SECTION TWO

PART 6

A STATISTICAL TRAFFIC ACCIDENT ANALYSIS

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INTRODUCTION AND ABSTRACT

This statistical analysis is based on accident data of Volvo vehicles during an approximate 12-month period completed in Sweden in 1972. The data collected in the Volvo Traffic Accident Research Project consists of comprehensive information about the accident and traffic environment, vehicle data, the occupants and the injuries sustained.

The analysis focuses on the value of various restraint items, such as safety belts, including retractor belts and head restraints. In this respect, the analysis is a follow-up of the Volvo investigation in 1967 involving more than 28,000 accidents (1).

The analysis further includes an evaluation of the material, in general, and the total accident cases, particularly in view of applicable requirements of the VESC specifications. The basic statistical calculations and estimations were made by Lars Westerlund, Chalmers University of Technology, Gothenburg.

METHOD OF DATA COLLECTION

The collection of data was made in close cooperation with Volvo dealers in Sweden and in connection with the Volvo PVG "Five-Year-Guarantee." This guarantee means, briefly, that each delivered Volvo car is insured by the company against damage, in case of an accident, during the first five years after delivery. The accident investigation and the applicable data collection were initiated when a damaged vehicle, under guarantee, was brought to the dealer for repairs. The conditions were, therefore, those which were present in the previous study (1).

The gathering of all case data, except occupant-injury data, was taken care of by special data-collectors who were situated at the dealers concerned. The data-collectors, who were employees of the Volvo company, were trained in filling out the questionnaire and interviewing the customer, in taking the required measurements of the vehicle and producing photo documentation.

The questionnaire used was prepared especially for the study and consisted of two parts (see Appendixes). The first part was a six-page information section dealing with the following groups of data:

	No. of questions
• road description and traffic situation	18
• accident type information	8
• vehicle data	54
• occupant data	13
• weather and visibility	7
• time of day identification	4

The second part, was referenced to the hospital or doctor, to whom the possibly injured occupants were brought, and included slides of the vehicle. The completed forms were then sent to the Volvo Traffic Accident Research Group. While the first part of the form was forwarded directly to the Data Computer Department for punching, the reference part was subjected to careful analysis and evaluation by a skilled accident-investigation team. The medical expert on the team requested detailed information about the injured occupant from the hospital, and the technical researcher evaluated the slides of the vehicle. The information was further discussed and analyzed by the group, entered on additional report forms and finally transferred to punched cards to join the data of the first part already in the databank.

INVESTIGATION CASE CRITERIA

The investigation criteria were to consider cases involving only:

- current models of the Volvo 140 and 164 with
- repair costs of 2,000 Swedish Crowns (U.S. $400) and above or
- any occupant injury, regardless of vehicle repair costs, or
- any other exceptional factors

The investigation was geographically limited to four main areas:

1. Stockholm and rural surroundings (Central Sweden)
2. Gothenburg and rural surroundings (West Sweden)

(1) Bohlin, N.I., "A Statistical Analysis of 28,000 Accident Cases, With Emphasis on Occupant-Restraint Value," *SAE Transactions*, Vol. 76, No. 670925.

3. Malmö and rural surroundings (South Sweden)
4. Sundsvall and rural surroundings (North Sweden)

ANALYZED MATERIAL

The material collected and analyzed was put in relation to the total number of "Five-Year Guarantee" cases in Sweden for the period concerned, and is summarized below. Reference is made in terms of estimated repair costs, which are meant to reflect the severity of accidents in general.

REPAIR COSTS ($ U.S.) NUMBER OF CASES

	$400	$ 400-$1,400	$1,400-$1,800	Over $1,800	Totals
Total in Sweden	27.684	8.556	994	491	37.725
Districts Concerned	7.251	2.808	115	113	10.287
Material Analyzed	270	920	115	98	1.403 + 102 unknown

There is a significant difference in the distribution of repair costs between the material collected and analyzed and the total numbers of accident cases in Sweden (guarantee cases). The difference is that the material collected has more high-cost repair cases than the total. This overrepresentation is primarily related to the most expensive cases.

Percentage of material costs in Sweden:
(total of PVG-cases)
Repair costs: U.S. $ 400-$1,400: 10.7%
Repair costs: U.S. $1,400-$1,800: 11.6%
Repair costs: U.S. over $1,800: 20%

The number of low-cost cases (non-severe accidents), which is not the subject of this analysis, forms the main part (73%) of the total number of accidents in Sweden.

Of the accidents "available" during the collecting period in the districts concerned, the material of the study shows:
Repair costs: U.S. $ 400-$1,400, 33% (approximate)
Repair costs: U.S. $1,400-$1,800, 100%
Repair costs: U.S. over $1,800, 82% (approximate)

BASIC COLLECTED DATA

The material analyzed comprises 1,505 accidents which comply with the criteria mentioned. A breakdown of the 2,440 occupants involved, is as follows:

- 1,505 drivers (61.5%); 1,473 vehicles had left-side steering
- 503 front seat passengers (20.7%)
- 432 rear seat passengers (17.8%)

The analysis of occupant-restraint value in the report deals with front-seat occupants in vehicles with left-side steering.

VEHICLE DEFORMATION INDEX (VDI)

The deformation of the case vehicles was codified firstly, according to the non-linear scale in the "Collision Deformation Classification – SAE J224a" and, secondly, according to the linear scale suggested by Volvo in the *U.S. Pilot Study on Traffic Accident Investigations.* In the linear scale, the front half, as well as the rear half, of the vehicle and the total width from one side to the other side are divided into 10 equal parts. To simplify the summary in this report, the results refer only to the non-linear scale.

CLASSIFICATION OF INJURIES

The injuries were codified according to AIS (Abbreviated Injury Scale) (See Appendix I).

ACCIDENT TYPES

The accident types in the material were divided into three main groups, depending on how the accident occurred:

- collision with another vehicle or object
- running off the road
- rollover on the road surface

Quite often there was a combination of two or even all three of these. The full classification of the types is shown as:

- total number of accidents – 1,505
- number of classified cases into accidents – 1,474
- number of unknown types 31

Collisions (C) (total 1239)				
C	C + O	C + O + R	C + R	C + R + R
1195	27	8	8	1
Running off the road (O) (total 229)				
O	O + C	O + C + R	O + R	O + R + C
19	160	12	23	15
Rollover (R) (total 6)				
R	R + O	R + O + C	R + C	R + C + O
1	0	1	4	0

C = Collision
O = Running off the road
R = Rollover

The *impact directions* in the total number of accidents, when related to a clock diagram were found to be as follows (see also Figure 19):

frontal	(12 o'clock)	–	34%
frontal	(11 o'clock)	–	16%
frontal	(01 o'clock)	–	14%
left side	(10 o'clock)	–	3%
left side	(09 o'clock)	–	4%
left side	(08 o'clock)	–	1%
rear	(07 o'clock)	–	2%
rear	(06 o'clock)	–	12%
rear	(05 o'clock)	–	2%
right side	(04 o'clock)	–	1%
right side	(03 o'clock)	–	5%
right side	(02 o'clock)	–	3%
roof		–	1%
unknown		–	2%

The *collision* accident was the most dominating type. Among them, the "pure collision," i.e. some kind of impact without running off the road or rollover, occurs most frequently.

- impact (beginning of accident) – 1,239 cases
- impact following running off the road – 187 cases
- impact following rollover – 5 cases

The other two main types of accident – running off the road and rollover – represented, together, the smaller part (15.7%) of the total.

USE OF SAFETY BELTS

All case vehicles were equipped with Volvo's 3-point slip-joint belts in the front seat. In the rear seats, safety belts of the 3-point type for the outer seats and lap-type belts for the center seat appeared in approximately 60% of the cases.

Front seat belt use: The overall use of safety belts by driver and front passenger was 39.2%. The mean use of the non-retractor belt in city areas (shorter trips and usually a 30-mph speed limit) proved to be 33.5%, an improvement of 40% of the result (approximately 24%) in the 1967 Volvo study (1). The corresponding figures for rural areas (longer trips and higher speed limits) were 43%, an improvement of approximately 32% in relation to the 1967 study (Figures 1 and 2).

Rear seat belt use: Only 22 (5.1%) of the 432 rear-seat passengers used a seat belt. Of the 432, however, only 282 were travelling in belt-equipped vehicles. The relative use increases, therefore, to 7.8%. There was no evident difference between the three rear seats.

(1) Ibid.

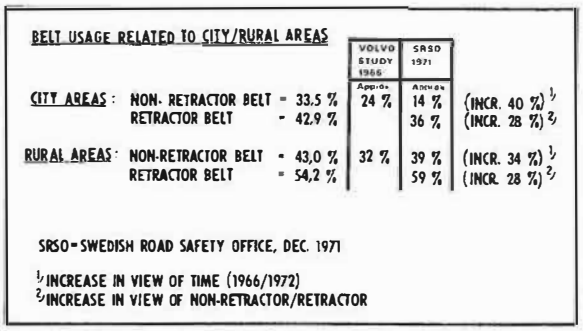


Figure 1

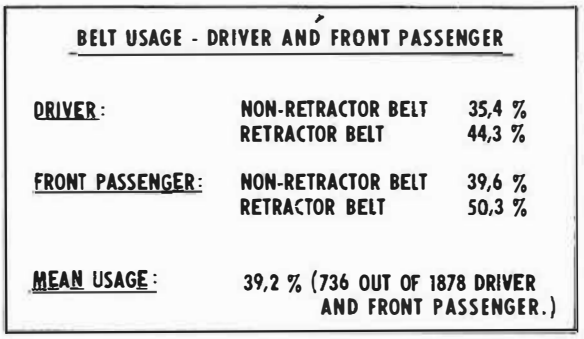


Figure 2

BELT USE RELATED TO OCCUPANT AGE

As may be seen from Figure 3, the percentage of use increased with increasing occupant age, from a mean of 30 – 35% at 20 years of age to 50 – 55% at approximately 50 – 55 years of age.

USE OF RETRACTOR VS NON-RETRACTOR BELTS

Of the belt cases, 28.5% involved a retractor connected to the upper torso strap. Of the drivers, 44.5% took advantage of their retractor-equipped belts, i.e., an improvement of 25% over the use of non-retractor belts. The front-seat passengers were

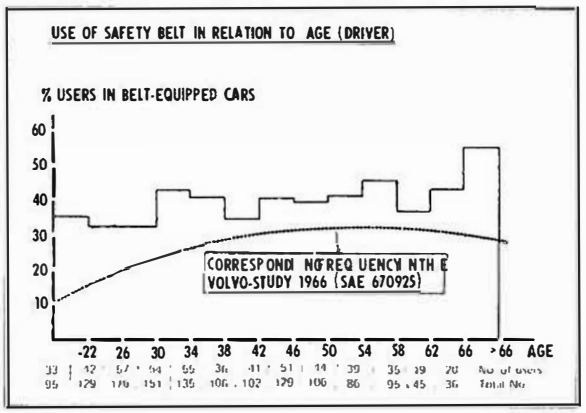


Figure 3

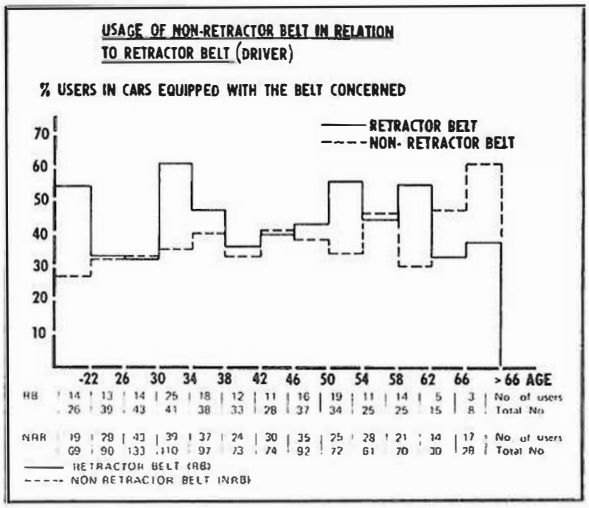


Figure 4

still more cooperative (50.3%), an improvement of 30%. The frequency of use of the retractor belt showed no noticeable relationship to age distribution (Figure 4). In fact, the retractor belt showed a lower use frequency, as compared with the non-retractor belt for the age of 62 years. It might be explained simply by the comparatively small number of observations, or it could be the effect of pressure of the upper torso strap on the chest, which older people could find irritating.

HEAD RESTRAINTS

The effect of head restraints, in terms of the number of neck injuries sustained, was evaluated in rear-end collisions, which were specified to impact directions 04 – 08 on the clock diagram.

