

ANTHROPOMORPHIC DUMMY POSITIONING AND REPEATABILITY MEASUREMENTS

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Contract No. DTNH-22-80-C-02063
Contract Amt. \$13,894



**JANUARY 1981
FINAL REPORT**

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Prepared for
U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Washington, D.C. 20590

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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. DOT-HS-805-882	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Anthropomorphic Dummy Positioning and Repeatability Measurements		5. Report Date January 1981	
		6. Performing Orgn Code	
7. Author(s)		8. Performing Orgn Rpt No. 3112-81-004	
9. Performing Organization Name and Address Dynamic Science, Inc. A Subsidiary of Talley Industries 1850 West Pinnacle Peak Road Phoenix, Arizona 85027		10. Work Unit No.	
		11. Contract or Grant No. DTNH22-80-C-02063	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Office of Vehicle Crashworthiness National Highway Traffic Safety Administration Washington, D.C. 20590		13. Type of Report and Period Covered FINAL REPORT October 1980-January 1981	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract The purpose of the tests conducted was two fold: 1. To determine if the proposed compliance procedure would provide repeatable results. 2. To see if the requirements can be met without violating the anchorage location requirements specified in FMVSS 210. Results: Repeatability in the positioning of the upper torso of the dummy was poorer for the van and pick-up than for passenger cars. Position of the belt in the belt fit zone is not highly sensitive to variations in dummy position. For standard belt systems tested, modifications made to the seat belt assemblies would still meet the requirements of FMVSS 210.			
17. Key Words Anthropomorphic Test Device Test Positioning, Belt Anchorages, Belt Fit Comfort Zone.		18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. Pages 60	22. Price

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* 1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10.286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

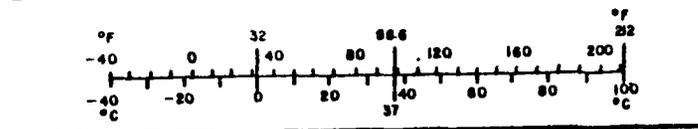


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1.0 INTRODUCTION

This test report presents the test procedures and results for "Anthropomorphic Dummy Positioning and Repeatability Measurements" conducted at Dynamic Science, Inc. This program was funded by NHTSA to provide documentation to support the Agency's reply to docket comments on the Notice of Proposed Rulemaking (NPRM) in the Federal Register on December 31, 1979 (44 FR 77210 Et Seq.).

The Notice proposes to amend Safety Standard No. 208 Occupant Crash Protection, to, "...specify additional performance requirements for both manual and automatic safety belt assemblies installed in motor vehicles with a Gross Vehicle Weight Rating of 10,000 pounds or less." The Notice state that, "The proposed performance requirements are intended to increase the benefits of safety belts by improving the comfort and convenience of belt assemblies and thereby raise the current low rate of safety belt use." The Notice included a requirement (S7.1.1.4) designed to improve the fit of torso belts in the front outboard seating positions of passenger cars with automatic belts and vehicles other than passenger cars with Gross Vehicle Weight Rating of 10,000 pounds and under with manual belts.

The requirement specifies that a Part 572 test device be placed in the front outboard seating position in accordance with the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Part 572 test device has a torso belt crossing zone located in a prescribed manner (S10.6). When the Part 572 test device is placed in the vehicle, the torso belt of the vehicle,

normally two inches in width, has to fall within the three-inch-wide belt fit zone located at a 55-degree angle on the Part 572 test device's torso.

In comments to the docket, industry stated that the requirement:

1. lacked objectivity because the compliance procedure was not repeatable and
2. may force the manufacturers to place anchorages in zones that would be forward of the specified zone in FMVSS 210.

This program was therefore designed to:

- Determine if the proposed compliance procedure would provide repeatable results.
- To see if the requirements can be met without violating the anchorage location requirements specified in FMVSS 210.

1.1 GENERAL PROCEDURE

Two main tasks were performed. For Task 1, two Part 572 dummies were placed in the driver's seat of four different vehicles by two independent technicians (see test matrix in Table 1-1) to determine the repeatability of dummy placement in a vehicle. The dummies were placed one at a time into the left front outboard seating position of a 1980 Volkswagen Rabbit, a 1979 Chevrolet Citation, a 1979 Chevrolet C-10 pick-up truck, and a 1980 Ford "Chateau" Econoline 150 Van. Prior to the start of Task 1, the seat belt anchorage locations were modified to ensure that the torso belt would fall into the "belt fit zone."

TABLE 1-1. TASK 1 TEST MATRIX

		Vehicle Designation							
		Ford Econoline 150 Van		Chevrolet C-10 Pick-up Truck		Chevrolet Citation		VW Rabbit	
		Dummy A	Dummy B	Dummy A	Dummy B	Dummy A	Dummy B	Dummy A	Dummy B
		Test Numbers							
Technician:	Leon	1,3,17	2,10	9,11,18	4,12	5,13,19	6,14	7,15,20	8,16
Technician:	Bergy	21,29	22,30,37	23,31	24,32,38	25,33	26,34,39	27,35	28,36,40
Dummy A:		Alderson Research Laboratories, SN A08							
Dummy B:		Sierra Engineering, SN S51							

For Task 2, the placement of a dummy in the Chevrolet C-10 pick-up truck was varied to determine the effect of dummy position on torso belt location relative to the belt fit zone.

Data acquired consisted of measurements of the location of three dummy landmarks relative to the vehicle SRP and information relative to the requirements of FMVSS 210 for modified anchor points.

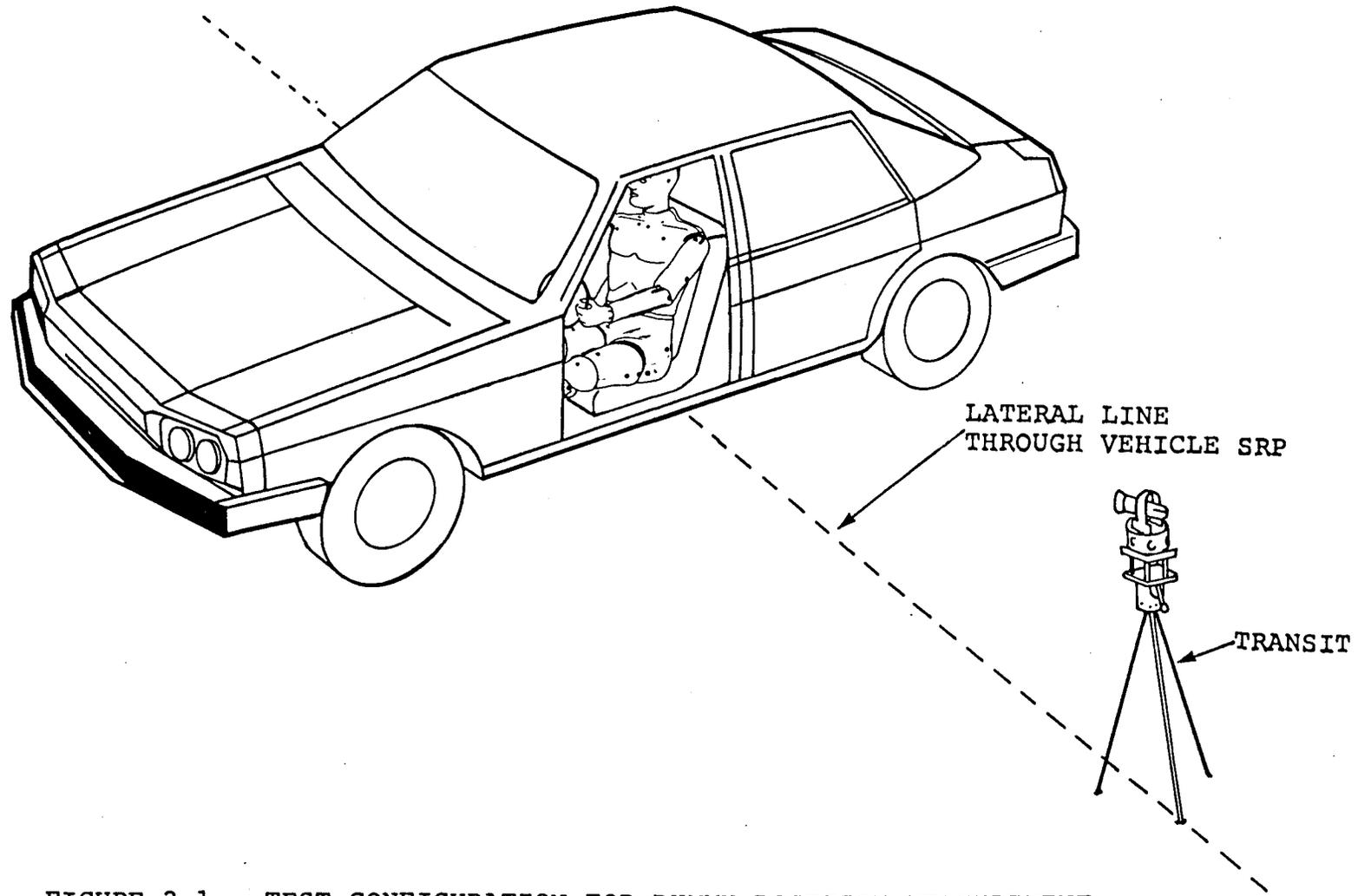
2.0 TEST METHODOLOGY

The general approach was to place the test dummies in the driver seat of each automobile and record the position of dummy landmarks relative to the SRP by means of a level scale and a transit.

