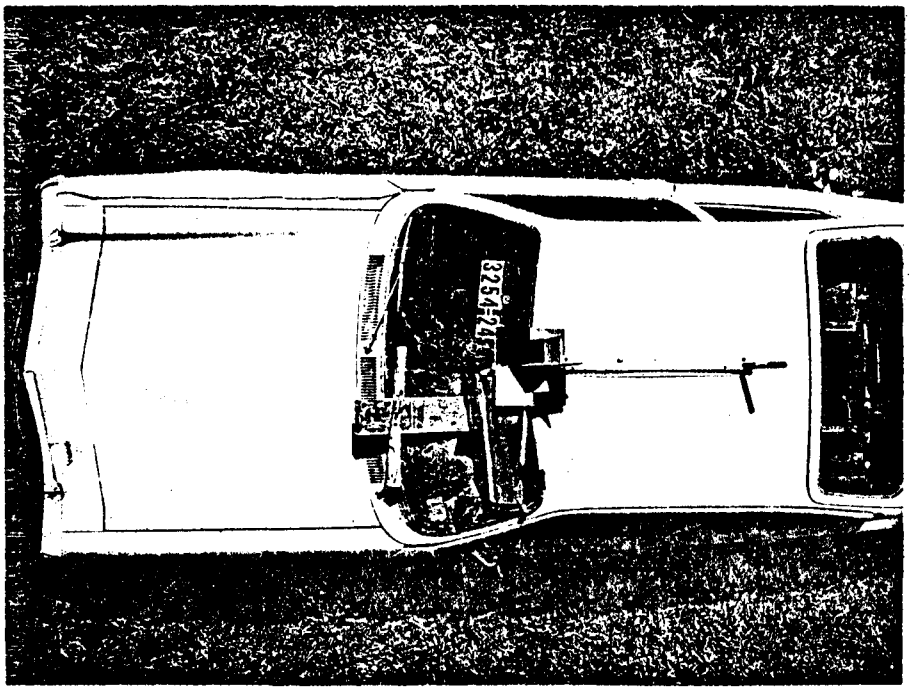
a) Interior View



b) Right Side View

Figure 37. Interior vehicle damage, test 24.

a) Front View



b) Top View

Figure 38. Vehicle damage, test 24.

Table 9. Summary of results, test 3254-25.

Impact Velocity = 58.8 mph

POST DATA

Type	Lap-Spliced Steel Pipe with Bolted Shear Connection
Size	1½ in. I.D.
Embedment Method	Augered
Embedment Depth (ft)	2

VEHICLE DATA

Make	Chevrolet
Model	Vega
Year	1972
Weight (lb)	2260
Impact Point	15 in. to left of center

ACCELEROMETER DATA	Left	Right
Change in Momentum (lb-sec)	189	245
Duration of Event (sec)*	0.229	
Peak Deceleration (G's)	4.03	4.03
Maximum 0.050 Sec Average Deceleration (G's)	1.14	1.13

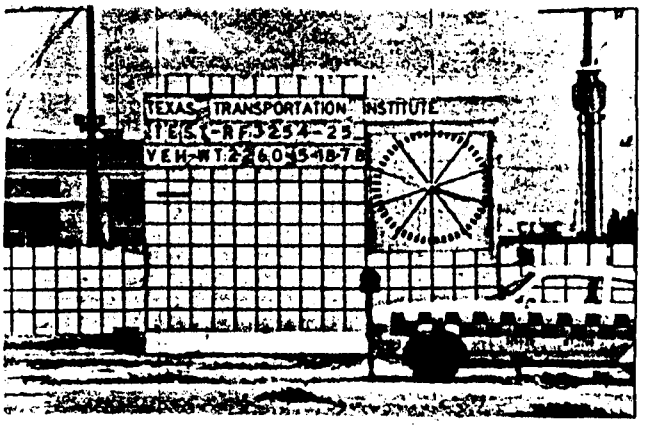
VEHICLE DAMAGE CLASSIFICATION

TAD	FL-0
SAE	12FLEN1
Did test article penetrate the passenger compartment?	No
Was windshield broken?	No

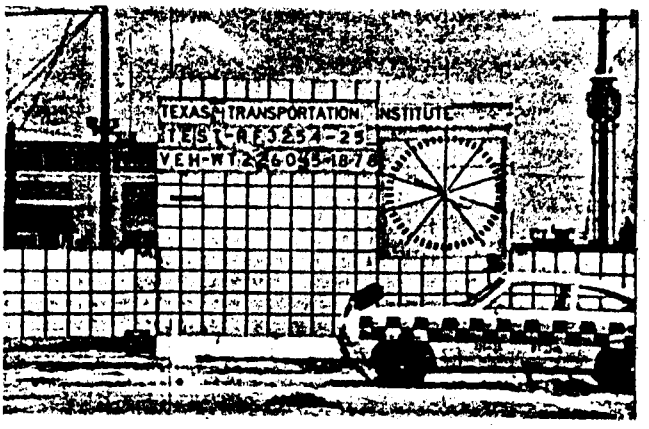
*Time of contact

Metric Conversions:

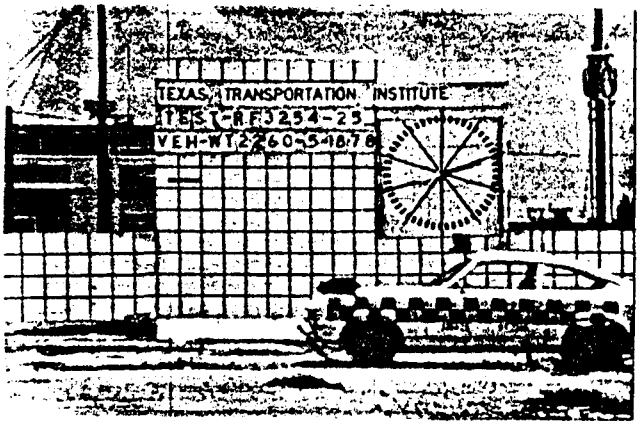
1 in.	= 2.54 cm
1 ft	= 0.305 m
1 lb_m	= 0.454 kg
1 lb_m-sec	= 0.454 kg-s
1 mph	= 0.447 m/s



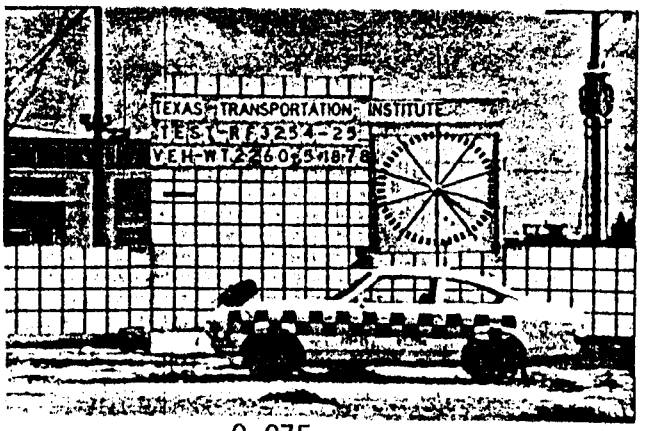
0.000 sec



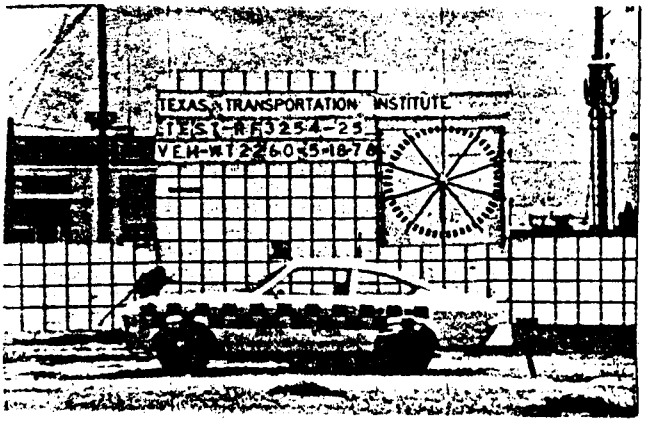
0.019 sec



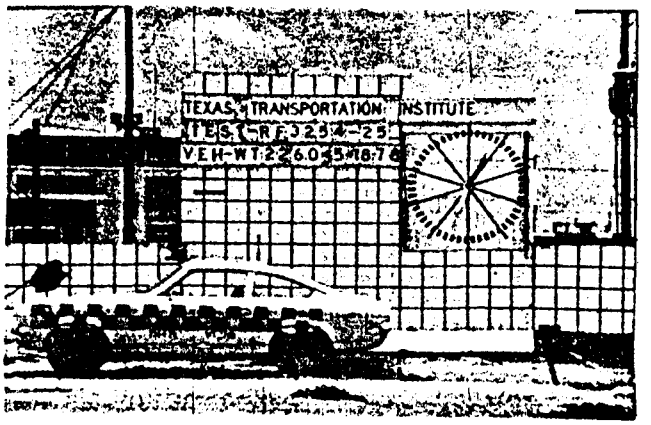
0.033 sec



0.075 sec



0.117 sec



0.176 sec

Figure 39. Sequential photos, test 25.

Table 10. Time displacement event summary for test 3254-25.

TIME (sec)	NOMINAL VEHICLE DISPLACEMENT (ft)	EVENT
0.000	0.00	Impact
0.019	1.52	Mailbox separates from support
0.033	2.68	Mailbox hits hood
0.075	6.04	Vehicle moving over post
0.117	9.37	Mailbox on hood
0.176	13.95	Mailbox clear of hood

Metric Conversions:

1 ft = 0.305 m

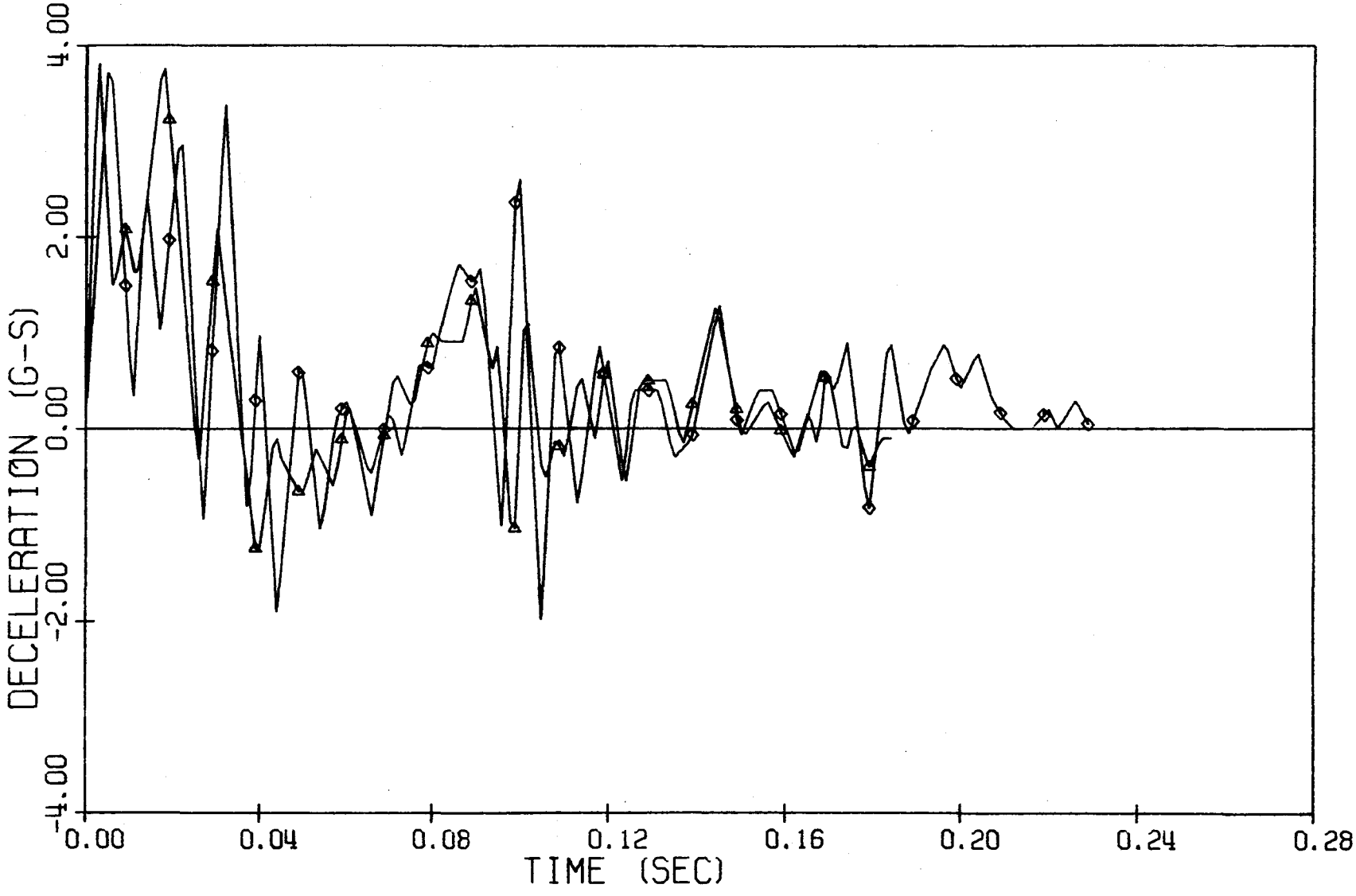


Figure 40. Deceleration versus time, test 25.

