Dynamic Tests of Restraining Devices for Automobile Passengers

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MOST SEAT BELT standards in the United States specify a static test method—a slow application of test load. In actual accidents, however, the belts are subjected to very rapidly applied loads. Under such dynamic conditions belts may react differently than when the load is applied slowly, as indicated by Finch and Palmer in 1956 (*1*).

The application of dynamic test methods to automobile safety belts is not a new idea. Indeed, the type of seat belt used in American cars today was developed with the benefit of information generated by dynamic tests of restraining devices for aviation by Stapp (*2*, *3*) and for automobiles by Severy and associates (*4*). Severy and associates performed their studies by controlled collisions of actual automobiles, with the vehicles, the passengers (usually dummies), and the seat belts instrumented to determine the magnitudes and durations of the forces produced in actual accidents. Similar controlled collision studies, using automobiles, have been done by research engineers of automobile companies (*5*). In addition to these research activities, laboratory dynamic tests have been used for several years for certifying seat belts for public sale by the California Highway Patrol and by the Swedish Government. Another laboratory dynamic test device has been used for some years in automobile safety research at the University of Minnesota (*6*).

During 1962 an increased interest in dynamic tests of seat belts developed in both the United States and abroad. The British Standards Institution, the RAI–TNO in The Netherlands, and the Battelle Institute in Frankfurt, have built equipment for such tests, and the International Organization for Standardization is preparing a standard dynamic test method for the United Nations Economic Commission for Europe. In addition, several automobile and seat belt manufacturers in the United States and Europe have built dynamic test equipment during the past year. But dynamic testing is still not an accepted method in official or semi-official standards (*7*, *8*) in the United States, except in California.

Static Versus Dynamic Tests

Basically, dynamic testing is superior to static testing because in actual use seat belts are subjected to dynamic loading conditions. Large loads are applied in short time intervals to elastic structures which respond differently to short-interval loading than to slower loading (*9*). The mathematical physics of phenomena of this general type have been described else-

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This report was originally presented in part at the Sixth Stapp Car Crash and Field Demonstration Conference, November 1962, and in part at the 42d annual meeting of the Highway Research Board, National Academy of Sciences-National Research Council, January 1963 (Highway Research Record No. 4, 1963).

where (*10–12*), and there is no need for detailed discussion here. However, these treatises leave no doubt that qualitative and quantitative differences in effects exist between a transient impulse and a relatively slow application of force to an elastic system, and that consequently a dynamic test method should provide a closer simulation of actual use conditions than a static test.

Furthermore, the static test subjects all belts to the same load, but the dynamic test does not, even under exactly controlled test crash conditions. This is not a defect of the dynamic test method; rather, it indicates a weakness of the static method. The static method assumes that all belts, to be equally effective, must sustain equal loads. But in identical crashes involving equal speeds, equal stopping distances, and equal weights of wearers, different belts may be subjected to greatly different loads. This occurs when the elongation characteristics of the belts differ, so that the distances in which they stop the wearer differ, and therefore the g's developed and the loads on the belts are different. When the static test subjects the belts to a fixed load regardless of the degree of elongation, it is thus subjecting the belts to varying degrees of collision severity. The dynamic test, on the other hand, permits the elastic characteristics of the belt to influence the peak load developed, just as it does in an actual collision situation. The dynamic method therefore tests the belts for effectiveness under comparable severity-of-collision conditions, which is a more realistic criterion from the consumer's viewpoint.

The dynamic test also subjects the buckles to the kind of forces which may cause them to open and release the belt in an actual collision situation. This aspect of an actual collision is not reproduced in a static test.

Therefore, in theory at least, a dynamic test should be a more realistic measure of the value of a seat belt than a static test. But the question arises whether a particular laboratory dynamic test does simulate the dynamic force and time conditions of severe car collisions more closely than the static tests now in general use.

The Swedish dynamic test (see Technical Note, page 134), which attempts to simulate a severe type of crash condition, has been criticized as being possibly too severe because of the short stopping distance of its cart. (A lead cone at the front of the cart causes it to stop in about 3 inches from impact speeds of up to 25 mph.) Instrumented tests with the Swedish method are presented here for comparison with controlled car collisions.

Fortunately, data from controlled studies are available on the magnitudes and durations of

Table 1. Forces generated in controlled car crashes, using lap belts, Ford Motor Company and University of California, Los Angeles

Collision type	Impact speed [1] (mph)	Dummy decelerations		Belt loadings	
		Peak (g's)	Durations [2] (ms)	Peak (lb)	Durations [2] (ms)
Head-on (U.C.L.A.)	21	44	55	7, 000	60
	21	40	60	5, 000	60
	21	30	90	------	------
	21	34	60	4, 500	65
	27	48	90	7, 500	45
	27	38	80	5, 000	80
	47	55	95	9, 000	130
	52	72	90	9, 000	135
	52	73	95	15, 000	150
Fixed barrier (Ford)	27	------	------	5, 700	75
	29	------	------	5, 800	65

[1] Speed of each car at impact, U.C.L.A. studies. [2] Durations in milliseconds are for 5 g and over and durations of loading are for 1,000 pounds and over, because in many cases the end points were indefinite.