2.1 VEHICLE PREPARATION

The SRP of each of the test automobiles was obtained from the manufacturer and located on the vehicles. The vehicles were then placed so that the line of sight of the transit was in the vertical lateral plane through the SRP (see Figure 2-1) and normal to the vehicle centerline. The vehicles were set on blocks to provide stability and to ensure that the rocker sills were kept level.

The seat in each vehicle was placed in the midposition and the seat back, if adjustable, was placed in the manufacturer's designated riding position. The dummies were placed in the driver's seat and positioned in each vehicle according to the FMVSS 208 placement procedure. The seat belt systems were fastened around the anthropomorphic test device and the test device was rocked laterally as well as longitudinally until the belt settled in an equilibrium position. The belt anchorage points were then modified so that the belt centerline coincided with the belt fit zone centerline. The dummy was then removed and the modified anchor point locations were compared with the FMVSS 210 requirements. A description of the anchor point modifications for each vehicle is contained in Section 2.3.1.



80 9501 1017 01

FIGURE 2-1. TEST CONFIGURATION FOR DUMMY POSITION MEASUREMENT.

2.2 METHOD FOR RECORDING DUMMY TARGET LOCATIONS

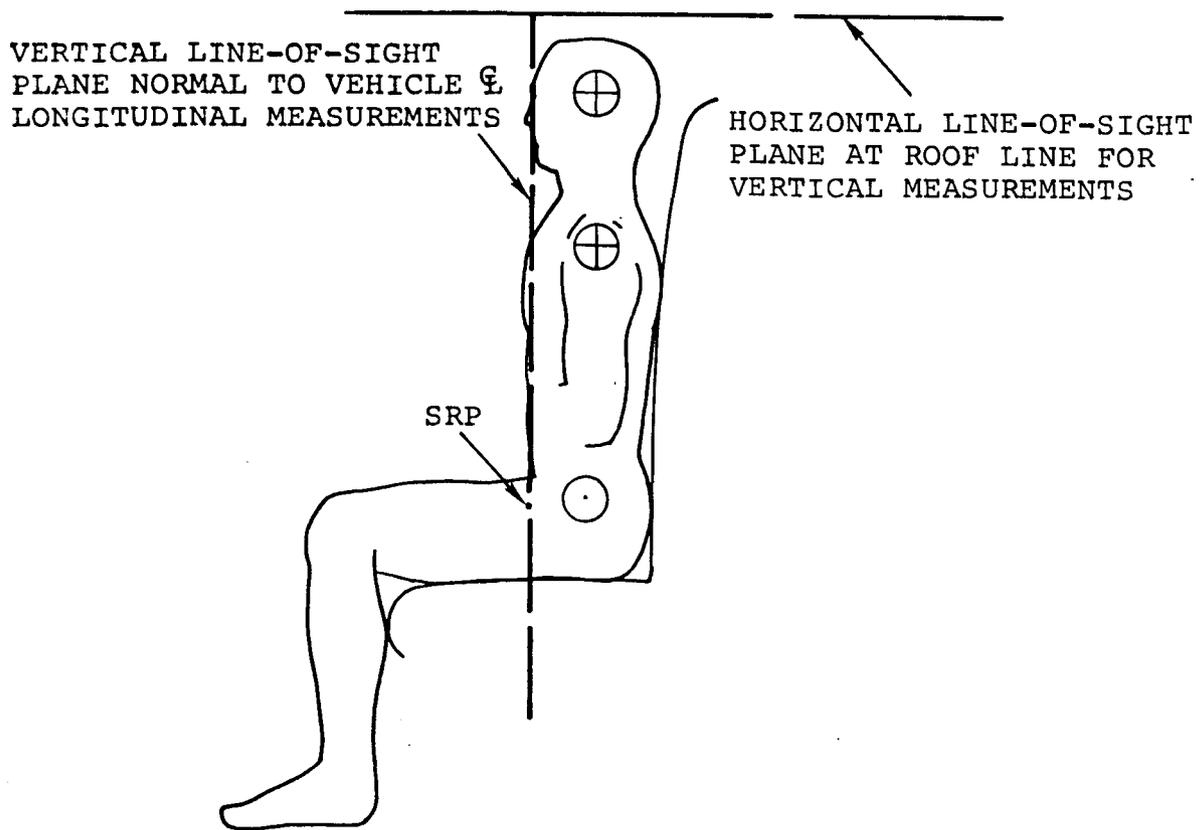
The three dummy landmark targets were the hip point, shoulder target, and head target. The positions of these targets were measured relative to the vehicles SRP by the following method.

A measuring rod was suspended vertically from the roof line of the vehicle through the SRP of the vehicle (see Figure 2-2). The height of the roof line at the point of attachment of the measuring rod was then recorded. A measuring rod with a level installed in it was placed with the zero point at the desired landmark and held level in a longitudinal plane parallel to the vehicle centerline. Both the vertical and horizontal measuring rods were read by means of the transit. By knowing the location of the reference system relative to the SRP, the location of the landmark relative to the SRP could be calculated.

The following sections describe the procedure used for the individual tasks.

2.3 TASK 1: REPEATABILITY OF DUMMY PLACEMENT IN VEHICLE

The objective of this task was to determine the repeatability of dummy placement in four different vehicle using two dummies and two independant technicians. A total of forty trials were recorded. The following subtasks were completed for Task 1.



80 9501 1017 04

FIGURE 2-2. REFERENCE PLANES FOR DUMMY POSITION MEASUREMENTS.

2.3.1 Belt Fit Zone on Dummies

The belt fit zone was marked on each the two 50th percentile anthropomorphic dummies. The zone was defined by NHTSA representatives as shown in Figure 2-3.

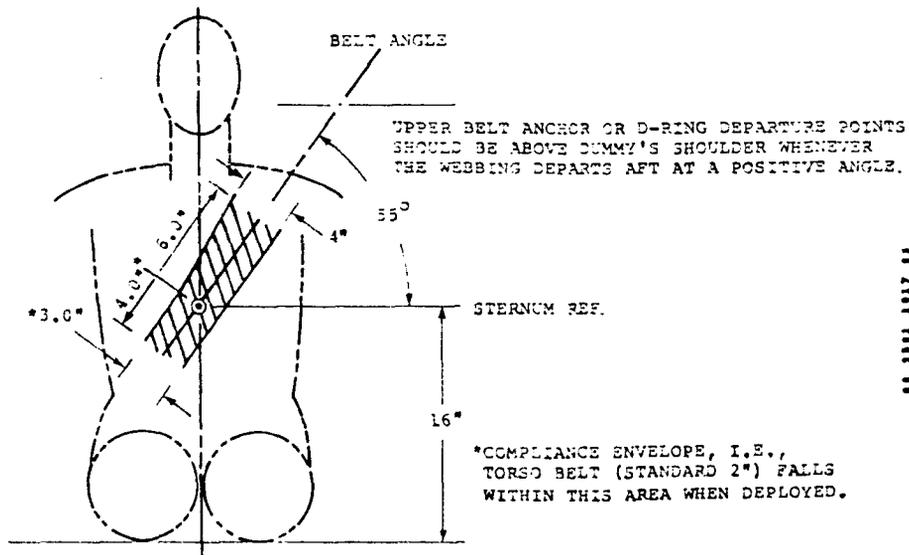


FIGURE 2-3. BELT-CROSSING GEOMETRIC CRITERIA USING 50TH PERCENTILE DUMMY.

2.3.2 Modification of Anchor Points

Modifications described in this section were made to the seat belt systems on the four test vehicles. A comparison of the modified anchor point locations relative to the requirements FMVSS 210 is included as Appendix A.

2.3.2.1 Modifications to Ford Econoline 150 Van Seat Belt System

Two modifications were made to the Ford Econoline 150 Van seat belt systems.

1. The in-board lap belt was lengthened 4-1/2 inches to move the junction of the torso and pelvic belt closer to the midsaggital plane of the dummy (see Figure 2-4).
2. The D-ring for the shoulder belt was held against the B-pillar thus effectively moving the anchor point down 7-1/4 inches and forward 5-3/4 inches (see Figure 2-5).

2.3.2.2 Modifications to Chevrolet C-10 Pick-up Seat Belt System

The Chevrolet C-10 pick-up truck contained a 3-point manual belt system and bench seats. The following modifications were made:

1. The in-board lap belt was lengthened by 5-1/4 inches to move the junction of the lap and torso belts closer to the midsaggital plane of the dummy (see Figure 2-6).
2. The upper torso belt anchor was relocated forward 4-1/2 inches and up 2-1/2 inches. Figure 2-7 illustrates the modified anchor.

2.3.2.3 Modification to 1979 Chevrolet Citation Seat Belt System

The Chevrolet Citation contained bucket seats and a standard 3-point manual restraint system. Modifications were made as follows:

1. The in-board lap belt was lengthened by 2.0 inches to relocate the junction of the torso and lap belts closer to the midsaggital plane of the dummy. Figure 2-8 illustrates this modification.
2. The upper torso anchor point was lowered 1-1/2 inches and relocated forward 2-3/8 inches. This modification is shown in Figure 2-9.