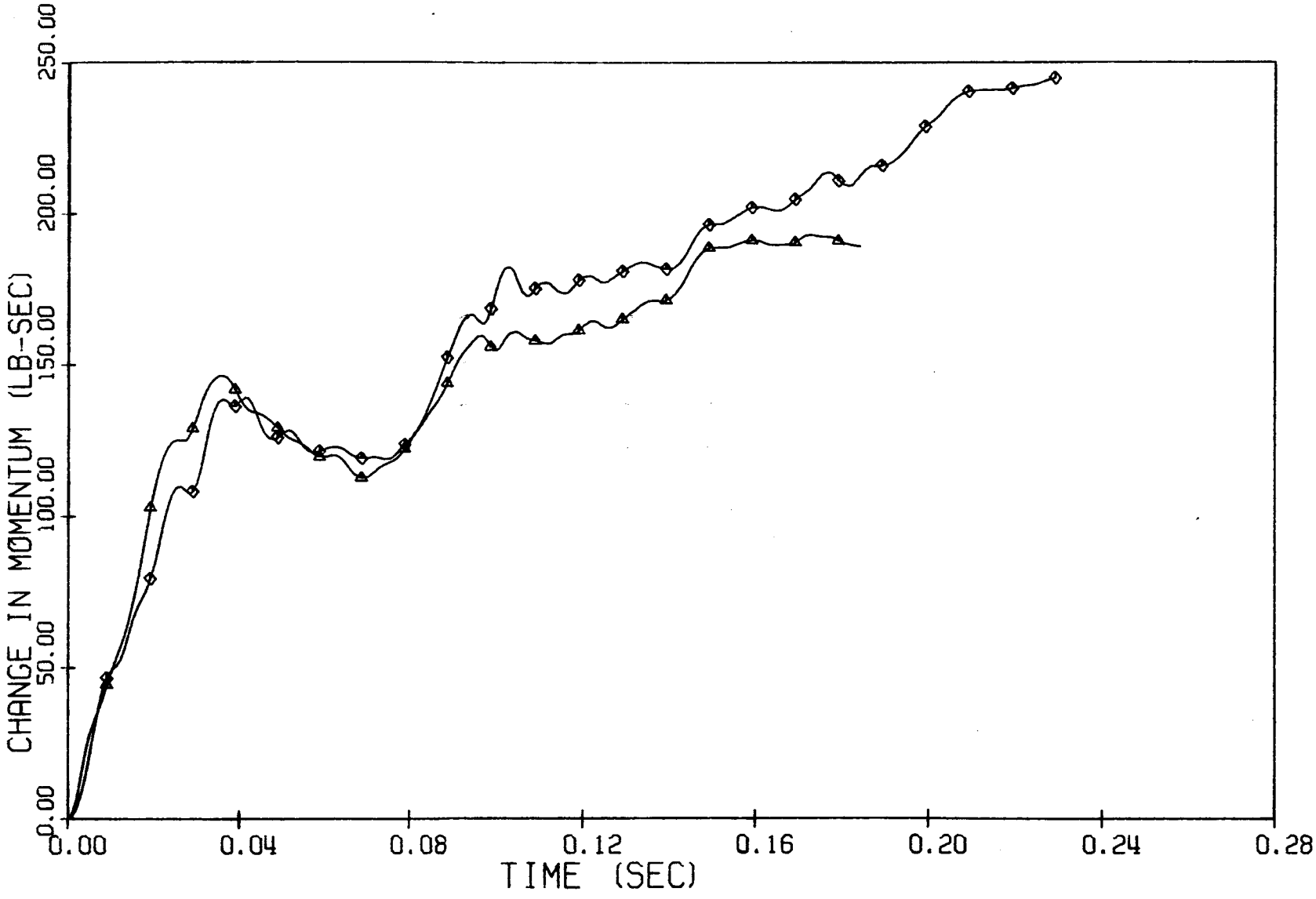


Figure 41. Change in momentum versus time, test 25.

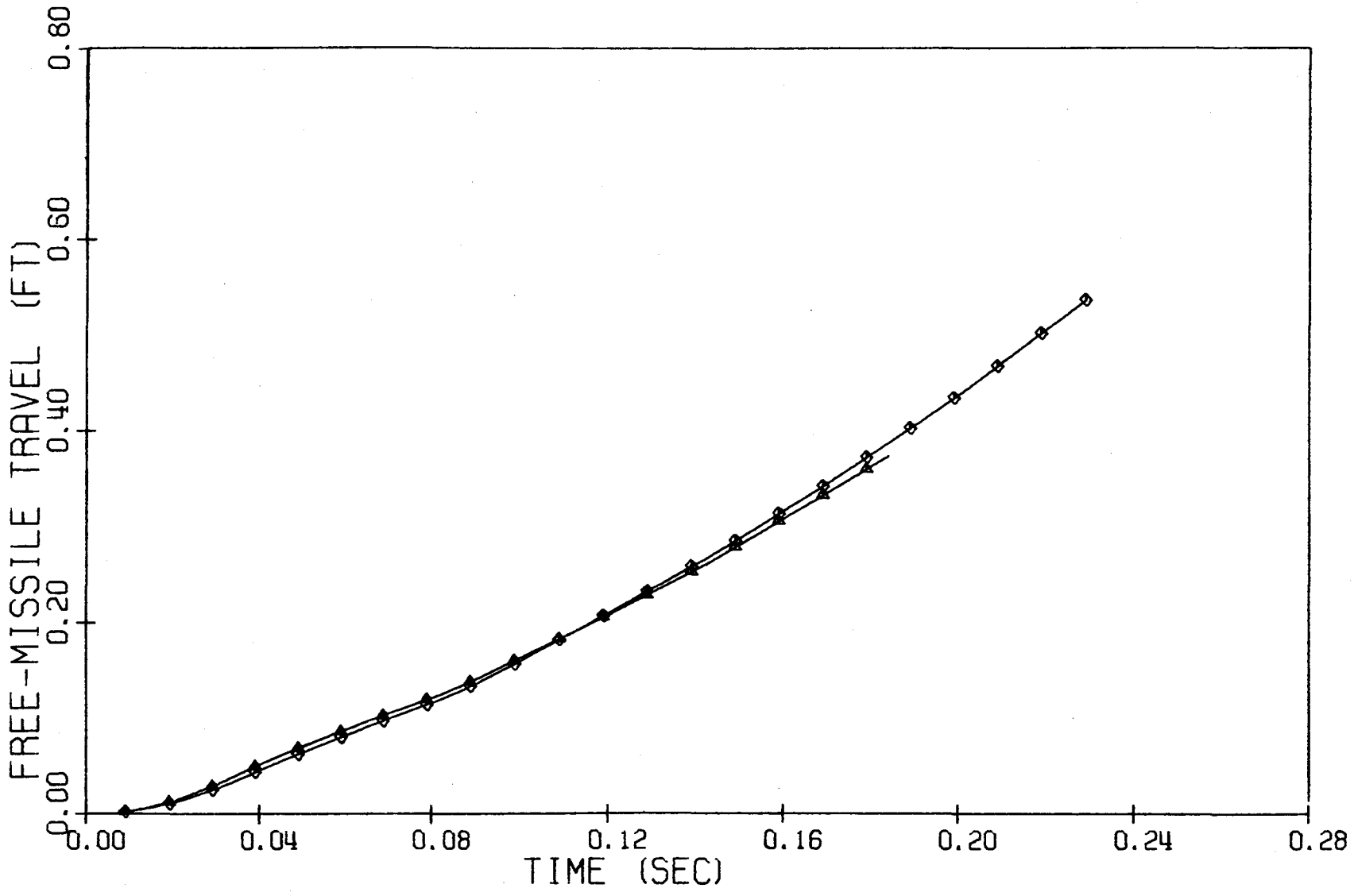


Figure 42. Free missile travel versus time, test 25.

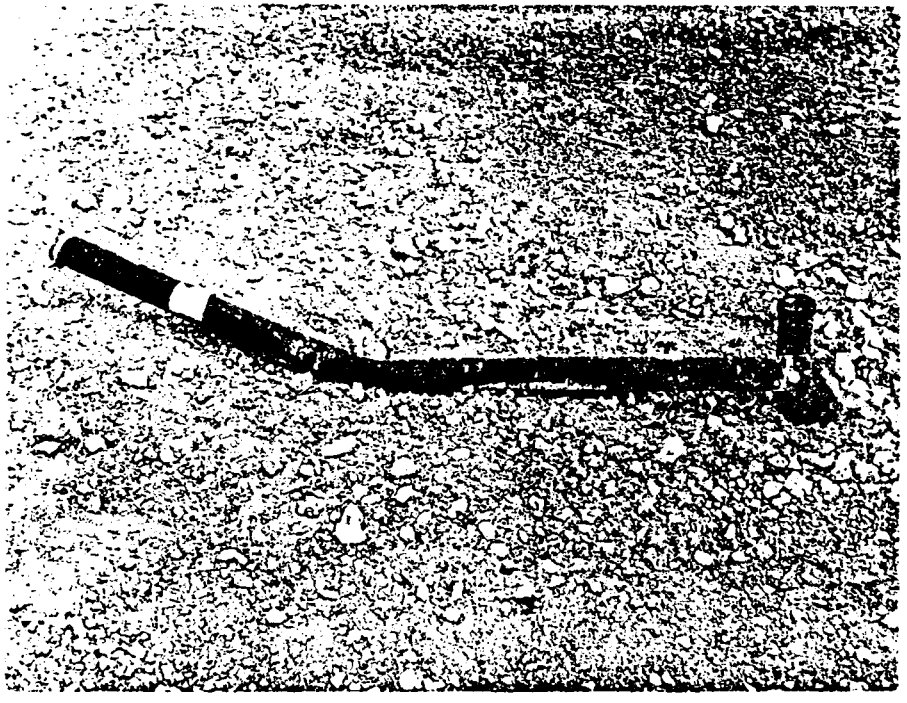
This was the first test in which the windshield was not struck by some part of the mailbox or its support. Although the mailbox broke free of the support, it remained intact long enough to attain a velocity approximately equal that of the vehicle. As a result, the mailbox rode along on the hood and harmlessly fell away. Investigation of the bracket-to-post connection showed that the lock nut threads stripped, allowing the box to separate from the post. Two lock nuts on the top of the bracket would have likely prevented this separation (see test 26 description). The support and mailbox were too badly damaged to be reused. However the anchor post was not damaged and could be reused. Damage to this system is pictured in Figure 43. Note that the shear bolt fractured as designed, retaining the post but allowing it to rotate downward. Vehicle damage was minimal as can be seen in Figure 44.

III-E. Test No. 26

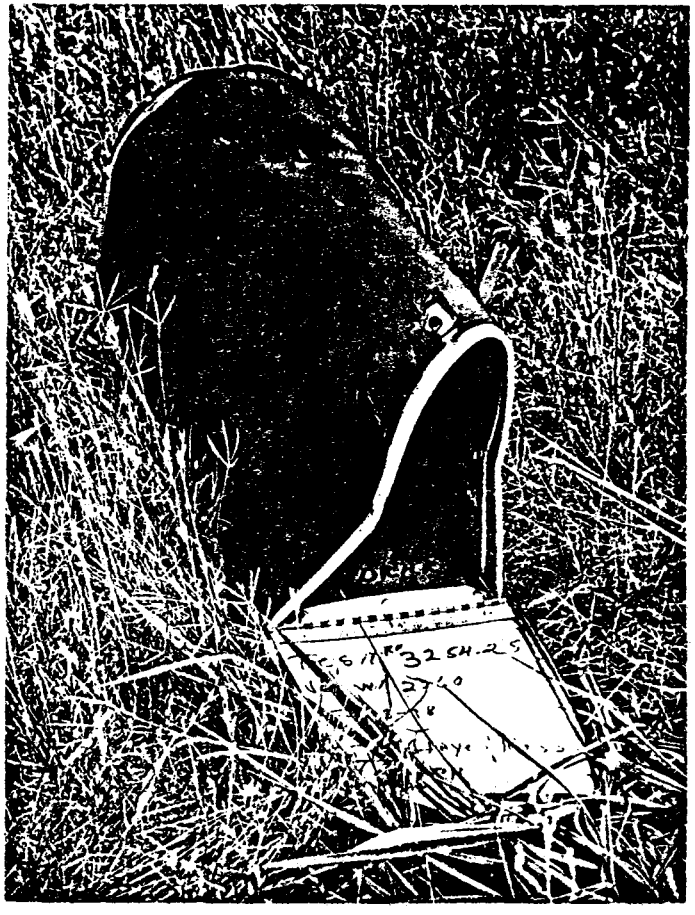
A summary of results for test 26 is given in Table 11. The sequential photos follow in Figure 45, and Table 12 gives the time displacement event summary. Deceleration, change in momentum, and free missile travel versus time data are shown in Figures 46, 47, and 48.

