CHAPTER VII: RECALLS AND DEFECTIVE VEHICLES

Definition and Prevalence of Defects in New Vehicles

202. The matter of defects in new vehicles is one which the Committee gave considerable attention throughout the inquiry. The Committee notes that it is a subject which in the past has received little attention in road safety inquiries and at conferences conducted in Australia. The elimination of defects in new vehicles is an important factor in ensuring maximum safety performance of vehicles on the road. This subject therefore, deserves the close attention and improvement by vehicle manufacturers, government authorities, consumer organisations and other responsible groups.

203. Vehicle defects fall primarily into two categories - safety related defects which may cost the consumer his life, and the others, which, although they may cost him money, are not vital to his safety. Whilst the vast majority of defects found are not safety related, the incidence of potentially dangerous defects have been brought to the attention of the Committee in correspondence and in evidence.

204. For the purposes of defining a safety related defect, the FCAI refers to a design defect as "An incorrect, defective or insufficient specification of a component or assembly which could or would cause the vehicle to be in an unsafe condition"; a manufacturing defect is "A defect in a component or assembly caused by an incorrect or faulty material or process which could or would cause the vehicle to be in an unsafe condition"; and safety related is "A Safety Related component or assembly is one on which the vehicle depends for its safe condition."[13].

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13. Federal Chamber of Automotive Industries, A Uniform Code of Practice for Safety Related Campaigns, Revised, June 1975.

205. No witness suggested to the Committee that all vehicles are or could be produced without faults. At the other end of the scale the AAA stated to the Committee that they had not yet inspected a vehicle that had been completely free of faults. Sometimes it was a whole string of minor imperfections - faulty paintwork, light bulbs that did not work. Sometimes it was important faults - brake stop lights, which did not work, speedometers that quivered, door catches that did not operate, and steering and headlamps that were out of alignment. The Committee's concern is just to what extent faults are occurring, what proportion of these are safety related, and to what extent vehicle defects are a contributing factor in road accidents.

206. The Committee realises that the existence of a safety related defect in a particular vehicle does not necessarily mean that that vehicle will have an accident. It means however, that its probability of being involved in an accident is increased. While it is not known, nor can it be estimated with any confidence, the extent ot this probability for any particular defect, the very existence of vehicle defects indicates to the Committee that every effort must be made to remedy those defects and as far as possible eliminate one of the factors of accident causation.

207. During the inquiry the Committee was made aware that non-safety related defects such as defective body work were generally clearly identifiable and evidence of their prevalence would appear to indicate a manufacturer's problem of quality control. The implications of this for the not so readily identifiable safety related defects, such as steering, brakes and some engine defects, are considered quite important (for further comments on consumer protection and quality control see later chapters of this report).

208. The Committee has studied two reports of AAA on vehicle defects inspected during the warranty period by its constituent member organisations.[14] The first report[15] released in March 1973 was based on testing 3500 vehicles covering 16 popular models. The report showed that all of them had defective parts which could affect safety, or cost the motorist money. The most common faults were brakes, steering, lighting systems and oil leaks from the engine and transmission. The report stated that some of the defects could be eliminated by better quality control at the factory or by the dealer during servicing.

209. The second report was released in May 1974[16] and covered 13,000 vehicles inspected under warranty during 1973 comprising 50 models which were allocated to 23 model groups. The report reached similar conclusions to the earlier report but stated that there had been noticeable improvements since 1972, for example in steering alignment, tyre balance and ignition systems. However, the report stated that it was clear that manufacturers needed to do much more to reduce the number of defects and faults occurring in areas such as brakes, oil leaks, body assembly, signalling lamps, etc.

210. The first report was criticised by the manufacturers on the grounds that the samples for some models were too small. In addition, it was difficult to establish the relationship of the vehicles sampled to the general population of new vehicles as delivered to the consumer and as presented at the end of the warranty period. However, AAA in its second

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14. A report on a third similar survey released on 20 May 1976, following the writing of this report, indicated that the situation was one "of no change" since the earlier reports.

15. Australian Automobile Association (AAA), Report on Vehicle Defects Within The Warranty Period, Canberra, March 9, 1973.

16. Australian Automobile Association (AAA), Vehicle Inspection Results for Cars Under Warranty, Canberra, May, 1974.

report, which used larger samples, suggested that it verified the results shown in the earlier report and industry representatives had recognised that the inspections were technically sound and that the report was factual.

211. Other criticisms of the report were that the cars covered by the survey may have been up to two years old by the time of publication and manufacturers may have already taken action to remedy weaknesses found in the field. Some of the defects may have been more in the nature of maintenance items.

212. The Department of Transport informed the Committee in relation to the AAA reports that the data published was an important source of information about defects in new vehicles. The Committee was also informed that while the number of vehicles inspected amounted to about 3 per cent of those sold in the period and since the vehicles may have been submitted for inspection by AAA members because of some problems they were having, it could not be assumed that they constituted a random sample of vehicles produced. The Department said that, although the survey could not be shown to represent a random sample of new vehicles as received by the purchaser, and in several items the method of recording could artificially increase the numbers of faults shown, the fact remains that the survey results raised a number of questions which needed to be answered in the public interest.

213. Following the second survey the Minister for Transport convened meetings between the vehicle industry and AAA to discuss the implications of the AAA survey. As a result AAA decided to introduce some amendments to its inspection procedures to ensure that future results will be more specific in defining the numbers and the severity of defects.

214. The Department of Transport concluded that undeniably, the AAA reports suggest that many near new vehicles have defects in a number of areas, some safety related. Where a

defect is found to repeat in low mileage vehicles, it is reasonable to assume that there is an inadequacy in one or more of the following areas:

vehicle design and development
quality control in manufacture
pre-delivery service

The Committee notes the Department's view that improvement could be achieved by changes in one or more of these areas.

215. The Committee has also noted the conclusion of AAA that -

> it is not inferred that all the defects reported could have been avoided by the manufacturer or by his servicing organisation. Cars obviously need maintenance to keep them in first class condition. Nevertheless, the manufacturer is responsible for the design and for the care taken in manufacture and these factors strongly influence the amount of maintenance needed.

216. Evidence in relation to defects was also received from the Army Quality Assurance Service which carries out the inspection of new vehicles purchased by the Department of Defence and vehicles purchased by the Department of Manufacturing Industry (Stores and Transport Branch) and other Federal Government departments. The Army does not test vehicles purchased by the Departments of Works and Construction and Transport, or the Telecommunications Commission. The Committee was informed that the government departments and instrumentalities which have occasion to purchase vehicles for their own use or purposes have found it expedient to use the Quality Assurance Service of an already established independent government organisation rather than set up their own service or rely on private industry concerns. Army undertakes new vehicle inspection

for other departments by mutual negotiations and arrangements only.

217. The Committee was provided with information from the Army on results of inspections carried out in early 1972 on 660 Ford Falcon utilities and 176 Holden Belmont vehicles. It was stated that with regard to the Ford vehicles, an average of 9.1 faults per vehicle were recorded which could well have been occasioned by some complacency on the part of the contractor. The company informed the Committee in respect of these figures that since 1972 there had been many changes in their product designs, supplier reliability and internal plant systems. For instance, in addition to revamping and supplementing normal final buy-off procedures, Ford now fully predelivers and obtains Government inspection buy-off at the plant of manufacture for the types of units referred to in the Army report.

218. In relation to the Holden vehicles, it was stated that the average number of faults per vehicle was 8.05. GMH informed the Committee that the results could not reasonably be used as a current measure of performance, particularly as extensive changes in design, in processing and in the organisation of quality control operations in GMH had occurred since that date.

219. Further results of Army inspection were received by the Committee relating to the period December 1974 to May 1975. A summary of faults discovered in new vehicles presented for acceptance by the Directorate of Army Quality Assurance appears as Appendix 12. Despite the advice that the proportion of safety related defects was found to be low, the Committee is concerned at the figures and regards 121 brake faults in 319 Falcon utilities inspected as alarmingly high.

220. In its submission the Army informed the Committee that -

> Upon examination, the nature of the defects although occurring in a sensitive area and although revealing a necessity for stricter quality control reveals that their existence does not necessarily constitute an immediate direct or potential safety hazard. We give attention to the brakes and record all defects because of the necessity to direct attention to inadequate quality control and the possible rather than the probable dangers ...one can appreciate the reaction of some dealers say, who would shrug off some of these defects as over sensitive reporting. We do not regard them lightly - they are indicative of a quality control malaise.

221. The then Department of Manufacturing Industry indicated that over a relatively short period (1 January 1975 to 30 June 1975), 303 in-service defects had been reported in the Stores and Transport fleet. The defects had been discovered after the Army Quality Assurance inspection and following registration. Sixty-eight defects were regarded as safety related. In effect, the defects occurred during the warranty period. The average size of the fleet for the period was 2,500 vehicles.

222. Further evidence was received from the Telecommunications Commission which operates 16,800 vehicles (The Postal Commission operates 1,200 vehicles). The following table was presented to the Committee.

TABLE 2.

SOME RESULTS OF RECENT INSPECTION OF CHRYSLER SEDANS, DERIVATIVES AND LIGHT COMMERCIAL VEHICLES.

Number inspected	147
Actual number of inspections per vehicle	Not less than 2; no greater than 4
Average number of inspections necessary per vehicle	2.6
Average number of inspection manhours per vehicle	1.5

Average number of major defects found initially per vehicle	0.2
Average number of minor defects per vehicle	17
Average number of paint touch-ups per vehicle	3.2

Source: Evidence p. 4543

It was stated that of the 30 major defects found in the sample of 147 light vehicles, only a few of these would present safety hazards. It was also stated that the high standard of the Telecommunications Commission's pre-delivery inspection had contributed to the small proportion of defects and in some cases had prevented some unsafe vehicles being taken on the road. Normally without this inspection they would have remained in service until repair under warranty.

223. The Department of the Capital Territory informed the Committee that new vehicles are either tested at the Department's Testing Station, or tested by "authorised dealers" prior to first registration. Although no reliable figures were made available on defects discovered in new vehicles, the Committee was told in evidence that communication with manufacturers has resulted in action being taken from time to time on recurring safety related defects.

224. The Consumer Affairs Bureau of the Department of the Capital Territory suggested to the Committee that there was a high frequency of faults in new motor vehicles. While there were only 43 formal complaints in 1973-74, these complaints only represented the "tip of the iceberg" in so far as the total number of faulty vehicles was concerned. Some of the reasons advanced to explain this point of view were that many people were not aware of how or where to lodge complaints, but more importantly, a large number of persons either do not know their legal rights, or, are

reluctant to exercise them. Apart from the formal complaints received by the Bureau, more than 4,000 telephone enquiries were handled during 1973-74 and a percentage of these would have referred to new motor vehicles.

225. Further evidence of the incidence of defects was received from State government departments and instrumentalities in relation to defects in new vehicles purchased for government use together with new vehicle complaints received by State government consumer branches. The information received is too numerous to be outlined in detail. The Committee makes the observation however, that the total evidence is indicative of a nation-wide problem which the Committee views with considerable concern. The Committee noted that some State governments were unable to provide overall figures on defects found in vehicles purchased for government use through not having effective centralised inspection and recording systems.

226. In addition to many individual cases of defective new vehicles brought to the Committee's attention, the Australian Car Consumers' Association (CCA) provided numerous examples of allegedly serious safety related defects. CCA suspected "that the percentage of accidents attributable to vehicle safety defects is alarmingly high" but admitted that all of their evidence was circumstantial. The CCA referred to the report on the Road Accident Situation in Australia which stated that several surveys had indicated that vehicle defects "were a contributing factor in between 8 per cent and 25 per cent of all accidents investigated".[17] The Committee is not in a position to comment on the individual

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17. Expert Group on Road Safety, Road Accident Situation in Australia, p. 49.

examples of defects referred to by CCA but regards the material as prima facie evidence of the existence of vehicle defects with serious safety implications.

227. The Sub-committee recommends -

- That the Bureau of Road Safety investigate means by which all appropriate bodies which inspect new vehicles, including State governments, will be required or requested to formally advise the Bureau of detailed results of their inspections in respect of safety related defects.

- That the Bureau of Road Safety communicate to manufacturers evidence of serious or recurring safety related defects and seek their co-operation with regard to their correction.

- That the Federal Government establish a stricter procedure for the comprehensive inspection and recording of safety related defects in new vehicles and that the testing of vehicles be conducted by the Army Quality Assurance Service on behalf of all Federal departments and instrumentalities on a cost-share basis.

Recall Codes

228. Until recently the system of recalling defective vehicles throughout Australia and almost every other country was on a voluntary basis by the vehicle manufacturer. These

schemes were not subject to legislative direction and varied widely in the criteria used, and the coverage and duration of the scheme. The United States was one of the first countries in the world to prescribe through legislation a set of conditions which had to be satisfied by manufacturers during what are termed "recall campaigns". The Committee was informed that, as far as can be determined, the United States and Canada are the only countries where a government operated recall system is in existence. In Australia, the method of recalling defective vehicles is in accordance with a code of practice framed and conducted by the FCAI.

The United States Recall System

229. The National Traffic and Motor Vehicle Safety Act of 1966[18] requires that -

> Every manufacturer of motor vehicles shall furnish notification of any defect in any motor vehicle or motor vehicle equipment produced by such manufacturer which he determines, in good faith, relates to motor vehicle safety, to the purchaser (where known to the manufacturer) of such motor vehicle or motor vehicle equipment, within a reasonable time after such manufacturer has discovered such defect.

The purpose of the National Traffic and Motor Vehicle Safety Act is to reduce traffic accidents and resulting deaths and injuries. The Act provides that the Secretary of Transportation shall notify the manufacturer of any defective motor vehicle or item of motor vehicle equipment that relates to motor vehicle safety.

230. The Act further provides that a manufacturer of motor vehicles shall notify owners of any defect in the performance, construction, components, or material of any motor vehicle or item of motor vehicle equipment which affects safety. Such

18. National Traffic and Motor Vehicle Safety Act of 1966, as amended (15 USC 1381), Section 113(a).

notifications, or recall campaigns, are to contain a clear description of the defect, an evaluation of the defect's risk to traffic safety, and a statement of the measures to be taken to repair the defect. The manufacturers are also required to notify their dealers of such defects within a reasonable time after its discovery. Copies of all notices, bulletins, and other communications to dealers or purchasers regarding defects must be furnished to the Secretary. The National Highway Traffic Safety Administration (NHTSA) administers the Act. The Safety Administration and the manufacturer are responsible for identifying motor vehicle defects. The Safety Administration deals with defects in two phases - investigating possible safety defects and monitoring vehicle recall campaigns.

231. A recent report on a review of the recall system by the Comptroller General of the United States to the Committee on Commerce of the United States Senate[19] indicated that from the inception of the motor vehicle safety program in late 1966 through June 1974, domestic and foreign manufacturers conducted 1,582 defect notification campaigns and recalled over 45.7 million vehicles for various safety reasons. The review indicates that the Safety Administration has influenced 160 of the manufacturers' recalls for safety defects. These recalls involved about 22.7 million vehicles and 1.2 million items of equipment.[20]

232. The Safety Administration receives 800 to 1,500 letters a month containing complaints about the performance of motor vehicles and motor vehicle equipment, indicating a possible safety-related defect. More than 50 per cent of the letters are received directly from vehicle owners. Consumer-oriented groups, the Congress, Government agencies, and insurance companies are other major sources of consumer complaints.

19. Comptroller General of the United States, The Auto Safety Program: Identifying Defects and Recalling Defective Vehicles, Report to the Committee on Commerce, United States Senate, February 11, 1975

20. Comptroller General, p.i.

233. Before October 1971 the Safety Administration could not measure the success of any particular campaign; however, at that time, it began requring manufacturers to report on the results of recall campaigns.

234. The Report to the Committee on Commerce indicated that recall campaigns, even when the manufacturer pays for correcting the defect, had not been completely successful.[21] The experience with recall campaigns between October 1971 and March 1974 is set out in the following table:

TABLE 3

SUCCESS RATES OF UNITED STATES RECALL CAMPAIGNS
OCTOBER 1971 TO MARCH 1974

Manufacturer	Number of Recalls	Number of Vehicles Recalled	Vehicles Inspected/ Corrected	Per Cent Inspected/ Corrected
Domestic	244	15,049,000	6,321,000	42.0
Foreign	54	4,302,000	220,000	05.1
Total	298	19,351,000	6,541,000	33.8

Source: Comptroller General, p. 5.

235. A considerable number of recalled vehicles had never been inspected and/or corrected. The report states, however, that three recalls involving over 14 million vehicles had drastically affected the overall results. Excluding these three recalls increases the percentage of vehicles inspected and/or corrected for the remaining 295 recalls to 64 per cent for domestic and 33 per cent for foreign manufacturers - or 60 per cent overall.

236. One important feature of the U.S. system investigated by the Committee is the dissemination of a monthly report basically for the information of consumers.[22] It lists

21. Comptroller General, p.p. 5-6.

22. See, for example, National Highway Traffic Safety Administration, Department of Transportation News, Monthly Defect Investigatory Cases Report, June 1974. NHTSA 92-74 (ELW).

current and recently completed investigations by NHTSA for claimed defects. Other similar publications are issued at less frequent intervals. The Committee noted that the monthly reports invite interested persons, including those with information bearing on current investigations, to write to the NHTSA indicating all pertinent facts relating to vehicle defects. Consumers are also informed of their right to review summaries of the NHTSA's findings in terminated cases or suspended cases.

237. The U.S.'s experience of recalling vehicles under the system outlined above indicates to the Committee a less than satisfactory success rate in ensuring correction of defective vehicles. The U.S. still has problems which need to be overcome. It is to be expected that there will never be absolute correction of vehicles or completion of all recall campaigns.

The Australian Code for Safety Related Defects

238. The present practice of recalling faulty vehicles in Australia is conducted in accordance with "A Uniform Code of Practice for Safety Related Defect Campaigns" prepared under the direction of the Executive Committee of the FCAI and endorsed by members of that organisation to operate from 1 September 1972. The Code was revised in June 1975 and a copy of the revised Code appears as Appendix 13.

239. The purpose of the Code is to provide uniform minimum standards and procedures for initiating and conducting a campaign in relation to safety related defects in vehicles and/or parts. The Code does not prevent any of the adopting parties from exceeding these standards or procedures either generally or in any particular case.

240. Until the adoption of this Code the initiation and conduct of recalling vehicles was on an ad hoc basis and entirely at the discretion of individual manufacturers, assemblers or importers. The Department of Transport informed the Committee that there was no joint discussion on the need for a campaign or on its success in terms of the proportion of candidate vehicles which were located. According to the Department, few statistics were available but it was apparent that there were defects in operating vehicles due to faults in design, construction and assembly and hence ATAC in July 1971 requested the industry to establish a suitable code which was finally endorsed in July 1972.

241. ATAC has requested reviews of the Code for consideration at its meetings of July 1973 and February 1975. Following the 1973 review it was agreed that manufacturers would make public, disclosure of the existence of campaigns as it was thought that this would assist in increasing owner response. Furthermore FCAI agreed to extend the period allowed for response by owners from 30 to 90 days. New paragraph "3.1" was written into the Code together with other minor changes in June 1975 again in response to a request by ATAC following its February 1975 meetings.

242. The Committee recognises that the industry's adoption of the Code was an improvement on the previous ad hoc system and possibly on admission that such a step was urgently required. But it makes the point that, unlike the American system, the initiation of a recall campaign and the procedures to be adopted are still entirely within the hands of the manufacturers, and there appears to be a reluctance on the part of the industry to allow recall procedures to be open to public scrutiny. The revision of the Code in relation to

publication of campaigns was only made following considerable public and government pressure and even now campaign details are only provided on a confidential basis. Individual manufacturers have, at the request of the Committee, provided details of all campaigns since the inception of the Code. A summary of these details provided by FCAI appears as Appendix 14.

Attitudes to Recall Code

243. In view of the evidence given to the Committee concerning defective vehicles and the Committee's concern that defects may not be receiving the attention they deserve, additional evidence was sought on the effectiveness, shortcomings and their solutions to the Australian code of practice.

244. The general attitude of the manufacturers was that the present practice of recalling vehicles was satisfactory and that any proposed government involvement would not improve the effectiveness of the present system.

245. GMH strongly rejected proposals for change indicating to the Committee that the system was run along similar lines to the U.S. except in respect of "notification and record keeping and things like this." GMH further informed the Committee that their own campaign committee was instructed that its decisions were to be made without any relation to costs whatsoever. It was stated later in evidence however, that cost was nevertheless a factor in deciding in what way the company went about effecting a fix or rectification. GMH emphasised to the Committee it was not the company's attitude that once a customer had bought a vehicle he was forgotten about. The witness pointed out that 75 to 80 per cent of sales are resales to satisfied customers and that, in order to stay competitive in the business, they were concerned that their customers' interests were not treated lightly.

246. Ford expressed similar views indicating that the responsibility for conducting a recall campaign should remain within the company which had to protect the reputation of its products and because it knew most about the question. The Managing Director informed the Committee that on one occasion relating to a problem with a seat belt, while it technically met the law, because it did not meet the intent of the law, the company decided to campaign at significant cost. This was indicative of the type of responsibility the company tried to project. The company admitted that they unfortunately had too many campaigns, but all except one had been generated within the company, with its own data and without outside pressure.

247. Chrysler expressed the view that there was a number of factors involved in a recall and Chrysler's committee represented a great number of skills and experience which was all brought into play in a major recall. The witness said that "when the penny is on the edge, we recall". It was stated that if anybody shows cause for a recall campaign, and there was sufficient evidence, Chrysler responds to it, from whatever source. It was also suggested that cost was not a factor in the decision to recall.

248. The attitude of manufacturers that "they do not need to be told" was reinforced by their evidence that few, if any, defects reported by bodies outside the industry had resulted in recall campaigns. The Committee was uncertain whether, as one witness suggested, manufacturers are selective in deciding which of their defects are safety related requiring a recall or whether outside bodies do not report defects or report defects which do not warrant a recall. The manufacturers assured the Committee that they welcome information on defects from outside the industry and respond to it.

249. A number of examples of defects allegedly necessitating recall programs were raised in evidence during the inquiry. Two important defects alleged which were regarded as safety related were brought to the Committee's attention by AAA, CCA and other witnesses. On both occasions AAA had been negotiating with GMH to institute a recall campaign to correct the fault.

250. The first case related to the ignition lock on the HQ and LJ Holdens. By turning the engine off it was possible to lock the steering while the vehicle was in motion. Although the ignition lock design was within the prescribed standards, witnesses informed the Committee that it was dangerous and that GMH had resisted a recall on the matter. The Committee was made aware that at least one fatal accident had been caused due to this ignition locking problem. A witness from GMH said that in his opinion "anyone who switches off the ignition when driving a car is wrong and should not be driving a car". GMH informed the Committee that if they were convinced that a fatality occurred due to a defect in their vehicles, the company would campaign. GMH indicated that to replace the steering column locks in all vehicles (380,000) produced before the incorporation of the revised lock in November 1973 at current rates would cost $5,400,739.

251. The second significant case was a braking defect with the LH Holden Torana to the effect that stopping capability was decreased under certain conditions in wet weather. AAA reported the defect to GMH who indicated that they did not act on reports of a few isolated cases and that their reports from the field did not show any verification of the complaint. AAA informed the Committee by letter that -

> ...after five months of negotiation with GMH they finally agreed to recall 24,000 vehicles late in December...a classic case of the need for an

> arbitrator to decide on recall campaigns where there is a dispute between organisations such as the Australian Automobile Association and a manufacturer. The Association was concerned during the period of its negotiations with GMH that they continually denied having a problem with that particular model. In the end it became necessary to recall 24,000 vehicles.

252. The Committee is in no position to pass opinions on the technical merits of these complaints and whether a recall should or should not have been conducted. The Committee realises however, that the present operation of the recall code does not fully recognise complaints of outside bodies and considers that there is evidence of a need for outside industry involvement in the recall field.

The Question of an Independent Arbitrator

253. The need for an independent arbitrator to decide when a recall campaign is warranted when disputes occur, as illustrated above, was put to the Committee by a number of witnesses. The Committee was guided by the Department of Transport which stated that -

> ...the decision on a recall program is not a simple 'black and white' case of 'pass or failure' to meet prescribed objective standards. What is involved is engineering judgement not only on whether to undertake the recall but also on what remedial action should be taken during the recall.
>
> This is important when considering proposals that the Government should be able to require recalls or act as the arbitrator in disputes over whether there should be a recall. The last thing anyone would want is for Governments to enter this field and share in the responsibility for decision-making without the professional resources needed to do this properly. (Evidence p. 1583).

254. The Committee recognises that the Department does not have the resources and it could be expected that it will be a number of years before the BRS would be in a position

to enter this field in a manner similar to the Department of Transportation in America. Moreover, the Committee is not convinced that the American experience has been as successful as anticipated. The Committee concurs with the Department's view that the professional resources available to it could be better utilised in other areas of safety research.