In the 171 rear-end collisions, the case vehicles were equipped with head restraints for the front seats in 73.6% (126). The severity of the rear impact is

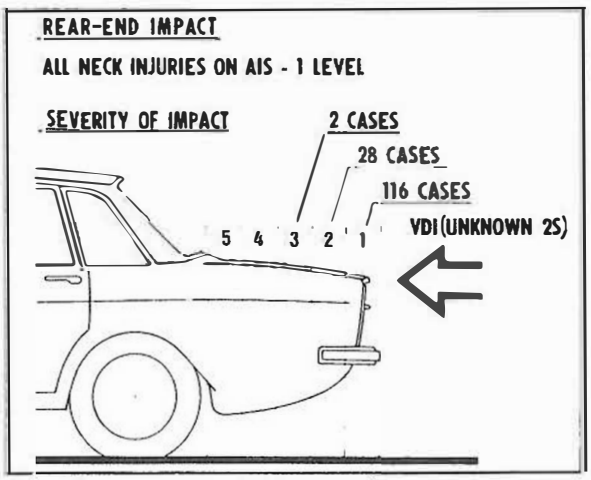


Figure 5

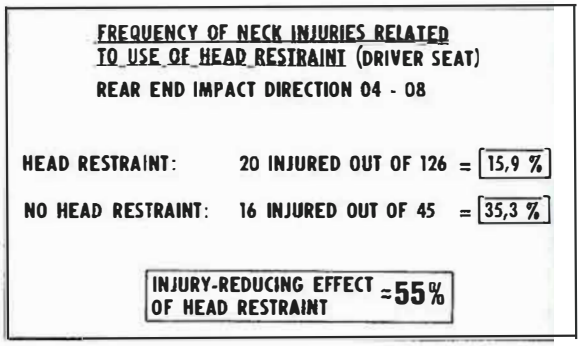


Figure 6

depicted in the Vehicle Deformation Index (Figure 5). The main part is referred to VDI = 1 group (116). Vehicle deformations with VDI = 2 and 3 are reported in 30 cases. The two groups – vehicles *with* head restraints and vehicles *without* head restraints – show roughly similar VDI-representation. To reassure complete information of any neck injury or hazard, including those appearing some days after the accident and therefore not reported, all occupants involved were contacted and interviewed.

Due to the small totals, when the material is divided into VDI – and AIS – degrees, especially on the >1-degree level, the material does not permit a meaningful evaluation in terms of AIS related to VDI, but only to the frequency of neck injuries.

Head restraint cases showed a significantly lower frequency of neck injuries – 15.9% (20 out of 126) – than no-head restraint cases – 35.3% (16 out of 45). Significance level was 0.05 (Figure 6).

The neck injuries sustained were, however, not very severe in either group. There was only AIS-1 degree injury, i.e. "whiplash" complaints (pain or strain) with no anatomical or radiological evidence. The injury symptoms appeared immediately after the accident in 50% of the cases, after one day in 30%; and after two days in 20% of the cases.

The fact that there were no severe neck injuries in the no-head restraint cases could possibly be credited to the yielding features of the back rest of the front seats. The reclining device of the seat is of a friction type, which is preset to yield for a certain load applied to the top of the back rest. The preset friction is high enough to withstand normal loading but low enough to yield in an excessive acceleration situation.

THE EFFECT OF THE SAFETY BELT – GENERAL

The injury-reducing effect of safety belts tells to what degree the number of injured occupants using belts is less than the number of injured occupants not

using belts. The effect is given in the percent of the number of unbelted occupants. No reference to severity degree of injuries sustained is made.

The evaluation of the safety-belt effect refers to front and rear seat occupants, in left-hand steering vehicles only. The effect of safety belts in the front seats is referred both to conventional (non-retractor) 3-point belts and 3-point safety belts with retractor for upper torso strap.

Two types of *statistical methods* were used to analyze the effect of safety belts; partly tests and partly calculation of confidence intervals. Tests have been used to determine if the belt effect is significant in various accident situations. Confidence intervals for p-values – i.e. the probability to sustain injuries in various conditions – have further been calculated. The 95% intervals are marked on graphs which reflect the uncertainty of the estimations. Certain statistical signs, which will not be dealt with in detail in this report, indicate, however, that the true uncertainty is somewhat less than what is shown by the intervals, i.e. the lengths of them should probably be shorter. Even though the intervals are overlapping each other, it is believed that the relations shown between the p-values (the columns) are right in most cases, even when significance is not achieved. From the discussion above, it is further noted that the uncertainty depicted by the confidence intervals is transferred to a corresponding degree of uncertainty in the estimations of the injury-reducing effect. As mentioned before, the injury-reducing effect calculated does not consider injury severity but only the number/frequency.

If the injury-reducing effect in different situations (VDI) are compared, the effect seems to be larger in a minor/moderate impact than in a more severe accident. Since the severity-degree of the injuries (AIS) is found to increase with increasing VDI, the smaller effect, in terms of quantity, is believed to be well compensated for in terms of quality.

By and large, the severity-degree of injuries sustained by belted occupants is lower than that of unbelted occupants, especially within the AIS-index groups 4 – 7, i.e. serious to fatal injuries, where only one single case (AIS 5) is related to belted occupant (retractor belt). In this case, the resulting true injury-reducing effect of safety belts should be higher than indicated by the figures in the various diagrams.

THE EFFECT OF BELT IN FRONT SEATS

Driver (Summary figures):

Belted

total number	528
injured	92 (17.4%).

Unbelted

total number	= 887
injured	= 226 (25.5%)

The *mean* injury-reducing effect of the safety belt on the driver was thus found to be 32%, or somewhat lower than in the previous study (1). One factor which might explain the difference is that the injury classification in this study is more rigorous and "picks up" many trifling injuries (strain, muscle ache, abrasions, etc.), which could have been characterized as "no injury" in the previous study. Even if valid for both categories, this factor is believed to have greater influence on the belt cases, which were more stringently investigated. Another explanation is that the current study refers to a basic material which represents by and large more severe accidents (more than U. S. $400, estimated repair costs).

Front seat passenger (Summary figures):

Belted

total number	= 208
injured	= 48 (23.1%)

Unbelted

total number	= 281
injured	= 102 (36.3%)

Dropout cases in this group of material, due to factors like limitation to left-side steering, type of belt unknown, use of belt unknown, were:

driver	= 87 cases
front passenger	= 14 cases

The *mean* injury-reducing effect for the front-seat passenger was 36%, somewhat lower than in the 1967 study, and it is referred to in the comments above for this tendency.

The mean figures above tell further that the hazard to the front-seat passenger, compared with the driver, is approximately 42% greater. This difference in hazard also is noticeable when a safety belt is used, but is then decreased to approximately 33%.

THE EFFECT OF BELT IN REAR SEATS

Belted

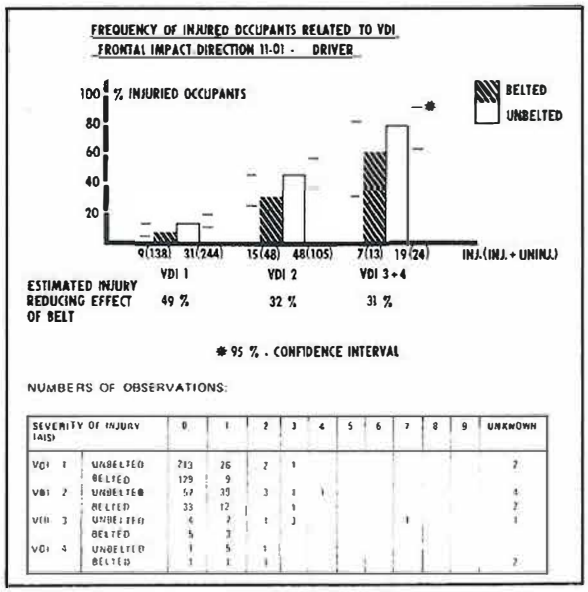
total number	= 22
injured	= 3 (13.6%)

Unbelted

total number	= 410
injured	= 103 (24.8%)

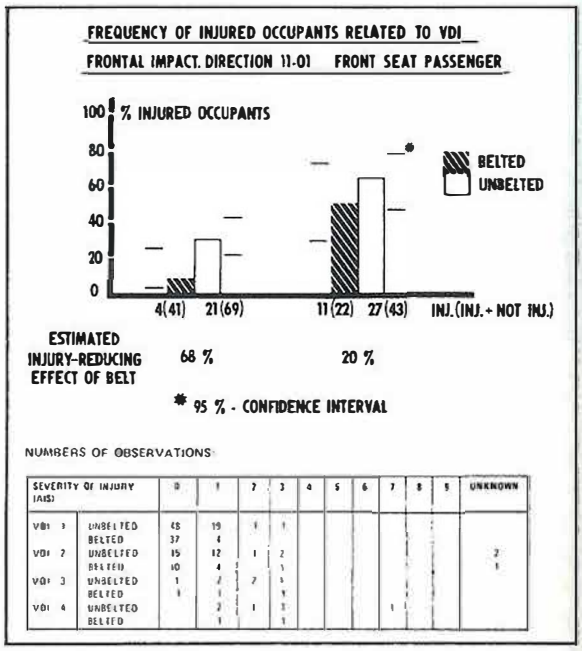
Very few (22) of the 282 rear-seat occupants who had had the possibility to be restrained took the advantage. The totals in this study group is too small to permit any confirmed conclusions on the belt effect. The three injuries reported are, however, all minor within AIS 1.

(1) Ibid



SEVERITY OF INJURY (AIS)		0	1	2	3	4	5	6	7	8	9	UNKNOWN
VDI 1	UNBELTED	213	26	2	1							2
	BELTED	129	9									
VDI 2	UNBELTED	57	35	3	1	1						1
	BELTED	33	12		1							2
VDI 3	UNBELTED	4	2	1	1				1			1
	BELTED	5	1									
VDI 4	UNBELTED	1	5	1								
	BELTED	1	1	1								2

Figure 7



SEVERITY OF INJURY (AIS)		0	1	2	3	4	5	6	7	8	9	UNKNOWN
VDI 1	UNBELTED	48	19	1	1							
	BELTED	37	4									
VDI 2	UNBELTED	15	12	1	2							2
	BELTED	10	4		1							1
VDI 3	UNBELTED	1	2	2	1							
	BELTED	1	1		1							
VDI 4	UNBELTED		2	1	1				1			
	BELTED		1		1							

Figure 8

The injuries sustained by the unbelted rear-seat occupants comprises, on the other hand, most categories within the AIS-scale from AIS 1 up to two cases of AIS 6–7 (fatal injuries).

THE EFFECT OF SAFETY BELT RELATED TO DIRECTION OF IMPACT

To evaluate the belt effect in view of direction of impact, four sectors of impact direction were chosen:

- frontal impact direction 11–01 (ref. to clock-figures)
- left side impact direction 08–10
- right side impact direction 02–06
- rear end impact direction 05–07

The material in these four groups represent possible "clean" impact cases. That means that the accidents involved mainly a pure impact. Accidents concerning very complex accident situations, as well as cases where the distinction of impact direction (e.g. 11 front or 11 side) was not sure, were deleted. The number of observations are given in the summary tables and frequency of injuries sustained are depicted for each group below.

FRONTAL IMPACT (11–01) – (Figure 7)

Driver: The total effect of the safety belt weighed over all VDI is significant on level 0.01. The lengths of the 95% confidence intervals marked in the graphs, show that the estimation of the injury-reducing effect is much more confirmed in VDI-1 group than in VDI 3 + 4 cases. The belt effect, which varies from 49% to 31% (approximately), decreases with increasing VDI.

Front seat passenger (Figure 8): Again, the total effect of safety belt weighed over all VDI is significant on level 0.01.

The injury-reducing effect for the front-seat passenger is higher (68%) than for driver (49%) in low VDI impacts, but drops 20% in the higher VDI-numbers.

The confidence in the effect estimation is somewhat greater in VDI 1.

DRIVER RELATED TO FRONT SEAT PASSENGER (BELTED/UNBELTED)– (Figures 9-10)

For *belted* driver, compared with belted front-seat passenger, no significant difference of injury frequency could be shown.

When both driver and front-seat passenger are *unbelted,* however, a significant difference of injury frequency (level 0.01) is found to the passenger's disadvantage.

RETRACTOR VERSUS NON-RETRACTOR BELT–(Figure 11)

The figures of injury frequency for the retractor belt related to the identical non-retractor belt reveal that there is no or very little difference (not significant). This result is valid for both the driver and front-seat passenger positions.

REAR END IMPACT (05–07)–(Figure 12)

There seems to be a certain positive belt effect (24% – 35%) in rear-end impacts. The effect, which

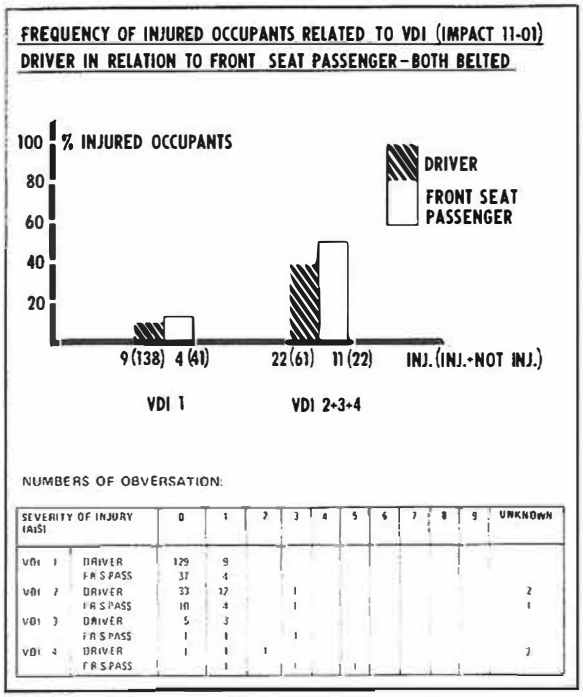


Figure 9

by and large is less than in frontal impacts is, however, not significant for either the driver or the passenger. No significant difference between driver or passenger, belted or unbelted, in terms of injury frequency could be shown.

SIDE IMPACTS (LEFT AND RIGHT) (08–10, 02–04)–(Figures 13-14)

A positive effect of the driver's belt in left-side impacts (8-10) is found to be significant (level 0.05).