In this test, the frangible coupling broke and the retainer straps held the post after fracture as desired. The mailbox remained with the support until the vehicle rode over the box and the support. Damage to the post and base are shown in Figure 49. It is noted that two lock nuts were used on the top side of the bracket to attach the bracket to the post (see Figure 10). Also note that the retainer straps functioned as designed, preventing its translational movement.

As in test 25, the support and mailbox were damaged beyond repair and reuse. The anchor post was also damaged and would likely have to be replaced. Vehicle damage was minimal, as shown in Figure 50.



a) Support Post Damage



b) Mailbox Damage

Figure 43. Installation damage, test 25.

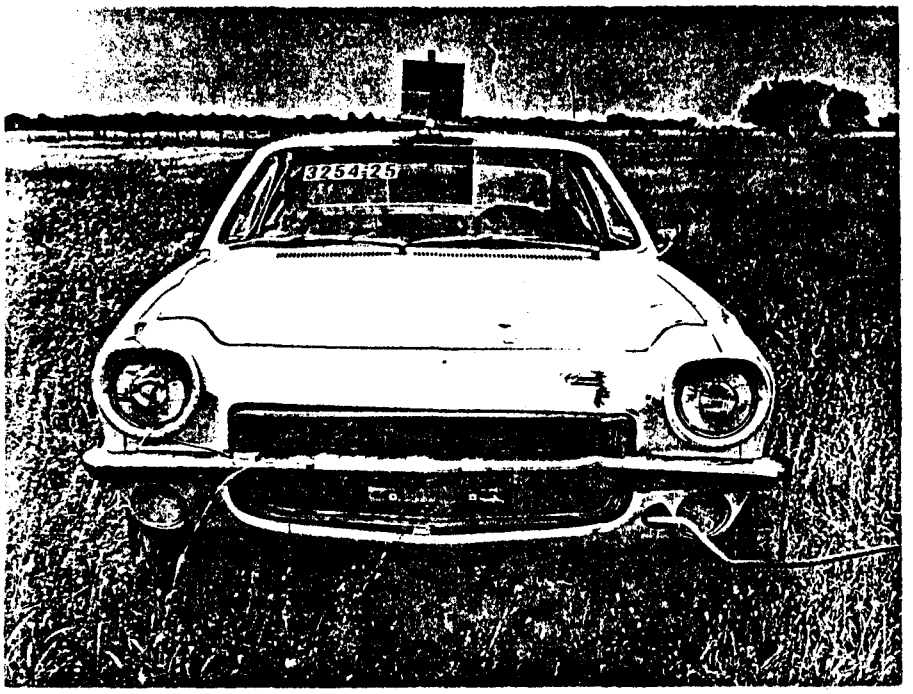


Figure 44. Vehicle damage, test 25.

Table 11. Summary of results, test 3254-26.

Impact Velocity = 60.9 mph

POST DATA

Type	Steel Pipe with Frangible Coupling
Size	1½ in. dia.
Embedment Method	Augered
Embedment Depth (ft)	2

VEHICLE DATA

Make	Chevrolet
Model	Vega
Year	1972
Weight (lb)	2260
Impact Point	15 in. to right of center

ACCELEROMETER DATA	Left		Right
Change in Momentum (lb-sec)	43		185
Duration of Event (sec)*		0.184	
Peak Deceleration (G's)	7.27		7.00
Maximum 0.050 Sec Average Deceleration (G's)	0.60		1.21

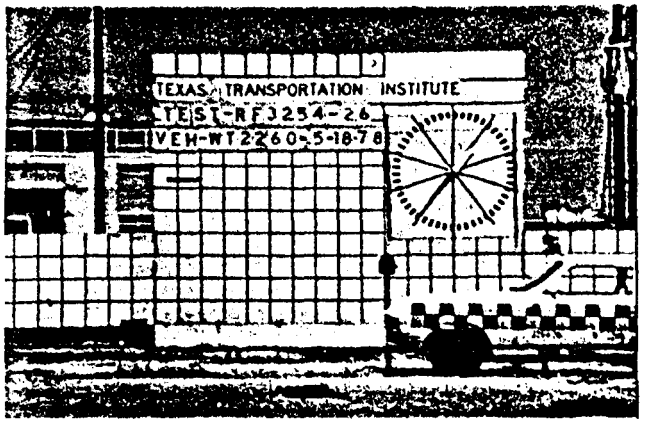
VEHICLE DAMAGE CLASSIFICATION

TAD	FR-0
SAE	12FREN1
Did test article penetrate the passenger compartment?	No
Was windshield broken?	No

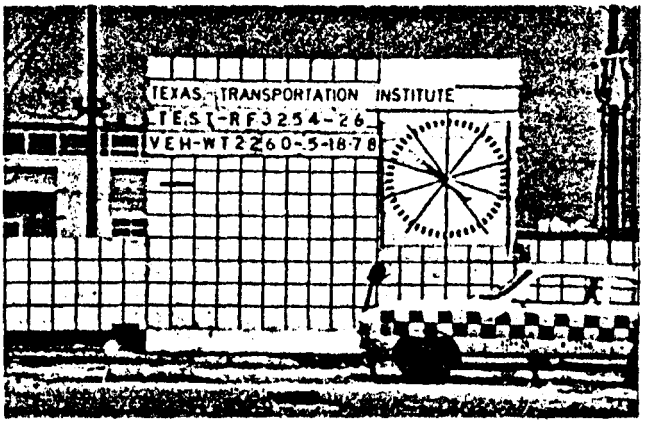
*Time of contact

Metric Conversions:

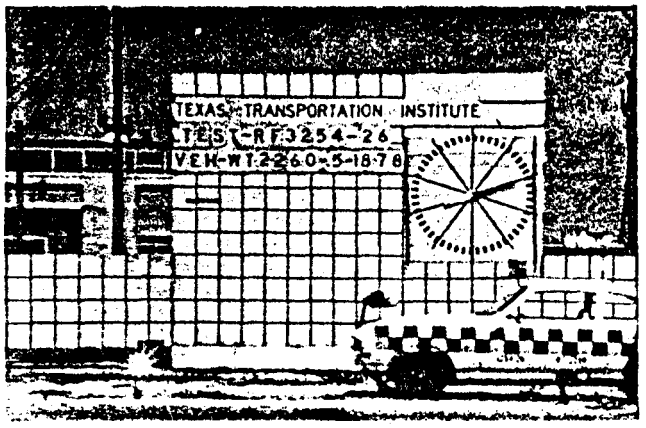
1 in. = 2.54 cm
1 ft = 0.305 m
1 lb_m = 0.454 kg
1 lb_m-sec = 0.454 kg-s
1 mph = 0.447 m/s



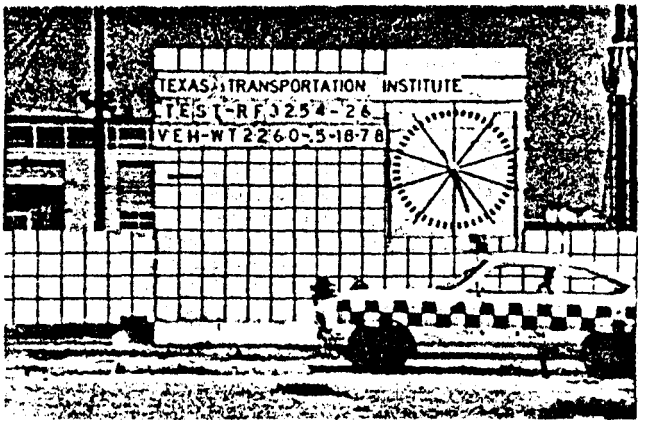
0.000 sec



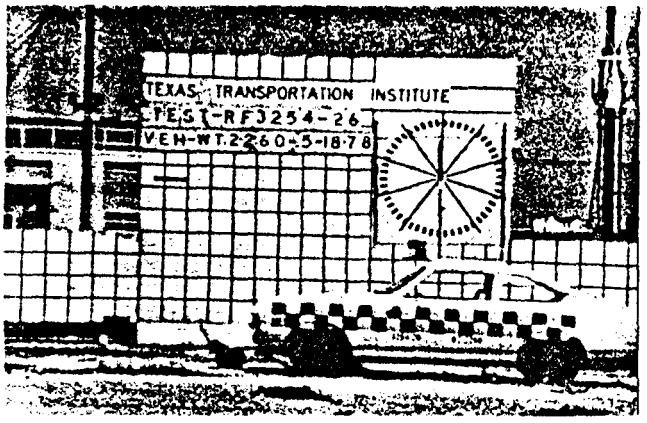
0.019 sec



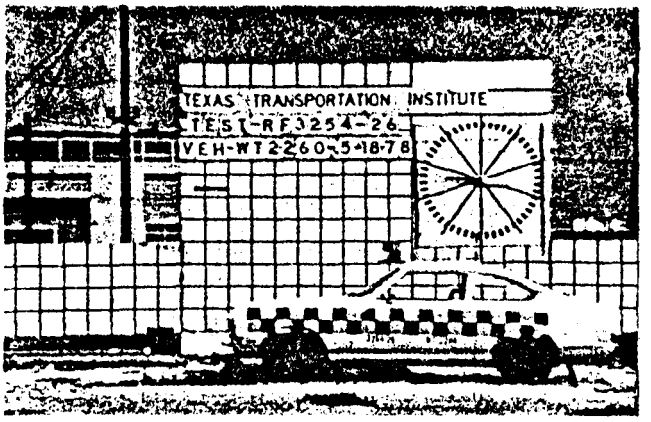
0.033 sec



0.075 sec



0.117 sec



0.176 sec

Figure 45. Sequential photos, test 26.

Table 12. Time displacement event summary for test 3254-26.

TIME (sec)	NOMINAL VEHICLE DISPLACEMENT (ft)	EVENT
0.000	0.00	Impact
0.019	0.74	Coupling breaks away
0.033	1.84	Mailbox bends over
0.075	2.62	Mailbox strikes hood
0.117	4.28	Mailbox first contacts ground
0.176	6.68	Vehicle begins to roll over mailbox

Metric Conversions:

1 ft = 0.305 m

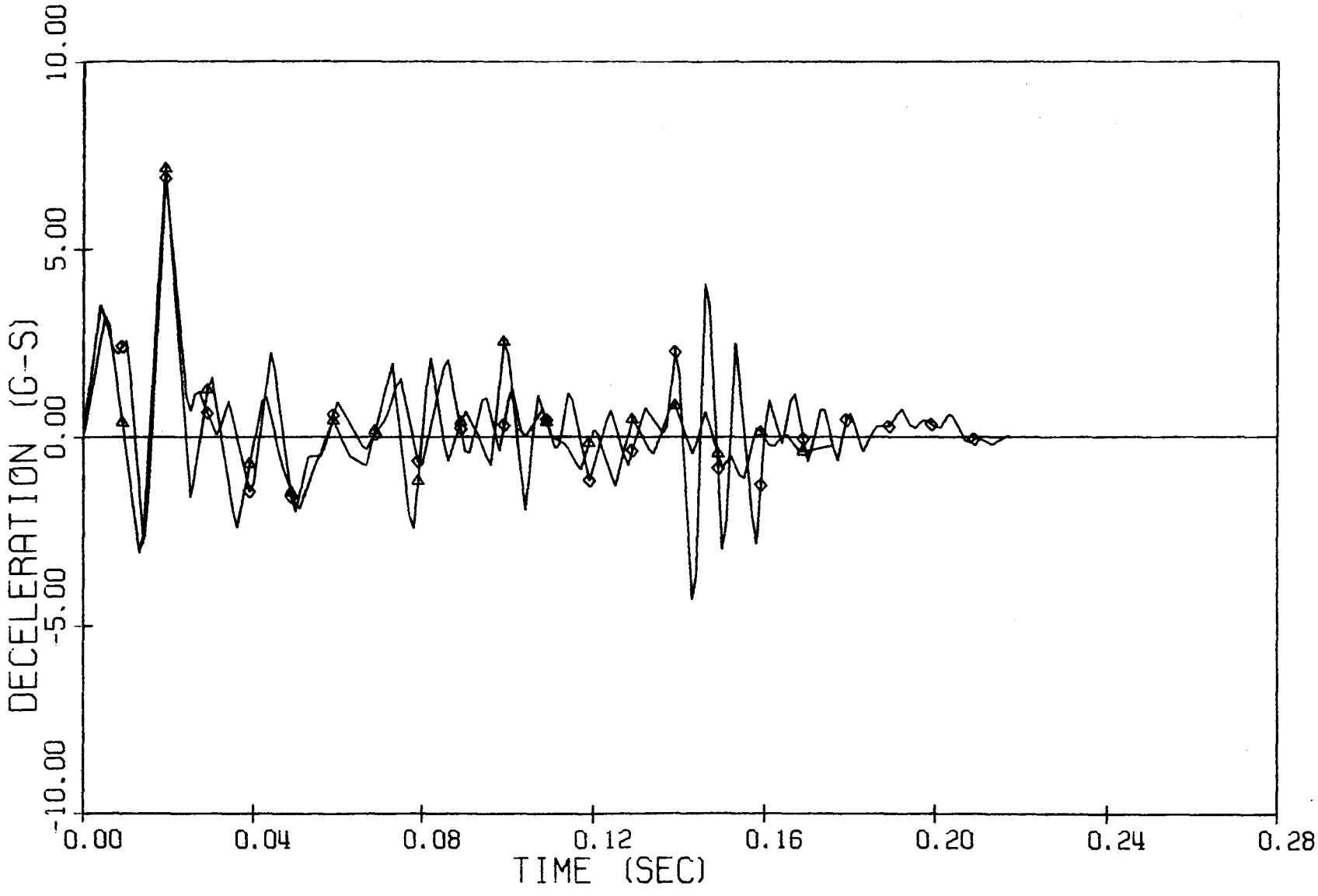


Figure 46. Deceleration versus time, test 26.

