Parliamentary Paper
No. 83/1977

The Parliament of the
Commonwealth of Australia

HEAVY VEHICLE SAFETY

House of Representatives
Standing Committee on Road Safety

Report

April 1977

Brought up and ordered to be printed
31 May 1977

The Commonwealth Government Printer
Canberra 1977

Printed by Graphic Services Pty Ltd, 516-518 Grand Junction Road, Northfield, S.A. 5085

PERSONNEL OF THE COMMITTEE

Chairman	..	The Hon. R.C. Katter, M.P.
Deputy Chairman	..	The Hon. C.K. Jones, M.P.
Members	..	Mr B. Cohen, M.P.
		Mr P.D. Falconer, M.P.
		Mr B.J. Goodluck, M.P.
		Mr J.L. McMahon, M.P.
		Mr P.M. Ruddock, M.P.
		Mr J.R. Short, M.P.

Clerk to the Committee - Mr F.R. Hinkley

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

TABLE OF CONTENTS - continued

ACKNOWLEDGEMENT

Material used for illustrations in this report came from the Department of the Capital Territory; Department of Motor Transport, New South Wales; Transport Regulation Board, Victoria; Mr A.G. Gibbs, Chairman, Victorian Railways Board; National Association of Australian State Road Authorities; Ford Motor Company of Australia Limited; Mercedes-Benz (Australia) Pty Ltd; and Volvo Australia Pty Ltd. Use of this material is acknowledged with thanks.

RECOMMENDATIONS

The Committee recommends that:

1. both the Advisory Committee on Safety in Vehicle Design and the Advisory Committee on Vehicle Performance give consideration to standardisation of the location of emergency braking controls within the cabin. (Paragraph 81)

2. further consideration should be given to the need for vehicles licensed for a gross mass exceeding 25 tonnes to be equipped with auxiliary retarding equipment. (Paragraph 84)

3. consideration be given to making auxiliary braking a requirement on all buses which may be used on long distance touring or in hilly terrain. (Paragraph 85)

4. the Advisory Committee on Safety in Vehicle Design specifies maximum steering effort in a design rule. (Paragraph 94)

5. a program of research be implemented with a view to the drafting of an Australian Design Rule on heavy vehicle tyres. (Paragraph 106)

6. retreaded tyres should not be fitted to the steering wheels of high speed or heavy service vehicles. (Paragraph 108)

7. the Advisory Committee on Vehicle Performance prepare a Draft Regulation requiring retreaded tyres in use on vehicles to meet, as a minimum, the Australian Standard on retreading. (Paragraph 109)

8. appropriate action is taken to provide for the enforcement of Australian Standards AS 1771-1975, AS 1772-1975, and AS 1773-1975. (Paragraph 113)

9. the consideration being given by the Advisory Committee on Vehicle Performance to the development of a national code of safe loading practice be expedited. (Paragraph 118)

10. action be taken by relevant enforcement authorities to prevent the failure of critical vehicle components by ensuring that vehicle manufacturers' recommended load ratings are not exceeded. (Paragraph 121)

11. the Advisory Committee on Safety in Vehicle Design when considering the strength of truck cabins in relation to load movement problems also review the need for load barriers. (Paragraph 124)

12. the Advisory Committee on Safety in Vehicle Design prepare appropriate design rules on forward and rearward fields of vision for heavy vehicles. (Paragraph 133)

13. the Draft Regulation on rear marking plates be immediately adopted in the Territories and that all States be urged to similarly act on this matter. (Paragraph 143)

14. a design rule on the springing of cabins be introduced as soon as possible. (Paragraph 156)

15. the Advisory Committee on Safety in Vehicle Design investigate and keep under review the level of noise to which heavy vehicle drivers are subjected and the need to specify permissible levels of internal noise in a design rule. (Paragraph 157)

16. the Advisory Committee on Vehicle Performance extend the Draft Regulation on under-run barriers to cover all trucks where the load carrying tray overhangs the rear suspension. (Paragraph 168)

17. all States and Territories should adopt the revised Draft Regulation on under-run barriers. (Paragraph 168)

18. the Advisory Committee on Safety in Vehicle Design prepare a Design Rule on under-run barriers. (Paragraph 168)

19. the Advisory Committees on Safety in Vehicle Design and Vehicle Performance investigate the safety aspects of bull-bars. (Paragraph 173)

20. the Advisory Committee on Safety in Vehicle Design prepare an Australian Design Rule specifying frame strength and design standards for buses. (Paragraph 179)

21. the Advisory Committee on Safety in Vehicle Design prepare an Australian Design Rule on truck cabin strength. (Paragraph 183)

22. the Advisory Committee on Safety in Vehicle Design when preparing a design rule on truck cabin strength also specify a standard for retaining clips on cab-over-engine vehicles. (Paragraph 184)

23. relevant authorities ensure that with the introduction of Australian Design Rule 32 occupants be required to use the seat belts provided. (Paragraph 202)

24. an Australian Design Rule be prepared requiring inter-urban buses to fit passenger seat belts in conjunction with well padded, high backed seats. (Paragraph 203)