255. The manufacturers dismiss the proposition of an independent arbitrator by stressing the view that recalls were the responsibility of the company. It was stated several times that an arbitrator would have no affect on the decision making of the company concerned. It was suggested that an arbitrator "would gum up the system rather than free it".

256. The Committee considers that, at this stage, there are legal and practical difficulties in the government undertaking direct responsibility for deciding recall campaigns. The Committee however, foresees that at some time in the future the BRS would develop a capacity in this and related areas which would enable more direct involvement in recalls in the interests of the consumer and to the benefit of increased vehicle safety.

257. The Committee is nevertheless concerned at the evidence of defects occurring in new vehicles and the lack of formalised procedures outside the industry to enable communication and understanding between manufacturers, research bodies, inspection authorities, police, fleet owners, insurance companies, government bodies and consumer groups etc. The Committee recognises that there is a need for closer two way communication on defect information, recall decisions and publication, methods of recall rectification, and results of recall campaigns. The Committee considers that steps should

be taken under the direction of the BRS to establish a formalised means of mediation between all groups to ensure that proper consideration is given to safety related defects.

258. The Sub-committee therefore recommends that the Bureau of Road Safety investigate the establishment of a committee, representing all relevant organisations, as a form of mediation between manufacturers and others to -

(a) monitor defect information,
(b) monitor manufacturers' action with regard to recalls, and
(c) regularly publicise all defect and recall information.

The Sub-committee further recommends that the Federal Minister for Transport report to the Australian Transport Advisory Council on the success or otherwise of this problem over a period of time with the view to obtaining by co-operation, a legal framework in which to operate if this is found necessary.

Additional Comments on the Code

259. Difficulties associated with contacting owners and ensuring vehicles are returned for rectification are experienced in both America and Australia. While the success rate of completion appears better in Australia than America, companies generally stated that improvement was necessary. Ford had considerably developed its system of notification with an improved computer system but stated that the longer the time after sale of new vehicles the greater the "unreachable" level. Ford and the Department of Transport were researching how to develop optimum means of contacting owners to achieve a better response rate. All manufacturers were anxious to have access to State registration authority's data and

information on owners. Evidence was given to the Committee that only the Australian Capital Territory and Queensland were co-operating in providing information. Although problems of data availability were apparent, one company offered computer services and was prepared to pay a fee for the information, however some States still refused.

260. The Committee was concerned by this and other evidence and sees no reason why State registration authorities cannot provide maximum co-operation with manufacturers in this matter. It should be noted that recent legislation in America requires manufacturers to use State records and other sources of information to update manufacturers' address information for owners of recalled vehicles.[23] The Committee urges all State Government authorities to give maximum co-operation and assistance with regard to registration details for the purposes of recall campaigns.

261. The American and Australian experience have shown that difficulties arise with respect to the following:

(a) not all owners receive defect notifications,
(b) some dealers apparently sell recalled vehicles without correcting the defects,
(c) some owners simply do not return their vehicles for correction of a defect, and
(d) dealers are not always prepared to service vehicles when owners bring their cars in for defect correction.

262. The Committee was advised by some manufacturers that they were now notifying the Department of Transport of recall campaigns, and providing service letters to the Department (and some other bodies) but results of campaigns were not made public or provided to the Department.

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23. Comptroller General, p. 11.

263. The Committee, during the inquiry, published details of campaigns without objection by the manufacturers. The Committee recognised that the revised Code in relation to the publication of campaigns has now formalised the need to inform the public of a recall campaign but there was no evidence to indicate why campaign details should only be provided to the Minister for Transport on a "confidential" basis. The Committee is of the opinion that the car consumer should be more informed on defects and particularly safety related defects provided that legitimate company interests are not jeopardised.

264. The Committee believes manufacturers should review their policy of generally witholding safety related defect and recall information. The Committee also regards that consultation between the BRS and manufacturers with regard to improving the effectiveness of campaign completion is considerably important. As in the case of providing cost information (See paragraph 184) the Committee intends to review the situation regarding the co-operation of manufacturers on defects and recall information at some future time.

CHAPTER VIII: QUALITY CONTROL, INSPECTION AND TESTING

Quality Control

265. The question of quality control has been referred to elsewhere in this report but the Committee considers that further comment on the manufacturing process and manufacturers' views of quality control require special comment. The quality of vehicles produced and the control of work on the production line are important factors affecting the standard and safety of vehicles which ultimately appear on the road.

266. AAA pointed out to the Committee the frustration of the motorist who takes delivery of a new vehicle and within hours, days or weeks it is back in the workshop for repair. AAA regarded this as indicative of quality control problems in the industry.

267. Sir Laurence Hartnett indicated to the Committee that, in his view, there was an urgent need to have production control, or quality control, better checked. He also indicated that the multiplicity of options was one of the reasons for poor quality control. This view was supported by some manufacturers, in particular, Chrysler and AMI.

268. Some manufacturers indicated that quality control contributes to the total performance and safety of the vehicle. Considerable staff and company expense is committed to quality control departments: in VW there is one inspector for each 12 workers in all plants throughout the world; GMH employs over 1,000 personnel in quality control activities and annual expenditure was about $10 million.

269. The majority of manufacturers were of the view that quality could not be inspected into the vehicle but must be built into the vehicle during all stages of manufacture.

It was considered that the quality of a finished vehicle was a reflection of the original design, the quality of individual components and the quality of assembly. The quality of assembly, the more important of these aspects, is related to the interest and motivation of employees performing the assembly operations. According to AMI witnesses, it is difficult to encourage process workers on the assembly lines to become quality conscious. Manufacturers indicated that they monitor defects during the warranty period and warranty reports had the effect of exposing weaknesses in quality control. However, results of defect monitoring were not made public. The Committee urges manufacturers to consider making such results available to appropriate bodies.

270. The General Manager of Ford indicated that Australia appeared to have a greater problem of quality control than other countries. It was stated that West Germany and Japan, for example, had a more disciplined and stable workforce than Australia with few problems in relation to matters such as turnover, absenteeism and language difficulties. The witness suggested that industry had to face up to the problem of providing incentives as in Canada and the United States, to ensure a more disciplined and stable workforce in order to develop the quality of assembly to a standard equivalent of other countries. The Committee acknowledges manufacturers' views that they should accept their responsibility for dealing with problems of staff turnover, absenteeism and language difficulties and notes that in the present economic climate turnover and absenteeism ought to be at a minimum and that now is an appropriate time for effort to be made to overcome language problems.

271. The Committee feels that the following comments by the General Manager of Ford summarise the manufacturers' attitude to quality control -

> Now what your problem is, you say that we have not gone far enough. I think we have got a common aim; it is the degree to which we achieve it, this is the problem. I am very conscious of it and not only me, but every assembler and manufacturer in Australia has got the problem because the public is much more aware of the product quality that it is demanding. I understand that, and our commercial success depends upon it. I think when you say should we put in inspectors at the end of the line, my answer is that it would not be helpful. Your thrust has got to be to reinforce the onus on the manufacturer to recognise that his own commercial success depends upon it. That is being done daily, make no mistake. I am very, very conscious of it. (Evidence p. 2740-1)

While the Committee recognises the difficulties associated with achieving satisfactory quality control, it recognises the responsibility of the industry for the safety of its vehicles. The industry may not be able to afford poor product quality in relation to its commercial success but the Committee believes that the public cannot afford poor product safety. The Committee holds the view that manufacturers should accept the onus and responsibility they claim for quality control in the interests of the consumer and vehicle safety.

272. The Committee considered the question of appointing quality control inspectors from outside the industry. Even though Chrysler welcomed the idea, the Committee concludes that this may not be necessary provided access to company plants is available to appropriate government authorities. The Sub-committee recommends that the Bureau of Road Safety establish formal access to vehicle company plants for quality control observation and develop a system of monitoring quality control standards.

Inspection and Testing of Vehicles

273. The Committee considers that adequate pre-delivery inspection and testing is essential in preventing faulty vehicles leaving the factory. The Committee is not

convinced by the evidence that the standard of pre-delivery checking claimed by manufacturers is achieved in practice.

274. The Committee realises the complexity of the motor vehicle and that the costs and benefits of additional inspection should be carefully considered. Inspection coverage could be doubled without eliminating all potential problems which are often only revealed after a vehicle is in service, but the Committee cannot accept the practice of manufacturers relying on dealers to correct faults in service during the warranty period. The Committee believes that in the interests of safety pre-delivery inspection should be properly carried out and faults remedied at the plant.

275. It is to be expected that the BRS will establish adequate procedures for in-plant inspection to ensure compliance with ADR's with the objective of minimising defects in the interests of both safety and the consumer. Manufacturers expressed no firm objections to the principle that nominated personnel of appropriate government authorities have access to plants for the purposes of inspection for compliance with ADR's.

276. Evidence from the Telecommunications Commission indicated that one reason why few defects exist in its vehicles is that it employs expert inspectors and that companies know that a thorough inspection can be expected. The Committee suggests that the BRS investigate the proposal of the Telecommunications Commission for a system of independent pre-delivery quality assurance checks for all Federal Government vehicles. The Commission suggested that such checks should take into account all safety and reasonable quality features of vehicles at the factory. This arrangement should be supported by a demerit system which would give an independent check on a given percentage of completed vehicles chosen at random and varying according to the success achieved by the factories on the

quality assurance scheme. Such a system could be supervised by a small government controlled inspection staff working on a random sample basis. The results of demerit points allocated against manufacturers should be published. The Commission stated that this approach would quickly raise manufacturers' standards of inspection to an acceptable level and in the medium term almost certainly would result in an overall cost saving to the community.

277. The co-operation of manufacturers with regard to pre-delivery testing and inspection is essential. On this matter the Committee was concerned by the following statement contained in the Army Quality Assurance Service's submission that:

> Our liaison is generally good, close and mutually understanding. We know that on occasions for economic reasons a manufacturer may try to seek some concession which tends to debase quality, but in the matter of supply and conformance we have little or no argument on principles except for one particular problem. This is our inability to inspect GMH vehicles at, in or ex factory. GMH insist that these be inspected by us at dealers' premises or dealers' distribution points.

The Committee urges all manufacturers to co-operate with regard to inspection and testing by Government authorities. The Committee believes there is a need for a uniform inspection system throughout Australia and recommends that the BRS establish a common procedure for the purchase and inspection of Federal Government vehicles.

CHAPTER IX: ACCIDENT AVOIDANCE

278. In the technical sense, the concept of vehicle safety is generally divided into two areas: Accident Avoidance (or as it is often referred to "primary safety" or "active safety") and Occupant Protection (or "secondary safety" or "passive safety").

279. The basic factor associated with accident avoidance is the responsiveness and visibility of the vehicle. Responsiveness refers to the ability of a vehicle to stop, turn and go precisely how and when the driver requires. The requirements of responsiveness are accurate steering, stable handling, powerful directionally controllable brakes; and a degree of driver comfort and support. Other important factors of accident avoidance are visibility for the driver, the ability of the vehicle to be seen by other drivers, and its intentions understood.

Steering and Handling

280. Steering and handling refer to the response of a vehicle to driver control, primarily steering inputs, and extraneous inputs (cross wind, road inclination, surface roughness etc.). In addition to direct driver control, handling encompasses the responses by the vehicle to indirect driver control such as the response to acceleration and deceleration (braking) which may change or modify directional control. Because vehicle handling has been an art rather than a science it is generally tested subjectively. Ride (primarily the physical confort of the reduced vertical motions) is related to handling but being simpler to analyse, has been studied more scientifically. Evidence from manufacturers indicated that subjective tests were the only evaluation method they utilised.

281 . When the Experimental Safety Vehicle (ESV) program began in the late 1960's, it was inconceivable that a safety car should be evaluated by subjective methods to determine if the handling specifications of the program were met. It was immediately evident, therefore, that handling needed to be quantified. The handling specification was to be developed to ensure that ESV's duplicated the handling of the "better" production vehicles of that time. Although some evidence was given that the size and weight of the ESV's degraded handling, the ESV's handling and steering response, by subjective and objective evaluations, was not at all degraded. Subjectively, they felt quite good.

282 . The resulting specifications were a very important beginning even though, in themselves, they were not sufficient to ensure against all possible undesirable handling characteristics. Since the beginning of the ESV program, advances have been made in the knowledge and understanding of vehicle handling, and in addition, some research programs are beginning to define better handling response in objective terms.

283 . Even though some recent research has attempted to determine what handling responses allow optimum driver-vehicle performance for a number of test conditions, the setting of universal handling standards for vehicles does not at present appear justified. The following reasons are advanced for not setting general standards in this area:

(a) It is not presently possible, in general, to directly relate accidents and vehicle handling.

(b) Due to the extreme complexity, a full set of objective handling tests is very expensive and time consuming to conduct. Compliance testing

might be justified if a positive indication of accident reduction potential existed, but at present no conclusive data is available.

(c) Vehicles are put to a wide variety of uses and handling characteristics optimised for one use may be distinctly different from that for another use.

(d) Drivers preferences, training, and optimum responses vary widely.

284 . The Committee is of the view that although overall handling standards may be possible in the future, they will probably be costly, complex, and will need to allow a variety of performances depending on the intended application. The reasons for not adopting general handling standards do not however diminish the need for research in this area. Although vehicle response can not generally be related to accidents, and no reliable data is available, there is evidence to suggest that in some cases, vehicle response and accident records are relatable. For example, standard swing axle cars exhibit drastic changes in response with speed and lateral forces and have a disproportionate number of loss of control accidents, roll over more easily, and have a higher frequency of roll over accidents.

285 . The Committee concludes that consistency and predictability of handling and roll stability should be primary handling criteria. The Committee, although realising that full objective standards in this area are presently not justified, considers that limited standards regarding roll stability should be considered. The Committee also concludes that accident statistics should be closely examined, to determine if specific

makes or models of vehicle are having an undue percentage of accidents in order to ascertain whether these accidents are related to poor handling characteristics. If there is a relationship, the manufacturer should be requested to withdraw or modify the vehicle.

High Performance Vehicles

286. The question of high performance (powered) vehicles and the safety implications associated with excessive power received a good deal of attention by the Committee during the inquiry.

287. Vehicles need performance power for the following principal reasons -

(a) to accelerate the vehicle to a desired cruising speed,

(b) to maintain cruising speed,

(c) to climb gradients,

(d) to pull trailers, and

(e) to avoid accident situations.

The primary propulsion needs vary quite widely, depending on the conditions. The lowest power requirement is that of maintaining a steady speed on a level road. Towing a trailer, climbing hills, adverse wind, or overtaking, all require large increases in power over the normal requirements for steady cruising. Naturally the heavier and bulkier the trailer, the steeper the grade, the stronger the wind, or the quicker the overtaking, the more power required.

288. The safety advantages of additional power (power above that required for level cruising at any given speed) can be described as:

(a) less exposure to on-coming traffic during overtaking,
(b) to enable merging manoevres, and
(c) the ability to maintain the speed of traffic flow under disadvantageous conditions when fully loaded, climbing a hill, driving into a strong wind, towing a trailer, or any combination of the above conditions.

The safety disadvantages of surplus power may be that it encourages deviant driver behaviour or increases the required level of driver skill, especially under advserse traction conditions (e.g. wet roads).

289. The Committee received evidence which suggested that limits should be placed on the maximum power to weight ratio or the top speed of vehicles based on the proposition that there is a connection between high-powered vehicles and deviant driver behaviour and accidents. Since almost any new passenger car which can be purchased, including those which may be considered inadequately powered, can exceed 130 km/h (80 mph) on a level road, some form of speed control would be required on all cars to limit top speed. The problem of top speed limiting devices was very thoroughly investigated by the NHTSA in 1971. The conclusion of that research was that top speed limiters were not practical and would not have the desired effect. The Committee is not aware of any new factors which have arisen since the research was completed to affect this conclusion. Certain speed limiting control devices were

brought to the attention of the Committee during the inquiry. While the Committee was impressed with these devices and their intent, it considers that at the present time it is extremely unlikely that a cost-benefit analysis would justify its use as a safety standard for all vehicles.

290. Limiting power to weight ratio by limiting top speed has been shown to be irrelevant to reducing accidents by limiting top speed. The Committee was informed that no country has legislation limiting power to weight ratio. In addition, it has been suggested that there are problems of administering an absolute maximum power to weight ratio.

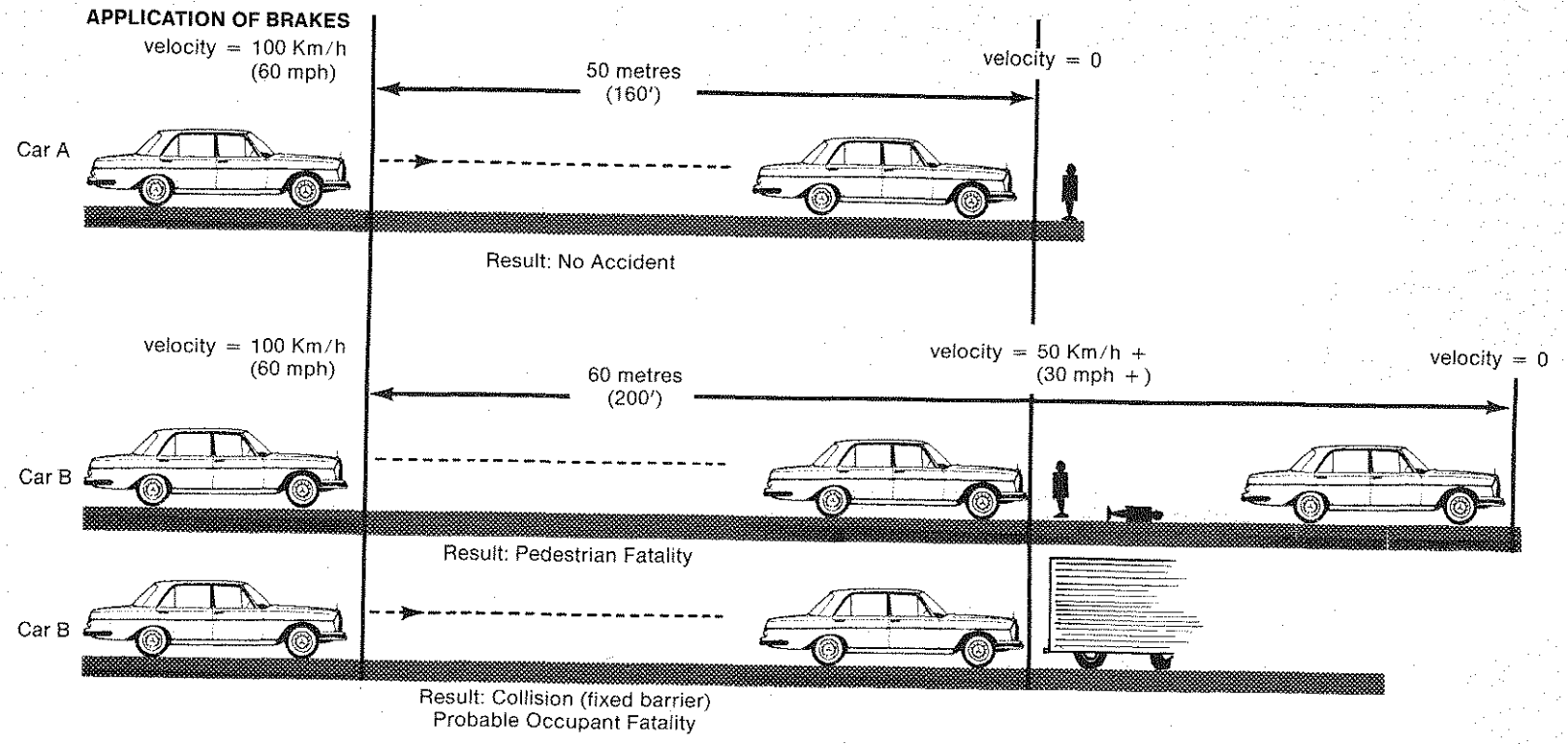
291. Accident statistics suggest that the combination of young and inexperienced drivers in high powered vehicles is a major problem. It has been suggested that the high price of the very high performance vehicles affectively restricts sales to older more experienced drivers, but as the vehicle ages, the younger driver is more likely to purchase such a vehicle.

292. The Committee suggests that the manner of approaching the problem of young, inexperienced, or proven deviant drivers driving high powered vehicles be tackled by restrictive licencing provisions. It points out that legislation has been adopted in a number of countries relating to the age and experience of motorcycle riders and the power of the vehicle. The Committee feels that a study of the driver licensing system should be conducted to ascertain whether licensing restrictions are necessary in this regard.

Brakes

293. As braking usually precedes a crash, poor braking ability (for accidents preceded by braking) will intensify the severity of an accident, and poor braking ability will also necessarily result in additional accidents. The importance of better brake capability can be demonstrated by the illustration on page 114, which indicates that, given two vehicles travelling at 100 km/h (60 mph) side by side on the same road - Car A can stop from 100 km/h in 50 metres (160 feet) and Car B can stop from 100 km/h in 60 metres (200 feet). If Car A could stop just before hitting an obstacle (such as a stationary truck), Car B would hit that obstacle at well over 50 km/h. Since a 50 km/h barrier crash is generally considered to be the limit of survivability, this variation in stopping distance of two normal cars can be the difference between no accident and a potentially fatal accident. Of even more importance is good braking performance under adverse traction, for example, wet asphalt.

294. Some manufacturers have stated that the handling and braking ability of a vehicle has for some years been their primary thrust in the safety field. Yet evidence has been given which indicates some manufacturers are utilising brake systems with known deficiencies in design and performance and indeed have indicated a lack of concern for basic concepts of brake technology and state-of-the-art. For example, GMH's view that the ability to stop a vehicle from any speed is the ability to lock all four wheels. This is doubtful for a properly designed system in view of evidence provided by other expert witnesses. Only a poorly balanced brake system stops quickest with all wheels locked and this stopping distance will exceed that of a properly balanced system. Since a number of competitors in all price ranges utilise brakes with significantly improved capability, it is possible to provide


APPLICATION OF BRAKES
velocity = 100 Km/h
(60 mph)
50 metres
(160')
velocity = 0
Car A
Result: No Accident
velocity = 100 Km/h
(60 mph)
60 metres
(200')
velocity = 50 Km/h +
(30 mph +)
velocity = 0
Car B
Result: Pedestrian Fatality
Car B
Result: Collision (fixed barrier)
Probable Occupant Fatality

better brakes and yet be competitive in the market place. Table 4, provided to the Committee in evidence, gives an indication of the variation in stopping distances between individual models of various manufacturers.

295. In general, some manufacturers have the attitude that brake improvements are not necessary. Brakes are "as good as required" was the attitude repeated in evidence. Given the importance of brakes in safety and considering the diversity of performance the Committee views this attitude with some concern.

296. Some manufacturers also indicated that they were unaware of any field problem with the performance of their brakes, in spite of known engineering problems such as large variation in load. The Committee feels that the fact that no field problem is evident may be due to good driving compensating for brake deficiencies or partly due to the accident reporting system which generally records driver deficiency even though a vehicle component may have been of sub-standard design or seriously degraded. The driver is normally recorded as being to blame unless the machine has a catastrophic, non self-correcting failure.

297. The Committee recognises that the driver bears ultimate responsibility for vehicle control but this should not be used as an excuse to produce vehicles with brakes with promote instability, are inconsistent in use, the performance of which may degrade alarmingly under "non-standard" conditions, and with braking capability which degrades much more rapidly than road surface conditions.

-Brake System Performance

298. Given that good brake performance is required for safe driving, the Committee considers that brake performance standards have been too long in formulation. Because comparative data on brake performance of Australian vehicles is

TABLE 4

COMPARISON OF TOP SPEED, BRAKING SWEPT AREA AND POWER TO WEIGHT RATIO INDICATING THERMAL CAPACITY OF TYPICAL EUROPEAN, UNITED STATES AND AUSTRALIAN VEHICLES

VEHICLE	BHP (1)	TOP SPEED (2)	SWEPT AREA IN^2/TON (3)	POWER TO WEIGHT LBS/HP (4)	PRODUCT OF (3) & (4)
VW BEETLE	60	79	173	39.5	6.8
FIAT 128	60	85	186	39.6	7.4
MORRIS 1100	58	80	143	38.4	5.5
PEUGEOT 304	70	88	232	34.9	8.1
MK II CORTINA GT	78	94	240	28.8	6.9
FIAT 124	76	85	237	32.9	7.8
SAAB 99E	95	88	267	28.3	7.6
PEUGEOT 504	87	98	284	35.3	10.0
RENAULT 16	70	93	202	37.1	7.5
ALFA BERLINA	132	110	283	21.3	6.0
VOLVO 164	145	110	266	22.5	6.0
BMW 3600	170	118	294	19.7	5.8
MERCEDES 250	167	115	225	24.2	5.5
LANCIA AGATO	87	109	349	27.0	9.4
PORSCHE 911S	200	144	380	13.2	5.0
ARITH. MEAN			257		7.0
STAND DEVT.			63.5		1.5
MAVERICK	120	95	142	24.8	3.5
US FORD LTD	172	110	140	27.4	3.8
MUSTANG II MACH I	119	99	142	28.8	4.1
TRANS AM MUSTANG	460	150+	205	8.0	1.6
VEGA	90	88	170	29.8	5.1
MONTE CARLO	245	117	143	19.8	2.8
PONTIAC GRAND AM	170	110	148	26.8	3.9
HORNET	175	108	178	21.0	3.7
AM MATADOR XX	220	99	180	19.0	3.4
OLDS-MOBILE CUTLASS	190	110	150	25.6	3.8
ARITH. MEAN			160.0		3.6
STAND DEVT.			22.2		1.0
419 CHARGER	300	135	169	12.7	2.1
GTS MONARO	240	120	167	15.8	2.6
SLR 5000	240	125	166	13.8	2.3
FALCON GT HO	300	128	220	13.0	2.9
351 FAIRLANE	260	115	159	15.7	2.5
VALIANT 245	165	105	175	22.5	3.9
HOLDEN 202	135	100	172	27.3	4.7
TORANA 2850	115	105	179	27.0	4.8
FALCON 250	155	105	177	23.7	4.2
ARITH. MEAN			176.0		3.3
STAND DEVT.			17.6		1.0

Source: Evidence p. 4334.

scarce, local manufacturers have claimed without serious challenge that their brake systems are as "efficient as possible".