NOTE: In the U.C.L.A. studies 3-inch nylon webbing belts were used (*13*); in the Ford studies conventional 2-inch webbing belts were used (*5*).

Table 2. Forces generated in Swedish dynamic tests, using lap belts and rigid dummy

Impact speed (mph)	Dummy deceleration		Belt loading	
	Peak (g's)	Duration[1] (ms)	Peak (lb)	Duration[1] (ms)
21	32	60	5, 400	52
21	25	47	5, 400	50
21	35	50	6, 600	50
21	27	63	5, 700	63
15	22	45	3, 800	42
15	23	43	4, 000	49
15	30	40	5, 200	42
15	------	------	5, 300	50
15	20	45	4, 400	58
15	29	43	5, 400	44

[1] Durations in milliseconds are for 5 g and over and durations of loading are for 1,000 pounds and over, because in many cases the end points were indefinite.

forces generated in automobile collisions. Data on dummy deceleration and lap-belt loading from controlled car crashes at the Ford Motor Company (*5*) and at the Institute for Transportation and Traffic Engineering of the University of California, Los Angeles (*13*), are shown in table 1. The data represent severe fixed-barrier and head-on collisions.

Before making the comparisons, it must be noted that the two sets of data on controlled car collisions in table 1 are themselves not strictly comparable. The U.C.L.A. data included both belt loads and dummy decelerations, but the seat belts used in their tests were 3 inches wide instead of the conventional 2 inches. On the other hand, the Ford tests used belts of conventional width, but provided only belt load data; no dummy decelerations were reported. Comparison of the U.C.L.A. and Ford belt load data indicates that the U.C.L.A. tests at 21 mph impact speed produced roughly the same forces as the Ford tests at 27 to 29 mph.

The results of instrumented runs, using conventional lap belts, made with the Swedish test rig during the summer of 1962 are shown in table 2. Comparison of the data in tables 1 and 2 shows that the dummy decelerations and the belt loadings generated in the 21 mph Swedish test and their durations were of the same order of magnitude as those observed in the U.C.L.A. and Ford controlled car collisions at 21 to 29 mph impact speeds. In fact, the ranges of the Swedish test data overlap the ranges found in the controlled car collisions in all the factors involved. The shapes of the curves of force and load versus time are also very similar.

These comparisons as well as the graphs of the instrument data demonstrate that the Swedish cart's short stopping distance (and its consequently high deceleration) do not control the deceleration of the dummy or the load on the belt. The major part of stopping the dummy occurs after the cart is completely stopped (*9*). This is typical of head-on collisions and collisions with fixed objects (*5*, *13*). The major factors which control the dummy deceleration and the belt load are the impact velocity, the weight of the dummy, and the elongation characteristics of the seat belt itself. It is therefore not surprising that the Swedish test method generates forces of the same magnitude and duration as those of actual collisions.

The reproducibility of the impact speed has been studied by the Swedish National Institute for Materials Testing, using microswitches along the track. The variations have been found to be within ± 0.3 mph at 25 mph, so that the variation in kinetic energy does not exceed ± 2.5 percent.

In testing seat belts, however, the dummy decelerations and the belt loadings are the points of primary concern. A summary of dummy decelerations and belt loadings for various test conditions, impact speeds of 15 and 21 mph using lap belts and a rigid dummy and impact speeds of 21 and 25 mph using harnesses and a jointed dummy, are shown in table 3. (The term "harness," as used in this report, designates any seat belt which restrains the upper torso, whether or not it also has a lap strap. The term therefore includes diagonal chest straps, combinations of lap strap and diagonal chest strap, and combinations of lap strap and double shoulder straps. The jointed dummy used by the Swedish laboratory for testing harnesses was found unsuitable for testing lap straps. The rigid dummy was made for testing only lap straps. The accelerometer was located on the lap of the rigid dummy and in the chest of the jointed dummy.)

In addition to the average peak values, the ranges of the dummy decelerations and the belt loadings in each case are also presented in table 3. There was considerable overlapping of ranges among the various test conditions. However, when differences among the belts themselves are considered (table 4), much of this overlapping is eliminated. Moreover, some of the effects of differences in design of the belts become apparent.

Webbing Elongations

The averages and ranges of dummy decelerations and belt loadings for various test conditions are shown in table 4 in separate groups on the basis of known differences in webbing elongation. The "high-elongation" webbings were those ranging from 21 to 29 percent elongation and the "low-elongation" webbings were those ranging from 14 to 15 percent (by the Society of Automotive Engineers test method).

Ranges within groups have not been entirely eliminated, however, because as stated earlier the characteristics of the belts themselves influence the deceleration of the dummy and the loads on the belt, and the belts within each group were not completely alike. Variations of webbing elongation existed within each group, and, among the harnesses, the geometric configurations of the harnesses themselves varied; for example, some had the chest strap anchored to the doorpost, others to the floor. The 25 mph runs are not separated into elongation groups because only high-elongation webbings were used in these runs. The comparisons are not complete because of still another factor—the three low-elongation lap belts tested at 21 mph broke when they reached the peaks noted. Had they not broken, the 21 mph peaks may have been higher, and overlapping may have been completely absent as it was in the 15 mph tests in which no breakage occurred.