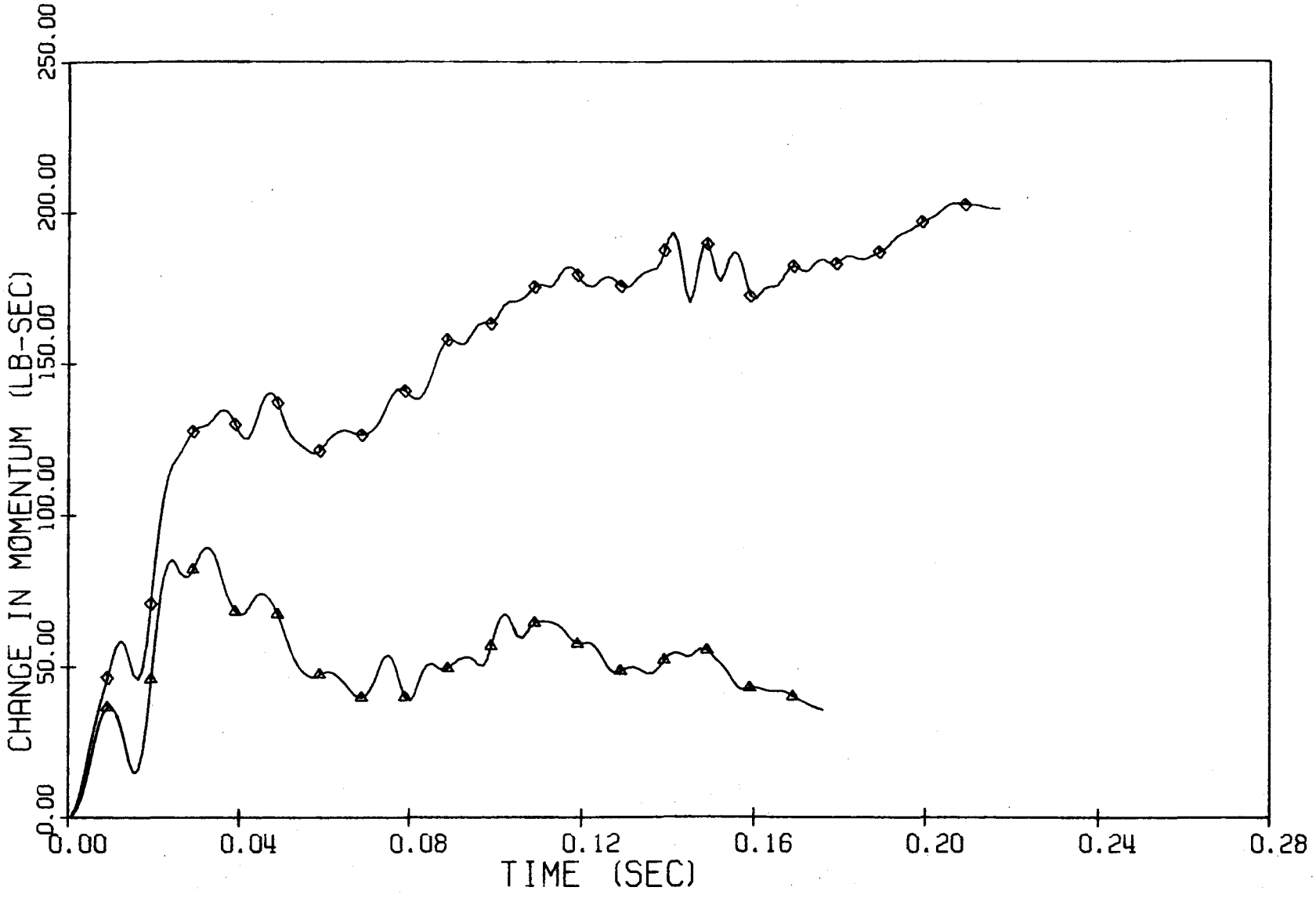


Figure 47. Change in momentum versus time, test 26.

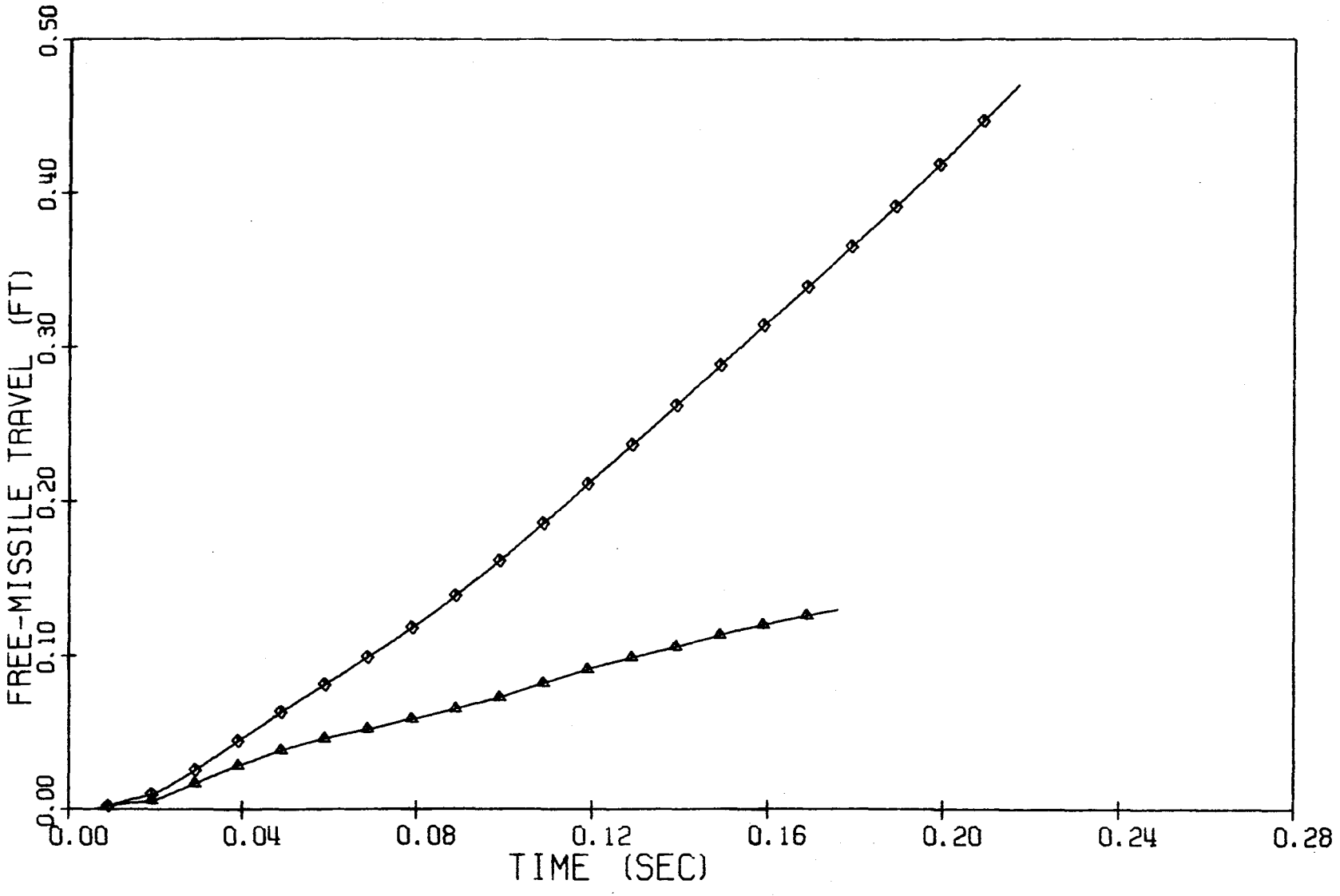
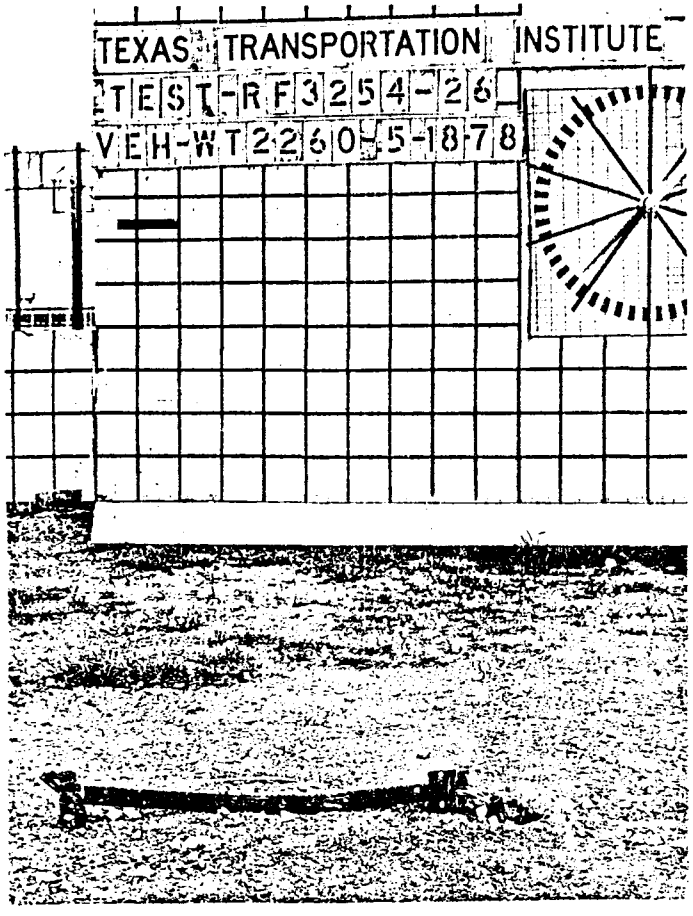
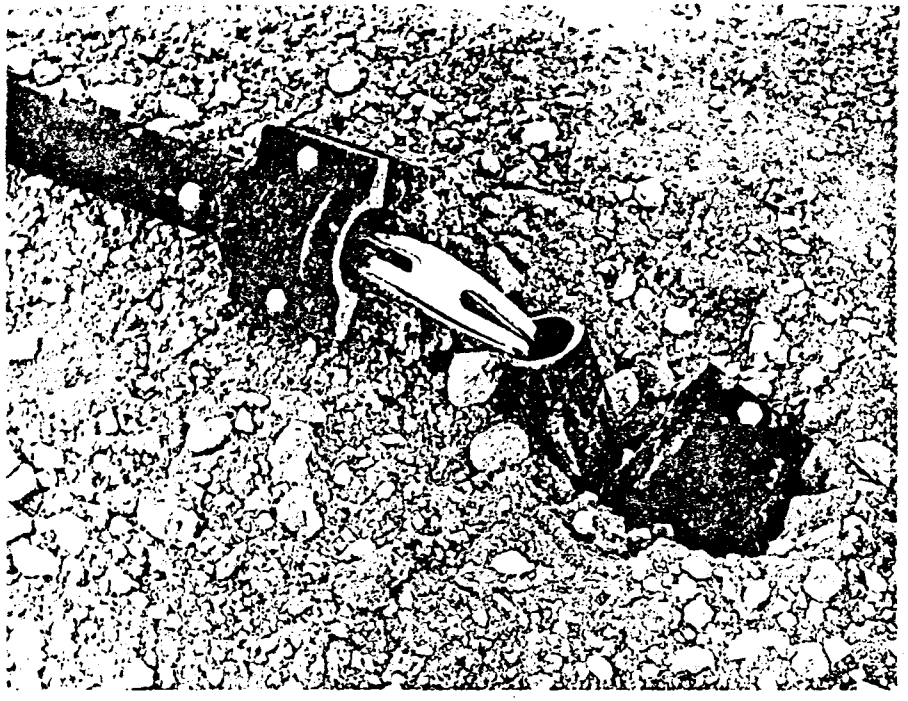


Figure 48. Free missile travel versus time, test 26.