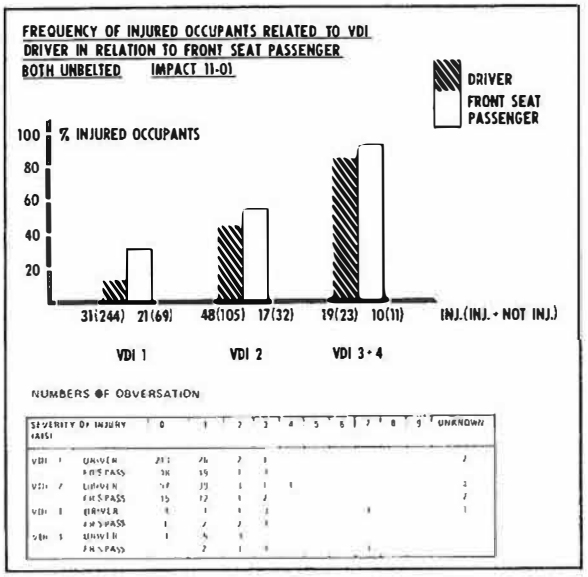


Figure 10

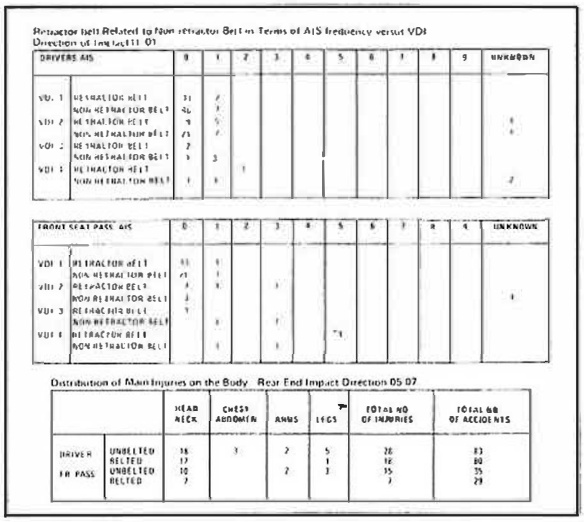


Figure 11

For all other side-impact parameters (driver in 02-04 impacts, passenger in 08-10 as well as 02-04 impacts) the belt effect proved to be of little significance. A reasonable explanation for the distinct difference between the left and right-side impact effect on the driver cannot be derived from the analysis carried out. The question will be subjected to further studies.

INJURIES SUSTAINED IN DEGREE OF SEVERITY

Injuries sustained by the front-seat occupants were related to AIS-scale as follows: (totals)

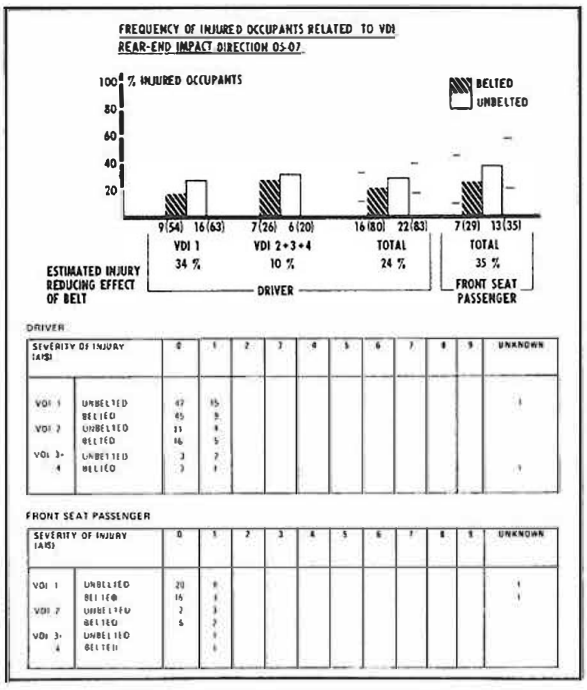


Figure 12

AIS	0	1	2	3	4	5	6	7	99X
Unbelted	840	228	15	14	1	1	2	2	65
Belted									
–Retractor	208	26	3	4	–	1	–	–	6
–Non-retractor	388	72	5	7	–	–	–	–	16

As depicted in the following graphs (Figure 15), the front-seat passenger sustained injuries of various AIS-index to higher frequency than the driver. That happened in all situations – unbelted or belted – but in the minor injury class when a safety belt without a retractor had been used there was no difference. AIS-difference was particularly dominant in the AIS 2 – 3 class, where the passenger was injured approximately two times (unbelted) and up to three times (belted with non-retractor belt) as often as the driver. Credit for the better outcome for the driver is given to the steering wheel and steering column with its "restraining" features.

All but one case of the very serious-to-fatal injuries were related to non-belted occupants. The *single critical injury*, when the belt had been properly used, was a front-seat passenger with a retractor belt in a complex accident situation.

In the accident concerned, the case vehicle impacted another vehicle, ran off the road and into a ditch, where it collided and finally was thrown against and impacted a pole with the roof. It is believed that the front-seat passenger's upper torso

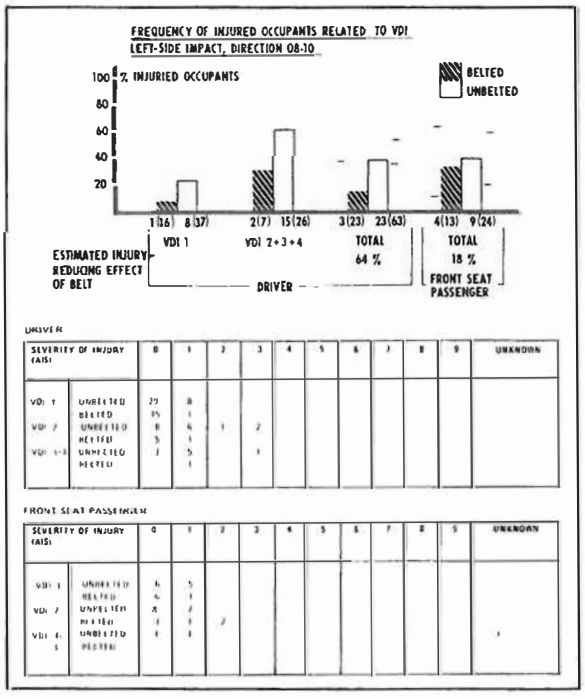


Figure 13

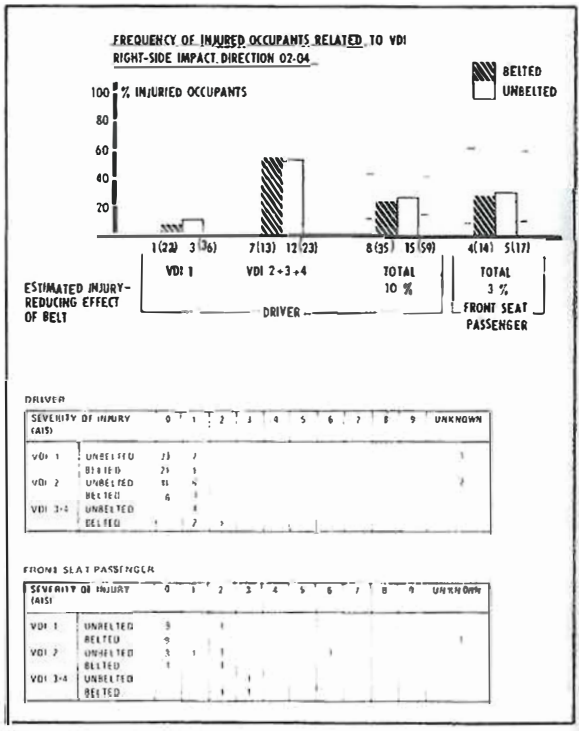


Figure 14

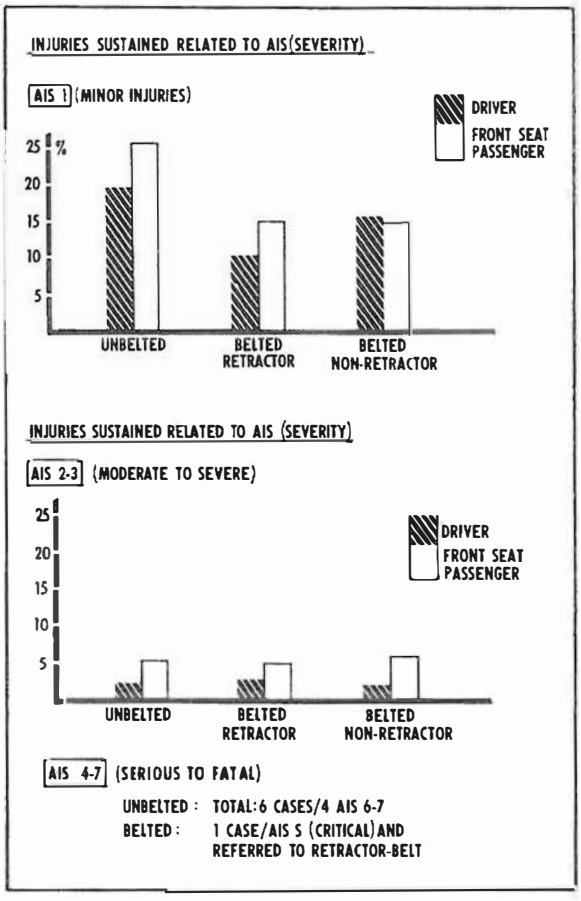


Figure 15

during the first part of the accident sequence might have slid out of the chest strap of the belt, resulting in decreased retraint efficiency during the later accident phase.

The passenger wearing a retractor belt sustained the following injuries:

- nasal fracture
- facial laceration
- concussion with loss of memory for five days (AIS 5)

The driver, also wearing retractor belt, sustained AIS-2 degree injury with scapula fracture (right) and pain in left arm.

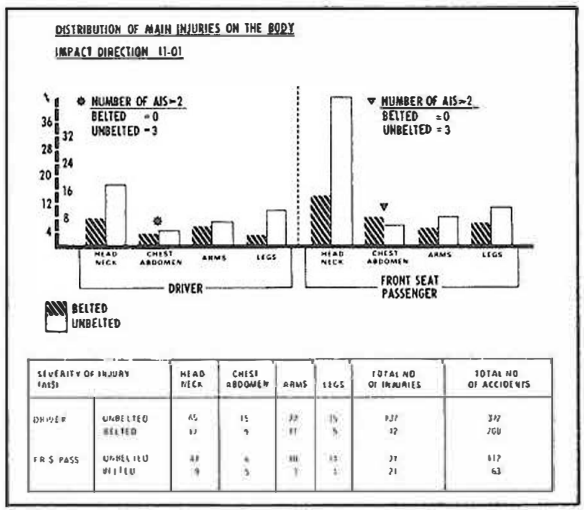
The distribution of main injuries on the body is summarized in the diagrams in Figures 16-17.

The frequency of head/skull injuries, which is significantly dominant both for unbelted driver (18%) and unbelted front-seat passenger (43%), is cut down to 8% resp 14% when belted. No significant difference in frequency of chest injuries was found between belted and unbelted occupants, but a significant difference in severity was found. The unbelted cases were responsible for all chest injuries with AIS-severity higher than 2.

The number of leg and arm injuries were, overall, comparatively small and of minor severity. The number of AIS-3 class very small.

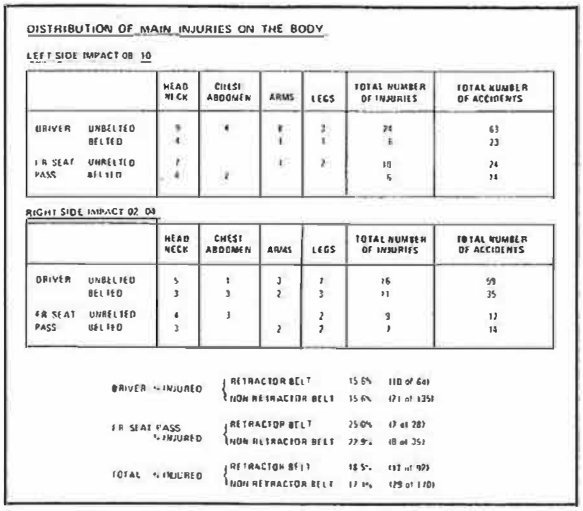
EJECTION

Ten occupants were ejected in eight accidents, of which all involved complex accident sequences, roll-over, rotation, etc. Five of the ejected occupants, none of whom used the safety belt, were in the front seat and five in the rear seat. The frequency of ejection counted from the total occupancy was approximately 0.4%.



SEVERITY OF INJURY (AIS)		HEAD NECK	CHEST ABDOMEN	ARMS	LEGS	TOTAL NO OF INJURIES	TOTAL NO OF ACCIDENTS
DRIVER	UNBELTED	45	15	22	15	97	347
	BELTED	12	9	11	9	42	200
FR S PASS	UNBELTED	42	6	111	13	71	117
	BELTED	9	5	7	1	21	63

Figure 16


DISTRIBUTION OF MAIN INJURIES ON THE BODY

LEFT SIDE IMPACT 08 10

		HEAD NECK	CHEST ABDOMEN	ARMS	LEGS	TOTAL NUMBER OF INJURIES	TOTAL NUMBER OF ACCIDENTS
DRIVER	UNBELTED	9	4	8	3	24	63
	BELTED	4		1	1	6	23
FR SEAT PASS	UNBELTED	7		1	2	10	24
	BELTED	4	2			6	24

RIGHT SIDE IMPACT 02 08

		HEAD NECK	CHEST ABDOMEN	ARMS	LEGS	TOTAL NUMBER OF INJURIES	TOTAL NUMBER OF ACCIDENTS
DRIVER	UNBELTED	5	1	3	2	16	59
	BELTED	3	3	2	3	11	35
FR SEAT PASS	UNBELTED	6	3	2	2	9	12
	BELTED	3		2	2	7	14

DRIVER % INJURED — RETRACTOR BELT 15.8% (10 of 64); NON RETRACTOR BELT 15.6% (21 of 135)

FR SEAT PASS % INJURED — RETRACTOR BELT 25.0% (7 of 28); NON RETRACTOR BELT 22.9% (8 of 35)

TOTAL % INJURED — RETRACTOR BELT 18.5% (17 of 92); NON RETRACTOR BELT 17.1% (29 of 170)

Figure 17

Injuries sustained by the 10 ejected persons:

- two persons were fatally injured (AIS 6) with complex head/skull injuries.
- one person sustained critical head injuries (AIS 5).
- two persons sustained AIS 3 injuries related to thoracic spine, head area.
- four persons sustained minor injuries (AIS 1) only (slight concussion, head laceration and abrasions).
- one person was lucky to sustain no injury.