Despite the qualifications described above, the distinctions between the high- and low-elongation groups were sufficiently consistent to demonstrate that differences in webbing elongation produce substantial differences in effects. In impacts of equal severity (equal impact velocity and equal vehicle stopping distance), the low-elongation webbing produced decelera-

Table 3. Average forces and durations, using lap belts with rigid dummy and harnesses with jointed dummy, Swedish dynamic tests

Impact speed (mph)	Number of runs	Dummy decelerations (peak g's)		Belt loads (peak pounds)		Average duration [1] (milliseconds)	
		Average	Range	Average	Range	Deceleration	Loads
Lap belts [2]							
15	6	25	20–30	4, 700	3, 900–5, 400	43	48
21	9	30	25–35	6, 100	4, 700–7, 500	55	54
Harnesses [3]							
21	8	62	35–82	6, 000	4, 000–8, 100	50	60
25	7	88	40–112	7, 800	6, 300–11, 000	51	58

[1] Durations in milliseconds are for 5 g and over and durations of loading are for 1,000 pounds and over, because in many cases the end points were indefinite.
[2] Accelerometer on lap of rigid dummy.
[3] Accelerometer in chest of jointed dummy.

tion peaks and belt load peaks averaging about one-third higher than the high-elongation webbing. One of the consequences we observed was that lap belts with stronger low-elongation webbings in static tests (7,200 pounds as against 6,800 pounds) broke in the dynamic tests at 21 mph, while the lower-strength high-elongation belts did not break.

That low-elongation webbings place more load on the body being restrained than high-elongation webbings is a point that should be considered from the medical point of view in designing seat belts.

Locations of Third Anchor

Test results on harnesses, grouped by location of the chest-strap anchor (either shoulder-high on doorpost or on the car floor behind the seat), are presented in table 5. These data indicate that the location of the third anchor affects the dummy deceleration and its rate of onset, the belt load, and the durations of the forces. Perhaps the most significant of these differences is that the floor-anchored chest straps produced the highest peak decelerations of the upper torso, and yet required more time to stop the dummy than those anchored shoulder-high to the doorpost. The significance of these apparently contradictory effects of anchor location is revealed by the high-speed photography studies described later.

A complete tabulation of the pertinent test data obtained in 30 runs is given in table 7 in the Highway Research Record No. 4, 1963 (Highway Research Board of the National Academy of Sciences-National Research Council). A view of the apparatus used is shown in

Table 4. Effects of webbing elongation, using lap belts with rigid dummy and harnesses with jointed dummy, Swedish dynamic tests

Impact speed (mph)	Dummy decelerations (peak g's)				Belt loads (peak pounds)				Average durations [1] (milliseconds)			
	High elongation		Low elongation		High elongation		Low elongation		Decelerations		Loads	
	Average	Range	Average	Range	Average	Range	Average	Range	High	Low	High	Low
Lap belts [2]												
15	22	20–23	29	29–30	4, 100	3, 900–4, 400	5, 300	5, 200–5, 400	45	42	50	45
21	30	25–35	-----	[3]	5, 800	5, 400–6, 600	-------	[4]	55	[5]	54	[5]
Harnesses [6]												
21	55	40–70	78	72–82	5, 500	4, 000–7, 300	6, 800	5, 600–8, 100	50	53	65	58

[1] Durations in milliseconds are for 5 g and over and durations of loading are for 1,000 pounds and over, because in many cases the end points were indefinite.
[2] Accelerometer on lap of rigid dummy. [3] Broke at 30–35. [4] Broke at 6,200–7,500. [5] Broke.
[6] Accelerometer in chest of jointed dummy.

Table 5. Results of tests on harnesses, by location of chest-strap anchor

Impact speed (mph)	Dummy decelerations (peak g's)		Belt loads (peak pounds)		Average durations (milliseconds)			
					Decelerations		Loads	
	Doorpost anchor	Floor anchor	Doorpost anchor	Floor anchor	Door	Floor	Door	Floor
21	59	64	7, 000	5, 400	32	61	48	67
25	72	100	8, 800	7, 000	37	61	48	66