299. A major problem in attempting to specify brake performance is the overall complexity of braking under normal variation in conditions. Stopping distance is one of the most common methods of measuring brake performance. Given that stopping distance is specified for a given load and pavement condition, the optimisation of stopping distance for normal vehicles, may be degraded under other conditions, unless adequate design precautions are taken. Australia's first braking performance requirement, ADR 31 (effective 1 January 1977) is designed to ensure safe braking under normal and emergency conditions.

300. The Committee considers that ADR 31 may be lacking enough criteria to ensure against degradation of stopping capabilities on low co-efficient surfaces. Other than standard effectiveness testing (presumably normal dry surface), this design rule is primarily concerned with fade, parking brakes, and partial system operation. While these are important requirements the Committee is of the view that the design rule may be insufficient to ensure desirable brake system performance.

301. The Sub-committee therefore recommends that Australian Design Rule 31 be reconsidered with a view to ensuring that overall braking performance will at least be maintained. The Sub-committee further recommends that the Bureau of Road Safety undertake or commission and supervise a test program over a range of surface and load conditions with a view to establishing braking performance requirements based on the statistical mean performance of present vehicles.

- Brake Proportioning

302. The Committee was informed that brake proportioning refers to the ratio of braking retardation on the front versus the rear wheels. This seemingly minor brake design factor has been shown to be of great importance in braking efficiency. It was indicated that the quickest, shortest stop is produced when all tyres are being slowed equally. If the front wheels lock, the vehicle will tend to go straight, but will be unsteerable. If the rear wheels lock the vehicle will try to spin. Driver inputs may or may not succeed in maintaining a straight, front end first, course but in either case the stopping distance will increase if all 4 wheels lock together, the vehicle is not under any control and its action will depend solely on the conditions just before locking and the surface over which it slides. Besides not being under control, and being damaging to tyres, the stopping distance will be significantly longer than if all wheels are retarded equally but not locked (the sole exception is on deep gravel, where locking may result in a slightly shorter stopping distance). Evidence indicates that if all wheels are designed to lock under all conditions then the front wheels should lock first since no immediate driver correction is needed and the car will continue on a straight course. Slight release of the brakes from front brake locking allows full driver control without the necessity of correcting spins. European brake philosophy, as indicated in ECE Regulations, is that the rear wheels must not be allowed to lock because of the resultant danger of loss of control.

303. The design problem in achieving this aim is that the front to rear braking ratio needs to be changed for different decelerations and loading. The simplest, cheapest, and least effective method is to utilise a fixed ratio which is common in Australia. Evidence showed that up to 30 per cent of maximum available braking is lost utilising such a system.

304. On the other hand, vehicles which have a high centre of gravity, a short wheelbase, and/or large variations in allowable loading could be effectively required to adopt some form of variable proportioning system, i.e. pressure or load proportioning. Evidence has indicated that a number of vehicles on the market are so equipped, and that the price of a pressure limiting valve would be less than $10.

- Brake Fade

305. Brake fade is the degradation of brake effectiveness, which requires increased driver pedal pressure, due to extended brake utilisation. If the fade is severe, very significant decreases in brake effectiveness result which may greatly increase the minimum stopping distance capability. Evidence has given to the Committee which indicated a lack of thermal capacity in Australian vehicle brakes, and were therefore more susceptible to fade. While there would appear to be some validity in this evidence, local manufacturers expressed a contrary opinion to this view. The Committee considers that since a primary purpose of ADR 31 concerns reduction of fade, such requirements should be sufficient to ensure against undue brake fade.

- Brake Response Time

306. The time required for a brake system to respond to a control input can be very important. If the response is slow in application, due to a poorly sized power brake booster for example, the vehicle continues to travel at an essentially undiminished speed for a period of time. If this time is perceptible to the driver, he senses that nothing is happening and presses harder, when the brakes do start to apply, they will probably be over applied leading to possible control problems. This delay in application also results in higher impact velocities even if the overall stopping distance is

equivalent. If the response is slow in release, control problems can result when trying to unlock an over-braked wheel. This is especially critical if the locked wheels are in the rear. The Committee was informed that slow response can be caused by either high viscosity brake fluid or under-designed system components.

307. The Sub-committee recommends that the Advisory Committee on Safety in Vehicle Design investigate brake response time with a view to incorporating reasonable standards into a design rule.

- Brake System Splits

308. Evidence has been given to indicate that single line brake systems are unsatisfactory to the point of being dangerous, as total brake failure can occur under certain conditions. Dual line braking systems have been developed as long ago as 1963 in Europe. The triangular split system provides for two of the front wheels and one of the rear wheels to remain in operation should one of the systems fail. When one braking system fails therefore, the remaining three wheels are in operation and due to the transfer of load to the front wheels, approximately 80 per cent of the braking efficiency can be maintained.

309. During the inquiry a number of methods of splitting brake hydraulic circuits were raised, to the effect that the braking system performance is only partially degraded rather than completely lost due to most failures. Each method has different advantages and disadvantages.

310. The Committee therefore considers that a review of all systems with regard to potential performance should be carried out to see if increasing partial failure requirements of ADR 31 are justified based on the available designs and hardware.

- Parking Brakes

311. Evidence was given indicating that parking brakes should actually be emergency brake systems capable of some reasonable brake performance in case of total hydraulic brake failure. The Committee noted that SAAB provides a parking "emergency" brake on the front discs which is an effective emergency brake without stability problems and will hold on a 30 per cent grade. The Committee considers there is some merit in this suggestion.

312. ADR 31 tests parking brakes solely for their capability to hold a vehicle on a grade rather than for actually slowing a vehicle. A number of local manufacturers have objected strongly to the requirement of ADR 31 for the parking brake holding on a 30 per cent grade. Evidence by one manufacturer suggested that such a brake would be difficult because it was possible for some vehicles to "slide down a 30 per cent grade with all wheels locked".

313. The Committee concludes that local manufacturers' objections to ADR 31 with respect to this requirement is not entirely valid and designers should be encouraged to improve this feature of braking performance.

- Brake Fluid

314. The Committee received evidence which indicated that contamination and the resultant degradation of brake fluid may result in serious brake failure, and is therefore, a very real and significant problem.

315. If the brake fluid is contaminated with water (even exposed to the atmosphere is sufficient), it may boil at too low a temperature causing total brake failure with the brake pedal going to the floor without effect.

316. The Committee was informed that due to the hydroscopic characteristic of brake fluid and loss of performance when

contaminated, the packaging and storage of fluid is an important consideration. Although there is an SAA standard in this area it is not always adhered to and has no legal enforcement. The Sub-committee therefore recommends that an educational campaign be conducted by the Government to inform the public, particularly mechanics, of the need for proper attention to the handling of brake fluids.

317. In addition, a number of witnesses indicated the desirability of a transparent master cylinder reservoir to allow fluid level checks without exposure to atmosphere. ADR 31 however, would seem to eliminate this need because of the requirement of a brake fluid level warning light.

318. The Sub-committee recommends that the Advisory Committee on Safety in Vehicle Design investigate the severity of the problems associated with brake fluids with a view to specifying a performance standard for brake fluids to ensure that only high quality brake fluids are utilised.

-Future Developments

319. The majority of evidence supports the view that anti-skid brakes have significant safety benefits, especially on low (e.g. ice) or different co-efficient-of-friction surfaces. The evidence however, indicated that anti-skid was presently too expensive to justify as a safety requirement. Estimates given for a 4-wheel modulation system are between $175 and $300. In addition, since better compabability may be achieved with discs, the change from four wheel drum to a four wheel disc with anti-skid can add quite significantly to the cost. However, high volume production, further engineering and electronic developments may significantly reduce the cost. It is not suggested however, that manufacturers' research should be neglected or compromised because of present costs.

320. The Committee notes that the three major U.S. manufacturers all have production systems available in the U.S. and that a full four wheel, three modulator anti-skid system has been available on a U.S. production vehicle since 1968. Australian manufacturers however, are not developing anti-skid for production vehicles.

321. The advantages of a well developed anti-skid system are that superior stopping capability is available on all surfaces, especially on low co-efficient surfaces with full control and stability.

322. The Committee recognises the performance advantages of anti-skid systems but considers that the cost would be hard to justify on all passenger vehicles (especially considering the lack of snow and ice in Australia) and considering the possible gains at low cost with respect to load or pressure proportioning systems and the upgrading of standard braking systems.

323. Evidence was given concerning a recently marketed device called a partial compensating master cylinder. This device has the effect during brake failure of essentially doubling braking capacity for the same amount of pressure and the extended pedal travel, which occurs in standard dual circuit master cylinder systems, is reduced. It was suggested that this device allows better braking performance in the emergency failure mode without any inherent disadvantages. The Sub-committee recommends that force and performance requirements of Australian Design Rule 31 be reviewed with respect to the development of a partial compensating master cylinder to establish whether less degradation of performance is now practical at a low cost safety benefit.

324. The Committee was informed that brakes which are automatically actuated when there is danger of a collision, sometimes called radar brakes, have been the subject of extensive research for a number of years. The complex control systems appear to be the primary development problem. Although there is evidence of significant development such systems do not presently appear suitable for safety legislation.

Tyres and Wheels

325. The Committee obtained evidence from Dr Hoffman that United States and English studies on the relationship between tyre failure and accidents do not show a consistent pattern. United States data suggested that not more than 2.42 per cent of all accidents were contributed to by tyre disablements. An English study based on a sample of accidents however, indicated a figure in excess of 10 per cent and further concluded that 32 per cent of single vehicle accidents were due to tyre failure resulting in loss of control.[24]

326. The tyre is the connecting link between the motor vehicle and the road and as such is a critical safety item. It must support the weight of the vehicle and transmit steering, braking and acceleration forces. As the tyre is subject to shock loads during use, and its tread surface is subject to wear from contact with the road and penetration by sharp objects, its condition deteriorates during use, so that a tyre which is perfectly satisfactory when first fitted to the vehicle will eventually become defective. The importance of tyres is even further emphasised when the direct relationship between braking and tyre condition is considered.

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24. E.R. Hoffman, A Review of Vehicle Design to Reduce Accidents, Department of Transport, Report No. NR/7, AGPS, Canberra, June 1973, p. 11.

327. The design requirements for tyres fitted to new vehicles, ADR 23 and ADR 24, generally establish loads and inflation pressures for various tyre sizes, specify load tests at various running speeds, and require tyres of load capacity and speed capability to match the vehicle. A tread depth indicator, which shows when 1.5 mm (1/16") of tread remains, is required in the tyre, and a placard in the vehicle, showing suitable tyre sizes and inflation pressures, is also a requirement. The requirements of ADR 23 and ADR 24 however, do not include any specifications or tests for traction (transmission of braking and acceleration forces) nor for side force characteristics, which transmit steering forces. The Committee was told by Professor Joubert and Dr Hoffman that there were no established standards by which tyres could be judged as acceptable or otherwise in these characteristics, but that research was being undertakn by the University of Melbourne into all aspects of tyre performance.

328. Tyre manufacturers told the Committee that a tyre cannot be designed to give maximum performance in all its functional areas under all vehicle/road conditions, but that modern tyres perform remarkably well in the varying conditions under which they are used and abused. Although some evidence of poor quality imported tyres was brought to the attention of the Committee, no substantial evidence was presented of new tyres being a safety problem to any significant degree. The Committee is concerned however, that although there is an SAA standard for new tyres, only one tyre manufacturer (licencee) has made application to have their products tested and certified. It was pointed out however, that this did not mean that other manufacturers did not comply.

329. Recent developments, such as the wide use of the radial ply tyre suggest that better performing tyres can be produced

perhaps at higher cost, and the Committee believes that it may be necessary to place additional mandatory requirements on new tyres in the future to ensure that the benefits of new technology are obtained by the community generally.

330. The Committee notes that design rule requirements can ensure that a tyre will perform its task when new but cannot ensure that tyres are kept in good condition, properly inflated, have adequate tread depth and are free from impact damage.

331. The problem of ensuring that tyres are maintained in good condition and replaced when worn or damaged raises the subject of compulsory vehicle inspection. In the Committee's view it is not sufficient to have a requirement that tread depth be no less than 1.5 mm if there is no effective means of policing this requirement. The Committee believes that this can only be achieved through random checks by police or a regular compulsory inspection system. Without a method of enforcement the requirement may only be enforced after the event - it does not prevent the accident but applies punitive measures after the accident.

- Radial Ply Tyres

332. Although both vehicle manufacturers and other witnesses referred to advantages of radial ply tyres over cross ply tyres, no information was presented which would enable the safety benefits to be expressed in anything but the most general terms such as "better roadholding", or "more suitable for high speeds". No quantitative means of identifying the benefits appear to be available, and both tyre manufacturers and vehicle manufacturers evidently rely on subjective assessment by road tests with trained drivers in deciding the suitability of a tyre in relation to the vehicle.

333. The Committee makes no recommendation on the mandatory fitment of radial ply tyres, but considers that the development of more comprehensive design rules for tyres including traction and side force requirements for both wet and dry conditions, will provide for the general use of tyres which have superior characteristics rather than the less satisfactory of the tyres now available.

- Retreaded Tyres

334. The Committee was advised by both Ford and GMH that they do not test the performance of retreaded tyres in relation to their vehicles, and Chrysler indicated that it would not recommend the use of retreaded tyres on its vehicles. The particular problem of retreaded tyres appears to be the absence of performance requirements, equivalent to say ADR 23. There is therefore considerable variation in quality between retreaders and from tyre to tyre. A number of witnesses, including AAA and SAA, were concerned for the need of minimum standards, inspection and testing and associated penalties with regard to some practices in the retreading industry with a view to sorting out legitimate manufacturers from "backyard" operators. The Committee was informed that an SAA standard was being formulated but as already stated above, SAA standards are not always adhered to and may not be the best way to remedy an unsatisfactory situation. The ACVP informed the Committee that the question of banning certain retreads was under active consideration but was unable to indicate any significant progress on the question.

335. The Committee was informed that retreaded tyres were not generally suitable for higher speeds, and that once retreaded, a tyre is not suitable for a vehicle with a top speed exceeding 110 km/h (70 mph), although for original equipment the tyre speed capacity should be equal to the vehicle's maximum speed.

336. The Committee recognises that the use of properly manufactured retreaded tyres is an accepted and economical method of obtaining the maximum utilisation of resources which go into the motor vehicle. Nevertheless, it is significant that the retreaded tyre is evidently inferior to some degree in respect of its reliability at higher speeds than new tyres. The Committee believes that if a retreaded tyre cannot be shown to meet all the requirements for a new tyre it should at least be clearly labelled to indicate its deficiencies in this regard.

337. The Committee does not recommend at this time that the fitting of retreaded tyres be restricted in any way, but believes that the ACVP should pursue the question of retread regulations with considerably more vigour with a view to establishing desirable objectives. It is recommended that the Bureau of Road Safety should investigate the appropriate labelling of retreaded tyres (including tread depth indicators) and maximum recommended vehicle speed when fitted with retreaded tyres.

- Wheels

338. In respect of wheels the Committee was informed of certain problems with the strength and durability of aluminium alloy wheels (sometimes called "Mag" wheels). No indication of the frequency of accidents due to faulty wheels was produced but the evidence shows considerable implications for safety. Since the problem wheels are apparently those sold in the replacement market, rather than those supplied as original equipment, the Sub-committee recommends that the Bureau of Road Safety provide a facility for approved marking of replacement wheels shown to comply with appropriate strength and durability standards.

Interior Design

339. Designing the vehicle interior to complement the visual and other needs of the driver to assist him to avoid accidents is an important aspect of motor vehicle safety.

340. The more important safety items brought to the attention of the Committee were:

- Accessibility and ease of operation of hand and foot controls (particularly the foot brake in relation to the accelerator).
- Provision of comfortable seats, preferably bucket seats for the driver.
- Positioning and marking of controls in a standardised system for all vehicles.
- Standardised location of instruments.
- Adequate adjustment range of seats for different sizes of drivers.
- Design of instruments for ease of reading.
- Brake light operating indicator on dashboard.
- Brake failure indicators on dashboard.

341. All of these technical objectives are aimed at actively assisting the driver to avoid causing a collision. In respect of some of these requirements Professor Cumming indicated that the need for their adoption could be established not necessarily from experience in vehicle accidents, but rather from design principles or implied safety. Only isolated objections were expressed with regard to the aims and objectives of these safety features.

342. Several vehicle manufacturers stated that they considered that comfort is a major consideration in designing vehicle interiors, while SAAB and AMI claimed that comfort was a definite factor. This would suggest that requirements for adequately designed seats could be reasonably regarded as a safety factor, but how urgent the need is is doubtful. The range of opinion varies between the SAAB suggestion that the heated drivers seat had indirect safety advantages to bench seats in general being totally unsatisfactory. The Committee considers that the need for driver comfort should be further investigated by the ACSVD with regard to possible design rule requirements.

343. Requirements for location, identification, and illumination of certain controls are expressed in FMVSS 101, while the ECE is still working on the matter. The Committee was informed that there was a problem of international consensus with regard to standardisation. For countries to develop unique standards in this area causes some concern for vehicle exporters. The Sub-committee recommends that an Australian Design Rule be developed to ensure that Australia obtains at least the degree of standardisation of controls and instrument panel achieved by overseas legislation. Similarly, when a standard on the arrangement of foot controls, on which the ECE is working, is finalised, an ADR giving at least equivalent benefit should be developed in Australia.

344. The Committee considers that the fact that a "tell-tale" brake light indicator is not required, as is required for turn signal lights is an example of under-estimating the importance of a simple and seemingly minor safety item. Ford stated that a brake light indicator was provided on some earlier Falcon models, but was now deleted. The Committee does not feel that the value of such a device need be proved from accident data. Vehicle manufacturers almost universally

provide indicator lights for low oil pressure, and low battery charging rate. These items of information are in the Committee's view, no more important than indication as to whether the brake stop light is operating. Volvo on the other hand incorporate in their vehicles a brake failure indicator as a safety feature. The Committee regards these features as essential driver information affecting safety performance. The Sub-committee recommends that a stop lamp indicator requirement be considered by the Advisory Committee on Safety in Vehicle Design to inform the driver of the correct functioning of brake lamps and that the provision of a brake failure indicator be investigated for its effectiveness and possible standard use.

345. The location and visibility of instruments is provided for in ADR 18. The design rule does not standardise the size or relative positions of dashboard instruments, but limits the position of the more frequently used instruments to an area which can be readily seen by the driver. The Committee believes that this requirement, which was developed in Australia and has no counterpart overseas, is an advance on a situation where manufacturers may for reasons other than safety, place instruments in positions which require inattention by the driver to the road in reading them. There does not appear to be a pressing need to further limit the choice of the vehicle designer by more specific requirements for the location and visibility of individual instruments but attention is drawn to SAAB philosophy which uses principles of aircraft design for optimum safety operation.

Colour

346. The role of colour in accident avoidance highlights the generally guarded nature of opinion based on the need for conclusive proof before action can take place on safety

development.

347. The Committee was advised that the question of colour and its relationship to accident occurance was not as simple as it appears and one needs to be cautious as the evidence is generally inconclusive. The Committee, however, regards the evidence as sufficiently conclusive to justify direct and immediate recommendations on this question. Accident data and other studies are available, albeit not in Australia, which suggest that there is a direct relationship between various colours and accident involvement and certainly between various colours and visibility.

348. The Committee believes that even if it was true that no "conclusive" proof is available, on the subject of accident avoidance, the established visibility advantages provides a classic example of the "implied safety" concept (see paragraph 90). Visibility comparison is well illustrated in the photographs shown on p.133.

349. Dr Hoffman indicated[25] that improvements in vehicle visability by means of light paint colours could be made in order to reduce the occurrence of accidents. He also suggested that the probability of occurrence of various types of accidents as a function of vehicle colour should be further investigated as this may be quite an important factor and is one which is easily controlled.[26] A number of other witnesses including the Department of Transport concluded that there was a need for further research as did EGORS in its first report[27]. The evidence would indicate that the ACSVD has not given the subject any serious consideration.

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25. Hoffman, A Review, p. 32.
26. Hoffman, A Review, p. 133.
27. Expect Group on Road Safety, Road Accident Situation in Australia, p. 40.

Marina lineup, 12.30pm. Light overcast, shot from 250ft away on a 60th at f11.

Marina lineup, 7.45am. Heavy overcast, light drizzle. Shot from 250ft away on a 60th at f4.

Marina lineup, 6.00pm. Deep shadow, 10/10ths clear sky. Shot 300ft away on a 30th at f4.

350. The Committee's attention was drawn to the following studies:

1. A study in Sweden of 31,000 collisions found that black vehicles were involved in 22.5 per cent of these collisions. As black vehicles comprised only 4.4 per cent of the vehicle population, they were over-represented by a factor of five. The "safest" colour according to Viberg was pink.[28]

2. Tests conducted in 1957 with two groups of 3,500 U.S. Post Office vehicles - one group painted olive drab, the other in red, white and blue - found their brightly coloured vehicles had 27 per cent less accidents overall than the olive drab vehicles. Rear-end collisions were reduced by 52 per cent.[29]

3. Research undertaken by Daimler-Benz[30] safety engineers demonstrates the importance of car body colours in passive safety under normal driving conditions. Daimler-Benz concluded that (while fluorescent paints are not yet being used) white is the easiest colour seen at 86 per cent. Relative conspicuousness of various colours is shown in the chart on p. 135.

351. While these studies may not be "conclusive proof" the Committee considers that the indisputable customer preference for light colours is a worthwhile consideration. A summary of sales distribution on the basis of colour by Ford, GMH and Chrysler appears as Appendix 15.

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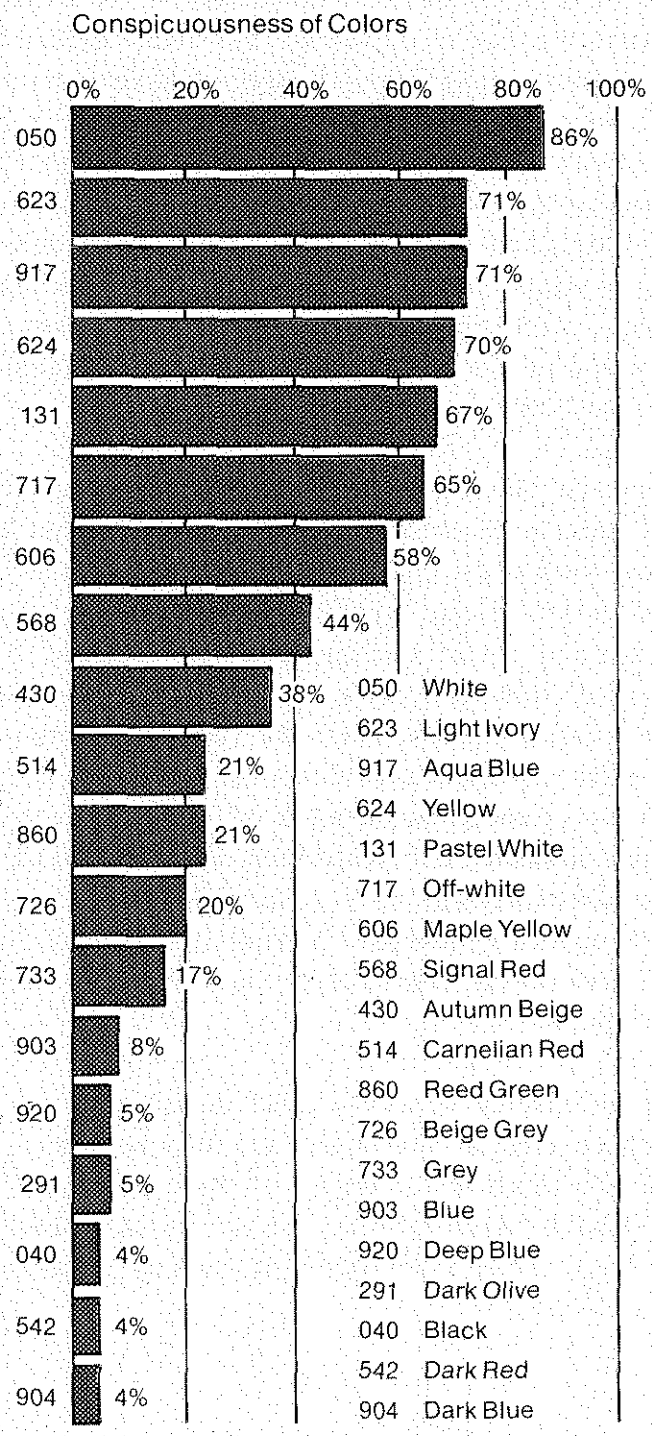
28. Hoffman, p. 17.
29. Hoffman, p. 18.
30. Mercedes Benz Experimental Safety Vehicle 22, Press Information Document presented to Committee on 11 September 1975.