Ejection from the vehicle proved to be much more hazardous than non-ejection (unbelted). The ejected persons were killed in 20% (and injured in 90%), while the non-ejected, unbelted occupants were fatally injured only in approximately 0.3% (some injury in 26.8%). It is further noted that a substantial part of the total killed (33% – 2 out of 6) is found among the ejected.

THE MATERIAL ANALYZED VERSUS THE VESC CRASHWORTHINESS SPECIFICATION AND OTHER SAFETY ITEMS

The Cases In General

The number of cases of the frontal impact group (11-01) related to Vehicle Deformation Index (VDI) were:

	Accident cases	Front seat occupant cases
– VDI 1 =	382	492
– VDI 2 =	153	201
– VDI 3 =	25	33
– VDI 4 =	9	14
– VDI 5 =	1	1
– VDI 6 =	2	3

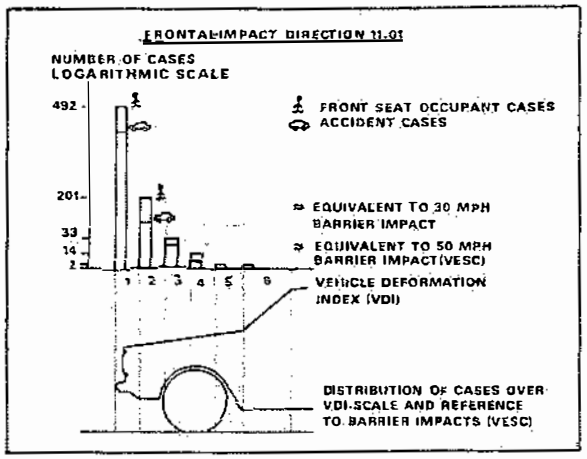


Figure 18

According to experience with extensive barrier collision tests with the vehicle models concerned, the VDI 3-accidents are judged to be approximately equivalent to the 30-mph frontal barrier impact test (Figure 18). The evaluation revealed that most frontal collision cases (98% – 560 of 572) corresponded approximately to barrier collision speeds up to 30-mph, while only about 2% of them corresponded to higher collision speeds. In other words, as the material analyzed is found to be over represented with high cost (more serious) accidents in view of the total accident pattern in all Sweden – as pictured in the Volvo PVG-statistics (five-years guarantee) – the relevancy and ambition to keep the 50-mphbarrier test specification in VESC, which in this respect is almost identical to the ESV, could be questioned. On the other hand, the belted occupants in these "50mph-barrier"-accidents were fairly successful.

The Fatal Cases

Five accident cases resulted in six fatallyinjured occupants. They were carefully analyzed and weighed in view of the questions (see Appendix 2) and described in the Volvo-report: "Fatal Accidents During a TwelveMonth Period (1972) in Volvo 140 and 164 Cars (2)," which includes all six fatalities. In this report, only a summary with estimations are given:

The fatal accidents comprised two frontal impacts (VDI 3 and VDI 6), two rollovers and one of another type. In four of the five cases, both an "improved interior" – Question 1, and "100% belt use" – Question 2 – were estimated to have a large fatal-injury-reducing effect. For the fifth accident,

(2) Samuelsson, L. E., "Fatal Accidents During a Twelve-Month Period (1972) Involving Volvo Models 140 and 164 Vehicles." AB Volvo.

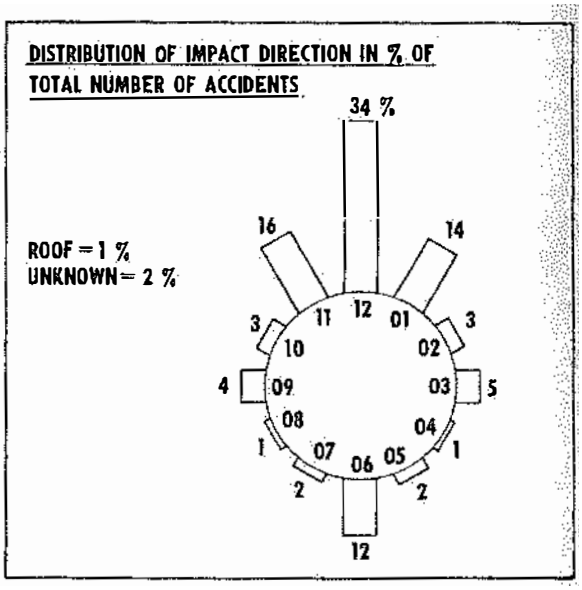


Figure 19

however, the 100% belt use was judged only to have a large positive effect.

The VESC specification applicable (Questions 3 – 6) would not have meant a large, positive, effect to any of the killed occupants. The estimations clearly indicated that the injury-reducing effect of a case vehicle compliance with the VESC-requirements would have been small or fairly small in the accidents concerned.

SUMMARY AND CONCLUSIONS

From the analysis made of the study material, which mainly represented the fourth quarter of a general composition of accident severity in terms of increased vehicle repair costs, the following is summarized and concluded:

- the *mean use of non-retractor belt* in front seats in city and rural areas was 33.5% and 43%, respectively.
- the corresponding *mean use of retractor belt* was 42.9% and 54.9%, respectively, or an increase of approximately 28% (mean) when related to non-retractor belts.
- the *use-of-belt figures for non-retractor belt* reveal an increase as high as 40% (city areas) compared with a similar study reported in 1967 (1). The credit for this improvement is given to improved belt design and continued "education" of customers.
- Use of rear seat belts was only 7.8% (mean).
- The mean injury reducing effect of belt for driver

(1) Op. Cit.

and front-seat passenger was 32% and 36%, respectively.

- None of the fatally-injured occupants (6) was restrained by belts.
- The resulting true effect of belt use was concluded to be still higher, since the belt evidently decreased the severity of the injury sustained.
- No or very little difference (not significant) was found between retractor and non-retractor belt use, either in terms of frequency or severity.
- The hazard to the front-seat passenger, in case of an accident, was 42% higher than to the driver when unbelted; 33% higher when belted.
- Ejection was found to be most hazardous to occupants, with 33% of the total killed, compared with a frequency of 0.4% of total occupancy.
- Head restraints in the front seats proved to be effective in reducing the frequency of neck injuries by approximately 55%.
- The severity of neck injuries was all minor (AIS 1), even in cases without head restraints. It was concluded that this probably was due to the designed yielding features of the front-seat backrests.
- From the severe accident composition of the material, it was concluded that most accidents (98% – approximately 560 of 572) corresponded to barrier collision speeds up to 30-mph, while only about 2% corresponded to higher collision speeds.
- From a detailed analysis of the fatal cases it was concluded that compliance with the VESC crashworthiness specification would have had some positive effect.

APPENDIX I

Injury Classification According To The AIS (Abbreviated Injury Scale)

Severity Code 0 – NO INJURY
Severity Code 1 – MINOR

General

- aches all over
- minor lacerations, contusions, and abrasions (first aid – simple closure)
- all 1° or small 2° or small 3° burns.

Head and neck

- cerebral injury with headache, dizziness; no loss of consciousness
- "whiplash" complaint with no anatomical or radiological evidence
- abrasions and contusions of occular apparatus (lids, conjunctiva, cornea, uveal injuries); vitreous or retinal hemorrhage
- fracture and/or dislocation of teeth

Chest

- muscle ache or chest wall stiffness

Abdominal and pelvic contents

- muscle ache; seat belt abrasion; etc.

Extremities

- minor sprains and fractures and/or dislocation of digits.

Severity Code 2 – MODERATE

General

- extensive contusions; abrasions; large lacerations; avulsions (less than 3" wide)
- 10 - 20% body surface 2° or 3° burns

Head and neck

- cerebral injury with or without skull fracture, less than 15 minutes unconsciousness
- undisplaced skull or facial bone fractures or compound fracture of nose
- lacerations of the eye and appendages; retinal detachment
- disfiguring lacerations
- "whiplash" – severe complaints with anatomical or radiological evidence

Chest

- simple rib or sternal fractures
- major contusions of chest wall without hemothorax or pneumothorax or respiratory embarrassment

Abdominal and pelvic contents

- major contusion of abdominal wall

Extremities and/or pelvic girdle

- compound fractures of digits
- undisplaced long bone or pelvic fractures
- major sprains of major joints

Severity Code 3 – SEVERE (Not Life-Threatening)

General

- extensive contusions; abrasions; large lacerations involving more than two extremities, or large avulsions (greater than 3" wide)
- 20 – 30% body surface 2° or 3° burns

Head and neck

- cerebral injury, with or without skull fracture, with unconsciousness more than 15 minutes; without severe neurological signs, brief posttraumatic amnesia (less than three hours)

- displaced closed-skull fractures without unconsciousness or other signs of intracranial injury
- loss of eye, or avulsion of optic nerve
- displaced facial bone fractures or those with antral or orbital involvement
- cervical spine fractures without cord damage

Chest
- multiple rib fractures without respiratory embarrassment
- hemothorax or pneumothorax
- rupture of diaphragm
- lung contusion

Abdominal and pelvic contents
- contusion of abdominal organs
- extraperitoneal bladder rupture
- retroperitoneal hemorrhage
- avulsion of urethra
- thoracic or lumbar spine fractures without neurological involvement

Extremities and/or pelvic girdle
- displaced simple long-bone fractures, and/or multiple hand and foot fractures
- single open long-bone fractures
- pelvic fracture with displacement
- dislocation of major joints
- multiple amputations of digits
- lacerations of the major nerves or vessels of extremities

Severity Code 4 – SERIOUS (Life-Threatening)

General
- severe lacerations and/or avulsions with dangerous hemorrhage
- 30 – 50% surface 2° or 3° burns

Head and neck
- cerebral injury, with or without skull fracture, with unconsciousness of more than 15 minutes, with definite abnormal neurological signs; post-traumatic amnesia 3 – 12 hours
- compound skull fracture

Chest
- open-chest wounds; flail chest; pneumomediastinum, myocardial contusion without circulatory embarrassment, pericardial injuries

Abdominal and pelvic contents
- minor laceration of intra-abdominal contents (to include ruptured spleen, kidney and injuries to tail of pancreas)
- intraperitoneal bladder rupture
- avulsion of the genitals
- thoracic and/or lumbar spine fractures with paraplegia

Extremities
- multiple-closed long-bone fractures
- amputation of limbs

Severity Code 5 – CRITICAL (Survival Uncertain)

General
- over 50% body surface 2° or 3° burns

Head and neck
- cerebral injury, with or without skull fracture, with unconsciousness of more than 24 hours; post-traumatic amnesia of more than 12 hours; intracranial hemorrhage; signs of increased intracranical pressure (decreasing state of consciousness, brady-cardia under 60, progressive rise in blood pressure or progressive pupil inequality)

Chest
- chest injuries with major respiratory embarrassment (laceration of trachea, hemomediastinum etc.)
- aortic laceration
- myocardial rupture or contusion with circulatory embarrassment

Abdominal and pelvic contents
- rupture, avulsion or severe laceration of intra-abdominal vessels or organs, except kidney, spleen or ureter

Extremities
- multiple open-limb fractures

Severity Code 6 – FATAL (Within 24 hours)
- fatal lesions of single region of body, plus injuries of other body regions of Severity Code 3 or less; fatal from burns regardless of degree.

Severity Code 7 – FATAL (Within 24 hours)
- fatal lesions of single region of body, plus injuries of other body regions of Severity Code 4 or 5.

Severity Code 8 – FATAL
- two fatal lesions in two regions of body

Severity Code 9 – FATAL
- three or more fatal injuries
- incineration by fire

Severity Code 10 – FATAL
- death, but details unknown

Severity Code 99 X – SEVERITY UNKNOWN
- injured, but severity not known

Severity Code 98 Z – PRESENCE UNKNOWN
- presence of injury not known

APPENDIX 2

METHOD OF ANALYSIS OF FATAL ACCIDENTS IN VIEW OF VESC-SPECIFICATION

The analysis method used here involved using the documentation of each accident to answer a number of pre-arranged questions and then to evaluate these answers against specific answer options.

QUESTIONS

1. What fatal injury-reducing effect would interior improvements have had, concerning an energy-absorbing steering wheel and steering column, fixed energy-absorbing front and rear seats and a passive-protection system in the form of padding, air bags or similar items?
   (The passive-protection systems mentioned here include systems which do not securely restrain the occupant throughout the entire accident)
2. What fatal injury-reducing effect would a 100% use of safety belts and children's safety seats have had? Appraisal has not taken into consideration any loads carried on the rear seat etc.)
3. What fatal injury-reducing effect would a VESC-body have had with regard to frontal collisions?
4. What fatal injury-reducing effect would a VESC-body have had with regard to lateral collisions?
5. What fatal injury-reducing effect would a VESC-body have had with regard to collisions from the rear?
6. What fatal injury-reducing effect would a VESC-body have had with regard to rollover accidents? (In the appraisal of items 3 – 6, consideration was taken as to how the actual accident conformed with the conditions in the VESC requirements.
7. How many accidents could have been avoided if the vehicles had been equipped with anti-skid brakes? (In this appraisal, consideration was given to: whether the driver of the car braked with locked wheels, braking distance length and the possibilities, with unlocked wheels, for driver to steer to avoid the collision obstacle).