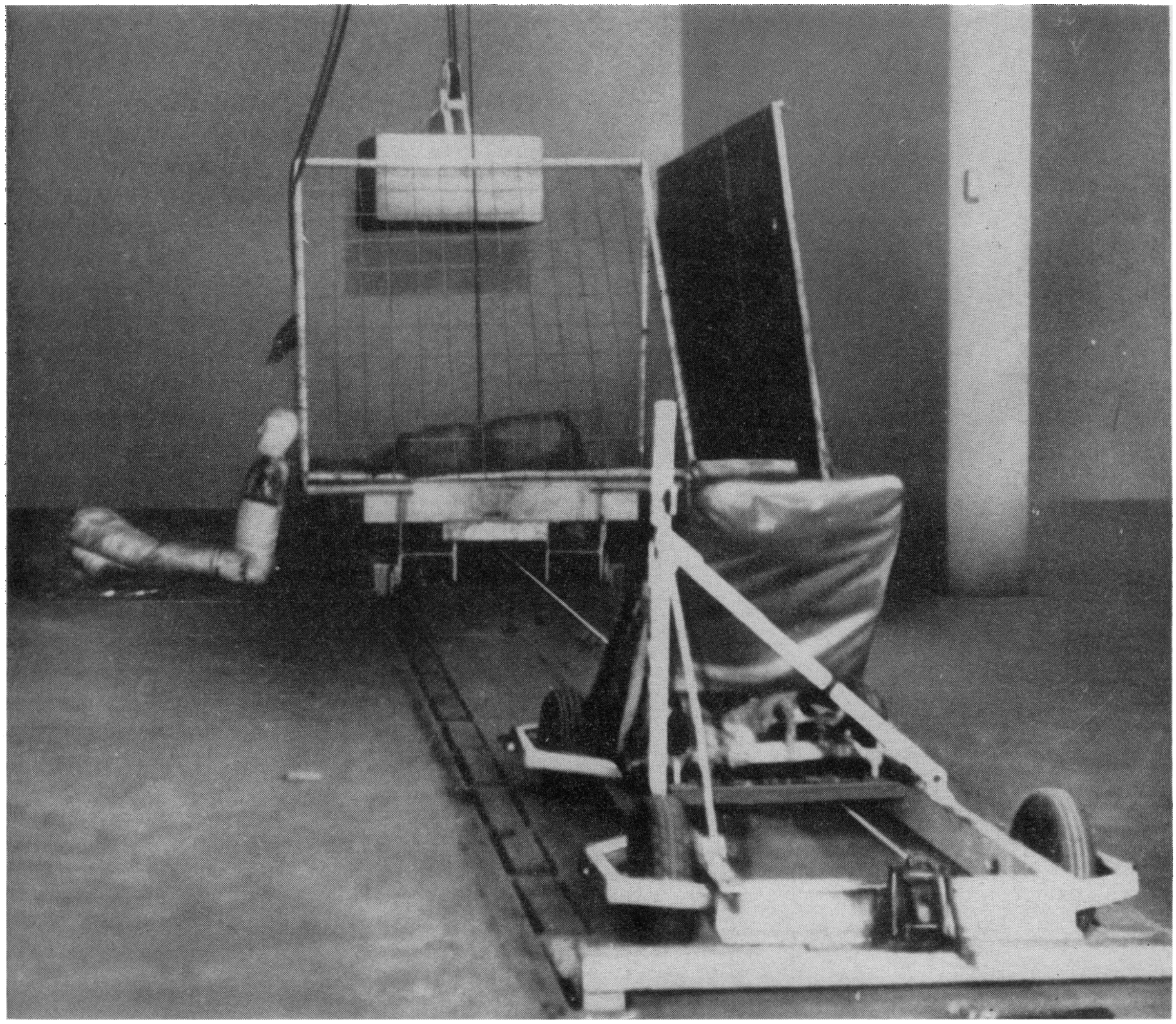


Figure 1. Swedish dynamic test equipment, looking down track toward the barrier. The jointed dummy is shown on the left

figure 1, and several examples of instrument data are shown in figures 2–5.

Restraining Characteristics of Harnesses

The data presented above pertained to decelerations of the belt wearer and loads on the belts themselves. But such instrumented runs supply no direct information on how well a particular belt limits the body's forward motion, that is, on how well it restrains the wearer. Restraining the upper torso, to minimize head and chest injuries, is considered particularly important in automobile accidents.

The proved virtue of the lap strap is its ability to minimize the incidence of ejection and the concomitant incidence of fatal injury (*9*), but lap straps do not always prevent their wearers from jacknifing and striking dashboards, windshields, or steering wheels, The occurrence of head and chest injuries clearly indicates that the lap strap is not always effective in controlling injuries to the upper half of the body, and that upper torso restraint, in addition to the lap strap, is highly desirable.

The possible benefits of harnesses are twofold: (*a*) reduction of head, neck, and chest injuries normally resulting from contact with steering wheel, instrument panel, windshield, and other interior components; and (*b*) decreased hazard of injuries from the belts

Figures 2–5. Plots of instrument data obtained in four typical runs: jointed dummy with combination lap and chest strap, impact speeds of 21 mph