2.3.2.4 Modification to Volkswagen Rabbit Seat Belt System

The VW Rabbit was equipped with an automatic (passive) restraint system. This system contained only two anchor points, one

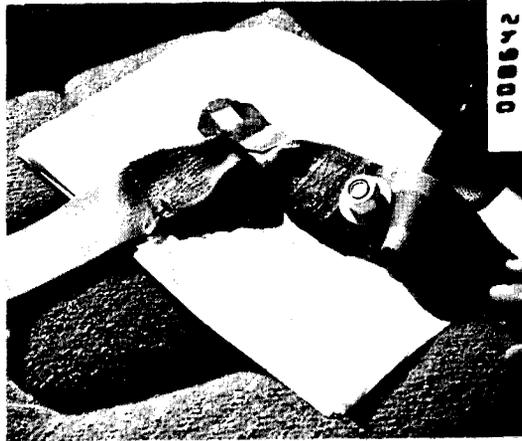


FIGURE 2-4. INBOARD LAP BELT SHOWING MODIFICATION - FORD ECONOLINE 150 VAN.



FIGURE 2-5. SHOULDER BELT D-RING - FORD ECONOLINE 150 VAN.

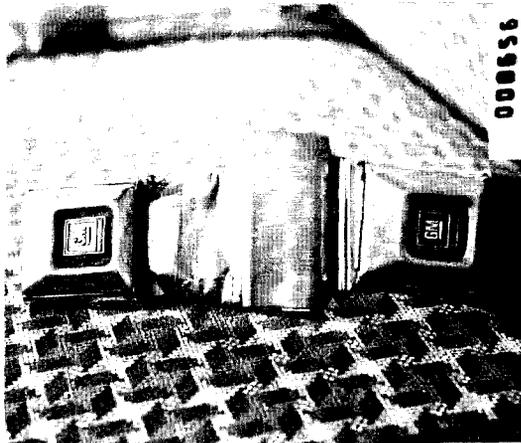


FIGURE 2-6. INBOARD LAP BELT SHOWING MODIFICATION - CHEVROLET C-10 PICK-UP TRUCK.

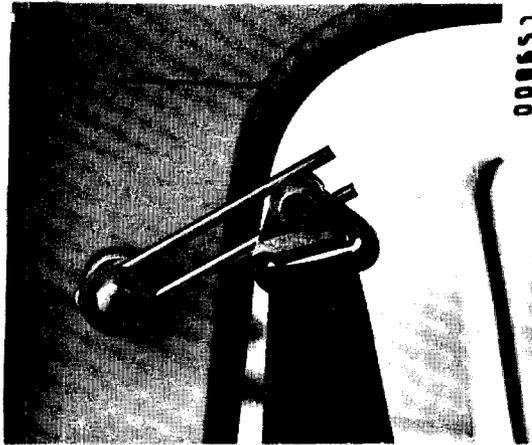


FIGURE 2-7. TORSO BELT ANCHOR MODIFICATION - CHEVROLET C-10 PICK-UP TRUCK.

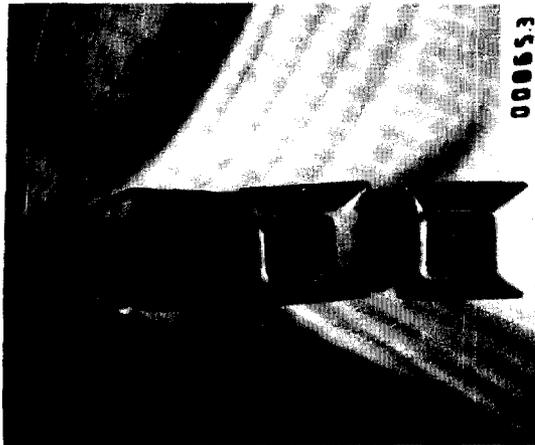


FIGURE 2-8. INBOARD LAP BELT SHOWING MODIFICATION - CHEVROLET C-10 PICK-UP TRUCK.

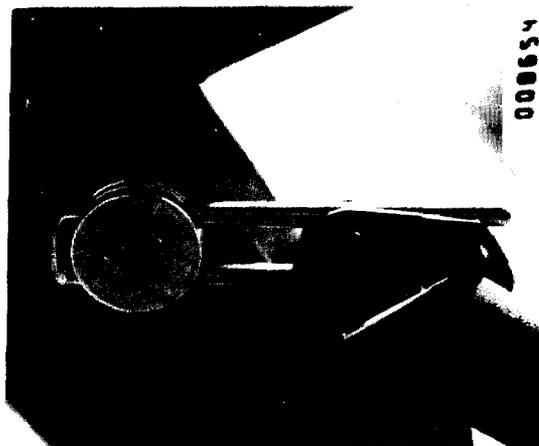


FIGURE 2-9. TORSO BELT ANCHOR MODIFICATION - CHEVROLET CITATION.

attached to the rear edge of the door and the other attached to the seat rail. Figure 2-10 shows the unmodified configuration of the restraint system. The Volkswagen restraint system was modified as follows:

1. A 3-1/2 inch loop was affixed to the belt guide near the top of the seat bottom as shown in Figure 2-11.
2. The torso belt attachment on the door was transferred to the B-pillar because the door had to be kept open for purposes of testing. The anchor point was raised 3 inches (see Figure 2-12).

2.3.3 Dummy Placement in Vehicle

After modifying the seat belt anchorages, the dummy was placed in the driver's seat and positioned to the requirements of FMVSS 208. The belt system was fastened and adjusted. The dummy was then rocked laterally and longitudinally until the belt reached an equilibrium position in the belt fit zone. Displacement of the belt centerline relative to the centerline of the belt fit zone was recorded at the top and bottom of the zone. The hip point, shoulder target, and head target landmarks were recorded relative to the SRP using the methodology described in Section 2.2. A post-test photograph was then taken.

The procedures were repeated for each of the forty trials outlined in the test matrix (Table 1-1). The post-test photographs for each test are included in Appendix B.

2.4 PHASE II VEHICLE REPEATABILITY

The object of this phase was to determine the effect of dummy placement variation on the relative position of the torso belt and



FIGURE 2-10. UNMODIFIED SEAT BELT SYSTEM - VW RABBIT.



FIGURE 2-11. MODIFIED BELT GUIDE - VW RABBIT.



FIGURE 2-12. TORSO BELT ANCHOR MODIFICATION - VW RABBIT.

and the belt fit zone. The 1979 Chevrolet C-10 pick-up was used for this phase.

The following tasks were completed for Phase II.

2.4.1 Task 2 Test 1 - Establishing the Baseline

The Sierra Part 572 dummy was placed in the driver's seat of the Chevrolet C-10 pick-up using the same procedure as in Task 1. Dummy landmark and belt position data were taken and the belt position was also photographed.

2.4.2 Task 2 Test 2 - Effect of Large Upward Deviation

The test device from Test 1 was raised 1.0 inch by placing a styrofoam block on the seat beneath the dummy pelvis. Figure 2-13 shows the block in position. The dummy landmark and the position of the belt within the belt fit zone were recorded and a photograph of the torso belt was taken.

2.4.3 Task 2 Test 3 - Effect of Upward and Rearward Deviation

A 50-pound force was applied to the torso and lower abdomen of the dummy as it was in the elevated position. Figure 2-14 shows the position of the FMVSS 208 Positioning Cylinders used to apply the 50-pound force. With the force in position, a photograph was taken of the torso belt and the location of the dummy landmarks. The position of the belt within the belt fit zone was recorded.



FIGURE 2-13. TASK 2, TEST 2 DUMMY POSITION WITH STYROFOAM BLOCK.



FIGURE 2-14. TASK 2, TEST 3 DUMMY POSITION.

2.4.4 Task 2 Test 4 - Effect of Upward and Forward Deviation

The test dummy was maintained in the elevated position of Test 2 and moved forward 1.0 inch on the seat. Styrofoam blocks were placed between the seat back and the dummy to maintain the dummy's position. The test configuration is shown in Figure 2-15.

2.4.5 Task 2 Test 5 - Effect of Downward Deviation

The Part 572 dummy was placed in the same configuration as in Task 2, Test 1. A 53.9-pound lead weight was then placed on the upper thighs as close to the abdomen as possible to lower the dummy in the seat. This configuration is shown in Figure 2-16.

2.4.6 Task 2 Test 6 - Effect of Downward and Rearward Deviation

A 50-pound force was applied to the torso and lower abdomen of the dummy in the downward position of Test 6. Figure 2-17 shows the position of the FMVSS 208 Positioning Cylinders that were used to apply the 50-pound force. While maintaining the 50-pound force, a photograph of the belt relative to the belt fit zone was taken. The location of the dummy landmarks as well as position of the belt within the belt fit zone were recorded.

2.4.7 Task 2 Test 7 - Effect of Downward and Forward Deviation

The dummy was placed in the lowest position of Test 5 (with the 53.9-pound weight on the thighs) and moved forward 1.0 inch



FIGURE 2-15. TASK 2, TEST 4 DUMMY POSITION.



FIGURE 2-16. TASK 2, TEST 5 DUMMY POSITION.