All answers have been graded according to the following scale:

1. Large positive effect
2. Fairly large positive effect
3. Fairly small positive effect
4. Slight positive effect
5. Not applicable.

APPENDIX 3

FATAL ACCIDENTS DURING A TWELVE-MONTH PERIOD (1972), INVOLVING VOLVO MODELS 140 AND 164 VEHICLES

LARS SAMUELSSON,
Traffic Accident Research
AB Volvo

INTRODUCTION

This report is only concerned with collisions involving Volvo model 140 and model 164 vehicles in Sweden during 1972. The conclusions made are relevant within the framework of these limits.

PURPOSE

The purpose of the investigation was to indicate the situations, and the ways occupants are fatally injured in Volvo 142, 144, 145 and 164 model vehicles, and to what degree, currently known, safety-improvement items could have led to a reduction in the number of fatal injuries. The items which have been evaluated are: improved interior with energy-absorbing units, safety belts and the VESC-body, with regard to impact/energy absorption in frontal, lateral, rear and roof deformation, and also anti-skid brakes.

DATA

The material analyzed consists of the total number of fatal accidents in Volvo 140 and 164 cars and is based on official fatal accident reports. A fatal accident is considered an accident where, as a consequence of injuries sustained, an occupant dies within 30 days of the accident.

DOCUMENTATION

Police reports, photographs of the vehicles and autopsy report/death certificates are available for all the accidents included in this report. Some of the accidents have been examined by Volvo's expert group.

ROAD TRAFFIC REVIEW IN SWEDEN IN 1972

All figures, with the exception of the number of fatal accidents in Volvo cars and Volvo's market share, are expolations. The total number of cars was 2,400,000, of which approximately 240,000 were Volvo 140's and 164's. The accidents totaled 16,500 and involved 15,500 cars; 23,000 individuals were injured and 650 killed.

Thirty-eight persons were killed in 31 Volvo 140's in 29 accidents. There were no fatal accidents in Volvo 164's.

The fatal-accident involvement was as follows:

19 frontal collisions with 23 killed
6 lateral collisions with nine killed
4 rollover accidents with four killed
2 other accidents with two killed

ANALYSIS METHOD

The analysis method consisted of using the documentation of each accident to answer a number of prearranged questions and then to evaluate these answers against specific answer options.

QUESTIONS

1. What fatal injury-reducing effect would interior improvements, involving an energy-absorbing steering wheel and steering column, fixed energy-absorbing front and rear seats and a passive-protection system in the form of padding, air bags or similar items, have had?
   (The passive-protection systems mentioned here include systems which do not securely hold the occupant throughout the entire accident).
2. What fatal injury-reducing effect would a 100% use of safety belts and children's safety seats have had?
   (Appraisal has not taken into consideration any loads carried on the rear seat, etc.).
3. What fatal injury-reducing effect would a VESC body have had with regard to frontal collisions?
4. What fatal injury-reducing effect would a VESC body have had with regard to lateral collisions?
5. What fatal injury-reducing effect would a VESC body have had with regard to collisions from the rear?
6. What fatal injury-reducing effect would a VESC body have had with regard to rollover accidents?
   (In the appraisal of Items 3 – 6, consideration was given as to how the actual accident conformed with the conditions in the VESC requirements, which are listed below.)
7. How many accidents could have been avoided if the vehicles had been equipped with anti-skid brakes?
   (In this appraisal, consideration was given to: whether the driver of the car braked with locked wheels; braking distance; and the possibility of steering past the collision obstacle with unlocked wheels.)

All answers were graded according to the following scale:

1. Large positive effect
2. Fairly large positive effect
3. Fairly small positive effect
4. Slight positive effect
5. Not applicable
0. Unknown

VOLVO EXPERIMENTAL SAFETY CAR (VESC)

Definition of requirements

Max 3 inches compartment intrusion at 50-mph barrier front collision
Max 3 inches compartment intrusion at 50-mph front collision pole
Max 3 inches compartment intrusion at 50-mph front collision barrier 15°
Max 3 inches compartment intrusion at 50-mph front collision pole 15°
Max 3 inches compartment intrusion at 30-mph front collision barrier 45°
Max 3 inches compartment intrusion moving barrier rear collision 50-mph
Max 3 inches compartment intrusion moving pole rear collision 50-mph
Max 3 inches compartment intrusion moving barrier rear collision 15° 50-mph
Max 3 inches compartment intrusion moving pole rear collision 15° 50-mph
Max 3 inches compartment intrusion vehicle to vehicle rear collision 75-mph
Max 4 inches compartment intrusion lateral collision 30 – 40-mph
Max 3 inches compartment intrusion lateral collision rigid pole 15-mph
Max 3 inches roof intrusion

The VESC requirements, against which these accidents were rated, correspond to the U. S. ESV requirements for similar situations, with the exception of the lateral collision where a 4-inch intrusion is accepted in the VESC project.

BASIS OF EVALUATION

Evaluation was made from two different viewpoints, one with the focus on the accident vehicle and the other with the focus on the killed occupant.

The purpose of focusing on the vehicle was to avoid any random, or irrelevant, factors involved in the accident. For this reason, the accident situation elements – vehicle deformation and the reduction in size of the passenger compartment – are the factors on which appraisal is primarily based.

The accident vehicles can be roughly divided into three groups: a) passenger compartment undamaged; b) passenger compartment reduced in size but VESC body would have kept it undamaged; and c) where

vehicle deformation and passenger-compartment reduction greatly exceeded the plausible limits of safety design. For accident vehicles within group a) an improved interior, or, optionally, a 3-point belt has, in principle, been judged as having large or fairly large fatal injury reducing effect, while the VESC body has been judged as having a low, or fairly low, effect. For accident vehicles in group b) the VESC-body has been judged as having a large, or fairly large, fatal-accident reduction effect. The total of groups a) and b) forms the total fatal-accident reduction effect for the VESC-body, with improved interior, and, also, for the VESC-body with 100% use of safety belts.

The purpose of focusing on the killed occupant was to indicate how many lives could have been saved. For this reason, the reduction of the size of the passenger compartment reported here is related to the seat which the deceased occupied in the vehicle. Otherwise, the factors analyzed conform with those analyzed for the vehicle. Independent evaluation has been made for interior improvements and for 100% use of safety belts.

RESULTS – CONCLUSIONS

(Figure 1)

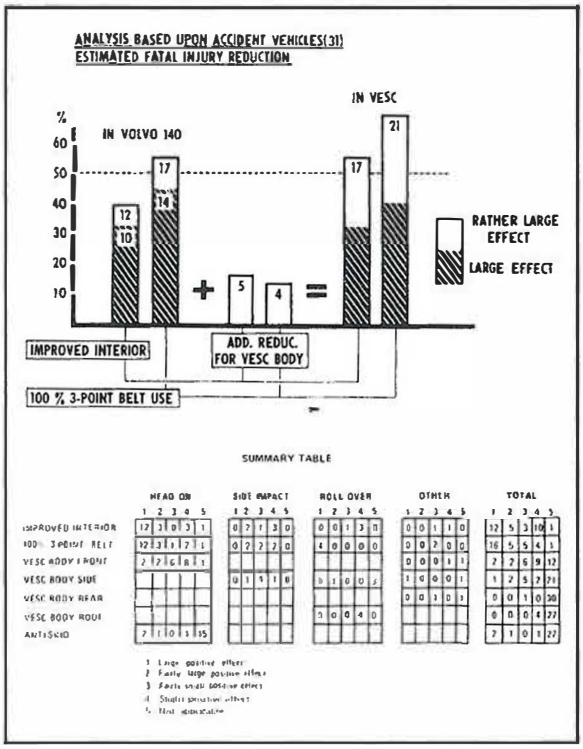


Figure 1

On the basis of the Volvo 140-series cars, it would have been possible to achieve a fatal-injury reduction of between 40% and 55% through interior improvements, alone, or, optionally, through 100% use of safety belts.

An improvement in interior design, along the lines mentioned previously, would have resulted in a fatal injury reduction in 12 of 31 vehicles. Eleven of these vehicles were involved in a head-on collision where the passenger compartment was undamaged or only slightly damaged. One case involved was a side impact towards a pole. (The lateral collisions which resulted in fatal accidents are not covered by the VESC requirements. In two cases, trucks travelling at speeds exceeding 50 km/h hit cars from the side; another case involved a bus travelling at about 50 km/h; another involved a train travelling at 110 km/h and three involved vehicles which skidded off the road at very high speed and side-impacted a pole or tree.)

The appraised results of 100% use of safety belts coincide with results attained from an improved interior, in the case of head-on collisions. The increase in fatal-injury reduction shown for 100% use of safety belts is the result of rollover accidents (4), a type of accident in which only safety belts have been judged to be effective. In these cases the passenger compartment was undamaged or only slightly damaged. In one case, an eight year old boy lying on the rear shelf was ejected through the rear window. In a second case, the driver, travelling alone, was thrown to the opposite side of the car where his head crashed through the side window and was crushed between the roof and the road. In another case, a three year old girl was ejected through the door aperture and in one accident a 72 year old woman was tumbled round in the vehicle and broke her neck. Totally, the use of the safety belt alone could have saved lives in 17 of 31 vehicles.

If it were supposed that the VESC requirements applying to body design (see above) had been conformed with in the accident vehicles, some additional reduction would have been gained (between 13% and 16%). These cases consist of an accident where two Volvo 142's collided head-on, at exactly "12 o'clock," at high speed (over 80 km/h) and also two accidents where the frontal collision was slightly off-side (11 o'clock). In all of these vehicles, considerable passenger compartment reduction was noted, but for the two latter, it was not of vital importance in the implications of the accident. In addition to this, one case was involved where it was presumed that the VESC-body would have had a fairly large positive effect through the anti-intrusion (side-impact members) and the improved interior.

(Figure 2)

When analysis is based on the killed occupant, the effect of the interior improvements or, optionally, use of the safety belts, increases for the Volvo 140 vehicles.

The fatal injury reduction through interior improvements or optional 100% use of safety belts together with the VESC-body is compatible in both the vehicle and occupant analysis.

In conclusion it can be said that 100% use of safety belts in the Volvo 140 is judged to give the same fatal injury reduction as the Volvo Experimental Safety Car without safety belts, but with passive, non-restraining, protective systems.

The VESC-body alone, with the current interior and without safety belts, would have given a fatal injury reduction in one accident vehicle.

If the vehicles involved had been equipped with an anti-skid brake system, three accidents could have been avoided.

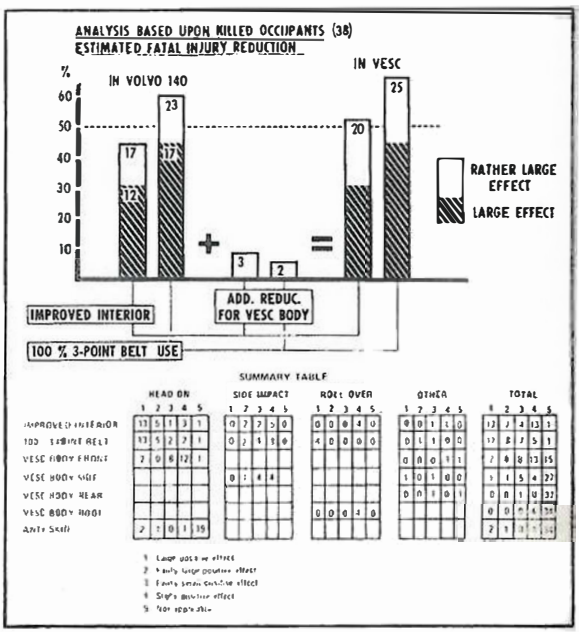
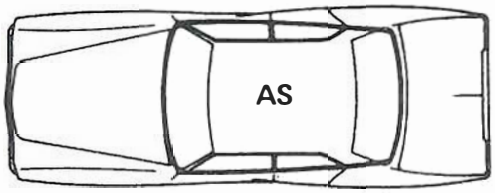


Figure 2

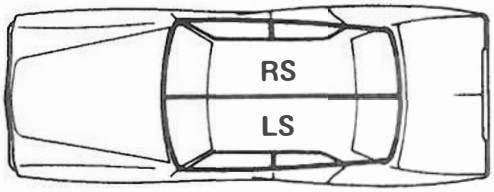
APPENDIX 4
ACCOUNT FOR THE EVALUATION OF EACH ACCIDENT

VEHICLE INTERIOR DEFORMATION INDEX

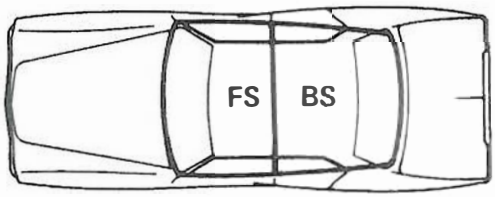
col 1 – 2



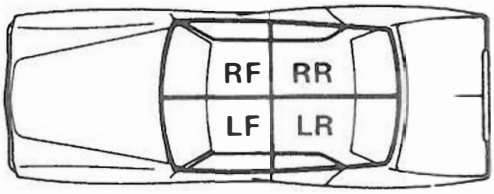
AS ALL SEATS



RS RIGHT SEATS
LS LEFT SEATS



FS FRONT SEATS
BS REAR SEATS



LF LEFT FRONT
LR LEFT REAR
RF RIGHT FRONT
RR RIGHT REAR

D = DRIVER
FP = FRONT PASSENGER
RP = REAR PASSENGER

An index has been drawn up for each individual accident (VDI covering collision deformation classification SAE 3224 a) and also for passenger compartment reduction as per the following:

VIDI is partly based on the same principles as the VDI and is meant to be used in combination with the VDI.