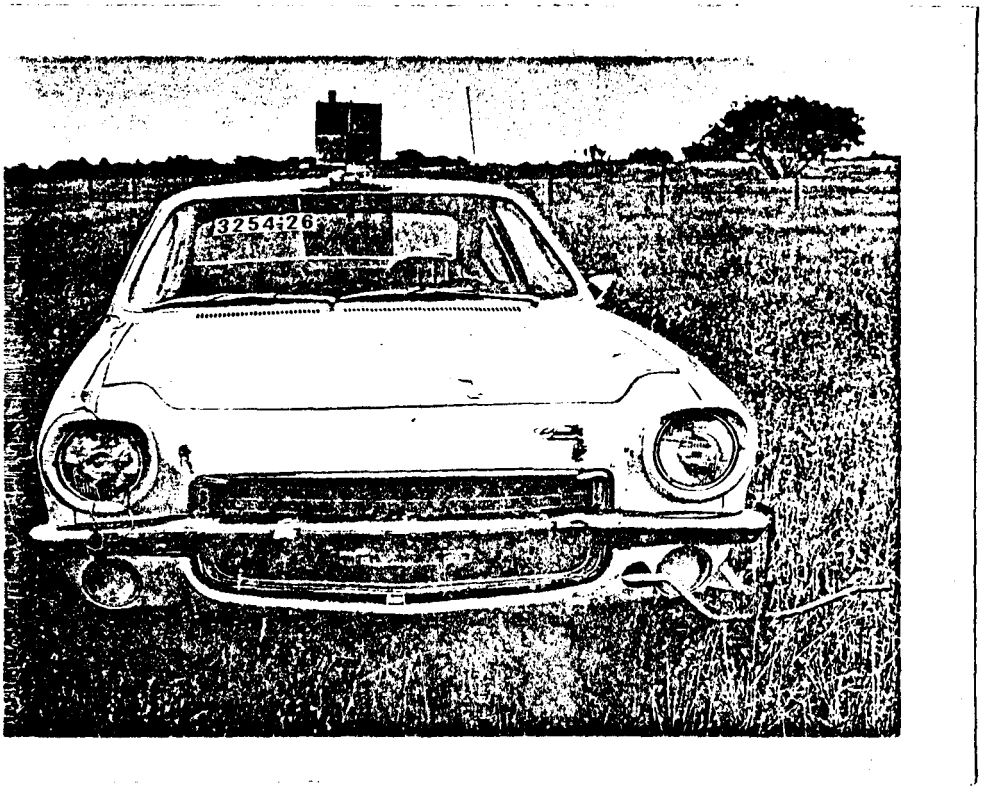


a) Support



b) Breakaway Coupling

Figure 49. Installation damage, test 26.



NOTE: Damage from test 26 is that on the right side of the vehicle.

Figure 50. Vehicle damage, test 26.

IV. SUMMARY AND CONCLUSIONS

This study has delineated several noteworthy points, as follows:

(1) Although the incidence of impacts with mailbox installations may be small in comparison to more formidable roadside hazards, mailbox accidents occur and the consequences are not always insignificant.

(2) While the U.S. Postal Service has design specifications for the mailbox itself, it has no such specification for the mailbox support.

(3) Only one state is known to have and enforce a standard design for mailbox supports.

(4) As a consequence of item 2 there is a proliferation of varied support designs, many of which are unnecessarily hazardous to the traveling public.

To gain insight into the hazard of mailbox installations the Federal Highway Administration elected to conduct a limited full-scale crash test program. Tests were conducted on widely used wood post supports and two promising new support concepts utilizing standard steel pipe. All tests were at approximately 60 mph (26.8 m/s). Table 13 contains a summary of the test results. Conclusions drawn as a result of these tests are as follows:

(1) Most mailboxes are mounted approximately 42 in. (106.7 cm) above ground. This places the box(es) in direct line with the windshield in many vehicles. It is therefore of primary importance that the strength of box-to-post attachment be sufficient to prevent separation during impact. This will reduce the potential for the box to impact the windshield.

(2) Multiple mailbox installations usually have a beam or support member running parallel to the roadway. When impacted, the beam can easily spear through the windshield which obviously can cause serious injuries or fatalities. At the present time, there are no multiple box support systems known to be acceptable.

Table 13. Summary of test results.

TEST NO.	TYPE AND SIZE OF SUPPORT	TYPE OF CAP	NO. OF MAILBOXES	CHANGE IN MOMENTUM (lb-sec)	COMMENTS
22	Wood 4 in. x 4 in.	Wood 1-5/8 in. x 8 in. x 19½ in.	1	65	Box and cap separated from post and hit windshield.
23	Wood 4 in. x 4 in.	Wood 1-5/8 in. x 8 in. x 19½ in.	1[a]	49	Box and cap separated from post and hit windshield.
24	Wood 4 in. x 4 in.	Wood 1-5/8 in. x 5-5/8 in. x 57 in.	4	151	Support arm separated from post and penetrated through windshield.
25	Std. Steel Pipe[b] 1½ in. I.D.	Formed Sheet Steel	1	217	Box and cap separated from post but did not hit windshield.
26	Std. Steel Pipe[c] 1½ in. I.D.	Formed Sheet Steel	1	114	Box and cap remained with post until box hit ground. No windshield contact.

[a]Mailbox strapped down with hanger straps.

[b]With lap-spliced bolted base connection.

[c]With frangible coupling and retainer straps

Metric Conversions:

1 in. = 2.54 cm
1 lb-sec =

(3) Standard steel pipe with a post-base design, incorporating some type of breakaway feature, offers considerable promise as a single mailbox support. Tests of a lap-spliced bolted base design and a frangible coupling design proved to be satisfactory. Cost of such systems are nominal.

(4) Wood posts may present special problems as mailbox supports when used on roadways with operating speeds in excess of approximately 40 mph (64.4 km/h). The major difficulty concerns the box-to-post attachment, and the brittle nature of wood under impact conditions. Typically, a wood post will fracture at bumper height and ground level. Depending on the mailbox size, vehicle geometry, and impact speed the upper part of the fractured post and mailbox may remain together and impact the windshield. If the mailbox separates from the post the probability of windshield impact increases significantly. In tests of two single mailbox installations having wood posts, mailbox separation occurred and the windshield was impacted. Attempts to prevent separation with hanger straps in the second test were unsuccessful.

V. RECOMMENDATIONS

(1) An effort should be undertaken on the national level leading to standards and/or performance specifications for mailbox supports. Tests have shown that simple, safe, and economical support systems are attainable. The U.S. Postal Service appears to be the logical agency to promulgate mailbox support standards and specifications, with assitance from the Federal Highway Administration. It seems reasonable to require that mailbox installations meet the same performance specifications now applied to signs, lightpoles, etc.

(2) Where possible, mailbox owners should be encouraged to place the installation on a side road, driveway, or safe distance from the main travelway.

(3) Multiple box installations utilizing a beam or support member running parallel to the travelway are extremely hazardous and should be avoided. As an alternate, each box can be supported by an individual crashworthy support.

APPENDIX A. U. S. POSTAL SERVICE SPECIFICATIONS FOR RURAL MAILBOX INSTALLATIONS.

156.4 PAYMENT OF POSTAGE

.41 ACCEPTANCE OF MAIL

.411 A rural carrier will accept any mailable matter, provided postage is fully prepaid or money equal to the required postage is furnished, unless the purpose of handling mail to the carrier for deposit into one office is to "boycott" another office or deprive it of legitimate revenue. During December customers are required to affix stamps to all greeting cards and letter mail.

.412 When a rural carrier finds unstamped mail in a customer's box and the required amount of money for postage, he will normally collect the mail and money and affix the necessary postage. The carrier has stamps, stamped envelopes, and postal cards for sale. For convenience and safety, customers who leave mail and money in rural boxes to be collected by the carrier should either wrap the money, place it in a coin-holding receptacle, or attach it to the mail by means of a clip or other fastener.

.42 POSTAGE UNCERTAIN

When mail is given to a rural carrier for mailing and he is unable to determine the postage, he will accept from the sender an amount sufficient to insure full payment of postage. On the next trip he will return to the sender any excess money.

.43 INSUFFICIENT POSTAGE

When mailable matter is deposited in a box and the required postage has not been paid nor sufficient money left to purchase stamps, the rural carrier will, when the identity of the sender is known, place in the box a notice that such matter cannot be dispatched until the necessary postage is paid. If the identity of the sender is unknown, the matter will be taken to the post office and treated as unpaid mail.

.44 UNPAID MAILABLE MATTER IN BOX

When a rural carrier finds in a rural box mailable matter on which postage is unpaid, addressed to or intended for the person in whose box it is deposited, the carrier will take such mail to the post office to be held for postage.

156.5 RURAL BOXES

.51 SPECIFICATIONS

.511 *Dimensions and Styles*

Three approved standard sizes and two styles of boxes are approved for use on rural routes:

Traditional and Contemporary Styles

Size	Inches (Approximately)		
	Length	Width	Height
1	19	6½	8½
1-A	21	8	[1] 10½
2	23½	11½	13½

[1] Optional letter slot.

In general, boxes may be constructed in any size between the maximum and minimum outside dimensions specified on approved drawings, provided the height, width, and length proportions and the general shape are maintained.

.512 *Drawings*

Construction standards and drawings for guidance in the manufacture of rural mailboxes may be obtained by writing to the Delivery Services Department, Operations Group, U.S. Postal Service, Washington, DC 20260.

.513 *Approval*

To secure approval of rural boxes, submit to the Delivery Services Department:

a. Not less than two complete boxes of each style made of exact materials, construction, coating, paint, etc., to be identical in every way with the boxes intended to be marketed. (Two boxes will be damaged during testing.)
b. The identification of all parts of the box, by material, alloy, heat treatment, and (for non-metallic parts) physical properties.
c. The complete composition, formula, and trade name and designation, of all paints and non-metallics.
d. A sample showing the marking required by 156.514.
e. A copy of the instructions required by section S–12 of the standards.
f. Color samples showing all color schemes expected to be used.
g. The boxes wrapped in the packaging proposed for shipping them.

Written notification of approval or disapproval, including reasons for disapproval, will be issued. All boxes submitted will be returned, including those damaged during testing, unless the Postal Service is authorized, in writing, to retain them.

.514 *Marking*

All boxes shall have the following inscription legibly embossed into the door of the box (after approval of the box): U.S. MAIL and APPROVED BY THE POSTMASTER GENERAL. The name of the supplier and the month and year of manufacture shall also be noted on the box, either by embossing in small letters on the rear of the box or by a permanent conspicuous marking on one inside wall of the box. This marking may be accomplished by embossing, stencilling, stamping, or a permanent-type decal. The address of the supplier may be included, if desired.