Figure 2. Third anchor on doorpost, 21 percent elongation webbing

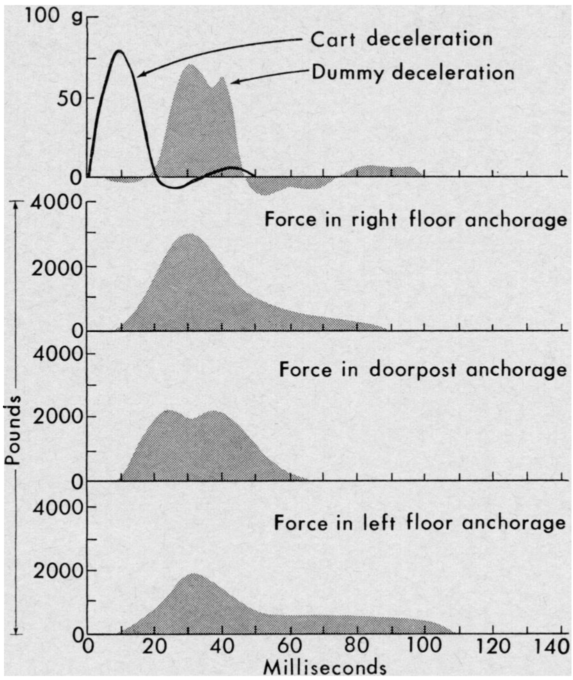


Figure 3. Third anchor on doorpost, 14 percent elongation webbing

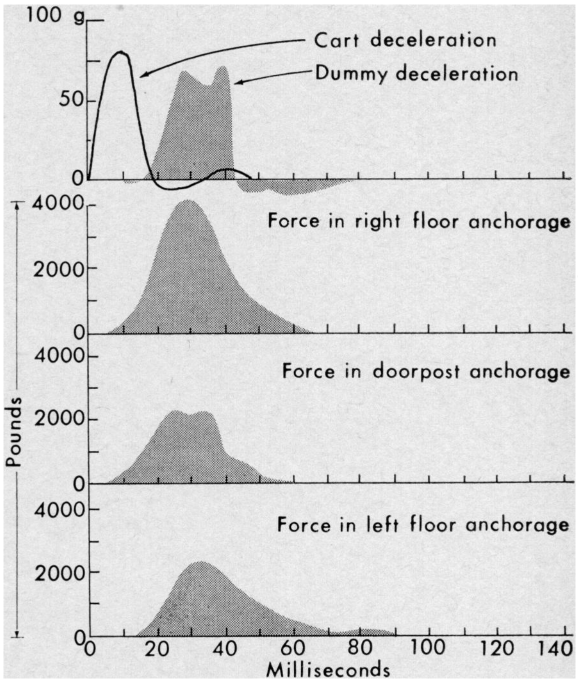


Figure 4. Third anchor on floor

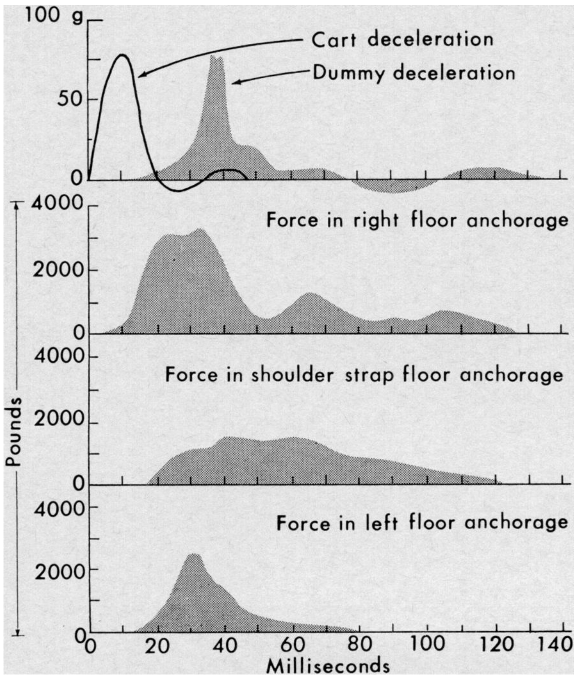
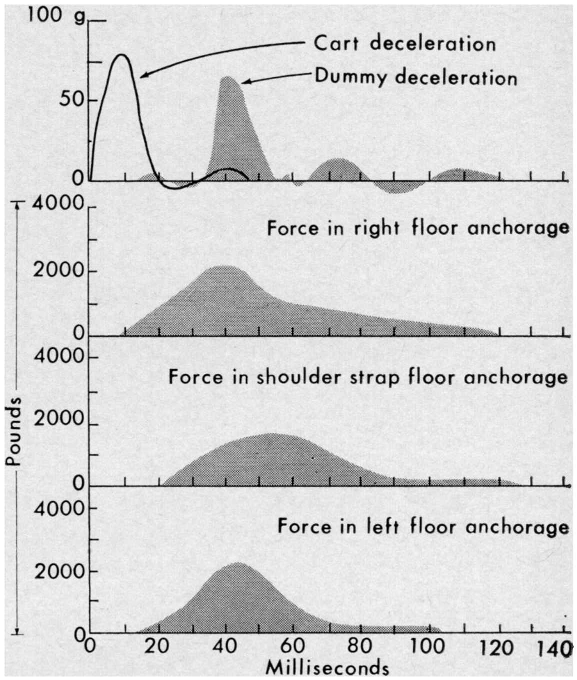


Figure 5. Third anchor on floor



themselves, particularly when worn by the very young and the very old, by distributing crash loads over the strong bony structures of both the pelvic girdle and the shoulder girdle.

The kinematics of the body restrained by the standard lap belt is well known (*13, 14*), but harnesses are not yet standardized in design, and the kinematics of the various available types are not well known.

The Swedish dynamic test method was used to observe, by high-speed photography, the degree of restraint of parts of the body by belts of various geometric configurations. The study was performed in the summer of 1962 on nine models of harnesses then available in the United States (*15*). This study revealed, among other things, that with diagonal chest straps alone the wearer may slide out from under the belt or suffer severe internal injuries, and that combination belts with shoulder-high anchors for the chest strap limit the forward motion of the upper torso to about half that permitted by floor-anchored chest straps.

The major types of harness design studied were:

1. A diagonal chest strap, with one anchor in the doorpost (or sidewall) at about shoulder height and the other on the floor.

2. A combination of lap strap and diagonal chest strap, with all anchors (two or three) on the floor.

3. A combination of lap strap and two shoulder straps with three anchors on the floor, two for the lap strap and the third for the shoulder straps.