Conspicuousness of Colors
0%
20%
40%
60%
80%
100%
050 86%
623 71%
917 71%
624 70%
131 67%
717 65%
606 58%
568 44%
430 38%
514 21%
860 21%
726 20%
733 17%
903 8%
920 5%
291 5%
040 4%
542 4%
904 4%
050 White
623 Light Ivory
917 Aqua Blue
624 Yellow
131 Pastel White
717 Off-white
606 Maple Yellow
568 Signal Red
430 Autumn Beige
514 Carnelian Red
860 Reed Green
726 Beige Grey
733 Grey
903 Blue
920 Deep Blue
291 Dark Olive
040 Black
542 Dark Red
904 Dark Blue

352. Mercedes-Benz indicated that the results of Daimler-Benz research into safety car colours has been reflected by purchasers' colour preference in Mercedes-Benz markets. In Australia, demand for bright yellow Mercedes-Benz has risen by 50 per cent in the past two years. Demand for black cars has dropped by more than 60 per cent in the same period. White was chosen by more than 25 per cent of Mercedes-Benz customers in 1974 while demand for less reflective colours such as dark blue, dark red and dark grey was halved. Mercedes-Benz has adopted the policy of promoting lighter colours to its customers.

353. The points made above have special significance because the majority of manufacturers have clearly indicated that fashion dictates what they sell. Virtually any colour is offered, as choice of colour may be the deciding factor in the sale of a vehicle. For instance, GMH indicated that many sales are lost within a dealership because the dealer has not the particular colour desired. The Committee found that none of the major manufacturers promoted or advised customers as to the safety advantages of certain colours. Chrysler however, advised the Committee that it would be prepared to issue a bulletin to all Chrysler dealers indicating which colours have the highest visibility and which it feels tend to be the safest colours under most average conditions.

354. The Committee firmly believes that manufacturers have a responsibility to advise customers in this matter. The Committee considers that the example of Mercedes-Benz is encouraging, and more particularly, considers Chrysler's initiatives in this field indicative of safety conscious thinking and promotion.

355. The Committee is of the opinion that, because the vast majority of sales are already light colours, then manufacturers should develop promotion procedures similar to Mercedes-Benz and Chrysler. The Committee suggests that by reducing their colour range cost savings could flow to manufacturers. Support for colour range reduction was expressed in evidence by the Managing Director of Chrysler who stated "We would just love it. Tommorrow if possible, make it law!" Similar views were expressed by AMI who have referred to "safety wattle" in their colour range to bring to customers' attention the fact that yellow is a safe colour.

356. The Committee realises that determining colour safety is not simple. As has already been shown, however, it is not impossible to research and certainly not impossible to implement at a probable cost saving. Customer choice and manufacturers' competitive interests are not significant objections if all manufacturers adopt the same criteria. Further study is desirable but the Committee does not consider that developing legislation is dependent on this fact. The Committee would expect that in-depth accident studies would take colour into consideration as a factor of accident causation. A further source of evidence in relation to accident involvement should be insurance companies.

357. The Committee is not concerned with establishing which is the "safest" colour and it is not suggesting that all cars should be white for example. It recognises the importance of contrast and changing conditions such as time of day and weather.

358. The Sub-committee therefore recommends that immediate steps be taken to develop an Australian Design Rule to prevent less conspicuous colours being applied to vehicles.

359. The Committee considers that manufacturers should be encouraged to follow the example of advising customers of the safety merits in selecting the colour of a vehicle.

- Colour of Government Vehicles

360. The Committee is pleased that the Federal Government is now purchasing light coloured vehicles which, it was stated, was decided partly for safety reasons. It was pointed out, however, that black appears in most manufacturers' colour ranges, only because there is still a government demand for it.

361. The Sub-committee recommends that all Federal and State Government Departments and Authorities ensure that vehicle colour selection is made on the basis of safety.

Field of View

362. Although the forward view of the driver would seem to be the single, most important requirement to enable him to drive safely, the evidence suggests that it has often been neglected by vehicle designers and safety legislators.

363. The Committee was told by members of the ACSVD that proposed ADR's 13, 13A and 13B for forward field of view were withdrawn following objections by vehicle manufacturers (see paragraphs 70-72). GMH stated that the objection to this standard was that thin windscreen pillars prescribed would have the effect of reducing roof strength. GMH vehicles met the first stage requirements of ADR 13, and the Torana passed the second stage, ADR 13A. The GMH written submission illustrated a test for roof strength which approximates vehicle rollover conditions and which is a U.S. requirement, FMVSS 216. It was stated that current Holden designs exceed the proposed performance requirements.

364. Ford also indicated that the design of the current Falcon model incorporated the thin windscreen pillar required to meet ADR 13, yet in roof crush tests the U.S. requirements

are exceeded by 40 per cent. The Managing-Director stated that "there is no question that the legislation and our response to it slimmed down the columns dramatically", and added that the designing of the thin pillar with adequate strength had been an extremely difficult engineering problem.

365. The Chairman of the ACSVD said that when a new design rule on field of view was developed, the requirements developed in Europe and U.S. should be considered for their suitability to avoid a unique Australian requirement which affects the structural design of the vehicle. Professor Cumming, however, expressed concern at the acceptance overseas that blockage to vision by the windscreen pillar must be accepted, as cars designed in Australia had shown that this could be overcome.

366. In summary the Committee notes that there is no ADR specifying forward field of view for the driver. Although ADR 13 was withdrawn it has been met in whole or in part by most locally designed vehicles and provides greater field of view width than any overseas requirement.

367. From this assessment the Committee concludes that the benefits of improved forward visibility which have been achieved in Australian vehicles when ADR 13 was issued, may well be lost if re-design of these vehicles occurs. It is recommended that a no less demanding design rule for field of view be substituted for Australian Design Rule 13, to ensure that advantages already gained are not negated.

368. Also important to the driver's field of view is his rearward vision which may be provided to him by interior and exterior rear view mirrors. ADR 14 specifies certain requirements for rear view mirrors for the purposes of providing a clear and reasonably unobstructed view to the

rear. For internal rear view mirrors, not only is the size and scope of the mirror important but so is the size of the rear window. Some vehicles on the road appear to be deficient in this regard.

369. It was also suggested to the Committee that other desirable safety design objectives include:

- rear view mirrors applicable to day and night use.
- the removal of obstructions to rear view such as venetian blinds.
- the location of the rear view mirror so that it does not impede forward field of view.

370. Optimum all-round field of view can be provided by a periscope device developed on some ESV's as indicated in the illustrated Fairchild vehicle. Whether this device is appropriate for all production vehicles however, is in some doubt. But it is indicative of vehicle design initiative deserving the attention of manufacturers.

371. The Committee believes that all these design objectives regarding rear field of view are based on design principles and, if not already achieved, should be pursued with vigour. Evidence would suggest that they could be provided at minimal cost while providing additional benefits for safety.

- Visibility and Lighting

372. Accident avoidance should have regard for additional important aspects of driver visibility other than his field of view. Visibility of other vehicles and the ability of other vehicles to make their intentions known (e.g. turning, stopping signals) are also important considerations.

373. Demisting of the windscreen is a requirement of ADR 15 and requirements for windscreen wipers and washers are covered by ADR 16. ADR 15 was developed to ensure clear visibility under adverse conditions. It is generally considered to be an essential safety item even by vehicle manufacturers.

374. The Committee received evidence to suggest that demisting of rear windows was a safety related item, although local vehicle manufacturers suggested that in this case it was merely a "convenience" item. Some manufacturers however, incorporate this item as standard equipment and regard it as an essential safety feature.

375. Historically, many items considered to be accessories fitted for convenience, have had such obvious safety advantages that they have become mandatory. These include exterior rear vision mirrors, turn signal lights, reversing lights, stop lights, and demisters. It seems to the Committee that demisting of rear windows (whether by heating element or other means), is no different.

376. It is recommended that Australian Design Rule 15 be upgraded to include demisting of the rear window.

377. Vehicle lighting has obvious implications for safety, particularly in view of the fact that the majority of road deaths occur at night. A number of ADR's specify requirements for lighting and visibility and generally these aspects of vehicle design have greatly improved over recent years.

378. It was suggested that the information already displayed on the exterior of the vehicle is sufficient but the important thing was to display this information in the most effective manner. This is particularly so with regard to the following:

- the need for separating stop, tail and signal lamps.
- signal lamps to be seen from the side.

379. One safety item which the Committee investigated was the incorporation of 4-way flasher warning lights on the exterior of the vehicle. The Committee is convinced that the fitting of 4-way flashers has considerable safety advantages. As mentioned earlier in this report (paragraphs 113 - 124) this additional item of driver information is currently under consideration by the ACVP with a view to making the fitting of 4-way flashers mandatory. The Sub-committee recommends that the fitting of 4-way flasher warning lights be subject to Australian Design Rule formulation without further delay.

380. Many innovations to improve vehicle lighting and visibility were suggested to the Committee. The Committee expresses no firm view on these proposals. The incorporation of reflectorised triangles, reflectorised strips inside the boot and off side doors, and reflectorised number plates on vehicles deserve closer attention before becoming standard equipment. All of these features have safety advantages and are at present in use to some extent in Australia.

381. The Committee recognises that vehicle lighting requires maintenance to remain in efficient operation. The Committee is also aware that too much lighting may be confusing by not providing sufficient contrast with the immediate surroundings. While ADR's are available, evidence of potential improvements nevertheless indicate the need for close scrutiny by the manufacturers and the ACSVD, if necessary, to optimise the safety of visibility and lighting techniques.

CHAPTER X: OCCUPANT PROTECTION

382. Whereas accident avoidance is concerned and is directed at preventing an accident, occupant protection is concerned with reducing fatalities and the severity of injuries of occupants in accidents which do occur.

383. The protection of occupants following a collision is dependent on all or any of the following basic requirements: the ability of the vehicle to withstand and absorb impact (crashworthiness), the restraint system, the design of the vehicle's interior, fire prevention and windscreen design.

384. A number of very important, inter-related factors must be considered in occupant protection. These factors are -

(a) human tolerances,
(b) restraint systems,
(c) crash structures, and
(d) cost effectiveness.

Occupant protection is generally considered a very complex subject and simple solutions are rarely possible; the use of seat belts being the outstanding exception.

385. Improvements in the knowledge and practical design of secondary safety has been dramatic in the last 10 years, largely as a direct result of the world-wide ESV programs. The recent Research Safety Vehicle (RSV) project and related studies are trying to find a balance between safety and economic practicability. With the tremendous amount of research being conducted, much of which has direct practical application, it has become increasingly important to carefully study the research results so that practical safety improvements may be instituted in Australia as they become available. Australia should probably not expend a lot of effort directly in the area,

rather, Australia should use worldwide research to formulate standards where possible.

386. The Committee considers that the inability to specify performance requirements for occupant safety should not be used as an excuse by manufacturers to do nothing. In almost any engineering endeavour, absolute knowledge is not possible nor required to effect improvements. The final proof of effectiveness is still in the performance. Thus, after assembling the best knowledge available, the practical approach is to institute a change and study the final result. The best example of this is the mandatory use of seatbelts. As vehicles become safer, it will become increasingly difficult and expensive to institute significant improvements. However, significant cost effective improvements are still possible through better vehicle design.

Human Tolerances

387. One basic technical area which is of crucial importance is human tolerances. Problems obviously arise in attempting to define the limits of survivability of humans. Although a very large effort has been applied in this area for a number of years, including extensive studies with animals, cadavers and living humans, actual tolerance levels are still disputable. As secondary safety becomes increasingly sophisticated, the variability in human tolerance levels becomes increasingly important.[31] It is no longer satisfactory to just have a mean tolerance level. It is now necessary to have some idea of the distribution of that tolerance level in the vehicle-occupant-population.

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31. European Experimental Vehicles Committee, The Future for Car Safety in Europe, Report prepared for presentation to the 5th ESV Conference, London, June 1974, p.p. 15, 18, 25 and 62. Also, Volkswagenwerk AG - Research Division, Research Safety Vehicle - Phase I, Prepared for the Department of Transportation, National Highway Traffic Safety Administration, April 1975.

388. In addition to, but related to the humal tolerance problem, is the problem of correlation between physical simulators (dummies) and actual human response and tolerances. Information before the Committee suggests that in the future improvements will need to be based on simulator (dummy) response to specified controlled crashes rather than on engineering strengths and deformations. This will require better correlation between actual tolerances and dummy responses.

389. Probably the most effective method of determining human tolerances and human tolerance variability is to utilise crash recorders similar to, but simpler than, an aeroplane crash recorder to determine the characteristics of actual crashes and then attempt to relate the vehicle motion, as determined by the crash recorder, to the injuries sustained by the occupant. This should allow accurate assessment of the variation of tolerances within the population and, through duplicate testing, develop correlations between human tolerability and dummy response directly. The information of a crash recorder is extremely useful for restraint and crash structure design as well as human tolerance correlations and could be considered in conjunction with future accident investigation programs.

Restraint Systems

390. The restraint system is the element with which the occupant will have contact during a collision and includes seat belts, air bags, seats, dashboard, steering wheel, glazing, header rail, roof, door panel and frame, firewall, etc. The object of the restraint system is to distribute the required load to the occupant in a non-injurious manner, so that energy may be absorbed to decelerate the occupant in a survivable manner (i.e. within the human tolerance limits).

Crash Structure

391. The crash structure, is that portion of the vehicle which deforms and absorbs energy and the associated supporting structure. In production cars, this structure has not always been designed for absorbing energy but has usually been designed solely for its basic function as a vehicle.

392. The function of the crash structure is to absorb (dissipate) the total vehicles crash energy in such a way that the occupant restraint system (itself absorbing part of the occupant energy) may serve its purpose and ensure the integrity of the passenger compartment.

393. The physical performance characteristics of the crash structure are of additional importance as it relates to other vehicles in a crash. Compatability between vehicles has been defined as the state where the occupants of both vehicles in a collision are in a survivable environment. This need for compatability requires extensive trade-offs in crash structure design to ensure increased overall survivability.

394. It has been pointed out in severe crashes where multiple injuries will be sustained, that the failure of the physical human should occur in the least destructive progression. Thus it is preferable to allow a femur to break than to have it well supported causing the spine to break instead.

Cost Benefit

395. The relationship of cost to benefits is a basic consideration for secondary safety development. Until

recently, crash safety was not a serious design consideration. Since in the past "crash structure" was there solely for other purposes, this "accidental" degree of protection had an infinite benefit-cost ratio - it didn't cost anything and did have some benefit. The initial ESV's were designed however for maximum crash performance as the primary objective. It is unlikely that either extreme will maximise the benefits in relation to costs for society as a whole.

Crashworthiness

396. The most important factor in improving crash performance is reducing the aggressivity between vehicles of different size and weight. The disparity of weight between vehicles is expected to decrease as the world vehicle market tends towards smaller sizes and weights due to rising operating costs of larger vehicles. Aggressivity is being researched throughout the world and the importance of compatability of vehicles has been brought to the attention of the Committee. The aggressiveness problem of car-truck collisions will not however diminish. Due to the great disparity of weight and the economic unattractiveness of enveloping trucks in enough crash structure to cushion impacting cars, it appears that the most practical solution to this aggressiveness problem is to improve truck primary safety (the subject of truck safety will be subject to future inquiry by the Committee). Evidence indicates that in general, local manufacturers are not taking significant steps to improve crash structures unless compelled to do so and do not appear to be keeping up with the techniques and innovations utilised by their parent companies.

397. Crash structure is not equivalent on all vehicles, as exemplified by static crush testing in the United States, even for similar types of construction. Technology has advanced enough that it may be practical in the relatively near future to specify improvements for crash performance.

In general, local manufacturers have indicated little planning for future improvements along these lines, for example, present barrier testing is essentially restricted to satisfying the requirements of current ADR's. Without legislative pressure, improved technology that is available today may therefore not be in vehicles within the next five to eight years.

398. The Committee feels that, since the locally manufactured vehicles are not, in general, duplicates of vehicles produced elsewhere, that significant development work in crash structures should be taking place for present and future Australian-made vehicles. The fact that the parent company does the basic research is not enough to ensure that locally designed vehicles are adequately designed, unless the benefits of this research are taken up and adapted where necessary to Australian conditions.

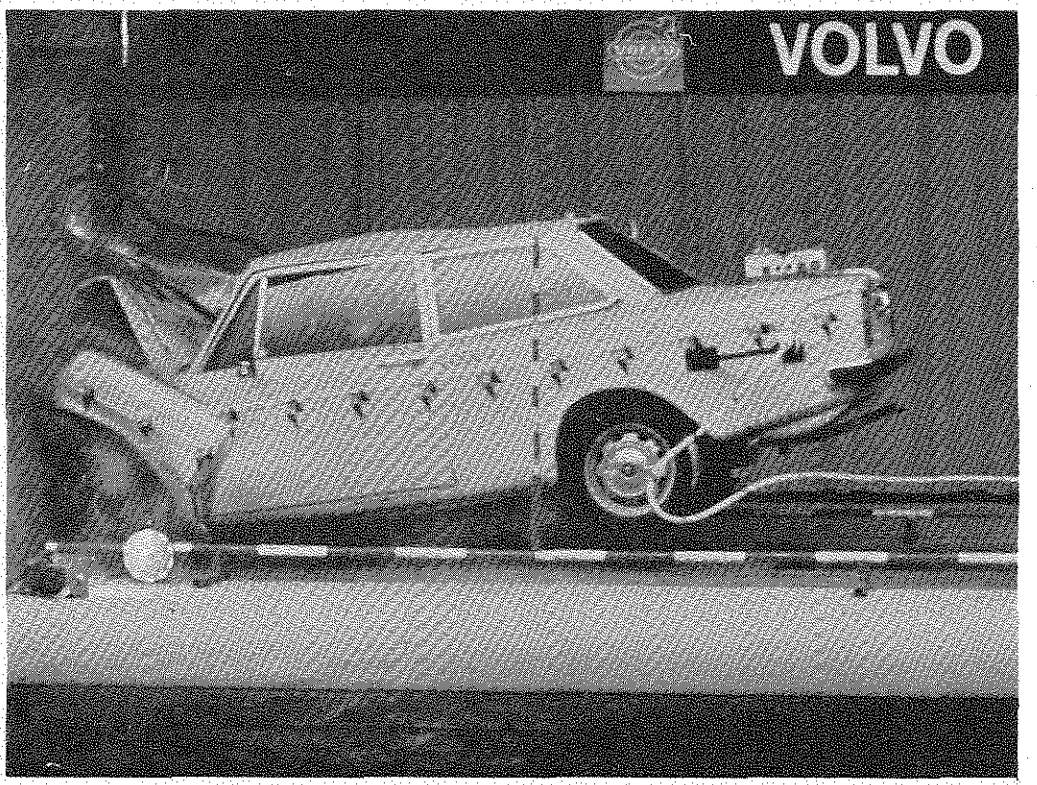
399. The Sub-committee recommends that developments in human tolerances, vehicle aggressivity and cost-benefit be closely monitored, supported by local research where possible, with the objective of drafting performance specifications for crashworthiness.

- Front Impact

400. Evidence indicates that front impacts (including front oblique impacts) are the most prevalent form of vehicle collision causing more death and injury than other crash modes. Due to its importance, relative simplicity of the crash model and the relative ease of improving crash performance, most research effort has been concerned with front collisions.

401. ESV research indicates that it is now possible to construct a relatively normal (but very expensive) automobile in which humans can survive a 80km/h (50 mph) front barrier crash. Such a crash is approximately equivalent to two equal mass cars, both going 80 km/h colliding head on. United States

statistics indicate approximately 90-95 per cent of all fatalities occur at impact velocities equivalent to or less than a 80 km/h barrier crash. Since "normal" cars are usually considered to have a survivable limit of approximately 50 km/h (30 mph), this represents a very large increase in capability. (See illustration).



This is a typical scene from a safety centre where it is possible to crash-evaluate cars at barrier speeds of up to 80 km/hour. Seat belts and many other types of safety equipment can also be tested in a crash simulator which allows testing to be carried out without totally destroying the car. A very comprehensive measuring system is used to study the behaviour of vehicles and passengers (dummies) under various crash situations. The computer centre gives the results of these tests in a few seconds.

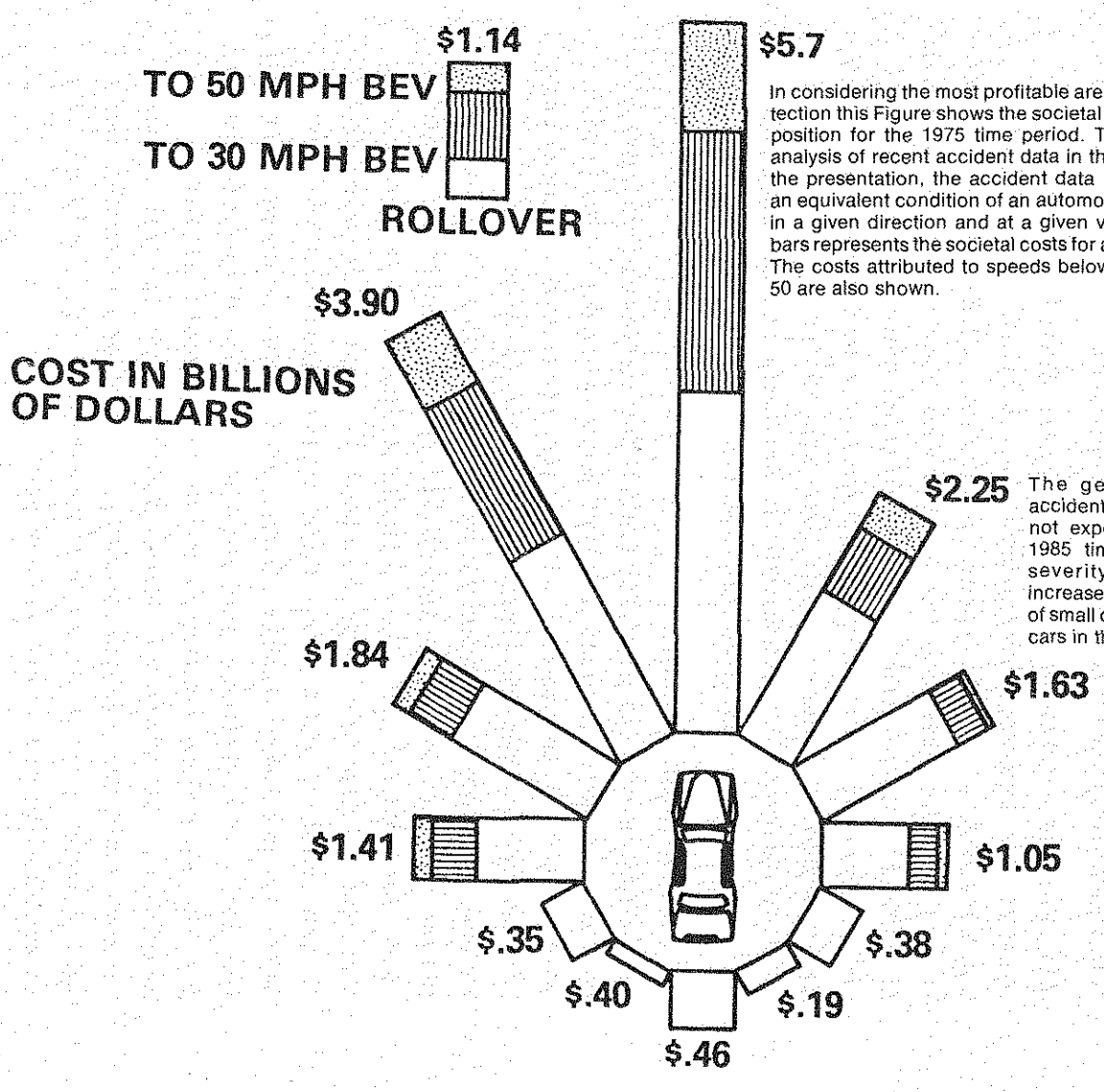
402. In the last five years a large number of practical improvements have been developed from the ESV program, some of which, in simplified form, can be incorporated in production vehicles. Indeed some manufacturers appear to be incorporating such changes as can be instituted either as low cost running changes or as designed-in low or no cost configurations on newly designed vehicles.