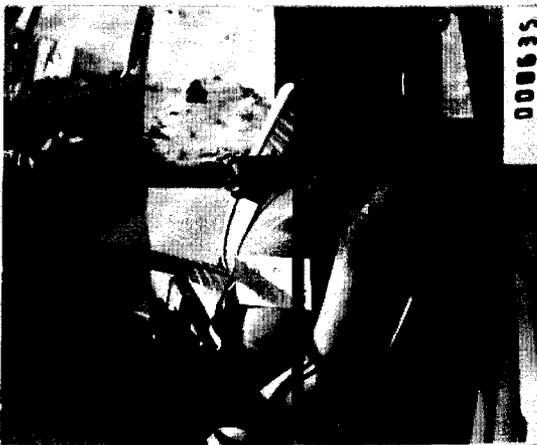


FIGURE 2-17. TASK 2, TEST 6 DUMMY POSITION.

on the seat. Styrofoam blocks were again placed between the seat back and the dummy to maintain the dummy's position. Figure 2-18 shows the test configuration.

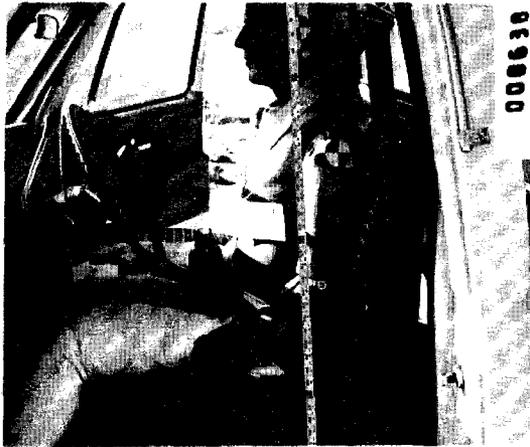


FIGURE 2-18. TASK 2, TEST 7 DUMMY POSITION.

3.0 RESULTS

3.1 TASK 1 RESULTS

All measurements are recorded by vehicle in Tables 3-1 (Ford Econoline E-150 van), 3-2 (Chevrolet C-10 Pick-up), 3-3 (Chevrolet Citation), and 3-4 (Volkswagen Rabbit). For each set of measurements the standard deviation is also tabulated in Table 3-5.

The data in Table 3-5 indicates that the head and shoulder targets in the van and pick-up show larger standard deviations than in the Citation and Rabbit. That is, repeatability in positioning of the upper torso of the dummy was poorer for the van and pick-up than for the passenger cars. In spite of this fact, the associated belt dislocation relative to the fit zone was approximately the same in all vehicles. This indicates that position of the belt within the belt fit zone is not highly sensitive to variation in dummy position.

A photograph of the belt position following each placement of the dummy is included as Appendix B.

As stated earlier, Appendix A contains data regarding the modified anchors of the restraint system and the specifications of FMVSS 210 "Seat Belt Assembly Anchorages." This data indicates that three vehicles involved in this program would still meet the requirements of FMVSS 210 with the modifications made to the seat belt assemblies.

TABLE 3-1. DUMMY LANDMARKS RELATIVE TO SRP AND BELT DISLOCATION DATA FOR FORD ECONOLINE E-150

Test No.	Dummy	Technican I.D.	Head Target Location		Shoulder Point Location		Hip Point Location		Dislocation of Belt Centerline Relative Fit Zone (in.)	
			X	Y	X	Y	X	Y	Upper	Lower
1	A08	Leon	4.8	40.6	3.5	32.9	-1.9	15.7	0.000	0.000
22	S51	Bergy	5.3	40.9	4.9	33.3	-1.9	15.1	Right 0.250	Right 0.375
3	A08	Leon	4.9	40.6	4.4	32.7	-1.9	15.4	0.000	0.000
30	S51	Bergy	5.2	41.1	4.8	32.9	-1.6	15.1	Right 0.313	0.000
21	A08	Bergy	2.1	41.1	3.3	33.3	-0.8	15.5	Left 0.375	Left 0.125
2	S51	Leon	5.1	40.2	5.1	31.4	-2.3	15.4	Left 0.250	Right 0.188
29	A08	Bergy	3.0	41.1	3.4	33.1	-1.3	15.5	Right 0.625	Right 0.125
10	S51	Leon	5.0	40.7	5.6	32.7	-1.5	15.7	Left 0.625	Left 0.188
17	S51	Leon	5.4	40.4	5.0	31.6	-2.3	15.4	Left 0.125	Left 0.063
37	A08	Bergy	4.9	40.5	5.2	33.7	-1.1	16.0	Right 0.313	Right 0.188
MEAN			4.6	40.7	4.5	32.8	-1.7	15.5	Right 0.013	Right 0.063
STANDARD DEVIATION			1.10	0.32	0.83	0.73	0.49	0.27	0.374	0.153

TABLE 3-2. DUMMY LANDMARKS RELATIVE TO SRP AND BELT DISLOCATION DATA FOR CHEVROLET C-10 PICK-UP

Test No.	Dummy	Technican I.D.	Head Target Location		Shoulder Point Location		Hip Point Location		Dislocation of Belt Centerline Relative Fit Zone (in.)	
			X	Y	X	Y	X	Y	Upper	Lower
9	A08	Leon	2.5	26.6	2.6	18.4	-2.4	0.3	Right 0.250	Left 0.500
24	S51	Bergy	3.8	26.4	4.6	17.3	-2.0	0.0	Right 0.375	Left 0.250
4	S51	Leon	2.9	26.3	3.5	18.6	-1.4	0.0	Right 0.250	Left 0.438
23	A08	Bergy	4.3	26.6	4.0	17.9	-2.4	0.4	Right 0.500	Left 0.500
32	S51	Bergy	5.0	26.0	5.7	17.6	-2.6	0.0	Right 0.500	0.000
12	S51	Leon	5.4	25.6	5.1	17.4	-1.7	-0.3	Right 0.250	Right 0.500
31	A08	Bergy	2.4	26.1	3.1	17.6	-2.0	0.6	Right 0.688	Right 0.063
18	S51	Leon	2.6	26.5	3.5	17.8	-1.8	0.4	Right 0.375	Right 0.438
38	A08	Bergy	3.0	26.1	3.6	17.9	-1.6	0.4	Right 1.000	Right 0.250
11	A08	Leon	2.3	25.9	3.0	17.6	-1.3	0.3	Right 0.125	Right 0.250
MEAN			3.4	26.2	3.9	17.8	-1.9	0.2	Right 0.431	0.256
STANDARD DEVIATION			1.14	0.33	0.98	0.41	0.44	0.27	0.258	0.273

TABLE 3-3. DUMMY LANDMARKS RELATIVE TO SRP AND BELT DISLOCATION DATA FOR 1979 CHEVROLET CITATION 2-DOOR HATCHBACK

Test No.	Dummy	Technician I.D.	Head Target Location		Shoulder Point Location		Hip Point Location		Dislocation of Belt Centerline Relative Fit Zone (in.)	
			X	Y	X	Y	X	Y	Upper	Lower
5	A08	Leon	4.6	30.3	3.8	21.8	-2.1	5.3	Left 0.500	Left 0.500
6	S51	Leon	4.8	30.8	4.0	21.3	-2.1	4.3	Left 0.500	Left 0.500
14	S51	Leon	4.1	30.5	4.4	21.0	-2.3	4.6	Left 0.250	Left 0.500
27	A08	Bergy	4.5	30.2	3.8	21.8	-2.8	5.3	Left 0.625	Right 0.125
33	A08	Bergy	4.4	30.3	4.0	21.9	-4.3	4.8	Right 0.125	Left 0.250
13	A08	Leon	4.5	30.6	4.9	23.0	-2.3	5.6	Left 0.438	Left 0.250
19	S51	Leon	4.6	30.8	4.9	22.2	-2.9	5.1	Right 0.563	Left 0.375
39	A08	Bergy	4.5	30.6	5.0	22.5	-2.5	5.4	Left 0.125	Left 0.313
26	S51	Bergy	4.3	30.9	5.0	21.8	-3.0	5.1	Right 0.250	0.000
34	S51	Bergy	4.0	31.1	4.4	22.0	-2.9	5.3	Right 0.063	Right 0.188
MEAN			4.4	30.6	4.4	21.9	-2.7	5.1	Left 0.144	Left 0.163
STANDARD DEVIATION			0.24	0.29	0.50	0.56	0.65	0.40	0.388	0.316

TABLE 3-4. DUMMY LANDMARKS RELATIVE TO SRP AND BELT DISLOCATION DATA FOR 1980 VOLKSWAGEN RABBIT 4-DOOR HATCHBACK

Test No.	Dummy	Technican I.D.	Head Target Location		Shoulder Point Location		Hip Point Location		Dislocation of Belt Centerline Relative Fit Zone (in.)	
			X	Y	X	Y	X	Y	Upper	Lower
27	A08	Bergy	6.0	23.4	4.8	15.0	-1.6	-0.9	Right 0.188	Right 0.375
7	A08	Leon	6.0	23.6	4.9	14.8	-1.6	-0.6	Right 0.313	Right 0.313
36	S51	Bergy	6.3	24.3	5.5	14.8	-2.0	-1.3	Left 0.125	Left 0.188
8	S51	Leon	6.3	24.3	5.7	15.4	-2.6	-0.8	0.000	Right 0.250
35	A08	Bergy	5.9	24.2	5.3	15.3	-1.8	-1.1	Right 0.500	Right 0.125
15	A08	Leon	6.1	23.6	5.5	15.0	-1.9	-1.4	Left 0.063	Right 0.063
40	A08	Bergy	6.1	23.6	5.1	14.8	-1.6	-1.5	Right 0.188	Right 0.500
28	S51	Bergy	6.0	24.1	5.6	14.4	-2.4	-1.3	Right 0.625	Right 0.500
20	S51	Leon	5.8	23.9	5.0	15.2	-2.6	-1.0	Right 0.313	Right 0.313
16	S51	Leon	6.0	23.9	5.1	14.4	-2.6	-1.1	Right 0.125	Right 0.375
MEAN			6.0	23.9	5.3	14.9	-2.1	-1.1	Right 0.208	Right 0.263
STANDARD DEVIATION			0.16	0.33	0.31	0.34	0.27	0.239	0.212	