.515 *List of Approved Manufacturers*

Following is a list of manufacturers and suppliers of rural and contemporary-style suburban mailboxes whose samples have been approved by the Postal Service:

Babco Manufacturing, Inc.
11677 Sheldon Street
Sun Valley, California 91352
C

Chicago Heights Furnace
Supply Company, Inc.
96–104 East 22nd Street
Chicago Heights, Illinois 60411
1–1A–2

E. Z. Manufacturing Company
Springfield, South Dakota 57062
(Door Conversion Kit for No. 2)

Falls Stamping & Welding Company
Post Office Box 153
Cuyahoga Falls, Ohio 44222
1–2

Fulton Corporation
Fulton, Illinois 61252
1–1A–2–C

Gemini Industries, Inc.
140 Delawanna Avenue
Clifton, New Jersey 07014
1-1A

General Housewares Corporation
800 West Willard Street
Muncie, Indiana 47302
C

Hermitage Stamping Company
7119 Cockrill Bend Industrial Rd.
Post Office Box 7885
Nashville, Tennessee 37209
1

Jackes-Evans Manufacturing Company
11737 Administration Drive
Saint Louis, Missouri 63141
1–1A–2

Kelley Manufacturing Company
Los Angeles Division
5100 Santa Fe Avenue
Los Angeles, California 90058
1–2

Leigh Products, Inc.
Coopersville, Michigan 49404
C

Macklanburg-Duncan Company
Post Office Box 25188
Oklahoma City, Oklahoma 73125
1

Montgomery Ward & Company
619 West Chicago Avenue
Chicago, Illinois 60610
1–1A–2–C

Northwest Metal Products Company
Div. of Noll Manufacturing Company
Post Office Box 10
Kent, Washington 98031
1

Parker Mailboxes, Inc.
Route 14, Box 318R
Richmond, Virginia 23231
C

Premco Mfg. Co.
8482 Brown Street
Ottawa Lake, Michigan 49267
1

Remington Hardware Company, Inc.
351 West Broadway
New York, New York 10013
C

Sears, Roebuck & Company
925 South Homan Avenue, Dept. 609
Chicago, Illinois 60607
1–2–C

Southern Fabricators
Post Office Box 7321
Shreveport, Louisiana 71107
C

Steel City Corporation
Post Office Box 1227
Youngstown, Ohio 44501
1–1A–2–C

Superior Sheet Metals Inc.
3201 Roosevelt Avenue
P.O. Box 18173
Indianapolis, Indiana 46218
1–1A–2

Trend House, Inc.
1200 North Eighteenth Street
Post Office Box 4088
Monroe, Louisiana 71201
C–1–A

Waterloo Industries, Inc.
Post Office Box 209
Waterloo, Iowa 50704
C

1 Traditional Rural Box Size No. 1
1A Traditional Rural Box Size No. 1A
2 Traditional Rural Box Size No. 2
C Contemporary Style Suburban Box (also approved for use on rural routes)

.516 *Custom Built Rural Mailboxes*

Postmasters are authorized to approve rural mailboxes constructed by individuals, who for esthetic or other reasons do not wish to use an approved manufactured box. The custom-built box must conform generally to the same requirements as approved manufactured boxes relative to the flag, size, strength, and quality of construction.

.52 PAINTING AND IDENTIFICATION

The Postal Service prefers that rural boxes and posts or supports be painted white, but they may be painted other colors if desired. Where box numbers are used, the box number must be inscribed in contrasting color in neat letters and numerals not less than 1 inch high on the side of the box that is visible to the carrier as he regularly approaches, or on the door if boxes are grouped. Where street names and house numbers have been assigned by local authorities, and the postmaster has authorized use of a street name and house numbers as a postal address, the house number will be shown on the box. If the box is located on a different street from the customer's residence, the street name and house number will be inscribed on the box. The placing of the owner's name on the box is optional. Advertising on boxes or supports is prohibited.

.53 POSTS AND SUPPORTS

.531 *Construction*

Posts or other supports for rural boxes must be neat and of adequate strength and size. They may not be designed to represent effigies or caricatures that would tend to disparage or ridicule any person. The box may be attached to a fixed or movable arm.

.532 *Newspaper Receptacles*

A receptacle for newspapers, not restricted to any one paper, may be placed above or below the box or on the post or support, provided it will not interfere with the delivery of mail, obstruct the view of the flag, or present a

hazard to the carrier or his vehicle. The receptacle must not extend beyond the front of the box when the box door is closed. No advertising shall be displayed on the outside of the receptacle except that the name of a publication may be shown.

.54 LOCATION

Rural boxes must be placed so that they may be safely and conveniently served by carriers without leaving their conveyances, and must be located on the right-hand side of the road in the direction of travel of the carriers in all cases where traffic conditions are such that it would be dangerous for the carriers to drive to the left in order to reach the boxes, or where their doing so would constitute a violation of traffic laws and regulations. (EXCEPTION: See 156.312.) On new rural routes, all boxes must be located on the right of the road in the direction of travel of the carrier. Boxes must be placed to conform with State laws and highway regulations. Rural carriers are subject to the same traffic laws and regulations as are other motorists. Customers must remove obstructions, including snow, that make delivery difficult.

.55 GROUPING

Boxes should be grouped wherever possible, especially at or near cross roads, at service turnouts, or at other places where a considerable number of boxes are located. A simple and practicable support consists of a board erected on firmly planted posts.

.56 MORE THAN ONE FAMILY

More than one family, but not more than five families, may use the same box, provided a written notice of agreement, signed by the heads of the families, or by the individuals who desire to join in the use of such box, is filed with the postmaster at the distributing office.

.57 LOCKS

The use of locks on boxes is not required. If customers provide locks, the keys should be delivered only to the postmaster, who will assign them to the carrier. The carrier will unlock and lock the boxes when serving them. To facilitate the carrier's work, customers should, as far as practicable, adopt locks for each route of such pattern that a master key may be provided the carrier for unlocking the boxes.

.58 UNSTAMPED NEWSPAPERS

Rural boxes are to be used for mail only, except that publishers of newspapers regularly mailed as second-class mail may, on Sundays and national holidays only, place copies of the Sunday or holiday issues in the rural and star route boxes of subscribers, with the understanding that copies will be removed from the boxes before the next day on which mail deliveries are scheduled.

.56 MORE THAN ONE FAMILY

More than one family, but not more than five families, may use the same box, provided a written notice of agreement, signed by the heads of the families, or by the individuals who desire to join in the use of such box, is filed with the postmaster at the distributing office.

.57 LOCKS

The use of locks on boxes is not required. If customers provide locks, the keys should be delivered only to the postmaster, who will assign them to the carrier. The carrier will unlock and lock the boxes when serving them. To facilitate the carrier's work, customers should, as far as practicable, adopt locks for each route of such pattern that a master key may be provided the carrier for unlocking the boxes.

.58 UNSTAMPED NEWSPAPERS

Rural boxes are to be used for mail only, except that publishers of newspapers regularly mailed as second-class mail may, on Sundays and national holidays only, place copies of the Sunday or holiday issues in the rural and star route boxes of subscribers, with the understanding that copies will be removed from the boxes before the next day on which mail deliveries are scheduled.

.59 BOXES THAT DO NOT CONFORM TO REGULATIONS

Rural carriers will report any boxes that do not conform to the regulations to postmasters, who will send to the owners of these boxes Form 4056, *Your Mail Box Needs Attention*, requesting that the irregularities or defects be remedied.

OPERATIONS GROUP
Washington, DC 20260

February 13, 1978

Mr. Hayes E. Ross, Jr.
Associate Research Engineer
Texas A&M University
College Station, TX 77843

Dear Mr. Ross:

Thank you for your recent inquiry concerning the design and manufacture of rural mailboxes.

Attached are specifications for the construction of contemporary and traditional rural boxes. Detailed drawings are available upon request to this office. Minor design and construction changes will be considered, provided they are equal to or better than the features replaced, and they are approved in advance by the Postal Service.

Firms proposing to manufacture rural mailboxes must submit two prototype boxes for examination and testing to the Delivery Services Department, Operations Group, U.S. Postal Service Washington, DC 20260. (See Section 3.19 of USPS Standard 7 attached.) Upon final approval, authorization will be given to emboss on the door of each box "Approved by the Postmaster General," and elsewhere the name of the manufacturer or supplier.

It is required that each new box offered for sale contain a printed sheet of instructions covering the proper installation of rural boxes. A copy of these instructions will be furnished each approved manufacturer.

Sincerely,

J. A. McDougald

James A. McDougald, Director
Office of Delivery and Collection
Delivery Services Department

Attachments

USPS-STD-7
February 1974
Supersedes USPS-STD-1b(R)
Dated March 23, 1972
Supersedes USPS-STD-2b(R)
Dated March 21, 1972

U. S. POSTAL SERVICE STANDARD
BOXES, RURAL MAIL

1. SCOPE AND CLASSIFICATION

1.1 Scope - This standard covers rural mail boxes.

1.2 Classification - The rural mail boxes shall be of the following types and sizes.

Type I - Box, Standard, Rural Mail

Size 1 - See Drawing RD-4, Project 3730-0310
Size 1A - See Drawing RD-5, Project 3730-0310
Size 2 - See Drawing RD-6, Project 3730-0310

Type II - Box, Contemporary, Rural Mail

	Minimum Parcel Size Acceptable	Minimum Unrestricted Opening in Front
Size C1	5"x6"x18-1/2"	40 sq. in.
Size C1A	6"x7"x19-1/2"	65 sq. in.
Size C2	8"x11-1/2"x22-1/2"	130 sq. in.

2. APPLICABLE DOCUMENTS

2.1 Specifications and Standards - The following documents of the latest issue form a part of this standard.

Specifications

MIL-T-704 - Treatment and Painting of Materials
MIL-W-8604 - Welding, Aluminum Alloys, Process for
MIL-W-8611 - Welding, Metal Arc and Gas, Steels, Corrosion and Heat-Resisting Alloys: Process for

MIL-A-8625 - Anodic Coating, for Aluminum and Aluminum alloys

MIL-W-6858 - Welding Resistance, Aluminum, Magnesium, Non-Hardening Steels or Alloys, Heat-Resisting Alloys, Titanium Alloys, Spot and Seam

Standards

Military

MIL-STD-171 - Finishing of Metal and Wood Surfaces

Federal

Federal Standard 595
Federal Test Method Standard 141, Method 6191
Federal Test Method Standard 151, Method 811.1

(Application for copies of specifications and standards may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attention Code: CDS.)

Other Documents

AWS C1.1 Recommended Practice for Resistance Welding
AWS C1.2 Recommended Practice for Spot Welding
AWS C2.0 Standard Welding Symbols

(Application for copies of American Welding Society publications may be obtained from the AWS at 2501 N. W. 7th Street, Miami, Florida 33125).

3. REQUIREMENTS

3.1 General Design

3.1.1 Type I - The general configuration of the box shall conform to USPS Drawing RD-4, RD-5, and RD-6. Minor design and construction changes will be considered for approval, provided they are equal to or better than the features they replace, and provided the operation of the box is not altered.

3.1.2 Type II - The general configuration of the box shall conform to USPS collection and delivery operations and requirements, and reflect the proper postal image. Designs of the contemporary rural mail boxes are not restricted to shape, material, finish or style;

however, boxes shall be designed and made so that they may be serviced in the same manner as the standard rural mail box. The box shall be free from harmful projections, sharp edges, hindrances to carriers and shall positively protect mail from the weather. All seams and joints shall be tight to prevent the loss or damage to mail or mail items placed in the box.

The bottom of the box shall be corrugated, ribbed or otherwise formed to prevent mail from adhering to it as a result of rain or snow entering thru an open door. Provisions shall be incorporated to prevent damage or destruction of finishes by moving parts of the box.

3.2 Materials

3.2.1 Type I and Type II - Ferrous or non-ferrous metals, wood, plastics, or other materials may be used. The thickness, form, mechanical properties and chemical properties shall be adequate to meet the operational, structural and performance requirements as set forth in this standard. Transparent materials are not acceptable. Materials used must be compatabile with each other and non-toxic and non-irritating to humans.

3.3 Carrier Service Door

3.3.1 Type I and Type II - The carrier service door must operate freely by pulling outward on a convenient handle, knob or ring located at the top or side of the door. The handle, knob or ring shall have adequate clearance to permit grabbing and pulling it with one hand to open the door. The design of the door, hinges, handles, etc. shall be such as to offer maximum protection against freezing rain, sleet or snow and freezing weather. Door catches shall hold the door closed, but allow easy opening and closing of the door. Action of the latch shall be a positive mechanical one not relying solely on friction of parts. Permanent magnetic catches are acceptable provided adequate closure power is obtained and maintained. The door shall, once opened, remain open until the carrier pushes it closed. Doors or any door attachments that reduce the usable area within the box are not acceptable.

3.4 Auxiliary Doors

3.4.1 Type I and Type II - Doors other than the carrier service door shall not interfere with the normal servicing of the box by the carrier or require the carrier to perform any operation not normally used. The auxiliary door shall not come open when newspapers, parcels or other mail items are inserted thru the carrier door.

3.5 Locking Provision

3.5.1 Type I and Type II - The box shall be provided with an effective means of locking it against theft of mail. Locking provisions must be designed for key operation and may consist of a built-in lock or a provision for locking the box with a padlock. Built-in locks must be reliable, made from corrosion resistant materials and resistant to freezing. Keys must be strong and be removable in both the locked and unlocked positions. The lock keyway shall be in the vertical position to give visual indication when it is locked and in a position other than vertical when unlocked. Unlocking shall be accomplished by turning the key clockwise not more than one-hundred and thirty-five (135) degrees. Padlocking provisions shall place the padlock in a position convenient to the carrier. A padlock is not required to be furnished with the box.