403. From the evidence it would appear that the greatest benefit for improved crashworthiness accrues from reducing the severity of front impact collisions. This is illustrated on p.152. According to the author the conclusion to be drawn from this illustration is that forward crashworthiness is most important, with sideway crashes of secondary importance and rearward crashes of even less significance. It is this type of analysis that assists in deciding on the level of protection which is required and its value to society.

-Side Impact

404. Side impact is significantly more difficult to design for than frontal impacts for two major reasons. The first reason is that the normal side crash structure is inherently less able to withstand impact and there is less distance before passenger compartment intrusion begins. The second reason is that for side impact the normal restraint systems (i.e. seat belts) are less effective and human tolerances are lower. The near side occupant is physically very close to the interior of the passenger compartment and the seat belts are not very highly loaded before the occupant contacts the door. The primary problem for both the crash structure and the near side restraint is the very short distance available. In addition, human tolerance to lateral impact is less than for frontal impacts. Therefore a normal car will provide a protective environment for the occupant only in relatively low speed side impacts.

SOCIETAL COST BY CLOCK POSITION—1975



In considering the most profitable areas in which to provide protection this Figure shows the societal cost of accidents by clock position for the 1975 time period. This chart is based on an analysis of recent accident data in the U.S. In order to simplify the presentation, the accident data have been translated into an equivalent condition of an automobile striking a fixed barrier in a given direction and at a given velocity. The length of the bars represents the societal costs for a given direction of impact. The costs attributed to speeds below 20, below 50 and above 50 are also shown.

The general distribution of accidents shown in the Figure is not expected to change for the 1985 time period. However, the severity may be expected to increase due to the larger number of small cars interacting with larger cars in the 1985 vehicle mix.

405. However, three possibilities exist for improving side collision performance:

(a) stiffen the crash structure so that penetration will not occur until higher impact velocities are reached,
(b) improve the restraint system, and
(c) increase the width of the car or decrease the interior width in order to gain more deceleration distance.

406. Stiffening the side structure is feasible and has been incorporated in some vehicles in the United States since 1969, and in fact became the subject of a vehicle standard in 1973. The intention of ADR 29, effective from 1 January 1977 is to specify strength and stiffness requirements for side doors of passenger cars to reduce intrusion into the passenger compartment as a result of side impact.

407. The effectiveness of the American standard has not been thoroughly assessed but at least two studies are available.[32] While these reports indicated that side door beams were marginally effective, no conclusive evidence has yet been produced. The author of one of these studies, however, stated in evidence that the ADR for side door beams was warranted. Manufacturers expressed certain objections to the requirements of ADR 29 and expressed doubts concerning its expected effectiveness.

408. As developments proceed in both front and side collision crash structure, it will become increasingly important for the

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32. A.J. McLean, Collection and analysis of collision data for determining the effectiveness of some vehicle systems. Chapel Hill: University of North Carolina Highway Safety Research Centre, 1973.
The second study by F. Preston and R. Shortridge, of the University of Michigan is summarised in the submission of Chrysler Australia Ltd. Evidence p. 2855-6.

structures to be compatible. The basic idea of stiffening the door structure to reduce intrusion and make the front of the impacting car absorb the energy is of no value if the front of vehicles, especially the heavier ones, are so stiff that they still will not absorb the energy through deflection. In the past, vehicles' front structures have been relatively soft getting harder as the deflection increases.

409. With regard to the restraint system, the standard seatbelts may be effective on the off-side but cannot develop the required restraining force in the short distance available for near side occupants. The only viable restraints in the short space available for the near-side occupant appears to be additonal padding. This could be in the form of padding on the door frame and roof side rail or an integral padded safety seat. Helmets could be investigated to protect the head. Manufacturers are encouraged to develop these features before legislative action becomes necessary.

410. Increasing deceleration distance in side impacts has also been shown to be possible (particularly for larger vehicles), however, the added space may not be utilised unless adequate crash structure and restraints are added.

411. Evidence indicated that no special protection is presently provided in side impact. Since side collisions are such a common crash mode in Australia, this Committee supports the use of increased side door stiffness and energy absorption foreshadowed by ADR 29. The Committee considers that side collision is so important that every effort should be made to reduce fatalities and injuries and continue to be made even if initial efforts are proven to be unsuccessful.

- Rear Impact

412. In general, the rear collision mode is not as significant a problem as other modes. Statistics show that the number of accidents and the number of injuries are relatively low. The

normal functional vehicle, with a few exceptions is admirably suited for occupant protection from rear impacts. The boot generally offers adequate crush distance and the occupants (at least in the front seat) are supported by full length seats or head restraints(ADR 22A) which act as a suitable form of restraint. A high degree of protection was provided in some ESV's. This protection was generally accomplished by ensuring that the spare tyre and wheel did not impede progressive collapse, that the fuel tank was not located in the collapsing zone, and by the utilisation of additional stiffness. Some of these ESV features could be regarded as marketable and practical in respect of rear crash structure and seats. In general, however, it appears that the inherent protection for this crash mode is relatively adequate and since the problem is small, improvements in other areas would be more cost effective.

- Rollover

413. Rollover is the most difficult crash mode to analyse since it includes a wide variety of possible accidents. A vehicle may roll for a wide variety of reasons, some of which are as follows:

(a) a relatively high centre of gravity and a narrow track (common for trucks and small cars),
(b) a combination of steering and braking inputs,
(c) sliding into a curb or soft earth,
(d) when one side of the vehicle is raised, and
(e) side impact.

414. In addition to the manner in which a roll may be initiated, the degree of roll and vehicle dynamics are also important. A vehicle may roll over on its side (quite common for trucks) or it may roll a number of revolutions, or it may stop at any intermediate point, e.g. on its roof.

415. Occupant dynamics depends not only on the motion of the vehicle, but also on the restraint system in all directions on the occupant.

416. Evidence suggests that the formulation of scientific rollover specifications is extremely difficult. In general, rollover criteria presently utilised are not representative of the wide variety of real world occurrences.

417. One method to reduce the number of rollovers is by increasing the inherent vehicle stability (see paragraph 285). Significant work has been conducted in the US on factors inducing vehicle rollover but so far no standard has evolved.

418. Statistics indicate a low number of rollover accidents in Australia compared to the US where approximately 20 per cent of road fatalities are attributed to this cause. These statistics would suggest that Australia and the US may define rollover differently. For example, Australia may categorise the collision by the first definable characteristic (side collision or left roadway) while the US may consider rollover highly and hence categorise any accident in which rollover occurs as a rollover. It would seem logical that with the extensive rural roads and relatively smaller cars (cars with narrower track and approximately the same height of centre of gravity) that the affect, and number, of rollovers in the US and Australia would be similar.

419. The Committee considers that low or no cost, world-wide rollover protection and prevention development be monitored for possible improvement in Australian vehicles. The Sub-committee recommends that the method of data reporting for rollover accidents be investigated.

Occupant Restraints

420. As a means of providing occupant protection, restraints have proved to be a most effective breakthrough in reducing vehicle occupant fatalities and injuries. This is particularly significant for child restraints which at this stage are not compulsory.

- Seat Belts

421. Victoria was the focal point of the introduction of seat belt legislation in Australia. The steadily rising number of people killed and injured as a result of road traffic accidents in Victoria during the 1960's precipitated a great deal of media activity in that State, urging the Government to take positive action to reduce the death and injury rate. Various "buckle up" education programs instigated by the Victorian Government were having little effect on the public attitude to seat belt wearing.

422. In September 1969, the Victorian Parliament's Joint Select Committee on Road Safety in its report[33] into the desirability of the compulsory fitting and compulsory wearing of seat belts expressed the opinion that no matter how much the public was exposed to education in the use of seat belts, apathy, lack of interest and lack of concern would mean that many people would not wear them. In light of this finding, that Committee recommended that all occupants of motor vehicles should be required to wear seat belts within a maximum period of two years. Subsequently, the Victorian Parliament enacted legislation which made seat belt wearing compulsory as from 22 December 1970.

423. By 1 January 1972, the remaining Australian States and Territories had enacted similar legislation. Legislation in the States and Territories generally, applies to any seating position in which a belt is fitted. ADR's required seat belts to be fitted in front "outboard" occupant seating positions on all passenger vehicles manufactured from 1 January 1969 and in rear seating positions in vehicles manufactured from 1 January 1971. Victoria, New South Wales and South Australia have legislated for the retrospective fitting of seat belts for certain passenger vehicles manufactured prior to 1969.

33. Victoria, Joint Select Committee on Road Safety, Third Progress Report, Report upon An Investigation Into The Desirability of The Compulsory Fitting and the Compulsory Wearing of Seat Belts, 9 September, 1969.

424. The most common penalty for non-compliance with the legislation is $20 but exemptions exist in certain circumstances. The common exemptions from compulsory seat belt wearing are children under 8, aged passengers, delivery people, driving in reverse and for certain medical reasons.

(i) Reduction in Death and Injury as a Result of Seat Belt Wearing Legislation

425. The Committee, in the course of its inquiry, received a substantial amount of evidence and data which proved the value of seat belt wearing in accidents, particularly since the enactment of seat belt wearing legislation in Australia.

426. The Committee was informed that the highest percentage of death and injury came from unrestrained occupants involved in vehicle accidents. Dr Henderson indicated to the Committee that, based on studies undertaken by TARU in N.S.W. approximately 80 per cent of fatalities was coming from the 20 to 25 per cent of people who did not wear belts. He reasserted this view in later evidence when he indicated that a relatively high percentage of deaths will always come from the non-wearers of seat belts or from those wearing them incorrectly. A Melbourne Study[34] supported this observation. It found that in 1973, only one half of the drivers and one third of the front seat passengers injured in accidents were wearing seat belts at the time of the accident.

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34. G.W. Trinca and B.J. Dooley, "The effect of mandatory seat belt wearing on the mortality and pattern of injury of car occupants involved in motor vehicle crashes in Victoria", The Medical Journal of Australia, May 31, 1975 p.p. 675-678.

427. A report[35] by the Victorian Office of the Commonwealth Bureau of Census and Statistics (now Australian Bureau of Statistics) found that following an examination of 1970 Victorian accident data the wearing of seat belts had a highly significant association with a reduced rate of driver fatalities and a reduced rate of serious injuries to drivers.

428. A New South Wales study[36] used a simple regression model to predict the anticipated number of deaths of motor vehicle occupants in 1972. The actual number of deaths of motor vehicle occupants in that year was 25 per cent below the predicted figure. At the same time, there was no comparable decrease in the total population of New South Wales, the number of licensed drivers, the number of vehicles on the register, the annual number of registrations of new vehicles, or the annual consumption of motor spirit (on the contrary figures indicate that due to natural increase, total numbers in these areas have in fact increased) and that no other measure had been introduced at the end of 1971 which might conceivably have had a marked effect on the number of occupants killed. It was concluded that the legislation requiring the wearing of seat belts was probably responsible for the drop in the number of occupant fatalities. The Australian Department of Transport supplied the Committee with data confirming the above trend.

429. The 1974 figures on fatalities and injuries involving vehicle occupants show that for Australia there was a 26 per cent fall in fatalities from the prediction limits (see Figure 1) in Victoria a 38 per cent drop in fatalities

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35. Commonwealth Bureau of Census and Statistics: Victorian Office, Report on a Statistical Investigation into effectiveness of seat belts in motor vehicle accidents January 1973.

36. M. Henderson and R. Wood, "Compulsory Wearing of Seat Belts in New South Wales, Australia. An Evaluation of its effects on Vehicle Occupant Deaths in the First Year", The Medical Journal of Australia, October 27, 1973, p.p. 797-801.

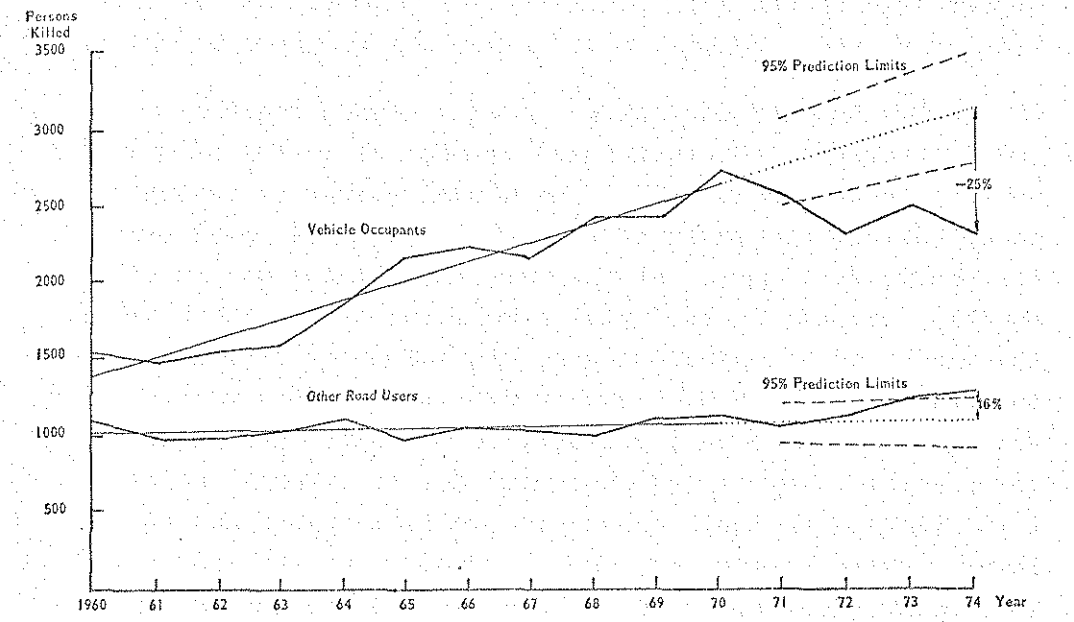

FIGURE 1. FATALITIES BY ROAD USER CATEGORY – AUSTRALIA

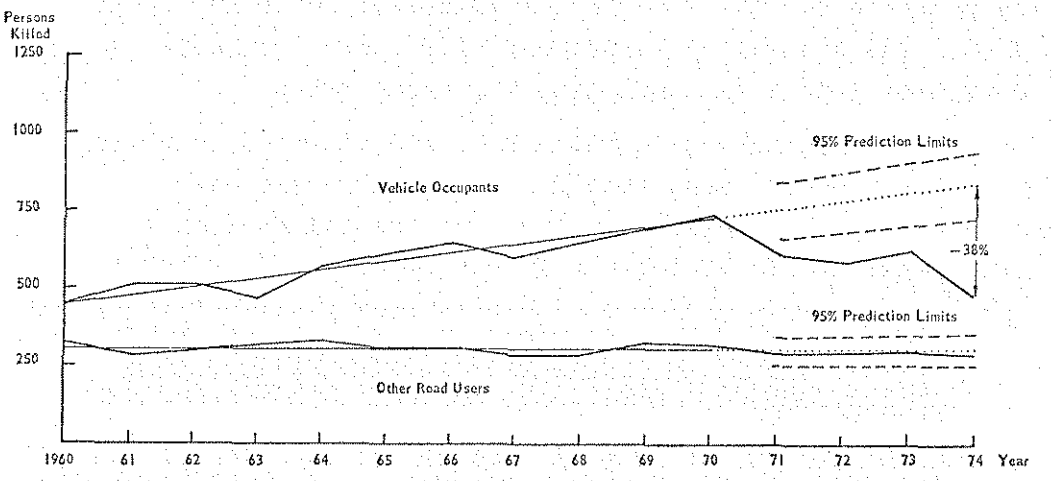

FIGURE 2. FATALITIES BY ROAD USER CATEGORY – VICTORIA

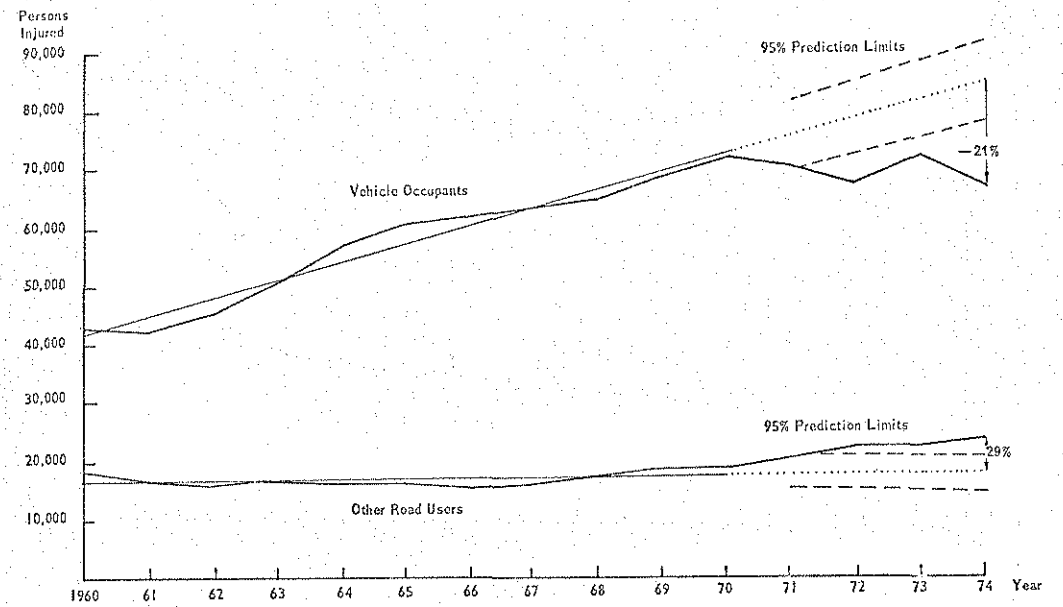

FIGURE 3 – INJURIES BY ROAD USER CATEGORY – AUSTRALIA

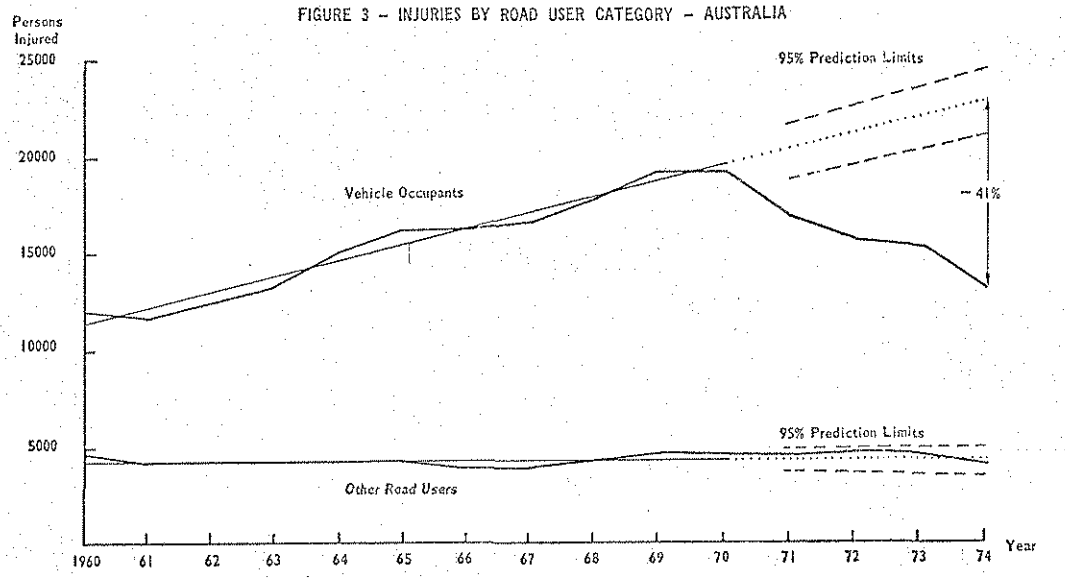

FIGURE 4. INJURIES BY ROAD USER CATEGORY – VICTORIA

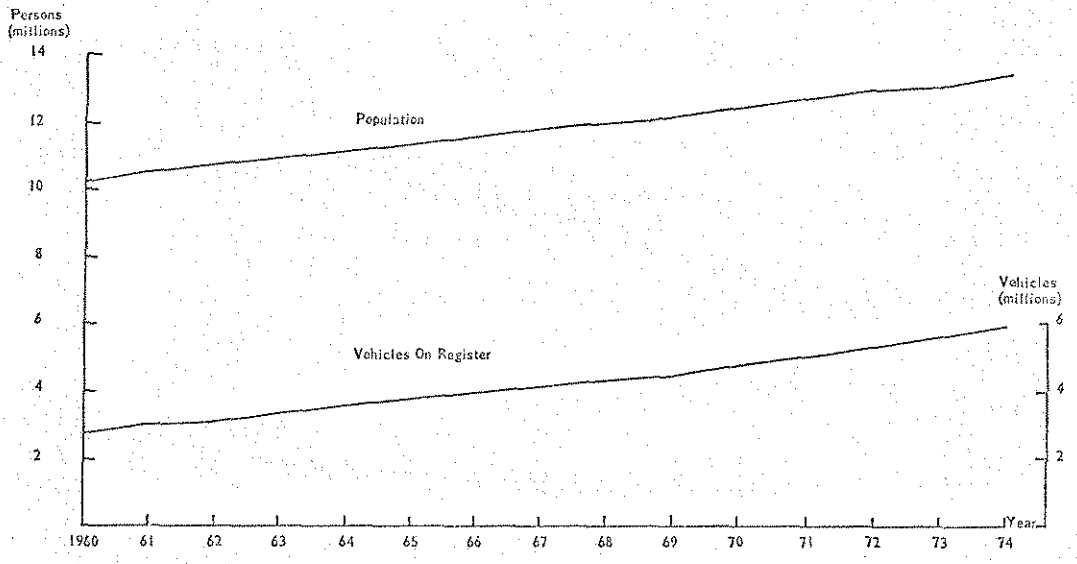

FIGURE 5 – POPULATION & VEHICLES ON REGISTER – AUSTRALIA
(as at 30th June)

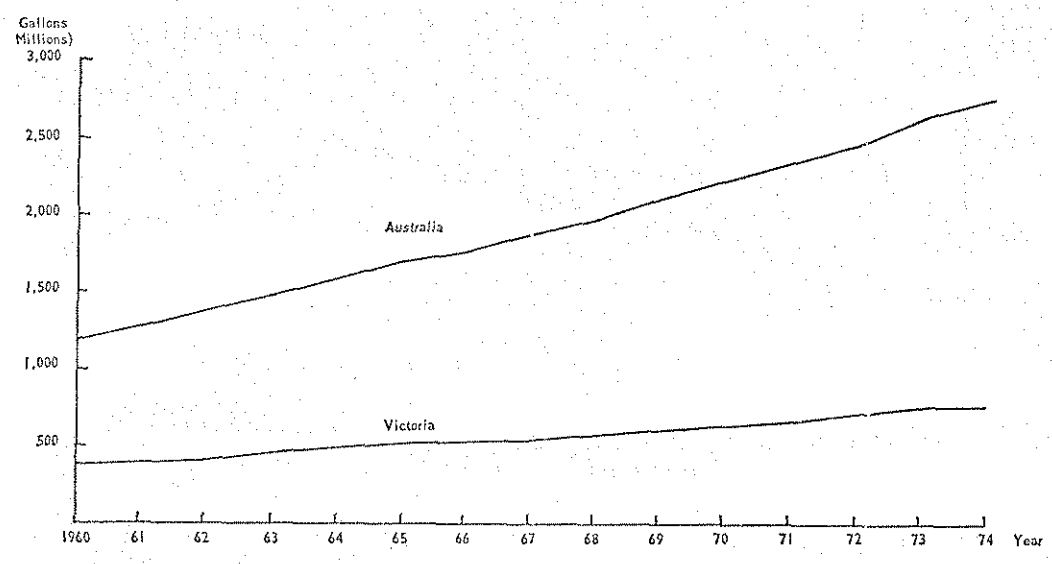

FIGURE 6 – GASOLINE CONSUMPTION

(Figure 2) and for injuries there was a 21 per cent fall for Australia (Figure 3) and 41 per cent drop in Victoria (Figure 4). Figures 5 and 6 indicate a steady increase in population, vehicles on register and use of gasoline which suggests an increase in vehicle usage.

430. It should be noted that fatalities and injuries of road users other than vehicle occupants (pedestrians, cyclists and motorcyclists) did not show a corresponding decline either in Victoria or in the rest of Australia. In fact, during 1974 other road user deaths increased by 18 per cent from the levels predicted and injuries for this group increased by 33 per cent. This strongly confirms the contention that vehicle occupants were being affected by a measure not operative so far as other road users are concerned.