TABLE 3-5. TABULATION OF STANDARD DEVIATION FOR ALL MEASUREMENTS (INCHES)

		Ford E-150	Chevrolet C-10	Chevrolet Citation	VW Rabbit
Head Target	Longitudinal	1.10	1.14	0.24	0.16
	Vertical	0.32	0.33	0.29	0.33
Shoulder Target	Longitudinal	0.83	0.98	0.50	0.31
	Vertical	0.73	0.41	0.56	0.34
Hip Target	Longitudinal	0.49	0.44	0.65	0.44
	Vertical	0.27	0.27	0.40	0.27
Upper Belt Dislocation		0.37	0.26	0.39	0.24
Lower Belt Dislocation		0.15	0.27	0.32	0.21

Modifications made to the upper torso anchor location of the VW Rabbit prevent this system from meeting S4.3.2 of FMVSS 210 in that the allowable angle of 80 degrees is exceeded by 7 degrees. That is, the measured angle with the modified anchor was 87 degrees and therefore does not meet the requirements of the standard.

3.2 TASK 2 RESULTS

The purpose of this task was to determine the effect of deviations in the position of the dummy on the location of the torso belt within the belt fit zone. Measurements were made as described in Section 2.2; the data are listed in Table 3-6. Photographs showing the belt position at the conclusion of each dummy placement are shown in Appendix C. Data in Table 3-6 and the photographs in Appendix C show that the torso belt falls within the belt fit zone in spite of large variations in dummy placement.

TABLE 3-6. TASK 2 DUMMY LANDMARKS RELATIVE TO SRP AND BELT DISLOCATION DATA FOR CHEVROLET C-10 PICK-UP

Test No.	Dummy	Technican I.D.	Head Target Location		Shoulder Point Location		Hip Point Location		Dislocation of Belt Centerline Relative Fit Zone (in.)	
			X	Y	X	Y	X	Y	Upper	Lower
1	S51	Leon	2.3	26.2	4.0	17.5	-1.6	0.1	Right 0.06	Left 0.39
2	S51	Leon	2.1	27.2	3.4	18.5	-1.9	1.1	0.00	Left 0.39
3	S51	Leon	5.6	26.7	5.3	17.8	-1.5	1.0	Right 0.13	Left 0.39
4	S51	Leon	1.0	27.0	2.4	18.0	-2.9	1.1	Right 0.81	Right 0.44
5	S51	Leon	2.4	25.5	3.9	16.8	-1.8	-0.4	Right 0.39	0.00
6	S51	Leon	5.5	25.2	5.5	15.8	-1.4	-0.4	Right 0.88	Left 0.06
7	S51	Leon	1.3	25.5	2.9	16.4	-2.9	-0.1	Right 0.69	Right 0.19
RANGE			1.0 to 5.6	25.2 to 27.2	2.4 to 5.5	15.8 to 18.5	-1.4 to -2.9	-0.4 to +1.1	0.00 to 0.88	Right 0.44 to Left 0.39
MEAN			2.89	26.2	3.91	17.3	-2.0	0.34	Right 0.42	Left 0.09
STANDARD DEVIATION			1.89	0.80	1.16	0.96	0.64	0.70	0.37	0.30

APPENDIX A
DATA SHOWING MODIFIED
ANCHORAGE DIMENSIONS RELATIVE
TO REQUIREMENTS OF FMVSS 210

APPENDIX A-1

Modified Seat Belt Anchor Locations as compared to FMVSS
210 requirements for Ford E-150 Van

FMVSS 210 Requirements (assuming adjustable seats)	Modified Anchor (W seat in rearmost position)
I - Pelvic Portion.	
A - If belt does not bear upon the seat frame a line from a point 2.50 inches forward of and 0.375 inch above the seating reference point to the nearest contact point of the belt with the hardware attaching it to the anchorage for an adjustable seat in its rearmost position, shall extend forward from the anchorage at an angle with the horizontal of not less than 20° and not more than 75°.	Does belt bear upon the seat frame? Yes _____ No <u>X</u>
	Angle measurement: <u>63</u> inches
B - If belt bears upon the seat frame the seat belt anchorage, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the belt frame shall extend forward from that contact point at an angle with the horizontal of not less than 20° and not more than 75°.	Is the anchor aft of the rearmost contact point on the seat frame? Yes _____ No _____
	Angle measurement: _____ degrees
C - Anchorages for an individual seat belt assembly shall be located at least 6.50 inches apart laterally, measured between the vertical centerlines of the bolt holes.	Minimum lateral distance between vertical centerlines of the bolt holes: <u>16</u> inches

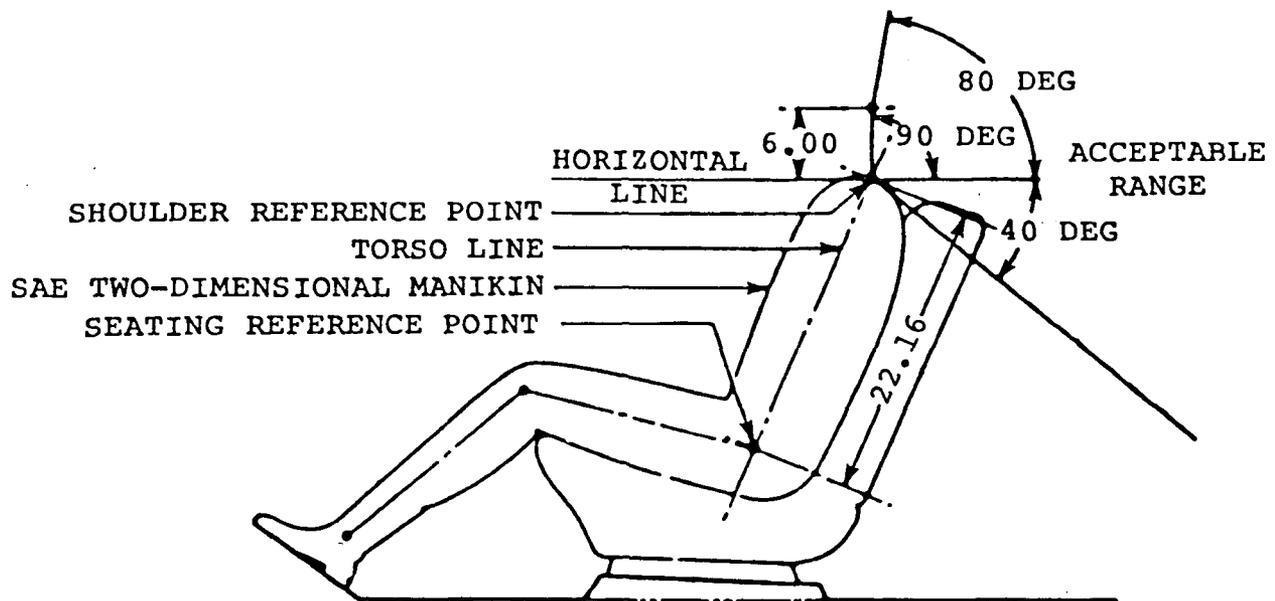
NOT APPLICABLE

II - Upper Torso Portion.
 With the seat in its full rearward and downward position and the seat back in its most upright position, the seat belt anchorage for the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two dimensional manikin described in SAE Standard J826 (November 1962) whose "H" point is at the seating reference point and whose torso line is at the same angle from the vertical as the seat back.

Place seat full downward and full rearward and seatback in most upright position.

Angular measurement: 63 degrees
 Above X Below _____
 Horizontal

For the unmodified anchorage the angle was 65° above the horizontal



80 9501 1017 05

LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

APPENDIX A-2

Modified Seat Belt Anchor Locations as compared to FMVSS
210 requirements for Chevrolet C-10 Pick-up

FMVSS 210 Requirements (assuming adjustable seats)	Modified Anchor (W seat in rearmost position)
I - Pelvic Portion.	
A - If belt does not bear upon the seat frame a line from a point 2.50 inches forward of and 0.375 inch above the seating reference point to the nearest contact point of the belt with the hardware attaching it to the anchorage for an adjustable seat in its rearmost position, shall extend forward from the anchorage at an angle with the horizontal of not less than 20° and not more than 75°.	Does belt bear upon the seat frame? Yes ___ No <u>X</u> Angle measurement: <u>34</u> inches
B - If belt bears upon the seat frame the seat belt anchorage, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the belt frame shall extend forward from that contact point at an angle with the horizontal of not less than 20° and not more than 75°.	Is the anchor aft of the rearmost contact point on the seat frame? Yes ___ No ___ Angle measurement: ___ degrees
C - Anchorages for an individual seat belt assembly shall be located at least 6.50 inches apart laterally, measured between the vertical centerlines of the bolt holes.	Minimum lateral distance between vertical centerlines of the bolt holes: <u>8.0</u> inches