3.6 Carrier Signal Flag

3.6.1 Type I - The carrier signal flag shall be as shown on the drawings. The flag shall be located on the right side near the front (when facing the box from the front). The flag operating mechanism shall operate properly and positively, without binding or excessive free play. The operating mechanism shall not require lubrication, shall not bind, and shall be resistant to freeze-up in the winter. The flag should be in a locked point in both the vertical and horizontal position and should not be free to rotate three-hundred and sixty (360) degrees.

3.6.2 Type II - The carrier signal flag may be of a contemporary design unlike that used on the Type I box and shall operate freely. The flag shall be located on the right side near the front (when facing the box from the front). The flag staff centerline shall be no farther back from the foremost projection of the box (excluding protruding catch hardware) than four (4) inches. When the flag is in the raised position, not less than six (6) square inches of the signal portion shall be visible above the top of the box and the flag shall project not less than two (2) inches above the top of the box. The flag should be in a locked point in both the vertical and horizontal position and should not be free to rotate three-hundred and sixty (360) degrees. The signal portion of the flag shall be in a plane perpendicular to the thoroughfare on which the box is located. The center of the signal portion of the flag shall be located between two (2) and four (4) inches back from the front of the box in the raised position. No portion of the flag shall extend beyond the top outline of the box when the flag is in the lowered position. The flag operating mechanism shall operate properly and positively, without binding or excessive free play. The operating mechanism shall not require lubrication, and shall offer maximum protection against freezing.

3.7 Marking

3.7.1 Type I and Type II - The box shall have the following inscription on the door (after approval) "U. S. MAIL" and "approved by the postmaster general". The name of the supplier and the month and year of manufacture shall also be noted on the box on the rear or on an inside wall of the box. This marking may be accomplished by embossing, stencilling, stamping or permanent type decal. The address of the supplier may be included.

3.8 Coating and Finishes

3.8.1 Type I and Type II - Choice of materials for coatings and finishes is optional, provided all requirements of this standard are met. All finish coatings shall be free from flaking, peeling, cracks, crazing, blushing and powdery surfaces. Finishes shall be compatible with the box materials, and can be prepared by primers or other protective procedures. Mirror-like finishes and coatings on large flat areas, which might cause reflected glare in motorists' eyes from the sun or vehicle lights will not be approved.

3.9 Color

3.9.1 Type I and Type II Boxes - Color of the box, in general, is optional with the manufacturer. Colors and color schemes shall, however, be dignified and must be of a hue, saturation, and brilliance which offer sufficient contrast with normal surroundings to allow easy observation by carriers and persons using the thoroughfare.

3.9.2 Type I and Type II Carrier Signal Flags - The signal portion of the carrier signal flag shall be red in color. The red shall closely match color No. 11105 of Federal Standard 595 or International Red. High-visibility (fluorescent) coatings and reflective coatings matching the required color may be furnished. Colors other than red will not be considered for approval. Red color shall not be used on any other portion of the box which might be confused with the signal flag.

3.10 Mounting Provisions

3.10.1 Type I and Type II - The box shall be provided with means for convenient mounting. Types of mounting such as to a metal post or stand may be offered by the manufacturer as an accessory. No part of the mounting provisions shall project beyond the front of the mounted box. Mounting provisions shall not require the

use of tools other than a hammer, screwdriver or common wrench unless such special tools are furnished with the box or accessory.

3.11 Instructions

3.11.1 Type I and Type II - A complete set of instructions for assembling and mounting the box and for properly locating it on the thoroughfare shall be furnished with each box.

Instructions shall include a notice that the customer must contact the local postmaster for proper height of the box. The instruction sheet shall carry a notice that the box meets all requirements of this standard.

3.12 Workmanship

3.12.1 Type I and Type II - Workmanship shall be of the highest quality throughout. All parts shall be clean, straight, accurately formed and assembled, of proper fit, and uniform in size and shape. Parts shall be free from delaminations, cracks, warpage, bulges, kinks, dents, porosity, voids, lumps, foreign matter, non-homogeneity and other defects. Finished or coated surfaces shall be smooth and uniform; and free from soft areas, stains, chips, foreign matter, color variations, lumps, runs, sags, cracks, and crazing. Seams and connections shall be tight. Welding, riveting, and other joining shall be done in a neat and approved manner. The box shall be free from sharp edges, sharp corners, protruding rivets and parts, and operational features which might injure or hamper the carrier or customer. All wooden material subject to delamination, warpage or weather cracking shall be treated with a waterproofing compound.

3.13 Operational, Structural and Performance Requirements

3.13.1 Type I and Type II Operational Requirements - Carrier service doors, auxiliary doors, door catches and mechanisms, carrier signal flags, and accessory devices shall be capable of operating 7,500 normal operating cycles without breakage of parts and without failure to operate correctly and positively.

3.13.2 Type I and Type II - Structural and Performance Requirements - Refer to attached Drawing #1 for explanation of load position method of application and bolster plates received for applying loads. At positions 1 thru 4, the box shall be supported on a horizontal board in a normal fashion. At position 5 the load shall be applied with the unmounted (without board or adapters) box lying on it's opposite side.

Immediately after release of the slowly applied load in each position, permanent deformation of the box in the load direction shall not exceed the permanent deformation indicated for the loads shown on Table I. No cracks in the material shall develop as a result of the load or cause the door to become inoperable. At position six (6), the flag shall be capable of withstanding an eight (8) pound load applied at the top of the flag without exceeding permanent deformation specified in Table I.

TABLE I
Permanent Deformation Limits

Position	Deformation, Inches	Load, Pounds
1	1/8	200
2	1/8	200
3	1/8	50
4	1/8	50
5	1/8	100
6	1/8	8

3.14 Coating Abrasion Test

3.14.1 Type I and Type II - The coating of all boxes formed from ferrous metal or other material subject to corrosion* shall meet the abrasive sand test specified herein. Boxes formed from corrosion-resistant alloys of aluminum, "stainless" steel, and other corrosion-resistant materials which are not painted or otherwise coated with a material subject to corrosion are exempt from this test. The test is an abrasive sand test in accordance with Federal Test Method Standard 141, Method 6191, rate of flow of two liters of sand in 22 plus-or-minus one second. Not less than 15 liters of sand shall be required to penetrate painted coatings, Not less than 75 liters shall be required to penetrate plating or other protective coatings. Not less than a total of 175 liters shall be required to expose an area of 1/4 square inch of corrodible base material.

3.15 Salt-Spray Resistance

3.15.1 Type I and Type II - The box will be subjected to a salt-spray test. The test shall be conducted in accordance with Federal Test Method Standard 151, Method 811.1, using a 5 percent saline solution. Test machine operation is on an intermittent basis of 8 hours in operation and 16 hours shut off. The box shall be in the finished condition, including all protective coatings and paint, but must be washed to remove all oil, grease, and other non-permanent coatings. No part of the box shall show corrosion (such as rust on steel box) or other destructive

reaction prior to 50 hours exposure (exposure time is based on time machine is in operation only: "off" time does not apply). Any accumulation of salt deposits upon surfaces tested will not be cause for box rejection.

*"Corrosion", as used in this standard, means any form of property change due to ambient conditions which seriously detracts from the appearance or function of the box such as rust, obvious color changes, perforation, accelerated erosion, and disintegration.

3.16 Flammibility

3.16.1 Type I and Type II - Materials which will support rapid combustion or which are of an explosive nature shall not be used.

3.17 Ambient Conditions

3.17.1 Type I and Type II - The box shall operate properly under the following ambient conditions: Temperatures of minus sixty-five (65)°F to plus one-hundred forty (140)°F; relative humidities of zero (0) to ninety-eight (98) percent (limited by a thirty-five (35°)F dewpoint temperature); full solar radiation; snow and freezing rain; heavy rainstorms during which the rain strikes the box at any angle from zero (0)° to ninety (90) degrees; wind velocities up to one-hundred (100) miles per hour; and water and slush thrown upwards by vehicles.

3.18 Packaging

3.18.1 Type I and Type II - The box shall be shipped fully assembled except that the following parts may be removed if necessary to protect them from damage: Protruding portions, such as door latching hardware, mounting adapters, and mounting posts or stands. Sufficient wrapping, padding, blocking and bracing shall be used to prevent damage to the box during shipment. The packaged box, adapters and accessories must be capable of being dropped from a height of 3 feet six times (striking once on each of the 6 faces of the carton) without damage to the box, adapters or accessories.

3.19 Approval Requirements

3.19.1 Type I and Type II - To secure approval of a box, the following must be submitted.

1. Not less than two complete boxes of each style made of the exact materials, construction, coatings, paint, etc., to be identical in every way with the boxes intended to be marketed. (The boxes may be damaged during testing).

2. A sample or description of the marking required by Paragraph 3.7.

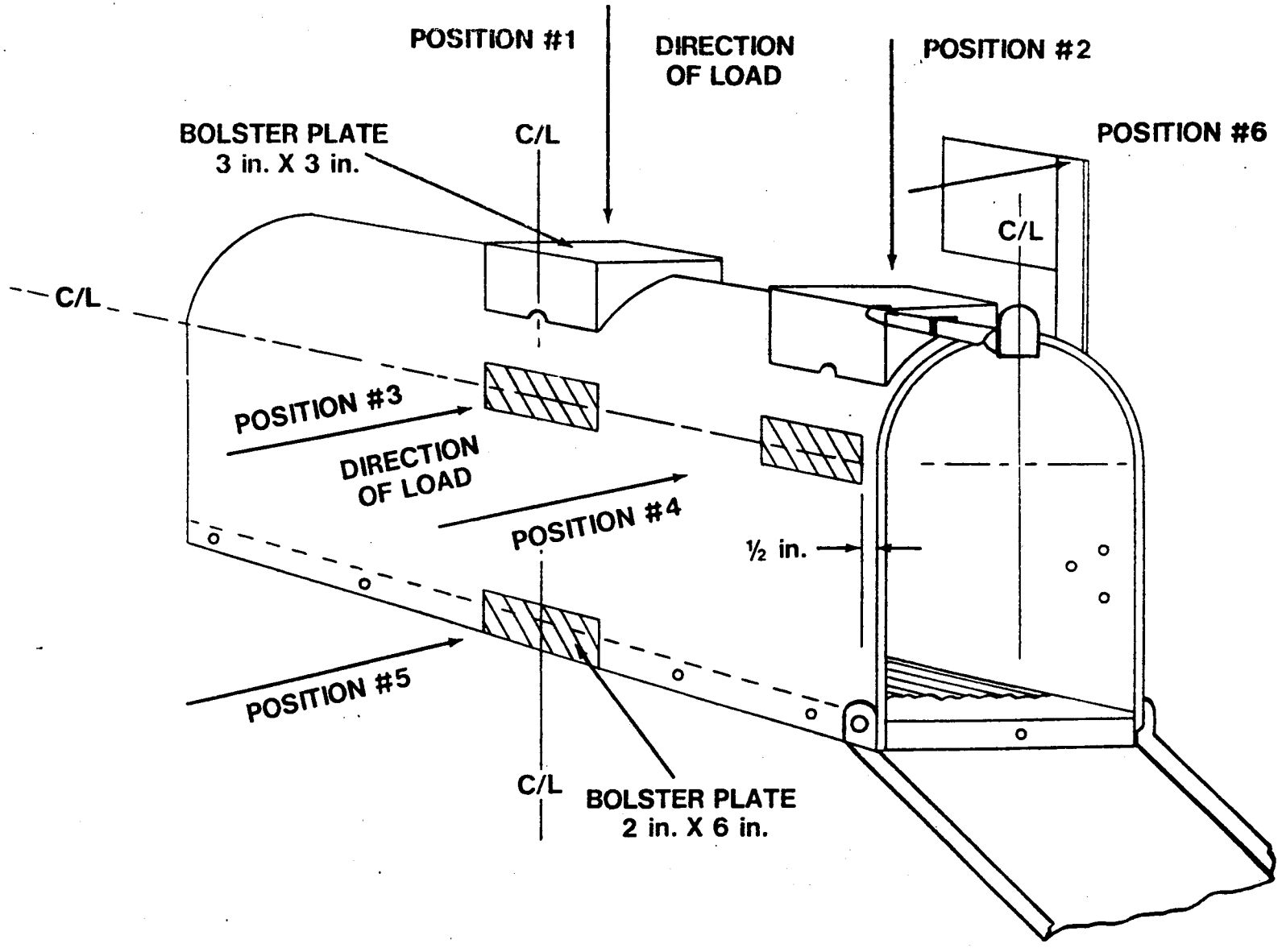
3. A copy of the instructions required by Paragraph 3.11.

4. Color samples showing all color schemes expected to be used.

5. Boxes must be submitted in the packaging proposed for shipping them.

Written notification of approval or disapproval, including reasons for disapproval, will be issued. All boxes submitted will be returned, including those damaged during testing, unless the USPS is authorized in writing to retain them.