431. The Committee was informed that the disparity between the fall in vehicle occupant fatalities and injuries for Australia compared with Victoria may well be due to the fact that Victoria had higher fitting and wearing rates of seat belts compared with the rest of Australia.

432. It can be concluded from these analyses that compulsory wearing of seat belts has had a marked effect on reducing casualties of vehicle occupants.

433. The Committee also received a substantial amount of evidence that seat belts had lessened the severity and incidence of certain types of injuries. Of particular note was evidence given by the Royal Australasian College of Surgeons based on a survey of vehicle crash patients admitted to the Preston and Northcote Community Hospital during the period from July 1970 to December 1973. Whilst there had been a slight increase in the number of patients

attending hospital for treatment in that period, there was a significant fall in the number of patients admitted. The major group, car occupants, showed a fall in demand from 14 per cent in 1970 to 9 per cent in 1973. The witnesses concluded that it was reasonable to assume that this decrease was principally due to the increased wearing of seat belts with reduction in severity of injury.

434. The Road Trauma Committee of the Royal Australasian College of Surgeons presented to the Committee its Pattern of Injury Survey of Victorian Automobile Accidents between June 1971 - June 1973.[37] Funds for this survey were recommended in the First Report of a previous Select Committee.

435. The results of the survey again show the benefits of seat belts in collisions but also point to some areas (e.g. rear end collisions, side impacts) where improvements could be made in the seat belt or general vehicle design to improve protection for seat belted occupants in such collisions.

(ii) Wearing and Fitting Rates since Seat Belt Wearing Legislation

436. The Federal Department of Transport supplied the Committee with the results of surveys it conducted in May 1973 and May 1974 on the wearing rates of lap-sash belts in Australian capital cities and major urban areas as shown in Table 5. It can be seen that relatively high usage rates apply throughout urban areas in Australia.

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37. P.G. Nelson, Pattern of Injury Survey of Victorian Automobile Accidents June 1971 - June 1973, Report to House of Representatives Select Committee on Road Safety, Royal Australasian College of Surgeons Road Trauma Committee, September, 1974, Evidence, p.p. 673-950.

TABLE 5

Fitting and Usage Rates for Drivers and Outboard Front Seat Passengers of Passenger Cars and Derivatives

	Lap-sash Belts Fitted %	Lap-sash Belts Used (where fitted) %	Overall Wearing Rate %
May 1973			
Adelaide (South Australia)	80	63	50.4
Hobart (Tasmania)	74	67	49.6
Melbourne (Victoria)	82	80	65.6
May 1974			
Brisbane (Queensland)	82	82	67.2
Perth (Western Australia)	79	83	65.6
Sydney (New South Wales)	92	82	75.4
Newcastle (New South Wales)	88	82	72.2
Wollongong (New South Wales)	88	79	69.5

437. The roadside surveys included only the two front seating positions of passenger vehicles. Some of the significant findings of the survey are as follows:

- the seat belt wearing rate for young males under 30 was higher than or equal to average.
- there was no consistent difference in wearing rates between occupants of different ages.
- the female wearing rate was consistently higher than males, for both driving and front left passenger positions.
- front left passengers had consistently lower wearing rates than drivers, this being mainly due to the low rates for males while front left passengers.

- drivers alone and drivers with passengers had similar wearing rates.
- the wearing rate in Adelaide decreased by 20 per cent after dark, and by 3-5 per cent in Melbourne, Sydney and Hobart - this did not appear to be due to any disproportionate decrease for young males under 30.
- the overall wearing rate was lowest in Adelaide (62 per cent in May 1973), followed by Hobart (67 per cent in May 1973), compared with 79-83 per cent in the other six cities observed.

438. At the Committee's request additional information was provided of the results of surveys conducted by State authorities, all of which indicate that there has been a significant improvement in wearing rates as a result of seat belt wearing legislation.

(iii) Retrofitting of Seat Belts to Vehicles

439. Although there is a draft code of practice prepared by the ACVP on the retrofitting of seat belts, no State has adopted the code in its recommended form. However, Victoria, New South Wales and South Australia have enacted retrofitting legislation which makes the fitting of seat belts for the driver and front outboard passenger positions in passenger cars cumpulsory.

440. Victoria makes no reference to the standard of installation. In New South Wales the only reference to installation is that the seat belt should be installed in accordance with the instructions issued by the manufacturer of the seat belt. The Committee notes that the draft code of practice on retrofitting includes a reference to the standard of installation.

441. The Committee was informed by the Federal Department of Transport that the difference between the fall in 1974 from the predicted levels for vehicle occupant fatalities and injuries for Australia and Victoria (see Figures 1 to 4) could be attributed in part to the emphasis on retrofitting and the requirement to fit belts on the resale of vehicles in Victoria.

442. The Committee is aware that many pre-1969 passenger vehicles and derivatives in Australia have not been fitted with seat belts, particularly in those States and Territories where retrofitting legislation has not been introduced. The Committee considers that this is an unsatisfactory situation given the proven benefits of seat belts.

443. The Committee therefore urges all State Governments, to immediately enact legislation based on the ACVP's draft code of practice for the retrofitting of seat belts in passenger cars and their derivatives. All States should ensure that retrofitting legislation applies to as many vehicles as practicable with appropriate standards for installation.

444. The Sub-committee recommends that the Federal Government ensure that the Australian Capital Territory and the Northern Territory immediately legislate for the retrofitting of seat belts based on the Advisory Committee on Vehicle Performance draft code of practice.

(iv) Problems Associated with Seat Belt Wearing Improvements and Future Design

445. Whilst seat belts have proved their undeniable benefit, the Committee is aware that problems do exist with seat belt wearing. The Committee notes that lack of comfort, injuries

caused by the seat belt itself and accident modes, which afford little or no protection to the seat belted occupant are important considerations. The Committee feels that a necessary and important corollary to compulsory wearing legislation and the subsequent high wearing rates is that improvements need to be made to ensure that the seat belt occupant is encouraged to use belts to receive maximum possible protection.

446. The Committee was told by many witnesses that lack of comfort and proper adjustment was a major problem confronting seat belt wearers, particularly those who do not have the benefit of the ADR on retractor seat belts.

447. Problems concerning comfort and the operational effectiveness of belts are: chafing of neck and falling off the shoulder due to poor siting of anchorages; impaired protection due to twisted webbing; susceptibility of buckles to damage; difficulty in achieving correct positioning of buckle; difficulty of buckle fastening; general ease of adjustment; difficulty in reaching controls; durability of components (webbing and plastic); unsatisfactory storage when not in use; the variety of belts used in vehicles.

448. Because of the problems related to seat belts, there is a tendency for occupants not to wear the belt correctly. Dr Ryan told the Committee that a study[38] on seat belted injuries found that seat belts themselves caused a number of minor injuries (abrasions and bruises) and some severe injuries (internal abdominal injuries and skeletal injuries). The study concluded that the incidence of maladjustment of

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38. G.A. Ryan and R.J. Baldwin, In-Depth Study of Seat Belted Accidents, Monash University, December 1972.

seat belts is alarmingly high, and warrants further action, especially as maladjustment seems to be associated with injury.

449. The Committee concludes that incorrect fitting of belts is partly due to the ignorance by the wearer of the correct method of adjustment and of the necessity for so doing, and partly due to inadequacies of seat belt design and fitment which make correct adjustment of the belt difficult or near impossible for people of extreme body size range.

450. The Committee studied a report which showed that some new seat belt buckles had been found to open under impact conditions whilst others, after years of wear, could be undone without pressing the release button. The correction of this failing could have been achieved by more thorough investigation at the design stage, particularly with the use of dynamic (simulated) tests as opposed to the practice of static (load) tests. The Committee feels that in the light of this information manufacturers lacked initiative in not conducting dynamic tests on seat belts until it became a requirement under the terms of ADR 4A which came into effect after January 1974.

451. The Committee feels that the design and fitting of inconvenient, low standard equipment, which met the then current standards in a way that encouraged ineffective wearing or no wearing at all illustrates the fact that the expectation that all vehicles will have effective safety equipment without legislation is perhaps unrealistic.

452. The Committee would expect that some of the problems associated with seat belt wearing should be overcome by improved ADR's which have recently come into operation. These design rules are: 4A, 4B, 4C and 5B. The most significant of these ADR's is 4B, which prescribes retractor

seat belts which, under normal driving conditions, allows the occupant to move at will, but as soon as a certain rate of deceleration is reached on sudden braking or on impact, the inertia retractor mechanism prevents any movement of the belt so that the front seat occupants are held securely in their seated positions. The full benefits of these rules will not be felt by the majority of vehicle occupants until the majority of pre-1974 models on the road are replaced. In the meantime, some of the present deficiencies may be overcome by the addition of locking retractor reels which prevent twist, ensure proper adjustment at all times and enable controls to be reached and webbing to be kept clean; sash guides; and rigid mountings for buckles.

453. The Committee was also made aware that seat belts can be rendered ineffective following a collision or due to inadequate maintenance. Whilst the Committee is aware that nationwide efforts are being made to educate road users in the correct wearing and adjustment of seat belts, this program pre-supposes proper installation of belt equipment. The Committee therefore feels a more comprehensive effort may be needed to overcome the problems on proper wearing and installation.

454. The Sub-committee therefore recommends that the Federal Department of Transport, in conjunction with the State and Territory registration authorities, immediately initiate a program to notify all pre-1974 model vehicle owners, at the time of registration renewal, of the inherent dangers associated with the incorrect wearing and fitting of seat belts.

455. A variety of accident modes provide little protection even for seat belted occupants. As indicated earlier in this chapter other occupant protection measures are necessary to determine survivability.

456. Vehicle design measures, both current and planned, aimed at reducing intrusion and thus the incidence of death and injury for occupants wearing seat belts, must be complemented by measures to reduce the incidence and degree of impacting objects causing intrusion.

457. Seat belts offer minimal protection in side impacts but prevent occupants being thrown around the vehicle or being ejected. The Committee feels that the whole question of reduction of side impact collisions can best be achieved by improvement of road and vehicle design. Other crash modes which afford the seat belted occupant with minimum protection are severe truck to car collisions and severe collisions with roadside objects.

(v) Enforcement of Seat Belt Wearing

458. The degree of enforcement of seat belt wearing varies throughout Australia. Evidence supplied to the Committee by the Federal Department of Transport on the number of prosecutions in the States and A.C.T. for eighteen months to December 1974 is shown in Table 6.

459. The Committee also notes with concern the correlation between the low overall wearing rates (see paragraph 436) and the low percentage of prosecutions for seat belt offences of all traffic convictions in South Australia and feels that until a more stringent enforcement program is undertaken, the fullest benefit from the law will not be gained.

460. The Committee feels that, in view of the fact that no other State police authority expressed any significant difficulty with enforcement, and the less populous States of

TABLE 6

POLICE REPORTED PROSECUTIONS - AUSTRALIAN STATES AND THE AUSTRALIAN CAPITAL TERRITORY EIGHTEEN MONTHS TO DECEMBER 1974

	Seat Belt Convictions (1)	Total Traffic Convictions (excluding parking) (2)	(3)= $\frac{(1)}{(2)} \times 100$	Number of Cars and Station Wagons Registered at December 1974 (4)
QLD	NO.	NO.	%	NO. ('000)
1/7/73 - 31/12/74	7,287	277,207	2.63	662.1
S.A.				
1/7/73 - 30/6/74	42	70,432	0.0596	467.3
TAS.				
1/7/73 - 31/12/74	1,577	45,383	3.47	147.0
VIC.				
1/7/73 - 31/12/74	20,585	318,350	6.466	1342.8
A.C.T.				
1/1/73 - 31/12/74	410	17,759	2.306	81.8
N.S.W.				
1/1/74 - 27/12/74	34,498	591,623	5.831	1644.1
W.A.				
1/1/74 - 30/12/74	7,366	91,132	8.083	399.8

Source: Evidence, p. 4179A.

Tasmania and Western Australia have a much higher percentage rate of prosecutions, the South Australian enforcement rate is inexcusable.

461. The Committee believes there is still scope for increased enforcement by the States. Together with the adoption of retrofitting legislation this may be achieved by a greater awareness of the value of seat belts by police, and increased fines. Unless there is a real threat of prosecution, vehicle occupants will tend to disregard the law.

462. The Committee is convinced that vigorous enforcement of the seat belt wearing law is of paramount importance if Australia is to reduce its vehicle occupant deaths even further, particularly in view of the fact that the highest percentage of death and injury is coming from that group of people not wearing seat belts.

463. Dr Henderson told the Committee that there was a core of deliberate non-wearers and that there was probably no practicable way of getting them to put on seat belts. He suggested that these people are probably the ones who drive badly, drink a lot and would be a high crash risk anyway. In his view some mechanical rather than behavioural means would be necessary to ensure 100 per cent wearing.

464. The Committee feels that the only way hard core non-wearer would respond to the legislation would be if non-wearing of belts could be made immediately obvious to the police (as is the case with motorcyclists' helmets). In this respect the Committee feels that a device such as an outside light or some other form of indicator to show that a belt is unconnected is desirable. This would assist the police particularly

at night when this offence is often more prevalent and harder to detect.

465. The Sub-committee therefore recommends that the Government investigate the practicality and feasibility of incorporating an outside device on vehicles to indicate whether seat belts are being worn.

466. Another device currently fitted in some production vehicles is a warning light on the dashboard which is operated by the ignition switch and indicates that the seat belt is not fastened. The Committee believes that this form of warning device is an important means of further encouraging the wearing of seat belts. It is therefore recommended that an Australian Design Rule be developed to ensure that vehicles are fitted with a "fasten seat belts" warning light on the dashboard operated in conjunction with the ignition switch.

(vi) Exemptions to Seat Belt Wearing

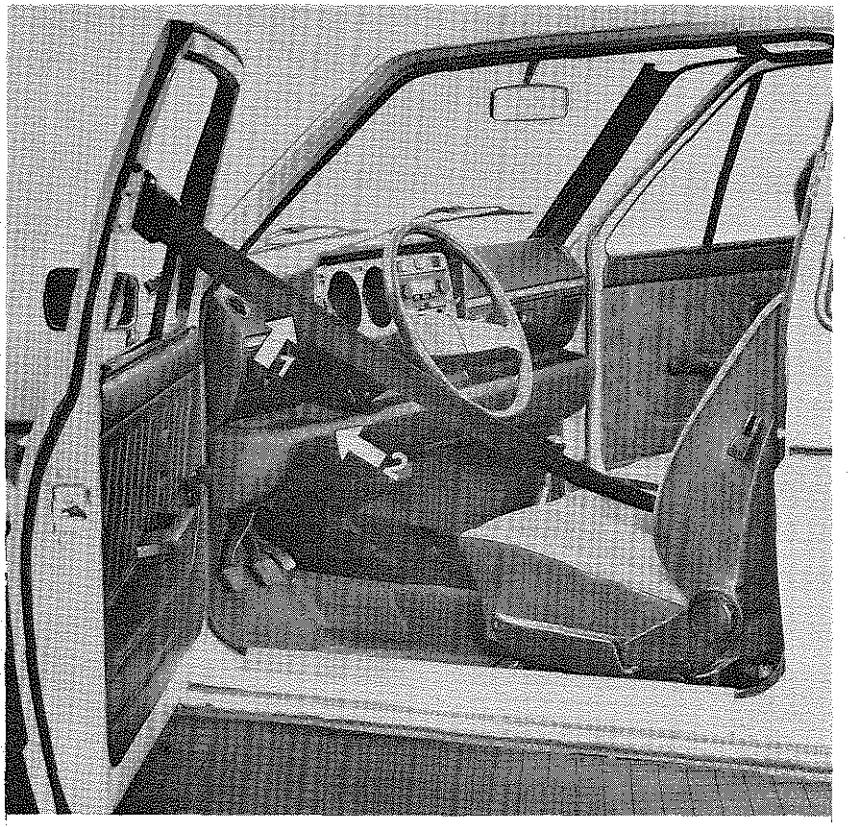
467. Reasons for exempting certain vehicle occupants (see paragraph 424) appear to be related to aspects of comfort. The Committee concludes that the advances made in seat belt design, in particular, inertia reel belts, have overcome many difficulties associated with comfort and fitting and that in some instances, the premise for granting exemption has been removed or greatly lessened.

468. The Sub-committee therefore recommends that the Government immediately investigate the present reasons for granting exemptions from seat belt wearing and encourage State and Territory authorities to amend their legislation according to the results of the investigation.

(vii) Present and Future Development in Seat Belt Design

469. In Australia, development on seat belts in the past has generally followed customer criticism rather than anticipating at the design stage. Evidence suggests that local manufacturers have only been responding to the requirements on seat belts stipulated by the ADR's rather than researching ways of improving seat belt technology. An exception to this was the telescopic seat belt buckle introduced by Chrysler into their vehicles in January 1975 - a feature unique in seat belt design.

470. One of the latest overseas developments in seat belt technology shown to the Committee was the passive (automatic) seat belt (Restraint Automatic) developed by Volkswagen.



The belt is secured by an inertia retractor to the front seat and the other end is anchored to the door pillar. When the door is closed the belt is automatically applied over the chest (as illustrated - arrow 1). In place of a lap belt there is an energy-absorbing knee bolster (arrow 2) which prevents the passenger from slipping out under the belt in a collision. The absence of a lap belt obviously reduces the effectiveness of the device in side collisions.

471. The Volkswagen Restraint Automatic is the only passive belt system introduced and is in present use in the United States and in the Federal Republic of Germany.

472. The Committee was informed that this type of restraint was precluded under the wording of the present ADR's. The Committee feels that one of the advantages flowing from a system of passive belt restraints would be the exceptionally high wearing rates. Another advantage is that the necessity for its enforcement would be negligible.

473. The Sub-committee recommends that the Advisory Committee on Safety in Vehicle Design investigate the desirability of passive belt restraints with a view to design rule implementation.

474. Other developments in seat belt technology are improved energy absorption and pre-tensioning. Evidence was given of extensive research conducted by Ford (U.S.) in relation to pre-tensioning (a sensing device which measures the deceleration of the vehicle) and by ARL with respect to energy absorption (the incorporation of energy absorbers into the restraint).

475. There is evidence to suggest that this research (particularly energy absorption) has resulted in new benefits for

improved seat belt design and their development should be closely observed by the ACSVD. The Committee feels that such developments should be actively encouraged and design rules be flexible enough to incorporate improvements (such as passive restraints and energy absorbing systems) and should not be precluded by the wording of a design rule.

476. Other developments taking place overseas include integrated seats, air bags and interlocking devices. While there is evidence to suggest that integrated seats have some merit (e.g. for side impact) the Chairman of the ACSVD explained effort was being concentrated on improving seat belt comfort and performance rather than becoming involved in such things as air bags and interlock systems because of the high wearing rates resulting from seat belt legislation. In addition, considerable doubts are placed on the value of experimental systems, particularly air bags, with respect to their expected cost-benefit.

477. The Committee was told that the air bag device was being "pushed" in the U.S. because it is considered that mandatory seat belt laws are unlikely and subsequently low wearing rates can be expected.

478. The Committee has concluded that through objective analysis of accident data, seat belt wearing, in conjunction with mandatory legislation, has significantly reduced the number of vehicle occupant fatalities and injuries on Australian roads. The Committee is of the opinion that now Australia has high seat belt wearing rates, resources should be directed to improving seat belt technology to increase its overall effectiveness and performance. Although it is not within the Committee's terms of reference the Committee is of the opinion that the results of Australian legislation for compulsory seat belt wearing should be widely distributed

to and promoted in overseas countries as a contribution to world health. The Sub-committee therefore recommends that the Federal Government should promote the beneficial effects of Australian seat belt wearing law in overseas countries.

- Child Restraints

479. As already noted, children under the age of eight are exempted from compulsory seat belt wearing. Other means of protection are therefore required for this group. This protection is afforded by a variety of restraint systems depending on the age of the child. Legislation to ensure that children are restrained in the front seat has been enacted recently in Victoria.

480. Accident statistics show that during 1973, 98 occupants under the age of seven were killed, and 3,033 were injured. In 1974 the corresponding figures were 71 and 2,893 respectively. Although these figures represents a small proportion of the total number of vehicle occupants killed and injured, a substantial number of these casualties may have been avoided if they had been wearing a form of restraint.

481. The importance of restraining a child can be illustrated by the fact that in a typical head-on crash at 50 km/h (30 mph) the weight of a child becomes twenty times greater, so that a 13.6 kg (30 lb) child suddenly puts a 272 kg (600 lb) force on say, its mother's arms, and of course it cannot be held. In effect, a child is likely to be catapulted about the vehicle. Evidence shows that children under eight have a higher incidence of major injury than other occupant categories.

482. The Committee is concerned that children are carried in arms or stand on seats, particularly in the front seat, and therefore risk serious injury in the event of a collision or sudden braking.

483. The Committee was presented with evidence of suitable child restraints based on age and weight as follows:

TABLE 7.

SUITABLE CHILD RESTRAINTS FOR CHILDREN OF VARYING AGE AND WEIGHT

		Age	Weight	Type
1.	Infant	Up to 9 months	Up to 20 lb	safety bassinet
2.	Toddler	6-9 months to 4 years	Up to 40 lb	safety seat
3.	(a) children	4 to 8 years	Up to 80 lb	safety harness
	(b) children	over 8 years	Over 80 lb	adult seat belt.

Source: *Federal Department of Transport.*

These child restraints are illustrated as follows:

484. The Committee's attention was drawn to a study[39] conducted by TARU on some commercially available infant restraint systems. This study, and other research, indicate that some bassinet restraining devices on the market have significant deficiencies and offer limited protection. Shortcomings include:

(a) a tendency for bassinets to pivot out under the restraint tipping the child out,

(b) insufficient strength and padding of bassinets,

(c) exposure of sharp protrusions during stress, and

(d) insecure attachment of bassinets to the seat.

485. Another TARU report[40] found that, with regard to certain unapproved child restraints, some so-called safety devices for children on the market, offer no real protection and may even add danger. The research found some deficiencies to be:

(a) inadequate hooks to attach the seat to the back of the front seat,

(b) inadequately padded horizontal steel tubes in front of the chest,

(c) harnesses without pelvic restraint or with closed loops placing excessive load on the stomach wall, and

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39. B.A. Vazey, D.C. Herbert, V. Leitis, Crash Protection for Babies, Traffic Accident Research Unit, Department of Motor Transport, New South Wales, February 1974 - TARU Report 2/74.

40. D.C. Herbert, B.A. Vazey, J.M. Wyllie, V. Leitis, J.D. Stott, R.G. Vaughan, Crash Protection for the Sub-Teen Child, Traffic Accident Research Unit, Department of Motor Transport, New South Wales, March 1974 - TARU Report 4/74.

(d) ejection occurring either as a result of mechanical failure or inadequate anchorage of the device.

486. In 1970, SAA first published a standard on child restraining devices for passenger cars, AS 1754. To obtain approval for a particular device, the manufacturer has to submit it for testing to an approved testing laboratory. The Committee was advised, by child restraint manufacturers, however, that approval was being delayed because there was only one approved testing laboratory at TARU, where the workload causes lengthy delays on approvals.

487. The devices must be able to withstand loads which could be experienced in severe crashes and these loads must be distributed efficiently. Furthermore, they aim to prevent somersaulting, ejection, vertical and sideways movements and sliding from underneath the restraint. The standard, in effect, lists types of restraining devices and sets out requirements for the design, construction and testing of every piece of assembly. It also specifies, instructions for installation, use and labelling. It is of some concern to the Committee that there is, as yet, no Australian standard for bassinet restraint.

488. The Committee considers that, because of the poor design and inherent dangers evident in some child restraints on the market, only restraints having SAA approval should be allowed. Certain manufacturers' objections to the SAA standard on restraints were brought to the attention of the Committee. Objections to standards by vehicle and component manufacturers need to be resolved with the SAA, preferably during the formulation of the standard.

489. The Committee supports the move undertaken by some State Governments to ban the sale and/or fitting of unapproved child restraints and considers that the remaining States

should immediately enact similar legislation. The Committee felt that regular checks by State and Territory consumer authorities on retail outlets would be a most effective way of enforcement.

490. The Sub-committee recommends that the Federal Government ensure that the Australian Capital Territory and Northern Territory legislate to ban the sale and fitting of unapproved child restraints.

491. Although improvements are being made, the Committee feels that there are still severe design deficiencies in most vehicles which makes the protection of children difficult. The Committee notes that ADR 34 which is to apply to vehicles manufactured on and after 1 July 1976, goes some of the way to alleviating this problem. The intention of this ADR is to specify requirements for child restraint upper anchorages in rear seats of passenger cars. This will facilitate satisfactory installation of child restraints and transfer of restraints between vehicles. It is intended that, except for bassinets, the lower part of the child restraint shall be secured by the adult seat belt. The Sub-committee therefore recommends that the Advisory Committee on Safety in Vehicle Design undertake research with a view to designing vehicles, particularly family type vehicles, to enable the fitting of approved child restraints.