VDI gives a detailed specification of the location and extent of external deformation. VIDI is meant to complete this information regarding the reduction of the passenger compartment.

The amount of reduction is given in a 10-degrees linear scale with "0" meaning no reduction, "5" meaning reduction to the half and "X" meaning total reduction.

The location of the reduction is related to the seat/seats concerned.

Col 3-7 are used to indicate the reduction, where:

Col 3 means the deformation between the top of the rear seat back rest and the instrument panel (not overhanging padding) or intruding objects

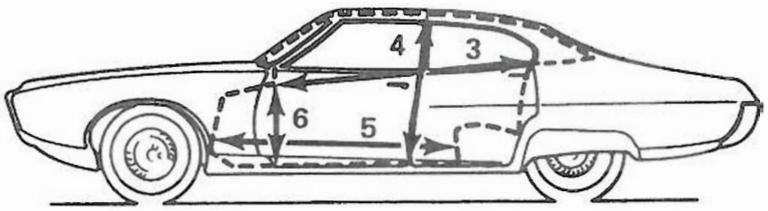
Col 4 means the deformation between floor and roof

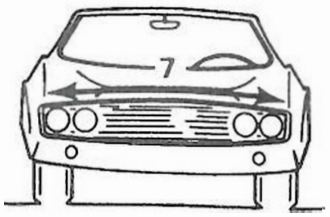
Col 5 means the deformation between the foremost lower part of the rear seat and the fire wall

Col 6 means the deformation between the lower part of the instrument panel and the floor

Col 7 means the inner width deformation.

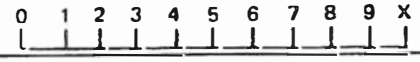
col 3 – 7





VIDI

DEFORMATION SCALE



INDEX COLUMN NO:- $\overline{1}$ $\overline{2}$ $\overline{3}$ $\overline{4}$ $\overline{5}$ $\overline{6}$ $\overline{7}$

ACCIDENT NO. 1

Volvo 142/1971, Type of accident: car underran truck.

Evaluation

1. Personal injuries due to contact with steering wheel.
   D 1
2. Examination of passenger compartment after accident indicates that correctly used safety belt would have had effect.
   D 1
3. Of no importance in this type of underrun accident.
   D 4
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. 65 m long skid marks from locked wheels.
   D 1

Remarks: Driver, sole occupant, killed.
Cause of death: chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: unknown, but probably not used.
Collision speed: below 50 km/h; estimated on extent of deformation VDI 12FRXA6, VIDI, 0.

Accident No. 1

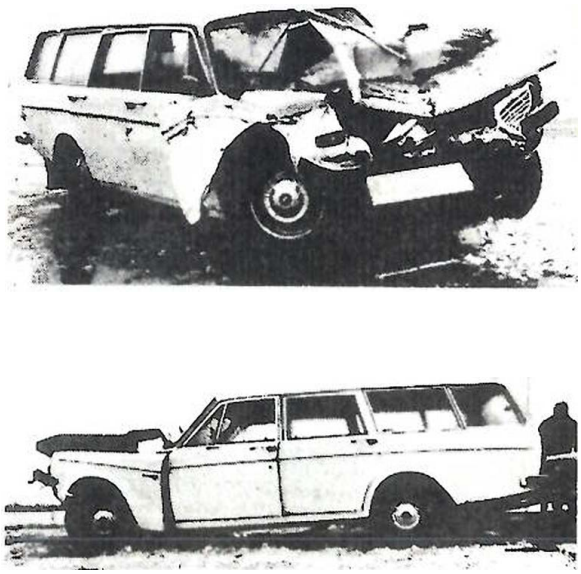
ACCIDENT NO. 2

Volvo 145/1969. Type of accident: head-on collision with road grader parked on highway.

Evaluation:

1. Rear-seat passenger, without seat belt, thrown forward onto driver causing extensive deformation of seat backrest and crushing driver to death against steering wheel and safety belt.
   D 1
2. Without unbelted rear seat passenger, safety belt would have had effect.
   D 1
3. Accident speed below 50 km/h. Passenger compartment largely intact.
   D 4
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. 102.5 m long skid marks from locked wheels.
   D 1

Remarks: Four occupants in accident vehicle. Driver killed; belted. Front-seat passenger seriously injured (AIS 5) crushed against dashboard; not belted. Rear-seat passenger slightly injured; not belted.
Cause of death: chest injuries.
Joint appraisal of occupants and accident vehicle.
Safety belt: used by driver.
Collision speed: below 50 km/h; estimated on extent of deformation. VDI 12 FZEW 3, VIDI FS10100.



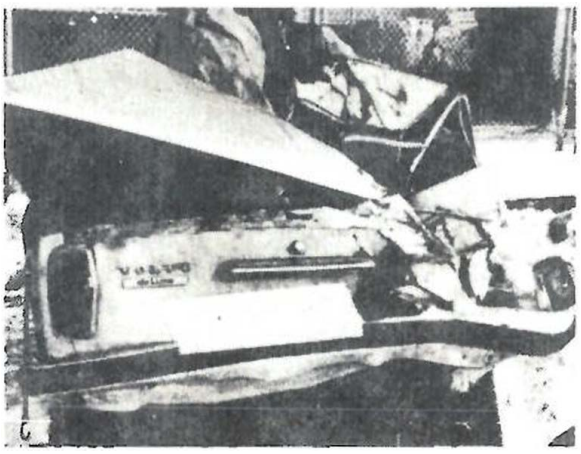
Accident No. 2

ACCIDENT NO. 3

Volvo 144/1972. Type of accident: skidded with rightside foremost against approaching truck of normal-control type.

Evaluation:

1. Severity of accident (see Item 4) was of such extent that influence of interior design can be disregarded.
   D 4
2. Driver was thrown from left to right side; can be presumed that had seat belt been used, would have had effect.
   D 2
3. Not applicable.
   D 5
4. Speed of skidding car was between 70 – 90 km/h; speed of approaching truck was 70 km/h, implying that conditions of VESC requirement were exceeded.
   D 3
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5



Accident No. 3

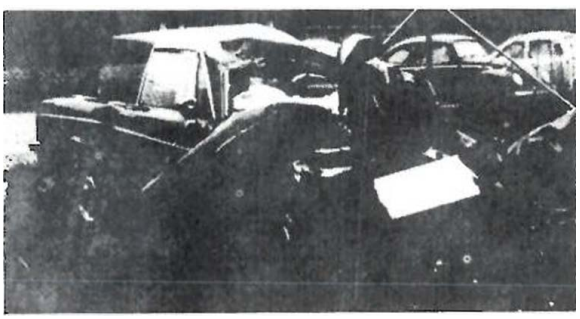
Remarks: Driver, sole occupant, killed.
Cause of death: head injury.
Joint appraisal of occupant and accident vehicle.
Safety belt: unknown, but probably not used.
Collision speed: Volvo 144, 70 – 90 km/h, truck 70 km/h; based on witnesses and time-speed recorder.
VDI 03RZAW5. VIDI RS00005.

ACCIDENT NO. 4

Volvo 142/1970. Type of accident: car underran truck.

Evaluation:

1. Severity of accident (see Item 3 below) was of such extent that influence of interior design can be disregarded.
   D 4
2. Use of safety belt would have had very limited effect, due to intrusion by truck platform and extensive deformation of the roof.
   D 3
3. Of no importance in this type of accident. Underrunning a stationary truck; speed 90 – 100 km/h
   D 4
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5



Accident No. 4

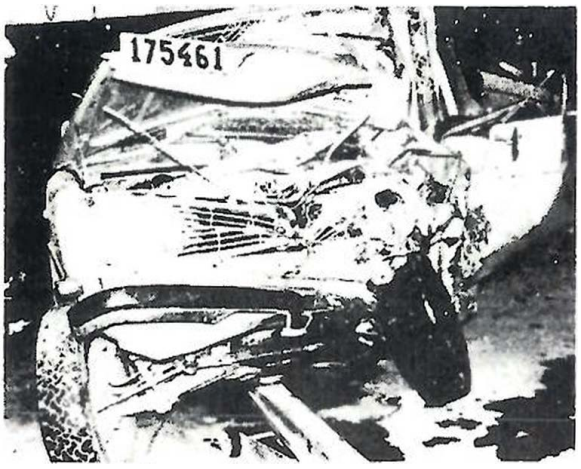
Remarks: Driver, sole occupant, killed.
Cause of death: head injury.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: approximately 100 km/h; based on witness reports.
VDI 2FDXA7. VIDI FS31390.

ACCIDENT NO. 5

Volvo 142/1970. Type of accident: off center frontal collision with approaching vehicle.

Evaluation:

1. Personal injuries caused by front seat passenger being crushed between dashboard and seat backrest, forced forward by dog weighing approximately 40 kg. Force of weight from rear is judged to have had considerable effect.
   FP I, Car 1
2. Passenger compartment area for front seat passengers was intact; therefore, correctly worn seat belts would have had effect.
   Passenger compartment in driver's seat was somewhat reduced, but is thought that safety belt also would have had effect here.
   FPl, Car 1
3. Passenger compartment on passenger side entirely intact; on driver's side, same reduction took place.
   FP 4, Car 2
4. Not applicable.
   FP 5, Car 5
5. Not applicable.
   FP 5, Car 5
6. Not applicable.
   FP 5, Car 5
7. Not applicable.
   FP 5, Car 5



Accident No. 5

Remarks: Front seat passenger died as result of injuries sustained in accident; driver probably died as result of acute cerebral hemorrhage, which could also explain the accident.
Cause of death: front seat passenger: chest injuries. Driver: intracranial bleeding.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: Volvo, 142 80 km/h, approaching car, 90 km/h; based on witness reports.
VDI 12FYEW6. VIDI LF20230.

ACCIDENT NO. 6

Volvo 142/1972. Type of accident: run into on rightside by normal-control truck.

Accident No. 6

Evaluation:

1. Severity of accident was of such extent that influence of interior design can largely be disregarded.
   D 4, FP 3, RP 3, Car 3
2. Driver was probably using safety belt. Quotation taken from autopsy report: "Diagonally across the front of the chest can be seen, from top left to bottom right, a number of hemorrhages approximately the size of a pinhead . . . Lower down, from the stomach across the hips, is a section where the outer skin is abraded and the cutis is dried out and reddish brown in color."
   Not possible to say whether passengers were wearing safety belts; but use of safety belt in this

type of accident is of lesser importance.
D 3, FP 3, RP 3, Car 3
3. Not applicable.
D 5, FP 5, RP 5, Car 5
4. VESC requirements could have had some positive effect.
D4, FP 3, RP 3, Car 3
5. Not applicable.
D 5, FP 5, RP 5, Car 5
6. Not applicable.
D 5, FP 5, RP 5, Car 5
7. Not applicable.
D 5, FP 5, RP 5, Car 5

Remarks: Three occupants of car killed.
Cause of death: driver: chest and abdominal injuries; front seat passenger: chest and abdominal injuries rear seat passenger: chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: used by driver.
Collision speed: intruding truck, above 50 km/h.
VDI 03PRAW4. VIDI RS00004.

ACCIDENT NO. 7

Volvo 145/1969. Type of accident: run into on left side by approaching vehicle; thereafter, thrown against guide rail and rolled over.

Evaluation:

1. Driver and front seat passenger used safety belts and escaped serious injury.
RP 4, Car 3
2. Three-year old girl sitting in rear seat was ejected from car when it rolled over and her head was crushed between car and road. Children's safety seat would probably have prevented this.
RP 1, Car 1
3. Not applicable.
RP 5, Car 5
4. Extensive side deformation (10 – 11 o'clock).
RP 4, Car 2
5. Not applicable.
RP 5, Car 5
6. No reduction of passenger compartment with regard to roof deformation.
RP 4, Car 4
7. Not applicable.
RP 4, Car 5

Remarks: Three-year-old girl sitting in rear seat was thrown out through right-hand rear door and her head was crushed between car and road when car rolled over. Children's safety seat not installed.
Cause of death: rear seat passenger: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: (not indicated).
Collision speed: Volvo 145, 90 km/h; other car, about 70 km/h.
VDI 11LYES3 1 2RDES1 00TDS01. VIDI LS 21333.

Accident No. 7

ACCIDENT No. 8

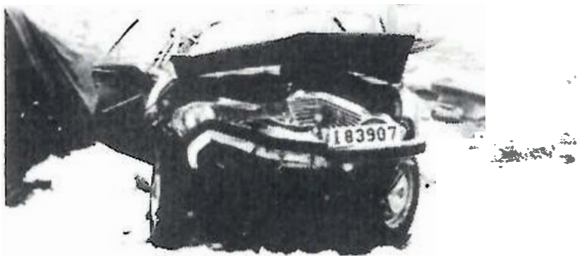
Volvo 144/1970. Type of accident: skidded against guide rail and was hit by approaching truck.