SKETCH INDICATING DIRECTION OF LOAD



DRAWING 1 USPS-STD-1b

APPENDIX B. DATA ACQUISITION SYSTEMS

B. DATA ACQUISITION SYSTEMS

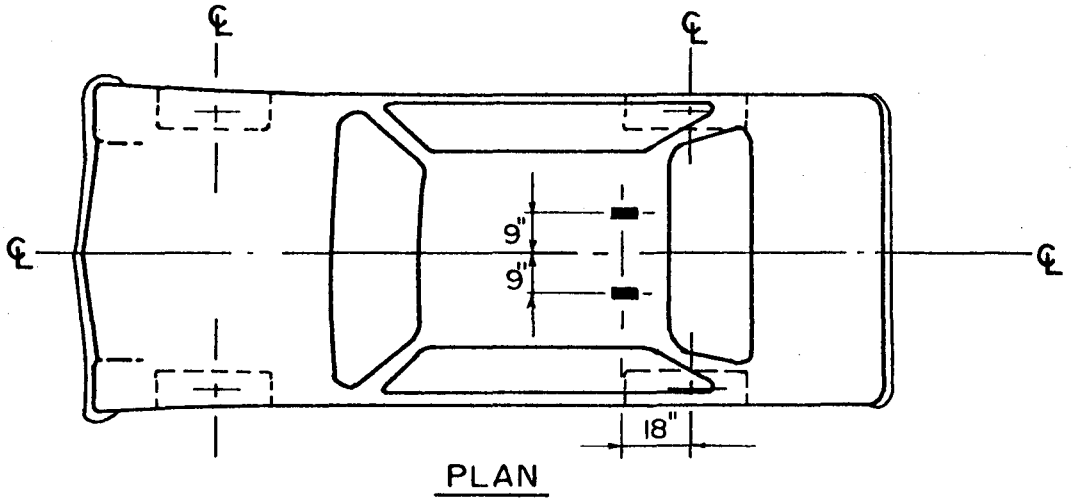
B-1. Deceleration Measurements

Vehicle deceleration measurements were made by means of two longitudinally oriented strain gage linear accelerometers. Position of each accelerometer was as shown in Figure 51. These accelerometers incorporate a balanced, fully active strain gage bridge which features rugged construction, low response to transverse accelerations and high overload capacity. The particular units used had a measurement range of ±50 g's with a bandwidth of 0 to 250 HZ. The nonlinearity and hysteresis is less than ±1% full scale with infinite resolution.

The accelerometers were physically calibrated by means of a Genisco 1074 precision centrifuge at various input levels. These calibration values were used to establish an 'R' cal value which was transmitted just prior to a test as required in final data reduction. Signals from the accelerometers were transmitted via a telemetry system to the base station for recording on analog tape.

B-2. High-Speed Cine

Three high-speed, ground mounted cameras were used to record the impact behavior of the test article and the vehicle. A fourth movie camera was used for documentary purposes, such as pre and postimpact scenes. Details of these cameras are given in Figure 52 and Table 14. Photos of the high-speed cameras are given in Figure 53.



NOTE: See Figure 17 for dimensions of test vehicle.

Figure 51. Accelerometer positions.

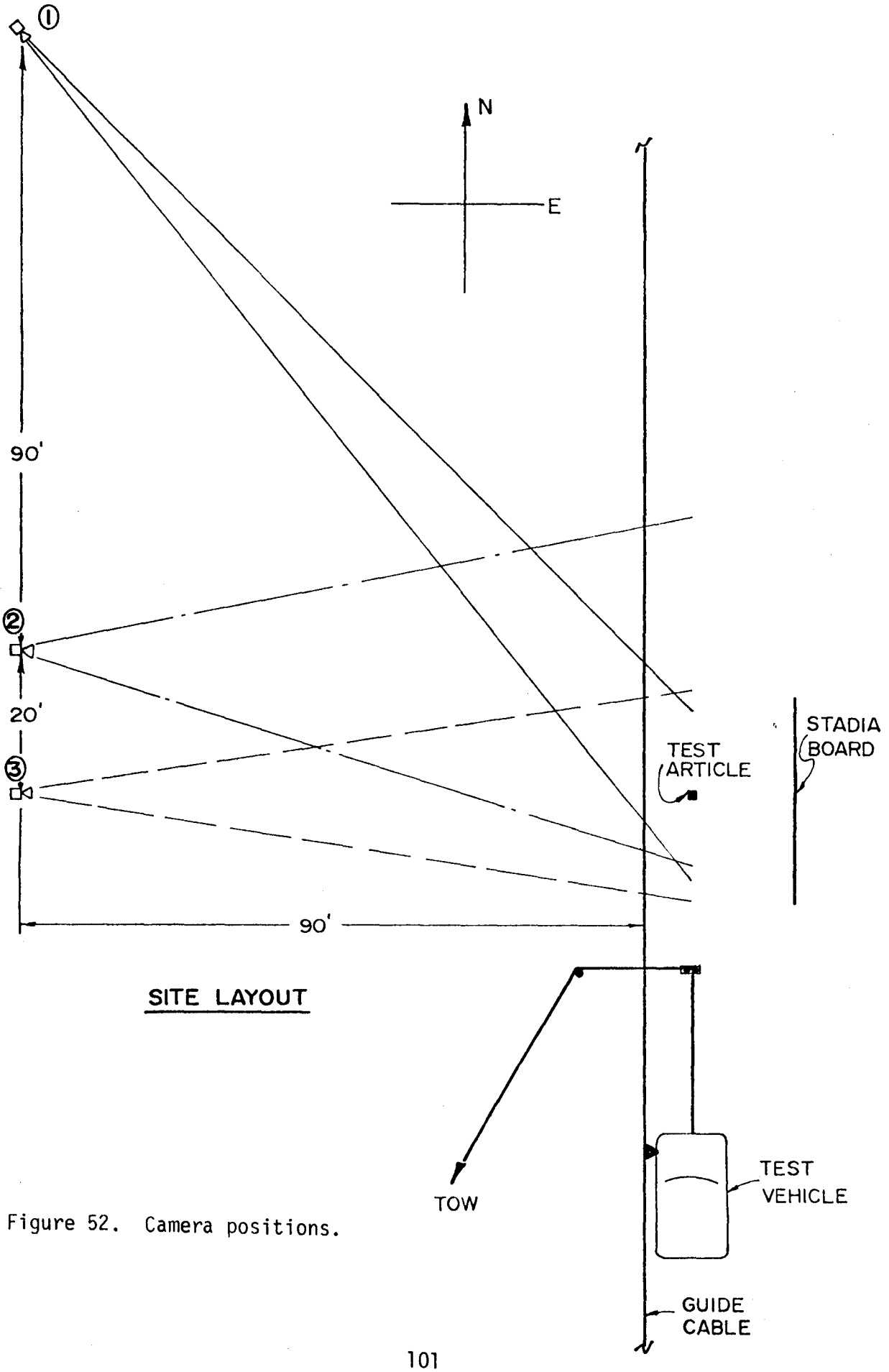
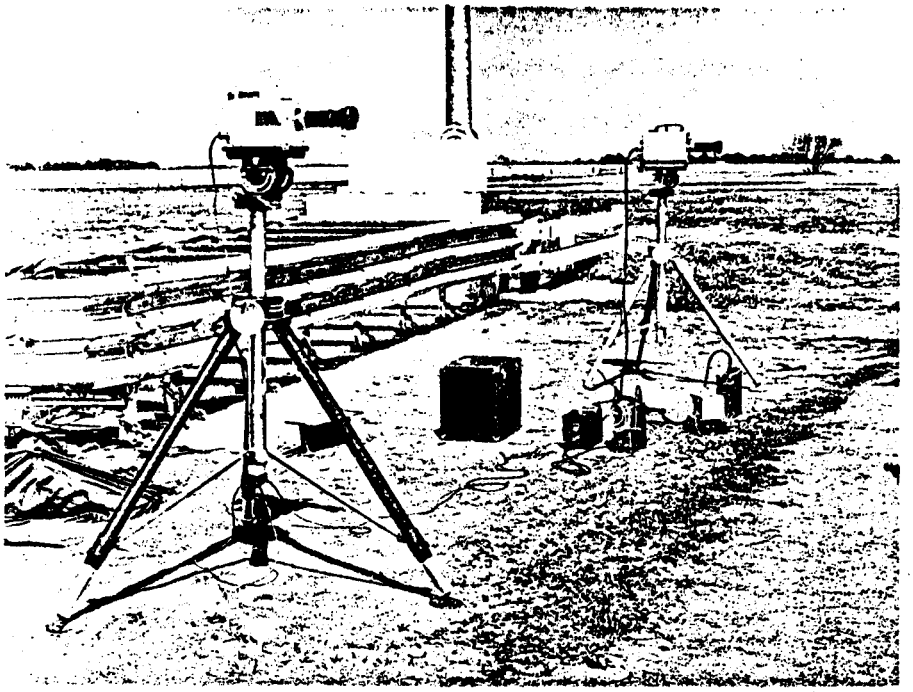


Figure 52. Camera positions.

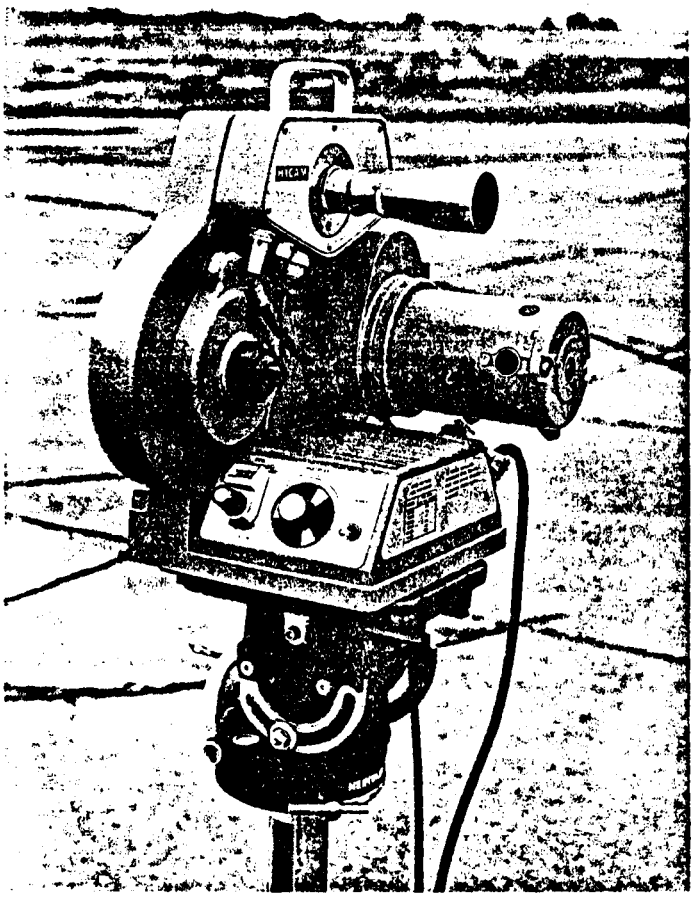
Table 14. Camera details.

CAMERA NO.[a]	TYPE	TYPICAL SPEED (Frames/sec)	BOUNDARIES OF SCENE	LENS
1	Redlakes Hycam	1000	12 ft before and after impact	74 mm Wollensak
2	Redlakes Locam	500	10 ft before and 40 ft after impact	12-120 mm Zoom Angeneaux
3	Photosonics 1P	500	15 ft before and after impact	12-120 mm Zoom Angeneaux
4	Arriflex-M	24	Documentary	17-70 mm Zoom Angeneaux

[a]See Figure 52.



a) Redlakes Locam and Photosonics



b) Redlakes Hycam

Figure 53. High-speed cameras.

REFERENCES

1. Fitzpatrick, J. F., et al., "The Law and Roadside Hazards", The Michie Company, Charlottesville, Va., pp. 465-469.

2. U. S. Postal Service Standard -- Rural Mailboxes, USPS-STD-7, February, 1974.

3. "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", American Association of State Highway and Transportation Officials, 1975.

4. Ross, H. E., Jr., and Walker, K. C., "Crash Tests of Small Highway Sign Supports", Research Report 3254-3, Contract DOT-FH-11-8821, Texas Transportation Institute, Texas A&M University, September, 1978.

5. "Recommended Procedures for Vehicle Crash Testing of Highway Appurtenances", Transportation Research Circular No. 191, Transportation Research Board, February, 1978.

6. General Post Corporation, 2831 Fleetwood Drive, Racine, Wisconsin 53403.

7. "Vehicle Damage Scale for Traffic Accident Investigators", Traffic Accident Data Project Bulletin No. 1, National Safety Council, 1971.

8. "Collision Deformation Classification, Recommended Practice J224a", Society of Automotive Engineers, New York, 1973.

9. "A Guide for Erecting Mailboxes on Highways", American Association of State Highway Officials, June 24, 1969.