492. While the Committee accepts that the exemption from seat belt wearing for children under 8 should apply, it nevertheless considers that some form of legislation should be framed to ensure the proper and efficient wearing of child restraints.

493. The Committee concludes that because of the number of children killed and suffering severe and lasting injuries (a large proportion of which may have been avoided if some form of restraint had been fitted), immediate action is

required. The Committee has studied recent Victorian legislation[41] which makes it an offence to carry an unrestrained child under 8 years of age in the front seat of a vehicle. All States are urged to follow this example and it is recommended that immediate steps be taken by the Federal Government to ensure that legislation is enacted to require the wearing of restraints by children in the Australian Capital Territory and the Northern Territory.

494. The Committee notes that seat belt legislation had the effect of focusing attention on adequacy of seat belt design and, as has been shown, stimulated improvements and better design. It could be expected that legislation would cause a similar demand for improvement in child restraint systems.

495. It was also brought to the Committee's attention that, in general, the use of a restraint is only required for a relatively short period (e.g. an infant would only need a bassinet restraint for about six months).

Interior Design

496. The overall restraint system includes not only the restraint itself but the interior of the vehicle which the occupant may contact during a collision. Since legislation has made wearing of seat belts compulsory, the attitude that the occupant is now saved has become too prevalent. In addition, as already noted, a significant proportion of injury and fatalities are sustained by occupants who do not wear seat belts. In many collisions there will still be contact with the interior of the vehicle. Seatbelts do limit contact but there are a number of accident modes (e.g. side

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41. Motor Car (Child Seat Restraints) Act (No. 8810) of Victoria.

collision) in which seat belts are not fully effective. Even a correctly worn and functioning seat belt allows significant motion due to slack, elasticity of the belt and elasticity of the occupant. Contact can still occur with the vehicle interior even in front collisions, especially in smaller vehicles with reduced interior space. Thus, the interior design of vehicles is an important consideration in reducing injuries and fatalities.

497. The interior of the vehicle likely to be struck by the occupant has not been improved on production vehicles in spite of the proven effectiveness of "padding" on ESV type vehicles. In fact the ESV-RSV program has indicated that interior padding and strengthening of the door area against intrusion is the only method of improving side crash performance. One major automotive company presented results of extensive work in this area at the 5th ESV conference[42] indicating significant gains can be made.

498. Good interior design for side collisions should also include care in location and design of door handles, window cranks, and relatively pointed mechanisms within the door which may be crushed through the relatively weak door inner panel into the passenger compartment.

499. In addition to these considerations for improved protection for the occupant other aspects of interior design brought to the Committee's attention were:

(a) glazing,
(b) steering wheel and column,

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42. P.M. Finch, British Leyland/TRRL Experimental Safety Systems Contract, April 1972 to April 1974, Paper presented at the 5th International Technical Conference on Experimental Safety Vehicles, Hilton Hotel, London, 4-7 June 1974.

(c) dashboard,
(d) header,
(e) head restraints, and
(f) seats.

- Energy Absorbing Steering Wheels and Columns

500. Since a large proportion of all accidents could be classified as frontal impacts, the steering wheel and column has been a leading source of death and injury for the driver. The Committee has therefore given this matter specific attention.

501. The Committee was informed that steering wheels and columns have been improved to lessen injury to the driver caused by the steering shaft being forced into the compartment through deceleration. The actual devices utilised have included deep dished steering wheels, telescoping columns, collapsible columns and energy absorbing devices.

502. When collapsible steering columns were introduced into the U.S. about 1968, accident studies showed an immediate decrease in chest injuries. Recent studies of accidents have indicated significant performance variations for the various column designs, even though all units presumably meet the same or very similar standards. Further experiments have indicated that some significant variations in performance are due to angled impact loading.

503. The Committee is aware of ADR 10 which is intended to minimise steering column penetration. Tests on the standard however, require barrier collisions only in a direction in line with the steering column. Evidence suggests, however, that as more Australian statistical data becomes available, the effectiveness of the energy absorbing function should be re-examined and evaluated, especially in view of potentially

better angled performance with respect to penetration of the steering columns.

504. Evidence has been given that GMH is utilising an energy absorbing column design which has been shown to be inferior and has been superceded by the parent company, for some vehicles as far back as 1968.

505. The Committee concludes that, overall, the effect of energy absorbing steering columns is considered beneficial. It should be noted, however, that the benefits of an energy absorbing column should decrease with properly adjusted lap/sash belts since, if chest steering wheel contact occurs it should at least be at a greatly diminished differential velocity. Even if the energy absorbing characteristics decrease in importance due to universal use of these belts, maintaining steering shaft intrusion at a minimum is as necessary as ever, particularly in angled collisions.

506. The Sub-committee recommends that the Advisory Committee on Safety in Vehicle Design review Australian Design Rule 10 in line with improved developments and that the angled effectiveness of energy absorbing columns be verified and possibly incorporated into the design rule.

- Dashboard and Header

507. Dashboard and header (reinforced roof immediately above the windscreen) energy absorption is still needed with seat belts since the occupant's head may still contact the dashboard or header in a frontal collision. The initial developments in these areas appear to have been quite effective and the combination of energy absorption and padding has provided substantial improvement for occupant protection. This protection is expressed by ADR 21.

508. Knee bolsters and heavily padded intruding dashboards are more recent forms of energy absorption development. The Committee feels that energy absorbing principles should be utilised generally rather than just on a dashboard (e.g. doors).

- Head Restraints and Seats

509. A necessary adjunct of seat belt effectiveness is adequate head restraint. Protection for the head and neck can be provided by adjustable head restraints, high backed seats or integrated seats. Problems of these safety features include, the risk of reduced all round visibility, correct location of adjustable head restraints and doubts regarding their cost-effectiveness. In addition, it is essential that the design and padding of these features provide protection for rear seat occupants in front collisions.

510. The importance of some form of head restraint is recognised by ADR 22 which required revision (ADR 22A) following problems of adjustment in the original ADR. The Committee considers that some form of fixed restraint is necessary.

511. A variety of methods of building high-backed seats without restricting visibility or making rear seat passengers claustrophobic have been demonstrated to the Committee. One method in production is a high-back seat with a hole through the top which reduces the visibility problem of conventional high-backed seats yet ensures the head is adequately restrained. Another method is to have a padded vertical bar (with longitudinal cross bars) which ties the seat to the roof providing added roof crush protection and reducing the loading on the seat proper during rear collisions.

512. The Committee concludes that the most advantageous protection, while currently adequate, may be provided in the long term by development of the integrated seat.

- The Case for Laminated Windscreens

513. There are two main types of glass used in windscreens, toughened glass (often called tempered glass), and laminated glass (often called high penetration resistant or HPR glass). Toughened glass is manufactured by a process of heat tempering with the result that when broken it shatters into small blunt-edged pieces. Laminated glass is manufactured in a more complex way and consists of two pieces of glass held together by a plastic interlayer. When broken, a laminated screen will crack but will tend to hold together because of the plastic underlayer (see illustration).

514. Australian vehicle manufacturers use toughened glass in their windscreens but offer laminated glass as an option, both of which comply with the requirements of ADR 8. The intention of this ADR is to ensure adequate visibility under normal operating conditions, minimise obscuration when shattered and the likelihood of serious injury. An overall estimate of the number of vehicles on Australian roads with laminated windscreens is 20 per cent of the total vehicle population. In Western Europe toughened glass is used in the majority of vehicles but in the United States laminated windscreens are mandatory (FMVSS 205). A very high percentage of imported vehicles into Australia have laminated windscreens.

515. Windscreens are usually broken in two ways: from outside the vehicle by an object thrown up from the road, or in an accident situation by being struck by objects from within the vehicle, particularly the occupant's head. There are no strong indications that the two types of windscreens vary in their ability to resist being broken by an external object.

516. When struck with sufficient force a toughened screen will shatter into small pieces which, if they remain in the frame of the front window, will obscure vision. A laminated screen under these circumstances will form a spider web of cracks but remain in the frame and reasonable vision will still be possible. In an accident situation where an occupant's head strikes the windscreen toughened glass by shattering may cause facial and in some cases eye injuries. A laminated screen under these conditions will crack and bulge out thus absorbing the impact of the head.

517. Many criticisms commonly made of laminated windscreens refer to the earlier type of windscreen which had a much thinner plastic interlayer than that used in the present type of laminated screen. The thinner interlayer meant that an occupant's head could penetrate the windscreen on impact

and splinters of glass could cause severe "horse collar" injuries to the face and neck as the occupant came back through the broken windscreen. The thickness of the interlayer used in more recent types of laminated windscreens prevents this occurring. Pilkington ACI Ltd gave details of the development of a new type of laminated windscreen, "Ten-twenty", which in tests has been shown to cause a considerably lower injury rate than conventional laminate. The Committee was informed that an impact of sufficient strength to cause the occupant's head to penetrate right through the newer types of laminated screen would very probably be fatal anyway.

518. An overseas study compared the injury rates in similar accidents of similar vehicles with laminated and toughened windscreens.[43] The results of this study indicated that moderate to severe injuries were sustained by 10 per cent of occupants of vehicles with laminated screens while this level of injury was sustained by 45 per cent of occupants of vehicles with toughened screens. Another study looked at by the Committee indicated that eye injuries do not occur in vehicles with laminated screens whereas they do occur in vehicles fitted with toughened screens.[44]

519. The safety advantages of laminated glass over toughened glass are summarised as follows:

- Better visibility through a windscreen after fracture and less liklihood of total loss of windscreen.

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43. G.M. Mackay, A.W. Siegel, P.V. Hight, Tempered versus HPR Laminated Windshields: A Comparative Study of United Kingdom and United States Collisions, Paper presented at 14th Stapp Car Crash Conference, November 1970.

44. G.M. Mackay, Eye Injuries and the Windscreen, The Barbara Knox Memorial Lecture, Irish Faculty of Opthalmology, Dublin, 29 November, 1974.

- Better protection against entry into the vehicle by external objects and glass fragments.
- Less likelihood of ejection from the vehicle of unrestrained occupants in a crash situation.
- Reduced severity of facial injury.
- Little likelihood of eye injury.
- Inhalation or ingestion of glass particles will not occur.

520. The main disadvantage is one of cost as the fitting of laminated windscreens is approximately twice that of a toughened windscreen, and would increase the price of a new vehicle by approximately 1 per cent, or $50. The Committee's view is that this price may be lower. In addition, when a windscreen has to be replaced, the cost of laminated windscreens is also a consideration. The ACSVD has considered the question of making laminated windscreens mandatory and commissioned a study to assess the cost-effectiveness. This study[45] stated that the benefits of laminated windscreens did not outweigh the higher cost because laminated windscreens could not be proved to break less easily than toughened windscreens. The study concluded that, given the very small number of accidents caused by loss of vision due to a shattered windscreen, the extra expense could not be justified. The Committee is concerned however, with the effect of a windscreen on the nature and severity of injuries suffered by the occupant following a collision.

521. The advantages of toughened glass over laminated glass are summarised as follows:

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45. Wilbur Smith and Associates, Economic Evaluation of Windscreen Breakages, Prepared for the Australian Department of Transport, July, 1974.

- Less than half the cost of laminated glass.
- Greater tensile strength - this being mainly significant in ease of fitting into the vehicle.
- Higher resistance to abrasion - less likely to be scored by wipers.

It appears to the Committee that the safety advantages toughened glass are negligible compared with laminated glass.

522. Some vehicle manufacturers such as Volvo, SAAB and Mercedes gave evidence that they considered laminated windscreens to be a safety related item. Other manufacturers disagreed and considered laminated windscreens to be a convenience item. Witnesses representing Chrysler stated in evidence that they did not consider toughened glass to be inferior to laminated glass, nor did they consider laminated windscreens to be a safety item. Wintesses representing the Department of Manufacturing Industry gave evidence that the Department only bought vehicles with laminated windscreens and that this has been Departmental policy since 1967. Witnesses representing Pilkington ACI told the Committee that they considered laminated windscreens to be safer than toughened windscreens.

523. It is true that the greatest advantages of laminated windscreens relate to the protection of an unrestrained occupant. Given that Australia has compulsory seat belt legislation, it could be argued that laminated windscreens are not necessary. However, the Committee is concerned that as already mentioned, the great majority of death and injury is coming from the small percentage of occupants who do not wear seat belts. Even with a seat belt there may still be occupant contact with the windscreen in certain instances and in addition laminated glass affords protection in other ways (e.g. reduced injury from contact with an inhalation of flying glass). Increased pedestrian safety is also a

consideration in the use of laminated windscreens.

524. The Committee considers that since there are both safety and convenience advantages in the use of laminated windscreens, there is a good case for the fitting of these windscreens and, notwithstanding the lack of proof in Australia that benefits will balance or outweigh the costs, it is recommended that an Australian Design Rule be developed to ensure that vehicles are fitted with laminated windscreens consistent with latest developments of laminated glass.

- Fire Protection

525. Statistics from various countries indicate that less than one per cent of all road accidents involve fire. A report on fire in road accidents prepared in 1970 by TARU stated that -

> Although the occurrence of fire in road accidents is a relatively rare event, it is one which usually receives considerable publicity. This is especially the case when a fatality occurs. There appears to be a particular horror and fear associated with accidents of this nature, which is apparently absent from other road accidents.[46]

526. The TARU report records results of a survey between January 1965 and June 1969 which indicated that heavy vehicles and other vehicles being other than passenger cars and passenger car derivatives which constitute about 9 per cent of vehicles on the road were involved in 64 per cent of the total fatal accidents associated with fire. Even the complete elimination of fire as a factor in passenger car fatalities only reduces the overall fatality

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46. R.G. Vaughan, Fire in Road Accidents, Traffic Accident Research Unit, Department of Motor Transport, New South Wales, January 1970, TARU Report 1/70.

rate by less than one per cent. The Committee notes, however, that fire precaution is an area where the protection of the occupant should not be ignored.

527. Volkswagen mentioned in evidence that fire accidents very often happen on high impact speeds where deformation of the car is severe, and the TARU report also mentions overseas findings that fire risk injury increases with severity of accidents, and that smaller vehicles were involved in accidents with fire disproportionate to the number on the road.

528. Although ADR 17 covers fuel systems for heavy vehicles, there is no current ADR for passenger cars which aims to reduce fire risks in crashes. In the U.S., FMVSS 301 determines fuel system integrity and covers all vehicles up to 4536 kg (10,000 lb) gross vehicle weight. The requirements of the original standard of 1968, specified no loss of fuel at more than 28.3 g (1 oz.) per minute after a frontal barrier collision at 50 km/h (30 mph). The new requirements from 1975 add a rollover test with no more than 28g per minute leakage when held for 3 minutes at each successive 90^{o} during rollover after the barrier collision test.

529. Evidence from SAAB and Volkswagen made reference to the advantages of placing the fuel tank where it is protected in a crash from the rear. Volkswagen stated that there is no requirement worldwide for testing rear mounted fuel tanks in a rear-end collision, a requirement which does not appear in the new U.S. standard although GMH stated that they test for fuel leakage after a rear impact at 30 km/h (20 mph). GMH also referred to a fusible link (i.e. fuse) in the wiring system to reduce the liklihood of fires caused by electrical short circuits, which are likely to occur following a severe crash.

530. In summary, the evidence indicates the following points are considerations in providing vehicle fire protection:

(a) vehicle fires in passenger cars are comparatively rare,

(b) fires are rarely the cause of road accidents,

(c) fires in which deaths occur are usually associated with severe vehicle damage, particularly to small cars,

(d) the location of the fuel tank in the least vulnerable position from impact is the most important design consideration particularly for front impact for rear engined vehicles,

(e) measures available to reduce fire risk include frontal crash tests, rear crash tests, rollover tests, and fusing of electrical circuits, and

(f) none of these measures are currently required in Australia.

531. The Sub-committee recommends that the Advisory Committee on Safety in Vehicle Design investigate developing a design rule to reduce fire risks, no less stringent than the United States standard. Consideration should be given to increasing the test speed for the barrier test to represent the more severe crashes in which fires occur, and including rear impact test. A requirement for protection of the electrical system should also be investigated.

CHAPTER XI: PEDESTRIAN SAFETY

Extent of the Problem

532. It should be mentioned that in the Committee's second report it was noted that pedestrian safety is maximised where pedestrians can move freely without exposure to collisions with motor vehicles. The Committee has given considerable attention to the relationship between vehicle design and pedestrian safety. Statistical evidence suggests that pedestrian safety is a major problem. The Committee notes at the outset that regardless of the cause of an accident, driver or pedestrian, the vehicle should be as least agressively designed in order to provide a minimum of injury and reduced risk of death for the pedestrian.

533. Of all motor vehicle fatalities in the United Kingdom 40 per cent are pedestrian deaths. The rate in Japan is 36 per cent and in Australia is 21 per cent, while the United States has one of the lowest rates with 18 per cent. If bicycle fatalities are added to pedestrian fatalities (the main effect of the bicycle is to elevate the cyclist otherwise the dynamics may be assumed to be similar), Japan's rate approaches 50 per cent and Australia's rate is approximately 24 per cent. There are almost 10,000 pedestrians injured and an additional 2,600 pedal cyclists injured each year in Australia. The number of injured is relatively small since there is a much greater probability of being killed if involved in a pedestrian to vehicle crash than if involved (as an occupant) in a vehicle crash.

534. In large metropolitan areas, the percentage of pedestrian deaths rises dramatically. In London 58 per cent of motor vehicle deaths are pedestrians. Other examples include Gotenburg, 54 per cent, New York, 53 per cent, and Paris, 49 per cent. The only Australian city for which the Committee has information is Melbourne with approximately 35 per cent.

535. It should be noted that as cars are made safer for occupants that the percentage of deaths for pedestrians will become increasingly important. For example, it is estimated that if the U.K. adopts compulsory seatbelt legislation, the pedestrian accidents are expected to increase from 40 per cent to 48 per cent. Thus, the pedestrian problem is not only important presently but is likely to become increasingly important.

536. Statistics indicate that the people most often fatally injured are the young and the old. This has generally been attributed to the inexperience/foolishness of the young and the slower reactions of the old. However, the Victorian statistics show that the comparative percentage of those injured and killed is markedly higher for older people (approximately 4 times) which may well be because of their lower human tolerance levels. In other words, older people may not be as over-involved as their fatalities indicate but rather may be more susceptible to being killed due to a "weaker" condition. In addition, alcohol is a contributory cause of non-children pedestrian accidents. The statistics are often quite hard to compare due to variations in age grouping and definitions, but universally it seems the young and old are over-represented in the percentage killed.

537. Until the last few years, the pedestrian accident problem has in general been badly neglected. Very little research has been conducted, although there are indications as illustrated of significant differences in the pedestrian lethality of production vehicles.

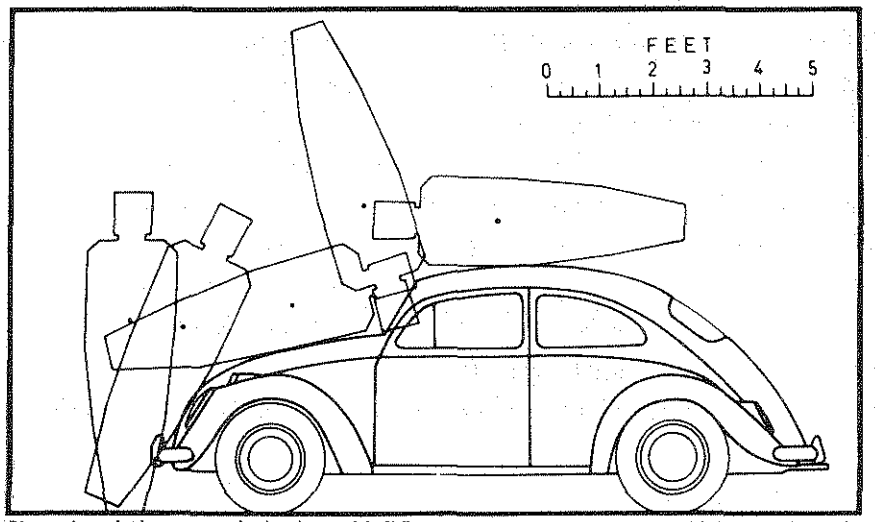
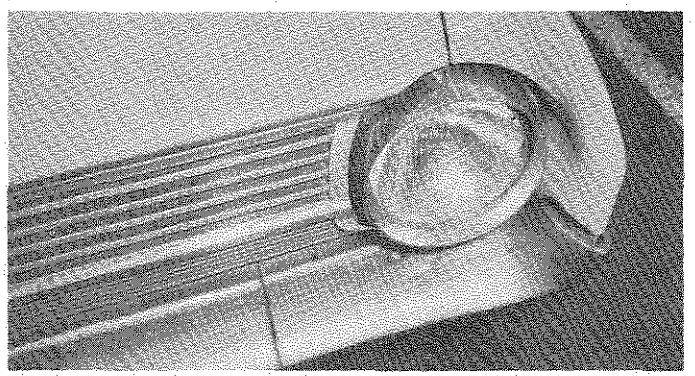
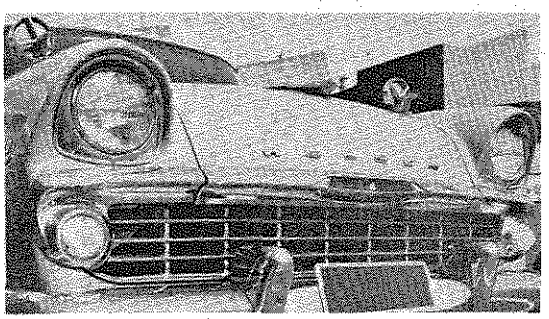


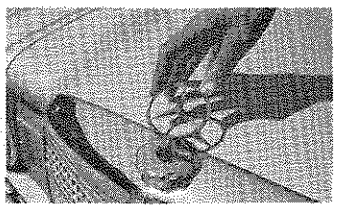
Diagram shows what happens to a pedestrian when struck by Volkswagen "beetle". A US study indicated that injuries sustained by people struck by VWs were usually less severe than those inflicted by bluff-front vehicles.



Public opinion played big part in Holden HD's premature removal from market because of concern about body panel projections at side of headlights.



"Vintage" Holden. Projections over headlights and protuberant parking lights are potentially dangerous to pedestrians, not to mention bonnet mascot, rear-vision mirrors.



Collapsible mascot on a Mercedes-Benz

538. Most sources indicate the vast majority of pedestrian accidents are low-speed, usually 15 - 30 km/h (10 - 20 mph). The pedestrian is almost never "runover", at least initially, but rather when struck pivots about the point of impact resulting in the head and torso striking the bonnet. At higher impact velocities, the pedestrian may slide or tumble into the windscreen area. For short bonnet vehicles the pedestrian's head and shoulders may strike the windscreen area initially. Thereafter the pedestrian usually slides forward off the bonnet and strikes the ground. The head-chest impact on the bonnet-windscreen area is therefore usually the major impact.

Design Factors

539. Important design factors include bumper height and shape, minimum protrusions, minimum of sharp objects and ornaments, windscreen and surrounds and the general shape and structure of the front and side of the car. The bumper height should be low to minimise knee injuries and to ensure pickup and rotation of the person. It is logically claimed that this low bumper height also encourages compatability in side collision by ensuring contact with the door sill.

540. The overall shape of the vehicle is considered to be very important. The shape should be rounded to deflect pedestrians to one side. It should definitely not tend to hook the pedestrian into the vehicle (such as having fenders which extend beyond the hood and grill). The angle of the bonnet and the height of its junction with the grill is also quite important. In general, the higher this intersection the reduced probability of a child being rotated and the more violent the rotation of the upper body resulting in higher head impact velocities, and a more direct impact to the pelvis area.

541. The location, type, angle, and framing of the windscreen is also important in higher velocity crashes or for cars which have short bonnets. The stiffness of the surface to be struck is also an important factor. The flat, relatively poorly supported sheetmetal of the bonnet is an excellent energy absorber as long as there is nothing solid just below the surface which will stop the required deflection. Soft foam is definitely not a good pedestrian protection surface since it will bottom long before the required energy is absorbed.

542. A minimum of protrusions and ornaments is desirable. The style of headlight "hoods" was an excellent example of poor pedestrian safety design since they tended to lacerate and their construction was inherently very stiff thus providing a more severe deceleration for the pedestrian. Bonnet mascots have been shown to be particularly injury producing and some manufacturers now design them to collapse. Protruding door handles have also contributed to injury. With regard to these aspects of design the more recent vehicles appear to be satisfactory.