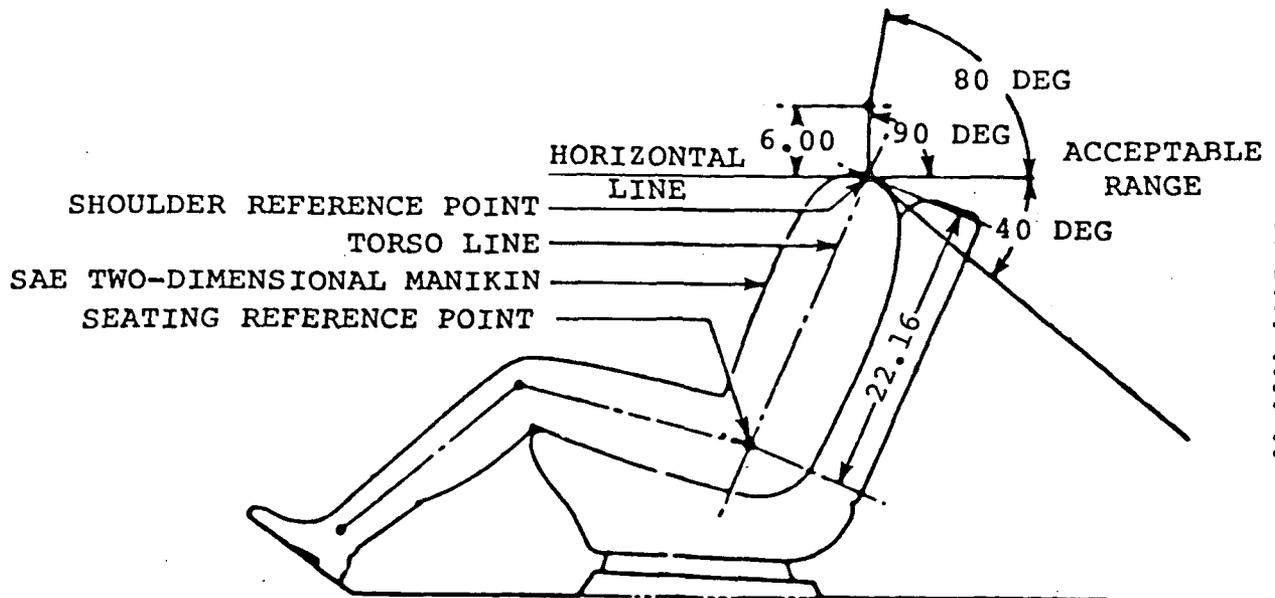
NOT APPLICABLE

II - Upper Torso Portion.
 With the seat in its full rearward and downward position and the seat back in its most upright position, the seat belt anchorage for the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two dimensional manikin described in SAE Standard J826 (November 1962) whose "H" point is at the seating reference point and whose torso line is at the same angle from the vertical as the seat back.

Place seat full downward and full rearward and seatback in most upright position.

Angular measurement: 72 degrees
 Above X Below _____
 Horizontal

For the unmodified anchorage the angle was 65° above the horizontal



80 9501 1017 05

LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

APPENDIX A-3

Modified Seat Belt Anchor Locations as compared to FMVSS
210 requirements for 1979 Chevrolet Citation

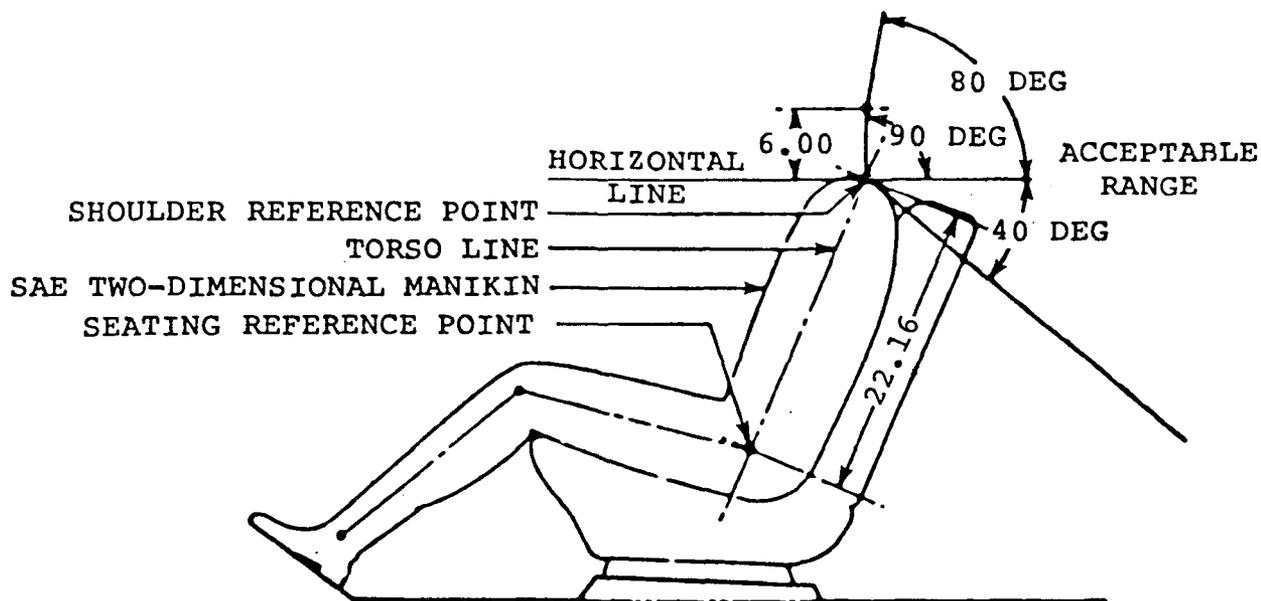
FMVSS 210 Requirements (assuming adjustable seats)	Modified Anchor (W seat in rearmost position)
I - Pelvic Portion.	
A - If belt does not bear upon the seat frame a line from a point 2.50 inches forward of and 0.375 inch above the seating reference point to the nearest contact point of the belt with the hardware attaching it to the anchorage for an adjustable seat in its rearmost position, shall extend forward from the anchorage at an angle with the horizontal of not less than 20° and not more than 75°.	Does belt bear upon the seat frame? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Angle measurement: <u>31</u> inches
B - If belt bears upon the seat frame the seat belt anchorage, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the belt frame shall extend forward from that contact point at an angle with the horizontal of not less than 20° and not more than 75°.	Is the anchor ^{NOT} aft of the rearmost contact point on the seat frame? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Angle measurement: <u>APPLICABLE</u> degrees
C - Anchorages for an individual seat belt assembly shall be located at least 6.50 inches apart laterally, measured between the vertical centerlines of the bolt holes.	Minimum lateral distance between vertical centerlines of the bolt holes: <u>8-1/4</u> inches

II - Upper Torso Portion.
 With the seat in its full rearward and downward position and the seat back in its most upright position, the seat belt anchorage for the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two dimensional manikin described in SAE Standard J826 (November 1962) whose "H" point is at the seating reference point and whose torso line is at the same angle from the vertical as the seat back.

Place seat full downward and full rearward and seatback in most upright position.

Angular measurement: 46 degrees
 Above X Below _____
 Horizontal

For the unmodified anchorage the angle was 47° above the horizontal



80 9501 1017 05

LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

APPENDIX A-4

Modified Seat Belt Anchor Locations as compared to FMVSS

210 requirements for 1980 Volkswagen Rabbit

FMVSS 210 Requirements
(assuming adjustable seats)

Modified Anchor
(W seat in rearmost position)

I - Pelvic Portion.

A - If belt does not bear upon the seat frame a line from a point 2.50 inches forward of and 0.375 inch above the seating reference point to the nearest contact point of the belt with the hardware attaching it to the anchorage for an adjustable seat in its rearmost position, shall extend forward from the anchorage at an angle with the horizontal of not less than 20° and not more than 75°.

Does belt bear upon the seat frame? Yes X No

Angle measurement: NA inches

A belt guide exists to guide the belt over the top of the seat. This ring was modified by attaching 3-1/2 in. loop to old ring.

B - If belt bears upon the seat frame the seat belt anchorage, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the belt frame shall extend forward from that contact point at an angle with the horizontal of not less than 20° and not more than 75°.

Is the anchor aft of the rearmost contact point on the seat frame? Yes X No

Angle measurement: 64 degrees

C - Anchorages for an individual seat belt assembly shall be located at least 6.50 inches apart laterally, measured between the vertical centerlines of the bolt holes.