25. materials used in furnishing buses be fireproof and of a material which does not produce toxic gases when subject to heat. (Paragraph 211)

26. high strength emergency exits be fitted to the sides and roofs of passenger buses used in inter-urban or charter services. (Paragraph 214)

27. all States implement the "Uniform Inspection Standard for Omnibuses" as a matter of urgency and that an annual inspection scheme for other heavy vehicles, supplemented by a system of random checking, be implemented as soon as possible. (Paragraph 237)

28. all States and Territories adopt Draft Regulation 120(4) relating to the modification of trucks and other commercial vehicles. (Paragraph 242)

ABBREVIATIONS

ABS - Australian Bureau of Statistics

ACSVD - Advisory Committee on Safety in Vehicle Design

ACVP - Advisory Committee on Vehicle Performance

ADR - Australian Design Rule

AMVCB - Australian Motor Vehicle Certification Board

ARRB - Australian Road Research Board

AS - Australian Standard

ATAC - Australian Transport Advisory Council

BS - British Standard

ECE - Economic Commission for Europe

FMVSS - Federal Motor Vehicle Safety Standard

GVM - Gross Vehicle Mass

MMTB - Melbourne and Metropolitan Tramways Board

NAASRA - National Association of Australian State Road Authorities

NHTSA - National Highway Traffic Safety Administration

NRTITC - National Road Transport Industry Training Committee

TARU - Traffic Accident Research Unit

CHAPTER 1

INTRODUCTION

The Reference

1. The House of Representatives Standing Committee on Road Safety was appointed by resolution of the House of Representatives on 17 March 1976 to inquire into and report on-

(a) the main causes of the present high level of the road toll in Australia;

(b) the most effective means of achieving greater road safety in Australia;

(c) the particular aspects of the problem to which those concerned with road safety could most advantageously direct their efforts; and

(d) the economic cost to the community of road accidents in Australia in terms of-

(i) material damage,

(ii) loss of man hours and earning capacity, and

(iii) cost of treatment of accident victims.

2. These terms of reference are identical with those of the Standing Committee on Road Safety established in the Twenty-ninth Parliament and with the terms of reference of the Select Committees of the Twenty-seventh and Twenty-eighth Parliaments.

3. In July 1974 the previous Committee began an inquiry into the safety aspects of vehicles using public roads, but due to the complexity and size of the subject, it subsequently decided to restrict its investigations to matters concerning passenger motor vehicle safety. The Committee's report entitled "Passenger Motor Vehicle Safety" was tabled in the House of Representatives on 2 June 1976. On 5 May 1976 the

Committee resolved that it inquire into a further section of the original vehicle inquiry, namely heavy vehicles, or more specifically, trucks and buses.

The Inquiry

4. On 5 June 1976 the Committee placed advertisements in major metropolitan newspapers inviting interested individuals and organisations to make submissions on the heavy vehicle aspect of road safety. Advertisements were also placed in a range of specialised journals and publications. In addition, vehicle and component manufacturers, Commonwealth and State road safety organisations, vehicle design experts, and numerous other organisations were approached directly and invited to make submissions on the inquiry.

5. Seventy-four submissions were received and sixty-two witnesses appeared before the Committee. A list of witnesses who appeared before the Committee is given at Appendix 1.

6. Commencing on 22 July 1976 ten public hearings were held at which over 2000 pages of evidence were taken. Evidence given at the public hearings is available for inspection in Hansard form at the Committee Office of the House of Representatives and the National Library of Australia in Canberra.

7. In July and September 1976 the Committee inspected truck and bus shows in Sydney. In November 1976 the Committee held informal discussions with drivers of heavy vehicles at a road-side cafe in Yass, New South Wales.

8. The Committee wishes to emphasise that while it has concentrated on the small area of heavy vehicles it is not unaware of the larger problems existing in road safety. In previous reports the Committee has already directed its attention to the need for a national authority on road safety and standards, to statistical and data collection needs, and

to the roads and their environment. As to the human aspect, a most vital area of road safety, the Committee intends inquiring into this very important area following the completion of its next inquiry into the safety of motorcycles and bicycles.

9. Like other inquiries conducted by this Committee, this one into heavy vehicle safety has been a complex one with a great deal of apparently contradictory evidence being put by witnesses, and with many viewpoints from which to assess the problems. *The Committee found that while the problems are* relatively easy to identify, in many cases it is almost impossible to support intuitive conclusions with well documented research and statistical evidence.

10. The Committee concentrated its investigations on endeavouring to determine the extent and nature of problems relating to heavy vehicle safety and on the range of measures by which heavy vehicle safety could be improved.

CHAPTER 2

REGULATORY MEASURES BEARING ON SAFETY

Draft Regulations and Australian Design Rules

11. The Federal Government, in conjunction with the States through the Australian Transport Advisory Council (ATAC) has considerable responsibility in vehicle safety matters. Through this body the various laws and regulations relating to transport are reviewed. Governments attempt to maintain a uniformity of approach through ATAC towards transport administrative procedures and policy.