4. A combination of lap strap and diagonal chest strap, with two anchors on the floor for the lap strap and the third anchor in the doorpost at shoulder height for the chest strap.

For testing the harnesses the jointed dummy was used at three impact speeds: 18, 21, and 25 mph.

Because the two major purposes of the tests were the determination of the relative effectiveness of the various harnesses in limiting body movement and possible hazardous side effects, high-speed photography of approximately 1,200 frames per second was used to observe the dummy's kinematics. A background blackboard marked with uniform spacings was used to measure the distances traveled by the dummy's head and chest after the impact. (At the instant the car stopped, the dummy's forehead was at the fourth line from the left, and the front of his chest was at the fifth line from the left.) The maximum forward motions permitted by the various combination lap and chest straps tested are shown in table 6.

Test Results

Combination lap strap and diagonal chest strap, floor-anchored. All four models tested restrained both upper and lower torso. The high-speed films of the crash test runs at 21 mph impact speed showed the hips advancing

Table 6. Maximum forward motion of head and chest obtained with various harnesses

Model No.	Harness type: lap strap plus—	Location of third anchor	Maximum forward motion (inches)					
			18 mph		21 mph		25 mph	
			Chest	Head	Chest	Head	Chest	Head
1	Diagonal chest strap	Doorpost			6	11		
2	do	do	8	15				
3	do	Floor	11	22				
4	do	do			13	26		
5	do	do			14	27		
6	do	do			14	23	14	23
7	Two shoulder straps	do			11	22	16	30
8	do	do	12	24				

NOTE: Averages of 18 and 21 mph data: doorpost-anchored models—chest 7 inches, head 13 inches; floor-anchored models—chest 12.5 inches, head 24 inches. Average forward motion obtained with doorpost-anchored models was 55 percent of that obtained with floor-anchored models.

Figure 6. Limit of forward motion in 21 mph impact, using a combination lap and chest strap, floor-anchored

only slightly, the chest advancing to a maximum of about 13 inches, and the head advancing about 24 inches (fig. 6). These movements may be tolerable only in cars having large passenger compartments. In smaller compartments, a large part of the kinetic energy may be absorbed before striking occurs. Interestingly, the greater forward motion permitted by floor-anchored chest straps correlates well with the longer stopping time observed in the instrumented tests.

As to the floor-anchored, lap-shoulder strap combination as an injury preventing device, there was some indication of undesirable side effects as well as some question of its efficacy in limiting forward motion. The high-speed films showed that the shoulder strap did not restrain the upper torso significantly until the dummy had leaned somewhat forward, so that the restraining action started late but suddenly. A jolt was thereby transmitted to the top of the shoulders, in a direction parallel to the long axis of the spine. Such kinematics suggest the possibility of fractured clavicles and compression fractures of the spine. The test data revealed that pressures possibly as high as 3,700 pounds may have been applied downward on the shoulders, practically parallel to the spine, at the 25 mph impact speed, and 2,400 pounds at 21 mph. In evaluating this side effect, it is necessary to consider whether the possible reductions in serious or fatal injuries by the use of this type of belt might outweigh the possible increases in nonfatal fractures of the clavicle and spine. Physicians with whom we have discussed this matter suggested that such injuries, which are almost always nonfatal, might be an acceptable alternative to the frequent fractured skulls, crushed chests, or even facial disfigurements which could occur if no chest restraint were used.

Combination lap strap and two shoulder straps, floor anchored. The two models of these harnesses tested showed about the same degree of effectiveness as the floor-anchored combination lap strap and diagonal chest strap and the same kind of hazard. This type of harness appeared to offer no advantage over the previous type, and it is generally more inconvenient to don.

Combination lap strap and diagonal chest strap, doorpost anchored. Tests on two models of this general design revealed much more effective control of forward motion than the floor-anchored harnesses. The doorpost-anchored models permitted only about half as much forward motion as the floor-anchored models, though one doorpost-anchored model was somewhat better than the other (fig. 7). For the doorpost-anchored models, the forward movement of the chest averaged 7 inches and the head 13 inches. Significantly, the films revealed no indications of appreciable downward force exerted on the shoulders. The elimination of

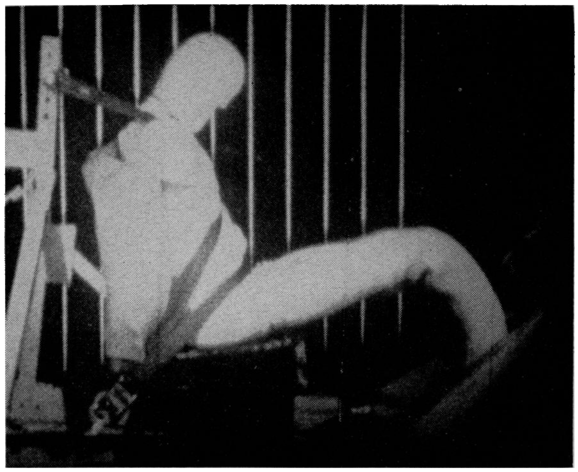


Figure 7. Limit of forward motion in 21 mph impact, using a combination lap and shoulder strap, door-anchored

this problem is clearly attributable to the anchoring of the chest strap at shoulder height.