Lateral distance between vertical centerlines of the bolt holes: 7.5 inches

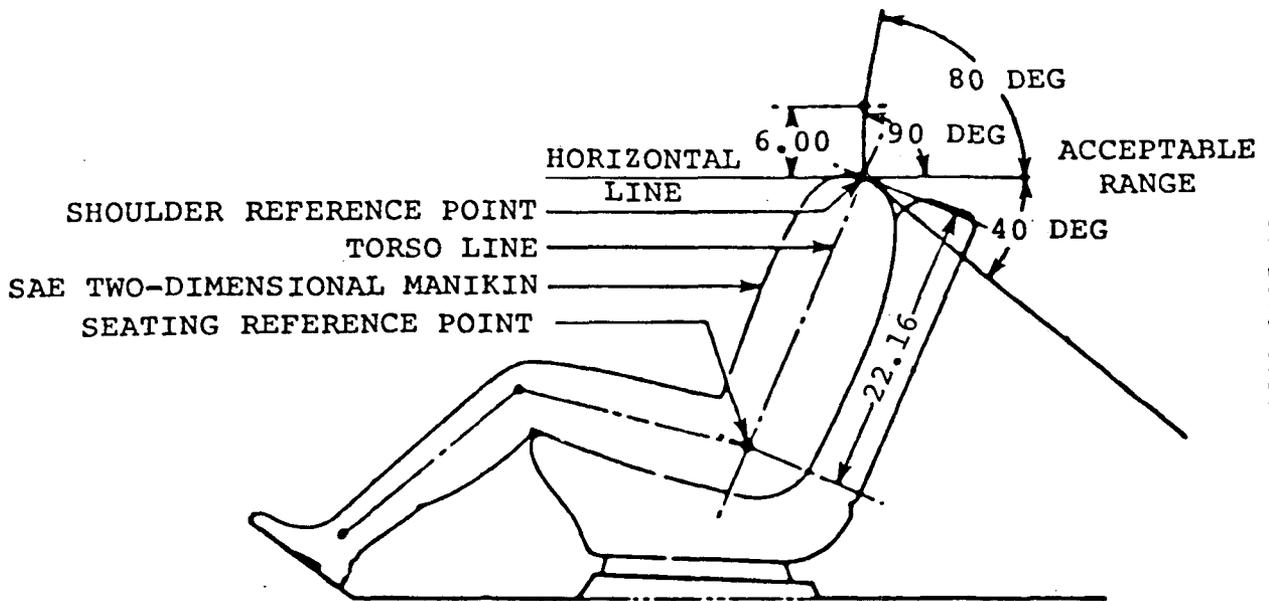
II - Upper Torso Portion.
 With the seat in its full rearward and downward position and the seat back in its most upright position, the seat belt anchorage for the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two dimensional manikin described in SAE Standard J826 (November 1962) whose "H" point is at the seating reference point and whose torso line is at the same angle from the vertical as the seat back.

Place seat full downward and full rearward and seatback in most upright position.

Angular measurement: 87 degrees
 Above X Below _____
 Horizontal

Belt D-ring is approximately 6 inches above shoulder reference point.

For the unmodified anchorage the angle was 72° above the horizontal



80 9501 1017 05

LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

APPENDIX B

TASK 1: PHOTOGRAPHS SHOWING BELT
POSITION AT THE CONCLUSION
OF EACH DUMMY PLACEMENT



FORD ECONOLINE 150 VAN
TEST 1 DUMMY A
TECHNICIAN: LEON



FORD ECONOLINE 150 VAN
TEST 2 DUMMY B
TECHNICIAN: LEON



FORD ECONOLINE 150 VAN
TEST 3 DUMMY A
TECHNICIAN: LEON

Photograph not available.

CHEVROLET C-10 PICK-UP
TEST 4 DUMMY B
TECHNICIAN: LEON



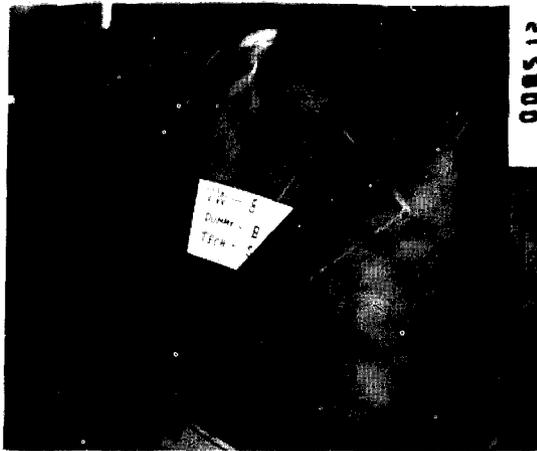
CHEVROLET CITATION
TEST 5 DUMMY A
TECHNICIAN: LEON



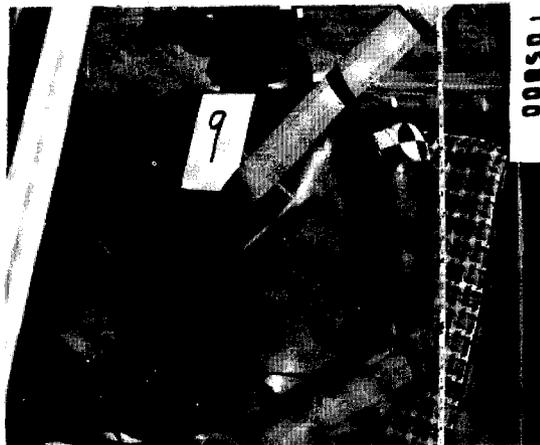
CHEVROLET CITATION
TEST 6 DUMMY B
TECHNICIAN: LEON



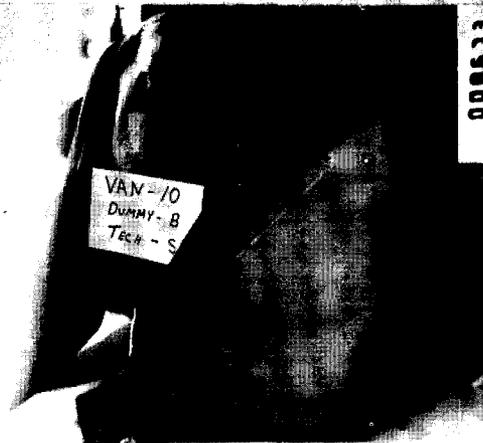
VW RABBIT
TEST 7 DUMMY A
TECHNICIAN: LEON



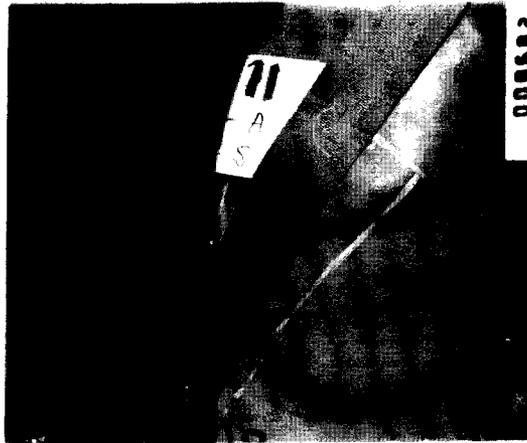
VW RABBIT
TEST 8 DUMMY B
TECHNICIAN: LEON



CHEVROLET C-10 PICK-UP
TEST 9 DUMMY A
TECHNICIAN: LEON



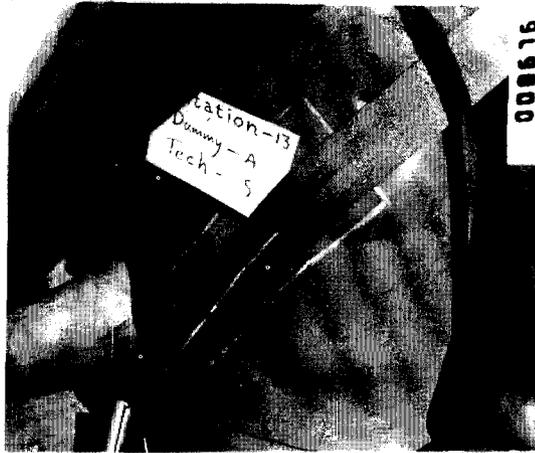
FORD ECONOLINE 150 VAN
TEST 10 DUMMY B
TECHNICIAN: LEON



CHEVROLET C-10 PICK-UP
TEST 11 DUMMY A
TECHNICIAN: LEON



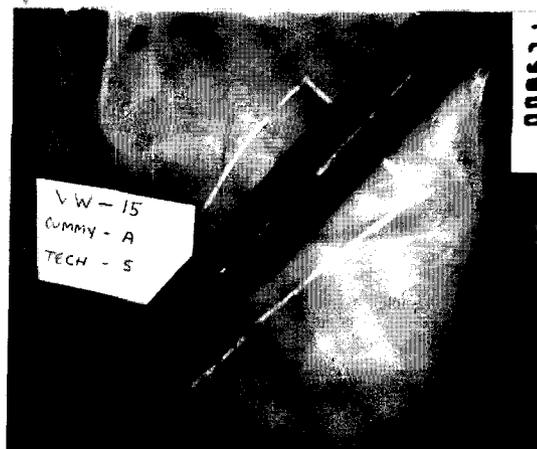
CHEVROLET C-10 PICK-UP
TEST 12 DUMMY B
TECHNICIAN: LEON



CHEVROLET CITATION
TEST 13 DUMMY A
TECHNICIAN: LEON



CHEVROLET CITATION
TEST 14 DUMMY B
TECHNICIAN: LEON



VW RABBIT
TEST 15 DUMMY A
TECHNICIAN: LEON



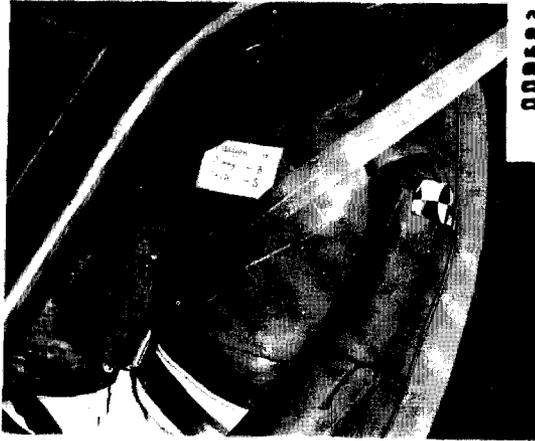
VW RABBIT
TEST 16 DUMMY B
TECHNICIAN: LEON