Evaluation:

1. Steering wheel and dashboard intact; otherwise, vehicle was total wreck rearwards of front seats.
D 4, Car 4
2. Correctly used seat belt would have had some effect for driver. With regard to this accident, effect would have been lower, due to extent of deformation.
D 2, Car 3
3. Head-on impact did not cause any reduction of passenger compartment; therefore, VESC-requirements would not have had any effect.
D 4, Car 4
4. Initial impact of truck was from rear offside (5 o'clock); therefore, side impact (anti-intrusion) would have had some effect.
D 3, Car 3

5. VESC requirement 80 km/h from rear is not wholly applicable, but would probably have had effect.
   D 3, Car 3
6. Not applicable.
   D 5, Car 5
7. Not applicable.
   D 5, Car 5

Remarks: Driver, sole occupant, killed; ejected from vehicle.
Cause of death: driver: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: Volvo 144, approx. 80 km/h; truck approx. 70 km/h.
VDI 12FDMN1 05RZAW8. VIDI BS52208.



Accident No. 8

ACCIDENT NO. 9

Volvo 142/1969. Type of accident: offside frontal collision with cliff (1 o'clock); thereafter, continued at 120° angle to left for 10 – 15 meters. Speed probably over 50 km/h.

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1, Car 1
2. Correctly used safety belt would have had effect.
   D 1, Car 1
3. VESC requirement 80 km/h against barrier would have had some effect.
   D 4, Car 3
4. Not applicable.
   D 5, Car 5
5. Not applicable.
   D 5, Car 5
6. Not applicable.
   D 5, Car 5
7. Not applicable.
   D 5, Car 5

Remarks: Driver, sole occupant, killed.
Cause of death: chest injuries
Joint appraisal of occupant and accident vehicle.
Safety belt: probably not used.
Collision speed: unknown, but estimated on extent of deformation as over 50 km/h.
VDI 01FZEW5. VIDI RS20330.

Accident No. 9

ACCIDENT NO. 10

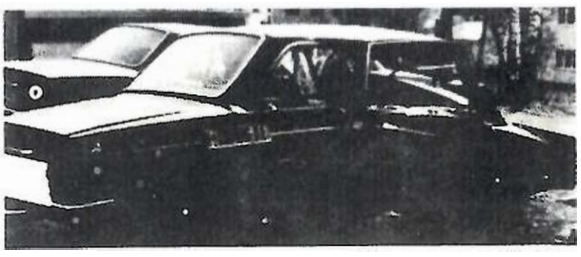
Volvo 142/1970. Type of accident: head-on collision (12 o'clock) with approaching vehicle (142 case 11).
Note: Possibility of acute heart attack having taken place immediately previous to accident can, according to autopsy report, not be ruled out. Accident was still appraised along lines of model.

Evaluation:

1. Personal injuries due to contact with dashboard and steering wheel.
   D 2
2. Correctly worn safety belt would have had effect.
   D 2

3. VESC requirements applicable; collision speed about 80 km/h.
   D 1
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Remarks: Driver, sole occupant, probably dead before accident, due to heart attack.
Cause of death: head and chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: probably not used.
Collision speed: over 80 km/h; estimated on extent of deformation.
VDI 12FDEW5. VIDI FS30350.



Accident No. 10

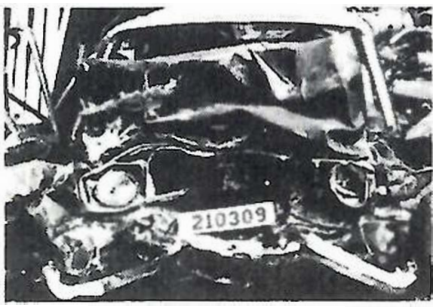
ACCIDENT NO. 11

Volvo 142/1971. Type of accident: head-on collision (12 o'clock) with approaching vehicle (142 case 10).

Evaluation:

1. Personal injuries due to contact with steering wheel. Seven-year-old girl thrown forward and sustained crushed skull.
   D 2, RP 2, Car 2
2. Correctly used safety belts would have had effect.
   D 2, RP 2, Car 2
3. VESC requirements applicable; collision speed about 80 km/h.
   D 1, RP 4, Car 1
4. Not applicable.
   D 5, RP 5, Car 5
5. Not applicable.
   D 5, RP 5, Car 5
6. Not applicable.
   D 5, RP 5, Car 5
7. Not applicable.
   D 5, RP 5, Car 5

Remarks: Driver and rear seat passenger killed.
Cause of death: driver: chest injuries; rear seat passenger: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: probably not used.
Collision speed: above 80 km/h; estimated on extent of deformation.
VDI 12FDEW5. VIDI FS30350



Accident No. 11

ACCIDENT NO. 12

Volvo 145/1972. Type of accident: offside frontal collision with approaching truck of forward-control type (11 o'clock).

Evaluation:

1. Front seat passenger crushed between dashboard and seat backrest. Seat backrest was forced for-

ward by rear seat passenger who was not using safety belt. A six-month-old boy lying on his mother's knee was crushed to death between mother and front seat backrest.
FP 1, RP 1, Car 1

2. Correctly used seat belts and children's seat would have had effect.
FP 1, RP 1, Car 1
3. VESC requirements would have had effect in this accident (fairly extensive deformation of driving area, driver was belted and escaped serious injury) but would probably have had no effect for deceased.
FP 4, RP 4, Car 2
4. Not applicable.
FP 5, RP 5, Car 5
5. Not applicable.
FP 5, RP 5, Car 5
6. Not applicable.
FP 5, RP 5, Car 5
7. Not applicable,
FP 5, RP 5, Car 5

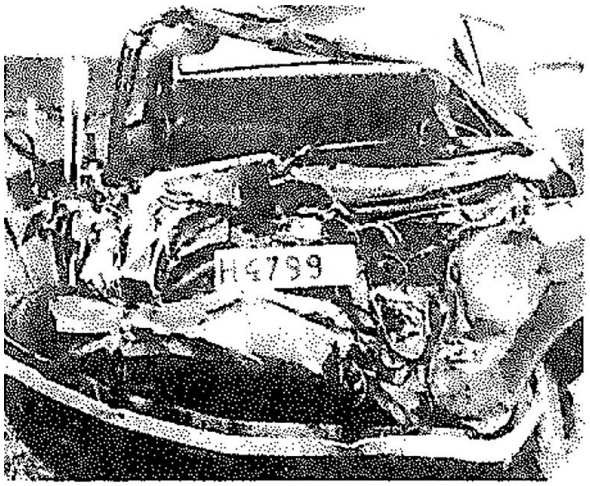
Accident No. 12

Remarks: Front seat passenger, and six-month-old boy lying on his mother's knee in rear seat, were killed. Other occupants, four persons, of which the driver was belted, escaped serious injury.

Cause of death: front seat passenger: chest injuries; rear seat passenger: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: (not indicated).
Collision speed: Volvo 145, approx. 60 km/h; truck 60 – 70 km/h; based on witness reports.
VDI 11FDEW6. VIDI LF20330.

ACCIDENT No. 13

Volvo 142/1968. Type of accident: frontal collision (11.30) with approaching truck of forward-control type.



Accident No. 13

Evaluation:

1. Personal injuries due to contact with steering wheel.
D 1
2. Driver had no injuries other than those to abdomen and chest; therefore, safety belt would have had effect.
D 1
3. Deformation pattern is of underrun type; therefore, VESC requirements would have had no effect.
D 4
4. Not applicable.
D 5

5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Remarks: driver: sole occupant, killed.
Cause of death: abdominal injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: (not indicated).
Collision speed: Volvo 142, unknown; truck 70 km/h, according to driver.
VDI 12FDXA7. VIDI FS21220.

ACCIDENT NO. 14

Volvo 142/1969. Type of accident: ran off road into ditch and turned over.

Accident No. 14

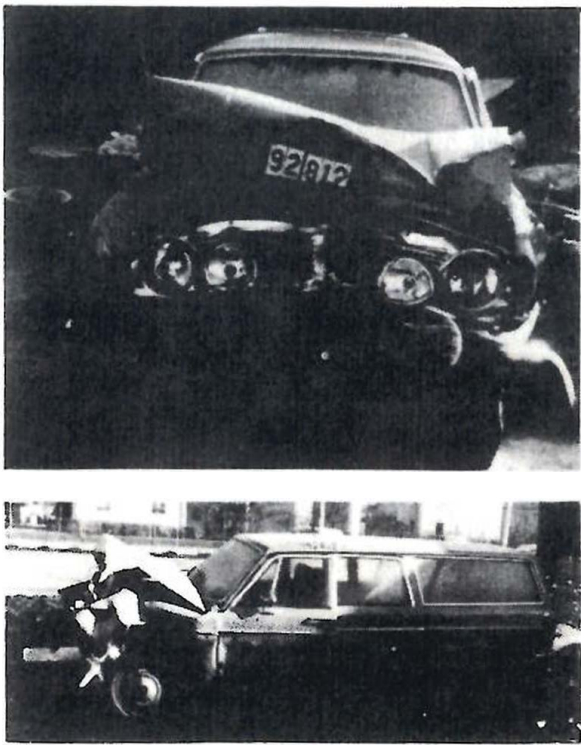
Evaluation:

1. Deceased, an eight-year-old boy lay on rear parcel shelf and was ejected from car when it rolled over. Other occupants of car were only slightly injured.
   RP 4
2. Correctly worn safety belt would have had effect.
   RP 1
3. Not applicable.
   RP 5
4. Not applicable.
   RP 5
5. Not applicable.
   RP 5
6. Deformation to vehicle very slight; VESC requirements would have had no effect. Fact that rear window "popped-out," however, is of considerable importance.
   RP 4
7. Not applicable.
   RP 5

Remarks: Eight-year-old boy lying on rear parcel shelf was killed.
Cause of death: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: approx. 90 km/h, according to driver.
VDI 00TDA01. VIDI AS010000.

ACCIDENT NO. 15

Volvo 145/1971. Type of accident: head-on collision (12 o'clock) with approaching vehicle.



Accident No. 15

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1
2. Correctly worn safety belt would have had effect.
   D 1
3. Collision speed below 50 km/h; VESC requirements would probably not have had any larger effect.
   D 3

4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Skid marks from locked wheels.
   D 2

Remarks: driver, sole occupant, killed.
Cause of death: chest and abdominal injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: probably not used.
Collision speed: Volvo 145, about 50 km/h.
VDI 12FDEW2. VIDI 0.

ACCIDENT NO. 16

Volvo 145/1969. Type of accident: skidded against tree, left side first.

Accident No. 16

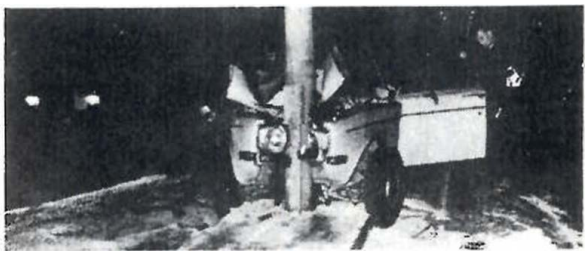
Evaluation:

1. Severity of accident was such that influence of interior design can be disregarded.
   D 4
2. Same as above for safety belts.
   D 4
3. Not applicable.
   D 5
4. Severity of accident considerably exceeded VESC requirements; their effect would have been limited.
   D 3
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Remarks: driver, sole occupant, killed.
Cause of death: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used
Collision speed: unknown.
VDI 90LPAN5, VIDI LS 00005.

ACCIDENT NO. 17

Volvo 144/1970. Type of accident: head-on collision with pole (12 o'clock).



Accident No. 17

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1
2. Correctly worn safety belt would have had effect. Front seat passenger escaped serious injury; was using safety belt.
   D 1

3. Passenger compartment was relatively intact; VESC requirements would have had limited effect.
   D 3
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Cause of death: driver: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt not indicated.
Collision speed: 60 – 70 km/h, according to passenger and deformation extent.
VDI 12FCEN3, VIDI FS10100.

Footnote:
The driver, a 50-year old woman, had her safety belt buckled. During the analysis to determine the fatal-head injuries sustained, it became quite evident (from assertions by the police and the rescue people appearing first on the accident scene), that the length of belt had been very poorly adjusted. The much decreased restraint efficiency which resulted was further pronounced by the fact that the woman driver was sitting close to the steering wheel. The case investigators, therefore, considered it justified to conclude that the belt had not been used and the case was codified accordingly.

The front seat passenger, who had his belt properly adjusted sustained only moderate injuries.

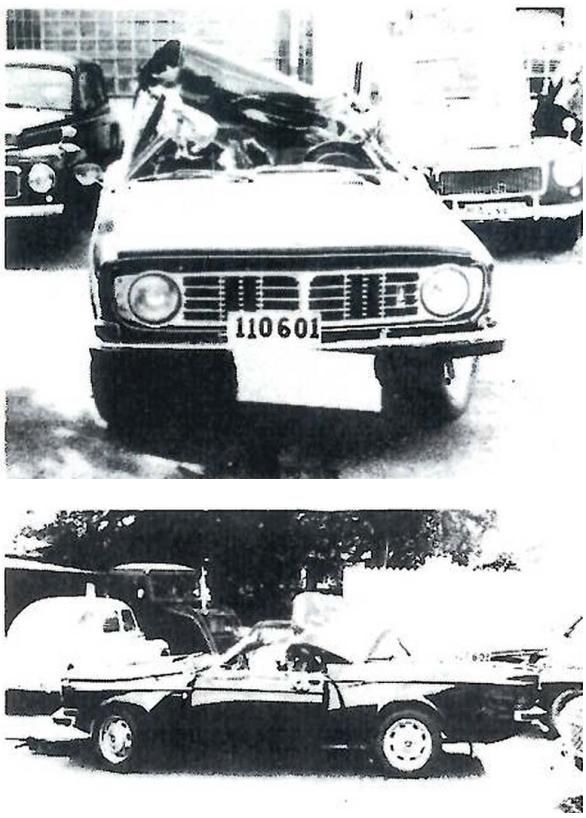
ACCIDENT NO. 18

Volvo 142/1969. Type of accident: front loader with bucket elevated approx. 1 m. Drove out from left side in front of Volvo 142 which was overtaking. Bucket hit Volvo slightly above engine bonnet and across half the car's width.