Diagonal chest strap. Two tests of a diagonal chest strap indicated that this type of seat belt, with no lap strap adjunct, can be inadequate and can produce severe side effects. In both of these tests the strap failed to stay on the hip; the lower torso slid forward practically unrestrained. In one test the strap pulled deeply into the dummy's abdominal section; in the other, the dummy slid completely out from under the belt (fig. 8).

High-speed film observations have demonstrated localization of loads on weak parts of the body rather than distribution of loads over strong parts, contraindicating use of the diagonal chest strap alone (*16*, *17*).

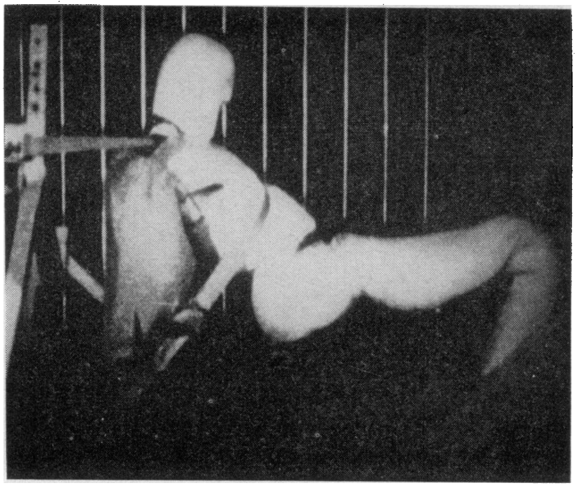


Figure 8. With diagonal chest strap alone (dummy slipped entirely out of harness a few milliseconds later)

Summary and Conclusions

Instrumented tests of seat belts by the Swedish dynamic test method have shown that (*a*) such equipment can produce the same deceleration of the belt wearer and the same loads on the belts as those observed in controlled car crashes of a moderately severe nature, (*b*) the characteristics of the belt itself exert a major influence on the deceleration rate of the wearer and on the magnitude and duration of the load on the belt, and (*c*) that belts made of webbings found to be equally strong by the standard static test are not necessarily equally resistant to the forces developed in impact conditions of equal severity.

The tests also demonstrated that the laboratory dynamic test produces information on the restraining characteristics of belts of different geometric configurations and of various materials, which can aid in the evaluation and development of improved safety belts.

The specific effects of different webbing elongations and of third-anchor locations (for combination lap and chest strap belts) were also demonstrated. The significant differences in protective capacity observed among the types of harnesses tested indicated that the door-anchored combination lap and diagonal chest strap harness is the most desirable configuration.

Use of floor-anchored shoulder straps may result in application of loads capable of fracturing the clavicle and spine. Use of the diagonal chest strap alone demonstrated localization of loads on weak parts of the body rather than distribution of loads over strong parts. Also, with the diagonal chest strap alone, the wearer may slip completely out from under it, as it tended to slip off the hips.

The tests clearly indicated that considerably more exploration of the performance of seat belts by dynamic methods would be profitable, particularly in the evaluation of current models and in the development of better designs and materials. While static testing may be useful in control of manufacturing quality of established designs of seat belts, it would be desirable to subject new designs and new materials to dynamic tests before they are offered to the public.

TECHNICAL NOTE

Apparatus

The apparatus used in these tests is located in Stockholm, Sweden, at the Statens Provningsanstalt (National Institute for Materials Testing). An overall view is shown in figure 1. The falling weight is at top center, behind the fixed barrier and the net to catch the dummy if the belt should break. The cart is held at the starting point by a quick-release mechanism fixed in the floor.

The cart is constructed of steel beams, and the bucket seat is rigidly fixed on the frame. A falling weight connected to the cart by a cable provides acceleration. The pulley system has a mechanical advantage of 2, and the net acceleration imparted to the cart is 0.9 g. When the acceleration is applied for a distance of 23 feet, a speed of 25 mph is achieved; lower speeds are obtained by appropriately shortening the run. The cart reaches the desired speed 5 feet before impact and runs free to impact.

To absorb the energy at impact, a lead cone (90 mm. long, with diameters of 40 mm. and 50 mm. at the ends) is fastened to the front of the cart.

The cart frame has suitable crossmembers behind the seat to accommodate any kind of floor anchor, and a braced vertical post to accommodate shoulder-high anchors.

Dummies

A 154-pound jointed dummy, approximately 5 feet 8 inches long, is used for testing harnesses. Its head, chest, pelvic section, and parts of its legs are wooden. Heavy sponge-rubber blocks separate the hips and chest and parts of the legs. Chains and springs through the centers of the various parts hold them together. Thus the neck, midsection, thighs, and legs are flexible. The head weighs 10.6 pounds; breast, 36.3 pounds; abdominal section, 17 pounds; pelvic section, 51.7 pounds; and the legs, including thighs, 38.5 pounds.

A 150-pound rigid dummy, constructed of wood and steel channel, is used for testing lap belts. Consisting of only a torso and thighs, the dummy is in a sitting position. Its hip section, on which the lap belt rests, is shaped like the body blocks used in the tests of the Society of Automotive Engineers, General Services Administration, and the University of California at Los Angeles. The lap is covered with a layer of sponge rubber, which in turn is covered with cloth.