FORD ECONOLINE 150 VAN
TEST 17 DUMMY A
TECHNICIAN: LEON



CHEVROLET C-10 PICK-UP
TEST 18 DUMMY A
TECHNICIAN: LEON



CHEVROLET CITATION
TEST 19 DUMMY A
TECHNICIAN: LEON



VW RABBIT
TEST 20 DUMMY A
TECHNICIAN: LEON



FORD ECONOLINE 150 VAN
TEST 21 DUMMY A
TECHNICIAN: BERGY



FORD ECONOLINE 150 VAN
TEST 22 DUMMY B
TECHNICIAN: BERGY



CHEVROLET C-10 PICK-UP
TEST 23 DUMMY A
TECHNICIAN: BERGY



CHEVROLET C-10 PICK-UP
TEST 24 DUMMY B
TECHNICIAN: BERGY



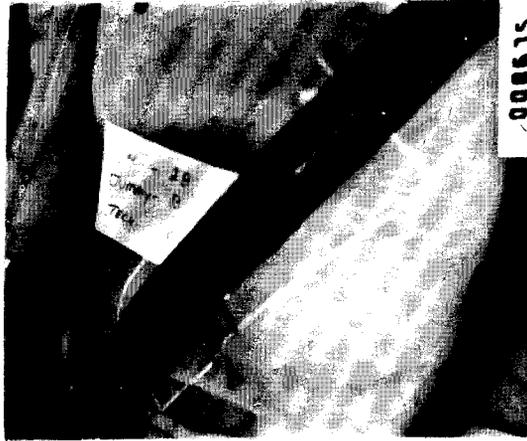
CHEVROLET CITATION
TEST 25 DUMMY A
TECHNICIAN: BERGY



CHEVROLET CITATION
TEST 26 DUMMY B
TECHNICIAN: BERGY



VW RABBIT
TEST 27 DUMMY A
TECHNICIAN: BERGY



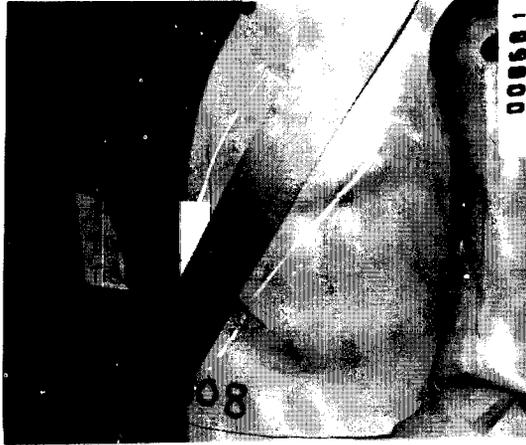
VW RABBIT
TEST 28 DUMMY B
TECHNICIAN: BERGY



FORD ECONOLINE 150 VAN
TEST 29 DUMMY A
TECHNICIAN: BERGY



FORD ECONOLINE 150 VAN
TEST 30 DUMMY B
TECHNICIAN: BERGY



CHEVROLET C-10 PICK-UP
TEST 31 DUMMY A
TECHNICIAN: BERGY



CHEVROLET C-10 PICK-UP
TEST 32 DUMMY B
TECHNICIAN: BERGY



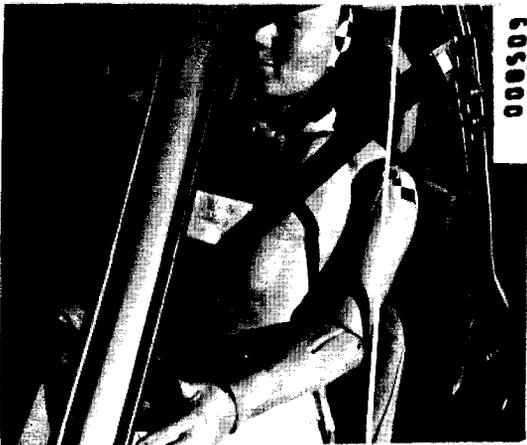
CHEVROLET CITATION
TEST 33 DUMMY A
TECHNICIAN: BERGY



CHEVROLET CITATION
TEST 34 DUMMY B
TECHNICIAN: BERGY



VW RABBIT
TEST 35 DUMMY A
TECHNICIAN: BERGY



VW RABBIT
TEST 36 DUMMY B
TECHNICIAN: BERGY



FORD ECONOLINE 150 VAN
TEST 37 DUMMY B
TECHNICIAN: BERGY



CHEVROLET C-10 PICK-UP
TEST 38 DUMMY B
TECHNICIAN: BERGY



CHEVROLET CITATION
TEST 39 DUMMY B
TECHNICIAN: BERGY



VW RABBIT
TEST 40 DUMMY B
TECHNICIAN: BERGY

APPENDIX C

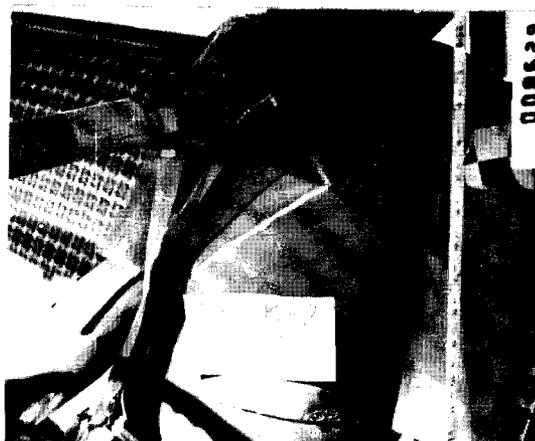
TASK 2: PHOTOGRAPHS SHOWING BELT
LOCATION ASSOCIATED WITH
VARIATIONS IN DUMMY
POSITION



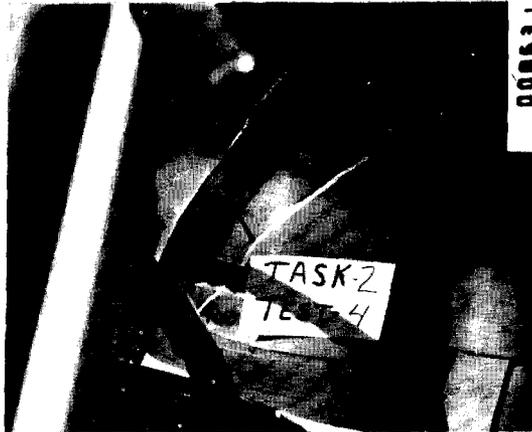
TEST 1 - BASELINE



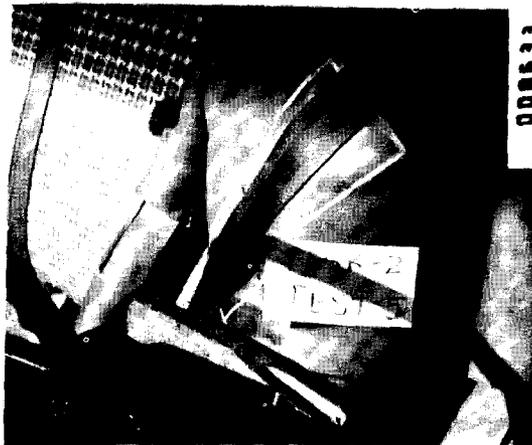
TEST 2 - UPWARD DEVIATION



TEST 3 - UPWARD AND REARWARD DEVIATION



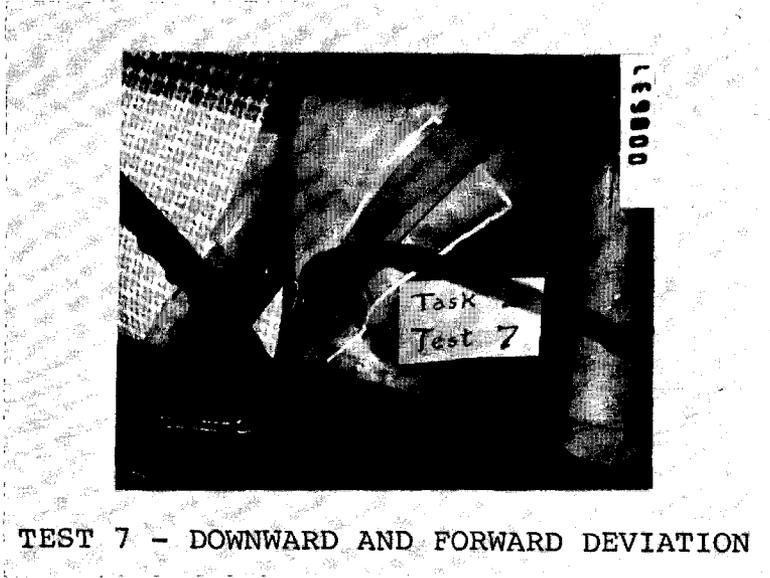
TEST 4 - UPWARD AND FORWARD DEVIATION



TEST 5 - FORWARD AND DOWNWARD DEVIATION



TEST 6 - DOWNWARD AND REARWARD DEVIATION



TEST 7 - DOWNWARD AND FORWARD DEVIATION