543. In the last five years, pedestrian studies have definitely received more attention but they are still a minor consideration in the total safety program. NHTSA has conducted a set of studies using a simulated vehicle, dummies and cadavers to study the effect of impact velocity, bonnet height, and bumper height and shapes. Leyland has conducted significant crash testing with vehicles and dummies and have developed a catcher to hold the pedestrian after the impact with the vehicle so that the secondary impact with the ground is avoided. Of course, this also eliminates the possibility of running over the victim after impact. Fiat has conducted considerable pedestrian crash testing with different shaped vehicles at a variety of velocities to ascertain dummy motion. This type

of research and other development work is encouraging and while there is evidence of improvement in Australian vehicles, the Committee feels that at present, vehicle designers do not give pedestrian safety sufficient consideration other than not to utilise projecting hood ornaments. The Committee therefore urges all manufacturers to give improved pedestrian protection careful consideration in their vehicle design.

544. The Sub-committee recommends that data collection and analysis be modified to more accurately relate pedestrian injuries to various vehicle designs and features in order to determine significant variations in protection performance.

CHAPTER XII: ROADWORTHINESS

General

545. The main thrust of the Committee's inquiry has been directed to the design and performance of new vehicles. The Committee, however, recognises the safety importance of vehicle performance on the road, or roadworthiness, in respect of maintenance, crash repairs and associated matters.

546. The single most important matter brought to the Committee's attention was that the significant safety advances provided by ADR's and Draft Regulations should not be allowed to deteriorate, be modified or removed once a vehicle goes into service on the road. To ensure that ADR's are not downgraded, procedures will have to be adopted for improving maintenance and repairs.

547. Vehicle manufacturers and road safety authorities and more particularly the ACSVD expressed concern with ensuring that the principles upon which ADR's are based are adequately maintained throughout the vehicle's life. The SAE, the IAME, and Motor Traders Association were very concerned about the inadequacy of maintenance and repair work in general.

548. Whereas there is evidence of a significant number of safety related defects caused by inadequate design and inspection of new vehicles, inadequate vehicle maintenance probably causes greater risks to vehicle safety as the vehicle ages. The onus should therefore be placed on the vehicle owner to maintain his vehicle so as to minimise danger to himself, his passengers, and other vehicles and passengers. In the situation where vehicle owners neglect their responsibility there is a case for greater government

involvement to ensure the safety standard of vehicles on the road in order to reduce accidents.

Vehicle Inspection

- Periodic Motor Vehicle Inspection (PMVI)

549. The case for compulsory PMVI has been subject to continuous argument for many years. The Committee was again faced with the problem of lack of reliable data to establish the relationship between accidents and faulty vehicles caused by poor maintenance. The question of cost effectiveness is therefore also a matter for consideration. Evidence supports the view however, that some form of inspection system substantially improves the quality of vehicles and contributes to their safety and efficiency on the road.

550. There is throughout the world a number of different inspection systems in operation. Countries with some form of PMVI system are outlined in Table 8. PMVI systems may be Government owned and operated or Government appointed and there are advantages and disadvantages in each system. Various States in the United States have both systems in operation and there has been a steady increase in the number of States adopting some form of PMVI system in recent years. Although the A.C.T. does not appear in the table, a vehicle inspection system has been in operation since 1936. It is the only Government owned and operated PMVI system in existence in Australia. The N.S.W. system is Government appointed in that existing stations (generally service stations) are authorised to undertake vehicle inspections according to procedures the Government determines. A fee of $3 is levied on the motorist to have his vehicle inspected. Under the

TABLE 8

COUNTRIES HAVING COMPULSORY PERIODIC MOTOR VEHICLE INSPECTION SCHEME IN FORCE (1970)

Country	Year Introduced	Categories of Cars Inspected	Frequency of Inspection
Australia, (New South Wales)	1939	All cars	Annual
Austria	Date varies	3 years old and over	Annual
Belgium	1960	5 years " " "	Annual
Bulgaria	1935	All cars	Annual
Cyprus	1962	14 years old and over	6 monthly
Finland	1922	All cars	Annual
Germany	1952	All cars	Every 2 years
Great Britain	1961	3 years old and over	Annual
Israel	1948	All cars	Annual
Italy	1928	Older cars ?	Every 5 years
Japan	1951	All cars	Every 2 years
Luxemburg	1955	5 years old and over	Annual
Malawi	1965	10 years old and over	Annual
New Zealand	1936	All cars	6 monthly
Norway	1926	All cars	Every 5 years
Sweden	1965	3 years old and over	Annual
Switzerland certain Cantons	Date varies	All cars	Every 3 years
United States of America	Date varies	31 States & Distr. of Columbia & Puerto Rico	Varies
Zambia	1962	8 years old and over	Annual

Source: L.A. Foldvary, Review of Vehicle Inspection in Relation to Road Safety, (Prepared for the Expert Group on Road Safety, January 1972, p.16).

A.C.T. system the Government owns the inspection station and equipment, employs the necessary staff and has direct control over the inspection of vehicles.

551. Government inspection stations are regarded as being more effective in relatively small, densely populated areas, as in the case of the A.C.T. The Committee, in considering the extension of the A.C.T. system throughout Australia, was aware of the significant cost factors particularly in the initial stages of implementation and the unique position of the A.C.T. in having easy access to a centralised inspection system. Important cost considerations are the purchase of land, the erection of buildings and the purchase of equipment. The Committee was advised that although the cost of the land was not recovered the $1 levy (included in the registration fee) for each motorist in the A.C.T. covered all operating costs and included amortisation of capital costs. Other important matters requiring consideration are the need to ensure minimum inconvenience to the motorist (too few stations would mean long waiting periods, increased travelling distances and problems of returning vehicles following repair for re-inspection) and the availability of trained inspectors.

552. A further system is provided (operated in New Zealand) where a combination of both these systems exists. The advantages of this system are well worth considering for Australian geographical conditions. Consideration could be given to Government owned stations in densely populated areas and authorised inspection stations in sparsely populated areas. It was suggested that such a system ensures that Government stations keep a quality check on the others.

553. In Sweden the system is half Government owned and half owned by differen organisations interested in road safety,

such as insurance companies. It is interesting to note that a book is published every half year showing the percentage of faults in different makes of cars. This exposes to all the car manufacturers the type of faults that their cars have. The Committee was informed that the system operated by the Swedish Motor Vehicles Inspection Company had resulted in the average life of the vehicle being significantly increased.

554. The Committee has considered the basic question as to whether or not there should be PMVI throughout Australia. The question then arises as to what sort of system would be the most suitable. The following arguments for and against PMVI were brought to the Committee's attention:

For	Against
Given that vehicles do wear out PMVI ensures that the driver (usually non-mechanically minded) is aware of when repairs are required.	There is a significant cost factor in establishing a PMVI system.
Proper maintenance should not be neglected if every area of possible accident causation is to be minimised.	Funds would be better directed towards other areas of safety at greater benefit.
Vehicle passengers and others are not placed at risk by an owner's neglect of vehicle condition.	Compulsory inspection is an example of denying individual rights.
The overall life of the vehicle is increased and savings may accrue to the owner if repairs are discovered and carried out sooner than later. Benefits may accrue at point of resale.	It will cost the motorist more money.
	It is inconvenient and may involve substantial distances to travel for inspection.
Less accessible operating vehicle parts cannot be adequately inspected by alternative means e.g. during random checks by untrained police.	Annual inspections do not account for vehicle failures in the intervening period anyway.
	Motorists may consider that annual inspections are sufficient and neglect their vehicle in the interveing period.

The safety consciousness of the motorist is increased.	There is no evidence that PMVI reduces accidents.
The high number of defects discovered by PMVI systems is evidence of a need to correct unsafe vehicle condition which could otherwise go undetected and unrepaired.	Time demands on skilled mechanics of whom there is a shortage.
Continual oversight of the performance of ADR's for the life of the vehicle.	
Supervision of Draft Regulations in relation to road safety requirements e.g. unsafe modifications.	
Opportunity to record VIN's and odometer readings at each inspection to provide average mileage per year for each car type and other advantages in data collection.	
Comprehensive and detailed statistics can be compiled on the frequency of faults in safety related components of vehicles.	
Assistance for locating owners of defective vehicles subject to recall campaigns.	
Specially trained mechanics ensure uniform standards, particularly in the case of Government owned systems.	

555. Many witnesses supported the implementation of some form of inspection and the Committee concludes from the evidence that there is a definite case for some form of PMVI system. The Committee firmly believes that some form of organised compulsory inspection is better than none at all and although the argument of costs and lack of data

concerning its effectiveness are important considerations they should not be regarded as insoluble but kept in perspective with the significant advantages which can be gained by PMVI. The Committee stresses the importance of the advantages of PMVI with respect to ADR's, data collection, draft regulations and recalls in addition to the advantages of inspecting the crucial safety components. Inspection is one part of the total passenger vehicle safety program and needs to be read in conjunction with the rest of this report.

556. No PMVI system operates in the States and Territories other than N.S.W. and the A.C.T.. Victoria and Queensland have inspections carried out by private garages only on change of vehicle ownership. If registration lapses, vehicles are inspected in Western Australia. No inspection of any kind operates in Tasmania or the Northern Territory. In S.A. inspections are made only when second-hand vehicles from interstate are registered. S.A. however, is about to provide for the establishment of a Central Inspection Authority. This Authority will initially inspect on a regular basis omnibuses and taxi-cabs outside the metropolitan area. Provision has been made in the legislation to extend the classes of vehicles to be inspected as the need becomes evident.

557. The Committee notes that the Victorian Parliamentary Joint Select Committee on Road Safety recommended in 1968[47] that annual inspection of all motor vehicles be carried out at the time of re-registration. To date this recommendation has not been implemented.

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47. Victoria Parliament, Joint Select Committee on Road Safety, Third Progress Report, Report upon an Investigation into the Desirability of the Compulsory Fitting and the Compulsory Wearing of Seat Belts Together with Minutes of Evidence and Appendices, Ordered to be printed by the Legislative Council, 9 September, 1969.

558. Both Government appointed and Government owned systems have basic similarities[48]-

1. The State Government establishes legislation that requires owners to have their vehicles inspected periodically to determine that specific items meet safety standards.
2. A designated Government agency establishes regulations and procedures for inspection stations.
3. A continuous and thorough system of program supervision is maintained to assure adherence to PMVI requirements.
4. An adequate number of inspection locations with qualified inspectors are needed to help vehicle owners satisfy the requirements of law without undue inconvenience or cost.
5. State and local enforcement agencies take appropriate action against violations by inspection stations and vehicle owners.

559. A summary of the advantages claimed for each system is set out as follows:

Government Appointed System (N.S.W.)	Government Owned System (A.C.T.)
A large number of stations may be authorised so that, even in the smallest communities, there are several stations available for the	It helps assure more uniform inspection of all vehicles in accordance with the standards and regulations estab-

48. American Association of Motor Vehicle Administrators and Auto Industries Highway Safety Committee, Motor Vehicle Inspection In Perspective, Auto Industries Highway Safety Committee, Washington D.C., Third Edition, 1966.

motorists' convenience. The stations to be authorised are already in existence and need only to be certified for space, manpower and equipment requirements. The problem of providing large sums of money for buildings and equipment is eliminated. The Government is not required to hire and train vehicle inspectors. Only administrative and supervisory personnel are needed. The Government has greater control on quality of repairs made through certification of mechanics and equipment. If unsafe conditions are discovered the owner may elect to have repairs made on the spot, avoiding the necessity to return for re-inspection.	lished by the government since there are fewer inspectors involved. The inspection is made by an inspector not personnaly interested in the proceeds arising from the cost of repairs that may be necessary. Re-inspection of vehicles initially rejected, provides a check on repairs made. The system provides a readily available means for distribution of information on matters pertaining to highway safety by a government agency at the time of inspection.

Source: Motor Vehicle Inspection in Perspective, p. 16.

560. The Committee does not feel that it should make any recommendation as to what sort of system would best suit Australia. It is obviously a complicated administrative problem and must be looked at in relation to the cost and available funds. It is possible to establish a system which would be largely self supporting at minimal cost to the motorist. The Committee would expect that some sort of a combined system might be appropriate for Australian conditions.

561. Evidence from the Department of the Capital Territory indicated that criticism of the A.C.T. system was usually centred around matters of inconvenience and unreasonably high standards of testing. Public ignorance of what is to be tested and the required standard of testing may well contribute to these criticisms and the Committee notes that the Department will be issuing a motorists' guide on vehicle testing requirements incorporating advice on ADR's, modifications, Draft Regulations etc., including what items are inspected and why. Notwithstanding these criticisms, it would appear that the A.C.T. system is generally accepted by the public. Evidence also suggests that inspection systems operating in other countries are generally well regarded by the public.

562. The Committee makes particular mention of the potential offered by PMVI for comprehensive and accurate data collection with regard to vehicle usage and defects occurring in particular makes and models of vehicles. The Department indicated that their recording system had not been fully utilised in this respect in the past but they were in the process of remedying this situation. The Committee expresses its concern that this source of data collection has not been utilised.

563. With regard to this matter a special survey was undertaken to provide more information to the Committee about the vehicles rejected and the faults found. The survey analysed all tests undertaken over a period of a week and involved about 2,350 vehicle tests. The results of the survey are set out in Appendixes 16 and 17 (It should be noted that the totals in these Appendixes do not precisely correspond. The reason for this is that the data for each table was extracted from a different computer print out and the 'rejections' from

the tabulations differed each case).

564. The Committee draws no conclusions from the figures in view of the small sample but expects that a greater depth of information will be available in future. The Committee also received a summary of the main faults found during inspection during 1973 and 1974 and appears as follows -

TABLE 9.

MAJOR FAULTS FOUND DURING REGISTRATION INSPECTIONS IN THE AUSTRALIAN CAPITAL TERRITORY, 1973-1974

Rejection Items	Number of Rejections	
	1973	1974
Brakes	8700	9770
Tyres	7554	8103
Suspension and Steering	8469	11995
Lights	9586	10903
Exhaust	6505	6759
Corrosion	1688	1185
Miscellaneous	9342	11188
TOTAL	51904	59903

Source: Evidence p. 3296.

565. The Committee was informed that the percentage of vehicles rejected by the inspection station was 29.1 in 1973 and 28.9 in 1974.

566. The Committee was made aware of problems associated with the N.S.W. system in that it is open to corruption (Government systems may also have an element of corruption) and particular difficulties arising from individual licensee/customer relationships.

567. However, the Committee concludes that some form of inspection system is better than no system at all. The Committee is convinced by the evidence that regular maintenance checks improves the quality and safety of vehicles on the road thereby reducing their potential accident risk. As already indicated, there are other significant advantages which flow from PMVI. The Sub-committee therefore recommends -

- That the Bureau of Road Safety urgently review existing information on Periodic Motor Vehicle Inspection with a view to urging the States not already using Periodic Motor Vehicle Inspection to adopt a suitable form of inspection system to to suit their needs, and

- That the Federal Government urgently investigate a form of Periodic Motor Vehicle Inspection suitable for the Northern Territory with a view to its early implementation.

- Random Checks for Roadworthiness

568. The Committee was informed that enforcement authorities in each State and Territory carry out random checks on vehicles to assess their roadworthiness and identify unsafe modifications. This function normally conducted by police may result in defect notices being issued against vehicles considered to be unroadworthy. Those States which do not have PMVI rely on this method of inspection to ensure the safe operating condition of vehicles on the road.

569. The Committee considers that random checks conducted by police serve a useful purpose in providing a continuous inspection of vehicles which is important with or without PMVI.

570. In Victoria, defected vehicles must be repaired and presented to a licensed tester and a roadworthy certificate issued before the vehicle can again operate on the road. A certificate of roadworthiness costs the motorist $5.60. The Committee was informed that roadworthiness checks are often made on vehicles stopped in conjunction with another traffic offence committed by the driver. Inspector Oakes of the Victorian Police indicated that police must decide visually on whether a vehicle may be defective. It is therefore not the most effective means in ensuring that unroadworthy vehicles are minimised. Police are not able, or indeed are not qualified, to determine whether non-visual safety factors, such as brakes and steering, are adequate. The Committee was informed that some police attend a vehicle safety testing school for training over a two week period. Police are not issued with a check list of safety items to be inspected.

571. In 1973, a year for which figures are available, 217,577 vehicles were checked for roadworthiness and the number of defect notices issued was 10,425, which means that about five per cent of cars examined were found to have some defect. This can be compared with the 29 per cent of vehicles rejected in the same year by the A.C.T. testing authority. It is also pointed out that only one sixth of vehicles were inspected and it could be concluded that proportionally an additional 50,000 vehicles could be defective but were not detected. There is no record kept of the frequency of faults by type etc. of vehicles found to be defective.

572. Inspector Oakes indicated that police "deal with the particular vehicle as such, and having dealt with it, that is the end of it". The Committee does not think that this system is the best method of ensuring unroadworthy vehicles

are kept off the road nor should the responsibility devolve onto the police force. It appears to the Committee that under this system the proper and detailed inspection required for proper seat belt functioning, for example, is not possible. While the police force still has a role in this matter it is more correctly a matter for trained specialists and a separate administrative structure and the Committee again stresses the advantages of PMVI as a possible solution.

573. The N.S.W. Government informed the Committee that because a system of PMVI is operated in N.S.W., other enforcement action to detect defective vehicles such as mass random checking by police is not warranted. However, police did stop vehicles from time to time and in 1973, 96,273 offences relating to defective equipment on motor vehicles were detected. The Committee considers this to be a very high number especially in view of the existing PMVI system in operation. It may be that the police are very efficient or that the inspection system is not efficient enough if compared to Victorian figures for the same year or that Victoria is less active in detecting defective vehicles. It was pointed out, however, that the figure of 96,000 included multiple offences on the one vehicle. As in Victoria, police normally stop vehicles in relation to another offence the driver may have committed and is again based on visual aspects of the vehicle. No check list of safety items is used by the police.

574. The South Australian Government indicated in its submission that the Police Department defects approximately 8,000 (16,488 in 1974) motor vehicles per year on a spot check basis. It was suggested that the most definite method of overcoming these problems is by means of compulsory periodic inspections of all motor vehicles. The Road Traffic Board is currently investigating the feasibility of this proposition. A witness from

the Road Traffic Board said "there is increasing evidence of vehicles with defects and I do not think the police can hope to keep up with the problem for all time".

575. The Committee is not fully satisfied that the method of random checks is a satisfactory method of detecting defective vehicles. Although they will always have a role in this matter, police forces are neither qualified nor expected to fulfil this function satisfactorily especially if it is only a matter of inspecting vehicles stopped in respect of other offences, and then only visual aspects of the vehicle. The lack of uniformity among the States is quite apparent and in some States the evidence shows a lack of real commitment to this important aspect of safe vehicle performance. The development of a check list of important matters requiring examination should be commenced, preferably on a uniform basis. The Committee would urge the States to reassess the merits of PMVI and ensure that adequate records on unroadworthy vehicles are compiled and made available to relevant road safety authorities including the BRS.

Modifications

576. The Committee realises that certain modifications may make a vehicle safer but modifications made to the suspension, wheels and tyres and performance capacity can be detrimental to the safety of a vehicle.

577. Draft Regulation 120 relates to "limitations on alterations to motor vehicles" generally known as modifications. The regulation provides that a motor vehicle or trailer shall not be altered from the manufacturer's specification with regard to chassis frame, wheels, suspension, steering, brakes, axles, engine body structure or exhaust system etc. without the approval of the administering authority. The underlined

words are significant with respect to two principal issues.

578. Firstly, neither South Australia nor Tasmania have legislated to give affect to the regulation. The second important issue is that the prevention of the fitting of unsafe modifications is again a matter for enforcement authorities. The comments made by the Committee in relation to roadworthiness checks apply equally with respect to modifications. Once again the most effective check of modifications would be through PMVI.

579. The Committee accepts the suggestion that modifications should only be approved following inspection and certification by a qualified engineer ensuring that the structural integrity of the vehicle is maintained. Modifications which are detrimental to the effective performance of ADR's are particularly unsatisfactory and while the Draft Regulation prohibits this, proper enforcement is again the important factor. An aspect of the problem brought to the attention of the Committee was the practice of removing certain modifications (e.g. types and wheels, exhausts) before inspection or subsequent to receiving a defect notice and fitting them later following re-inspection. It is clear that there will always be a role for random checks for practices of this kind. Concern for these problems regarding the practice of modifying vehicles was repeatedly expressed in evidence.

Repairs and Maintenance

580. The motor vehicle repair industry is so complex that it has not been possible for this Committee to inquire into it in any great depth at this time. Aspects of the repair industry nevertheless have significant implications for motor vehicle safety which the Committee briefly discusses in the following paragraphs.

581. The Department of Transport informed the Committee that it had commissioned a study in various aspects of the motor vehicle repair industry. The study covers the following matters: licensing of mechanics, the licensing and examination of accident surveyors assessing vehicle crash repairs, brake and clutch repairers, national training for repairers, second-hand parts and crash repair standards.

582. The SAE informed the Committee that their published test procedures have in the past concentrated on vehicle design and development although attention is now turning to in-service testing procedures as well as recommended criteria for vehicle repairs and replacements. One guiding principle in this activity is that repair and replacement functions be targeted at preserving the integrity of the original vehicle design, particularly where safety aspects and compliance with safety related ADR's are involved.

583. The SAE indicated that it had a strong membership in the after-sales market and these engineers had expressed their concern at -

(a) the lack of attention to the maintenance of vehicles once they are in the field,

(b) the need to set up minimum standards for vehicle repair shops particularly if they are permitted to perform repairs that affect vehicle integrity - of special interest in this area are Steering, Braking and Structural repairs, and

(c) the need to have a minimum standard of competence for mechanics working on the areas nominated above.

584. The SAE has initiated action to make investigations and come up with recommendations as to the criteria that should be used for the guidance of authorities, when setting up requirements in the three areas nominated above.

585. The Committee is pleased with these early initiatives taken by the Department and SAE recognising the importance of the repair industry on the safe operation and roadworthiness of vehicles.

586. Other witnesses and organisations expressed their concern at the inadequacies of the repair industry and supported some form of licensing. These included AAA, Mr D. Wait, Head of School of Vehicle Trades, Sydney Technical College, CCA, IAME and most State Governments.

Licensing of Mechanics and/or Repair Premises

587. A number of witnesses drew the Committee's attention to the licensing requirements for employees in other trades, e.g. building, electrical, plumbing etc. Such analogous situations referred to in many cases had not the significant safety importance compared with vehicle maintenance and repair.

588. The Committee considers it unusual that the vehicle repair industry has not been subjected to some form of licensing as in other trades and other countries e.g. Canada and New Zealand. Licensing could cover any or all of the following: mechanics, repair premises, proprietor of repair premises, specialist repair premises and smash repair premises.

589. IAME indicated that there was a general view of "shoddy workmanship" in the repair industry because of the lack of

qualified mechanics. It was suggested that there was approximately 60,000 qualified mechanics and 12,000 unqualified persons employed in the repair industry throughout Australia. It was thought that licensing of mechanics would establish the status of qualified persons which would attract more people to the industry.

590. The shortage of qualified mechanics is one of considerable concern and one witness suggested that N.S.W. required an additional 10,000 more qualified people. The Federal, South Australian and N.S.W. Governments gave evidence on the training and retraining of people in motor vehicle trades. The Department of Labor and Immigration illustrated that there has been a long standing shortage in the supply of motor mechanics and the occupation of motor mechanic has been one of the few occupational categories still to show an excess of vacancies over registered unemployed applicants. It was indicated that through the National Employment and Training Scheme and the National Apprenticeship Assistance Scheme endeavours were being made to overcome the shortage of mechanics.

591. IAME suggested that employees in the industry not eligible for licensing should be allowed to continue working but that their work should be supervised by qualified (licensed) mechanics. IAME took this view in conjunction with a recommendation that the person not the premises should be issued with licences. In addition, IAME suggested that restricted licences be available to repairers involved solely in specialist areas of the motor repair trade.

592. In summary, the basic objectives of IAME with regard to the licencing of motor mechanics were -

(a) to satisfy the need that exists for close control of the vehicle repair and service

industry as indicated necessary by the reports prepared by motorists and consumer groups,

(b) to improve the status of motor mechanics thereby inducing suitable people to enter the trade and to retain those skilled and qualified persons already in the trade,

(c) to control the scope of unqualified and unskilled persons working within the trade thereby adding to the status of qualified persons and reducing the possibility of sub-standard repairs, and

(d) to reduce the incidence of accidents occurring due to mechanical failure.

593. The Committee also received evidence with regard to the high cost of spare parts, the use of poor quality secondhand parts in vehicle repair and the lack of inspection of vehicles repaired following a collision. The Committee is fully aware that the existence of these problems affect vehicle safety in varying degrees.

594. While there is almost unanimous opinion on the desirability of some form of licensing in all areas of the trade, the Committee considers that continuous examination of the problems is essential and expects that the studies in progress by the Department of Transport and SAE will lead to effective counter-measures being taken. In the meantime, every effort should be made by the appropriate authorities to further train and develop the skills of mechanics in order to reduce the severe shortage of mechanics in the motor vehicle repair industry. The Committee is deeply concerned about the problems apparent in the repair industry and the effect of these problems on safety. It will therefore give close attention to the results of current investigations and review the situation at some future time.