Instrumentation

Instruments consisted of an accelerometer and three load cells mounted directly on specially constructed ladder brackets through which the webbings were threaded for attachment to the anchors. Two dual beam oscilloscopes, with Polaroid cameras, were used to record the instrument data. (*Accelerometer:* Statham model KPF 402; range ±200 g; output linear up to 750 cps; used in conjunction with low-pass filters, 370 cps with rigid dummy and 530 cps with jointed dummy. *Load cells:* Bonded strain gauges, Philips 9812, mounted on heavy ladder brackets, and calibrated thereon; range 4,400 pounds. *Oscilloscopes:* Tektronix type 502, dual beam; range 0 kc. to 100 kc.)

Plots of the instrument data obtained in four typical runs are shown in figures 2–5. (Although the cart deceleration curves shown were not determined in this study, they are typical curves obtained in a separate study by Dr. Aldman. These typical curves were inserted here only to show the order of magnitude of the cart deceleration and the time relationship between the deceleration of the cart and the dummy.)

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Program Notes

Smallpox Drug

A new drug to control smallpox has been successfully tested in Madras, India. Between February and July 1, 1963, 1,100 persons who had been in close contact with the infection were given n-methylisatin betathiosemicarbazone (B.W. 33–T–57). Only three mild cases of smallpox occurred among them, and in two of these the full dosage had not been taken. In a similar number of exposed persons who did not receive the drug, although most had been vaccinated, there were 76 cases of smallpox, 12 fatal. (*Lancet*, September 1963.)

Hearing Tests for Infants

After conducting a class to teach volunteers how to test the hearing of infants 8- to 14-months old, in November 1963 the Baltimore City Health Department began offering the service for infants at well-baby clinics.

The tests, recently developed in England, check the baby's response to familiar sounds, such as rattles, the rustle of paper, musical tones, and voices.

Preventive Medicine Institute

The New York State Health Department and Albany Medical College recently established an Institute of Preventive Medicine to promote closer association between their professional staffs. Dr. Victor N. Tompkins, assistant commissioner for the health department, serves as director.

Tuberculosis Rate in Aged

In a 10 percent random sample of board and care homes for the aged, the Tuberculosis and Health Association of Los Angeles County found seven cases of active tuberculosis (one in a proprietor) among the 1,989 persons given chest X-rays. In addition, two cases were diagnosed among those not X-rayed. The rate was 3.3 per 1,000, seven times the community rate.

The report, "Tuberculosis in Homes for the Physically-well Aged in Los Angeles County" by Anne Kaplan and Duane O. Crummett, was published in June 1963 by the Tuberculosis and Health Association of Los Angeles County, 1670 Beverly Boulevard, Los Angeles, Calif.

Treating Mental Retardation

The child development clinic of Los Angeles Children's Hospital found, in a 9-year study of 143 children retarded before the age of 1 year, that 24 percent were not retarded a few years later. Dr. Richard Koch, the director, attributes the children's improvement to correction of physical handicaps; parental understanding and affection, combined with care at home; association wth normal children in their own family and in their neighborhood; and participation in retarded children's training programs sponsored by local parents groups.

Home Care of the Ill

Recent North Carolina legislation permits county health departments, providing the chronically ill with public health nursing and physical therapy in their homes, to collect fees from those able to pay or from agencies authorized to pay.

Nursing in Nursing Homes

A report of care in nursing homes, carried out by the Milwaukee (Wis.) Health Department with Public Health Service support, urges accelerated programs to improve services.

The study determined the amount of time used by personnel in providing nursing service to a random sample of 114 ambulatory and nonambulatory patients in 14 selected nursing homes in Milwaukee. Ambulatory patients were shortchanged of care because of the more pressing needs of the nonambulatory. Also, almost all nursing time was devoted to physical needs, little to emotional and mental health requirements.

In 9 of the 14 homes studied, personnel with little or no training provided most of the nursing on the night shift. In 5 of the 9 homes, nurse aides or home assistants provided both supervision and "nursing" care. Patients were quartered apparently with little attention to interests, potentials, or capabilities.

S. Gertrude Mulaney, public health nursing superintendent of Milwaukee, recommends cooperative development by health and welfare personnel and nursing home operators of a flexible master staffing guide for nursing homes, a registered nurse on all shifts every day, upgrading of minimum educational requirements for employees, and more rigorous classification of patients.

"America Challenges Medicine"

Copies of "America Challenges Medicine," by Dr. Michael M. Davis, a lecture given at Billings Hospital, University of Chicago, on May 23, 1963, are available to persons engaged in teaching medicine, hospital administration, nursing, or welfare. For copies, free of charge in reasonable quantities or available at 10 cents each for extra large amounts, address: Dean, Graduate School of Business, University of Chicago, Chicago, Ill.

Guidebook for the Handicapped

The "Greater Cincinnati Guidebook for the Handicapped," compiled by the local Junior League and the Public Health Federation, aims to alert persons with physical limitations to the facilities and obstacles they may encounter in 281 major local buildings. Another purpose of the publication is to impress architects and builders with the need to adapt public structures to patrons with heart disease, arthritis, or worse disabilities.

Medicine Cabinet Safety

To rid medicine cabinets of outdated drugs, 16 Baltimore pharmacies give 25-cent gift certificates for every prescription bottle over 3 months old.