Evaluation:

1. This type of accident cannot be evaluated with regard to items 1 – 6.
   D 5
2. D 5
3. D 5
4. D 5
5. D 5
6. D 5
7. Not applicable.
   D 5

Remarks: Driver was killed and front seat passenger slightly injured.
Cause of death: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: 90 km/h, according to witnesses.
VDI 12FLGA9. VIDI LSX5000.



Accident No. 18

ACCIDENT NO. 19

Volvo 142/1970. Type of accident: ran off road and crashed into adjoining road bank.

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1
2. Correctly worn safety belt would have had effect.
   D 1
3. Deformation localized to lower section of front; of slight extent
   D 4
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Remarks: Driver sustained injuries to chest and died 20 days later. Two passengers were slightly injured.
Cause of death: pulmonary embolism.
Joint appraisal of occupant and accident vehicle.

Safety belt: not used.
Collision speed: approx. 70 km/h, according to witnesses.
VDI 12FDLW1. VIDI 0.

Accident No. 19

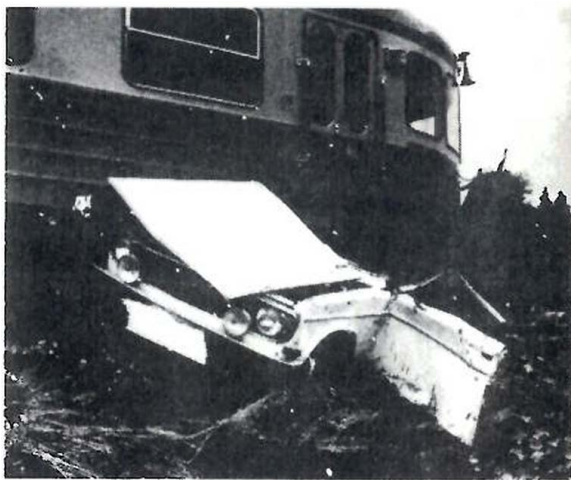
ACCIDENT NO. 20

Volvo 142/1971. Type of accident: run into by rail bus on right hand side.

Evaluation:

1. Vehicle completely destroyed.
   D 4, FP 4, Car 4
2. See Item 1.
   D 4, FP 4, Car 4
3. Not applicable.
   D 5, FP 5, Car 5
4. See Item 1.
   D 5, FP 5, Car 5
5. Not applicable.
   D 5, FP 5, Car 5
6. Not applicable.
   D 5, FP 5, Car 5
7. Not applicable.
   D 5, FP 5, Car 5

Remarks: Both the driver and front seat passenger were killed.
Cause of death: driver: total laceration; front seat passenger: total laceration.
Joint appraisal of occupant and accident vehicle.
Safety belt: (not indicated).
Collision speed: rail bus, 110 km/h, substantiated information.
VDI 03X. VIDI AS X.



Accident No. 20

ACCIDENT NO. 21

Volvo 142/1968. Type of accident: frontal collision with approaching vehicle (Volvo 145).

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1
2. Correctly worn safety belt would have had effect. Driver of other vehicle escaped injury; was wearing safety belt.
   D 1
3. Collision speed relatively low, not above 50 km/h. Passenger compartment intact.
   D 4
4. Not applicable.
   D 5

5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Short skid marks, approx. 10 m.
   D 4

Remarks: driver, sole occupant, killed.
Cause of death: chest and abdominal injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: below 50 km/h; estimated on extent of deformation.
VDI 11 FDEW1. VIDI 0.

Accident No. 21

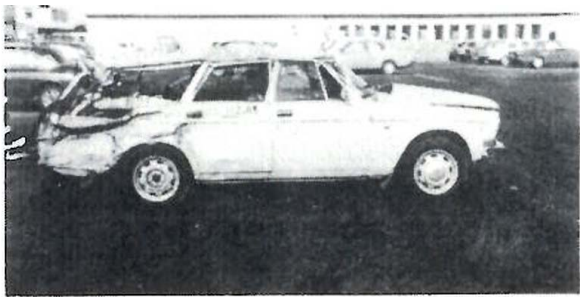
ACCIDENT NO. 22

Volvo 145/1972. Type of accident: run into by approaching car from side and rolled over.

Evaluation:

1. Design of interior would not appear to have had any importance in this accident.
   RP 4
2. Correctly worn safety belt would have had effect.
   RP 1
3. Not applicable.
   RP 5
4. VESC requirements of no importance in this accident. Vehicle was hit behind rear wheel and spun 90° after which it turned over twice.
   RP 4
5. Not applicable.
   RP 5
6. Slight roof deformation.
   RP 4
7. Not applicable.
   RP 5

Remarks: Woman, 72 year old, sitting in front seat killed.
Cause of death: chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: Volvo 145, 70 km/h; other car, approx. 50 km/h, according to drivers.
VDI 03RBEW2 00TDAO1. VIDI RS01000.



Accident No. 22

ACCIDENT NO. 23

Volvo 145/1971. Type of accident: hit on right side by bus.

Evaluation:

1. Interior design could have been of importance.
   FP 2
2. Use of safety belts would probably not have been of importance in this accident.
   FP 3
3. Not applicable.
   FP 5
4. Judging from deformation pattern, VESC requirements may have had effect.
   FP 2
5. Not applicable.
   FP 5
6. Not applicable.
   FP 5
7. Not applicable.
   FP 5

Remarks: Front seat passenger killed.
Cause of death: chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: (unknown)
Joint Appraisal of occupant and accident vehicle.
Collision speed: bus, approx. 50 km/h.
VDI 03RPAW3. VIDI RS00003.

Accident No. 23

ACCIDENT NO. 24

Volvo 142/1968. Type of accident: car skidded and was rammed by approaching car on A-pillar, left side. Impact approach, 11 o'clock.

Evaluation:

1. Personal injuries can, in part, be due to contact with steering wheel.
   D 3
2. Correctly worn safety belt would probably have had some effect.
   D 3
3. Not applicable.
   D 5
4. VESC requirements for side impact would have had effect.
   D1
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Remarks: Driver, sole occupant, killed; found after accident lying beside his vehicle.
Cause of death: chest and adbominal injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used
Collision speed: Volvo 142, unknown; other car, 60 km/h, according to driver.
VDI 11LPES 3. VIDI LS10003.

Accident No. 24

ACCIDENT NO. 25

Volvo 142/1971. Type of accident: skidded against asphalt edge and rolled over.

Evaluation:

1. Interior design of no importance.
   D 4
2. Correctly worn seat belt would have had effect.
   D 1
3. Not applicable.
   D 5
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Passenger compartment fully intact. Driver's head was ejected through right-hand side window and was crushed between car and road.
   D 4
7. Not applicable.
   D 5

Remarks: driver, sole occupant, killed.
Cause of death: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: unknown.
VDI 00TDAO 1. VIDI 0.

Accident No. 25

ACCIDENT NOS. 26, 27

Volvo 145/71 and 145/72. Type of accident: head-on collision, exactly 12 o'clock and centered.

Evaluation:

1. Severity of accident was such that no evaluation could be made on any of the items.
   Both 26 and 28: D 4
2. Vehicle deformation 175 cm each.
   Both 26 and 27: D 4
3. Possibly some effect.
   Both 26 and 27: D 3
4. Not applicable.
   Both 26 and 27: D 5
5. Not applicable.
   Both 26 and 27: D 5
6. Not applicable.
   Both 26 and 27: D 5
7. Not applicable.
   Both 26 and 27: D 5

Remarks: Two drivers, each sole occupant of their cars, were killed.
Cause of death: Driver 1: chest and abdominal injuries.
Cause of death: Driver 2: chest, head and abdominal injuries.
Joint appraisal of occupants and accident vehicles
Safety belt: one driver probably wearing safety belt.
Collision speed: unknown.
VDI 12 FDAW 7. VIDI FS 41590.
VDI 12 FDAW 7. VIDI FS 41590.

Accidents Nos. 26, 27

ACCIDENT NO. 28

Volvo 142/1971. Type of accident: frontal collision with approaching car.

Evaluation:

1. Personal injuries due to contact with steering wheel.
   D 1
2. Correctly used safety belt would have had effect.
   D 1
3. Collision speed below 50 km/h.
   No reduction of passenger compartment.
   D 4
4. Not applicable.
   D 5
5. Not applicable.
   D 5
6. Not applicable.
   D 5
7. Not applicable.
   D 5

Accident No. 28

Accident 28 (Cont'd)

Remarks: Driver was killed; passenger escaped serious injury.
Cause of death: Driver: chest injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: below 50 km/h; estimated on extent of deformation.
VDI [illegible] VDI 0.

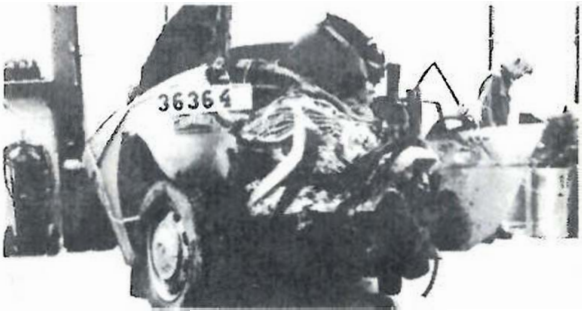
ACCIDENT NO. 29

Volvo 145/1970. Type of accident: offside frontal collision with approaching car.

Evaluation:

1. Severity of accident and accident situation were of such a nature that interior design, with regard to driving area, would only have had slight effect. However, improved interior design would have been of great importance for other occupants.
   D 3, FP 2, RP 2, Car 2
2. Use of safety belt by driver, would have had limited effect; for other occupants, safety belts would have had effect. Passenger compartment was relatively intact in passenger areas.
   D 3, FP 2, RP 2, Car 2
3. Collision conditions for VESC requirements were exceeded widely. Speed of Volvo 145, approx. 80 km/h and approaching vehicle approx. 100 km/h. Probability that VESC requirements on frontal collision would have been of importance for driver.
   D 3, FP 4, RP 4, Car 3
4. Not applicable.
   D 5, FP 5, RP 5, Car 5
5. Not applicable.
   D 5, FP 5, RP 5, Car 5
6. Not applicable.
   D 5, FP 5, RP 5, Car 5
7. Not applicable.
   D 5, FP 5, RP 5, Car 5

Remarks: Three of four occupants in vehicle were killed.
Cause of death: driver: head, chest and abdominal injuries; rear seat passenger: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: unknown.
Collision speed: Volvo 145, approx. 80 km/h; other car approx. 100 km/h.
VDI 11 FDEW 7. VIDI LF40492.



Accident No. 29

ACCIDENT NO. 30

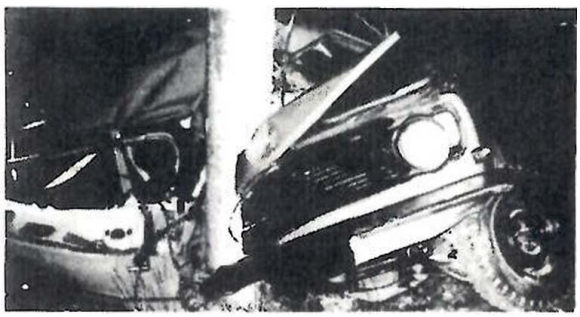
Volvo 142/1969. Type of accident: skidded off road, right side of car hit pole.

Evaluation:

1. Passenger compartment on driver's side relatively intact.
   Interior improvements would, therefore, have had effect.
   D 2, Car 2
2. Correctly worn safety belt would have had effect.
   D 2, Car 2
3. Not applicable.
   D 5, Car 5
4. Judged on condition of vehicle after accident, VESC requirements could have been of some

importance.
D 4, Car 3
5. Not applicable.
D 5, Car 5
6. Not applicable.
D 5, Car 5
7. Not applicable.
D 5, Car 5

Remarks: driver, sole occupant, killed.
Cause of death: head injuries.
Joint appraisal of occupant and accident vehicle.
Safety belt: not used.
Collision speed: approx. 80 km/h, according to witnesses.
VDI 01 RYAN 3. RF 32222 LF 11000.



Accident No. 30

ACCIDENT NO. 31

Volvo 145/1972. Type of accident: frontal collision with approaching vehicle.

Evaluation:

1. Front seat passenger killed. Was using safety belt but was crushed through weight of two dogs in rear seat, weighing 35 – 40 kg each. Driver without safety belt. Moderate injuries.
FP 1
2. Correctly worn safety belts would have had effect.
FP 1
3. VESC requirements of no importance. Speed below or about 50 km/h. No reduction of passenger compartment.
FP 4
4. Not applicable.
FP 5
5. Not applicable.
FP 5
6. Not applicable.
FP 5
7. Not applicable.
FP 5

Remarks: Front seat passenger, a woman wearing a safety belt died after approximately 30 days, due to changes in condition of lungs resulting from accident.
Joint appraisal of occupant and accident vehicle.
Safety belt: used by front seat passenger but not by driver.
Collision speed: approx. 50 km/h.
VDI 12 FDEW 2. VIDI 0.

Accident No. 31