12. The Australian Transport Advisory Council has appointed a number of specialist committees to assist it in its tasks. One such committee is the Advisory Committee on Vehicle Performance (ACVP) which advises ATAC on the "on road" standards for road vehicles, their equipment and loads. Draft Regulations formulated by this committee detail minimum standards of vehicle construction, equipment and performance. These regulations are recommended for adoption in the legislation of States and Territories. Where adopted they are enforced at the point of registration.

13. The Australian Transport Advisory Council also endorses Australian Design Rules (ADRs) for vehicle safety. The Advisory Committee on Safety in Vehicle Design (ACSVD) formulates these rules to cover cases where the requirements are too complex for compliance to be established at registration. These rules are detailed technical specifications for each safety feature to be incorporated in new vehicles. Certification for compliance with design rules is the responsibility of the Australian Motor Vehicle Certification Board (AMVCB) which was also appointed by ATAC. Where compliance with the design rules applicable to a vehicle at the date of manufacture has been established to the satisfaction of AMVCB, the manufacturer is issued with approval to affix a compliance plate

to his vehicle. This plate indicates to registering authorities that the vehicle complies with the appropriate design rule.

14. Australian Design Rules applicable to heavy vehicles by vehicle category and date of application are shown at Appendix 2. The costs of complying with these ADRs were supplied by a number of witnesses and are shown at Appendix 3. The Advisory Committee on Safety in Vehicle Design is currently working on possible ADRs in the following areas affecting heavy vehicle safety: strength of truck cabins, bus seats, semi-trailer brakes and truck rear-vision.

15. The ADR system when first established involved a form of type approval and central certification by AMVCB of safety features incorporated in mass-produced passenger cars sold in high volume in Australia. The extension of ADRs to heavy vehicles however has involved particular difficulties for both manufacturers of these vehicles and the AMVCB.

16. A major difficulty is that created by the fragmented nature of the industry. While it is relatively easy to secure compliance to certain standards from the small number of first or sole manufacturers who often produce only the basic truck cabin and chassis, there are considerable difficulties in meeting these requirements for the many small and dispersed second manufacturers who complete a vehicle to suit buyers' particular needs. The production of test reports required in the certification process place severe strains on the limited skill, equipment and financial resources of many second manufacturers and often the task of establishing compliance with a complex body of Design Rules is beyond them.

17. The multiplicity of applicants for approval increases the work load for the AMVCB. The AMVCB issues approvals to original vehicle manufacturers for the ADRs met in chassis construction and deals separately with second manufacturers

(see paragraph 26). The work load for both AMVCB and manufacturers is also increased when approval is required for the multitude of options which are available for basic trucks.

18. These problems were recognised by AMVCB and formed one of the reasons for a decision by ATAC to conduct a review of the ADR system which was completed in October 1976. The Review[1] proposed that for second manufacturers an alternative method of certification be introduced which would require these manufacturers to submit a standard form of application to the AMVCB's State representative. Information to be provided would include identification of the vehicle, model, and each manufacturer contributing to the final product; extent of compliance already established; identification of the relevant first manufacturer's code of practice and the extent to which it has been followed; identification of any approved components used; and a statement of the safety standards observed or safety features incorporated. It is proposed that the accuracy of information provided in the application form should be confirmed by visual inspection of the vehicle or by the conduct of simple on-the-spot tests.

19. To further reduce the difficulties of administering the ADR system particularly as it relates to second manufacturers the Review recommended firstly that ATAC approve in principle the establishment of standards for a selected range of vehicle component parts and secondly that the AMVCB in consultation with the rule-making committees develop and propose a scheme for the approval of vehicle component parts on a progressive basis with priority being given to the assistance of second manufacturers.

---

1 The Australian Design Rules For Motor Vehicle Safety and Emission Control, A Review Of The Development and Administration Of The System. Prepared at the request of the Australian Transport Advisory Council. October 1976.

20. Evidence in this Inquiry has pointed to the inability of the ADR system to effectively cope with the difficulties of manufacturers producing a low volume of heavy vehicles for the Australian market. The Committee therefore agrees that there is need for appropriate changes to be made in the ADR system. Changes are necessary in order that manufacturers now operating outside the system may operate within the system and that others will not be forced out of the market. The Committee believes that the introduction of approval for selected component parts is desirable as it would provide considerable assistance to first manufacturers, second manufacturers, component manufacturers, consumers and to enforcement agencies.

21. A particular problem in relation to one such rule, ADR 35 on heavy vehicle braking, was raised by a number of manufacturers. Manufacturers have complained that to establish compliance with this rule they require access to testing facilities of which there are insufficient in Australia. The Review recognised this problem and recommended an urgent study be conducted by ACSVD and AMVCB of the industry's capacity to demonstrate compliance with a view to amendment of this rule as necessary. The Review also recommended that the Commonwealth take action to establish, at the earliest possible time, independent test and experimental facilities which would be available to all Governments and to all sectors of the motor industry.

22. States and Territories have adopted many of the safety related matters endorsed by ATAC. These matters have been taken up either by enacting legislation or adjusting administrative processes within the States and Territories. Uniform adoption and interpretation of ATAC recommendations concerning Draft Regulations and other matters however have not always been achieved. Appendix 4 provides examples of variation from ATAC recommendations in respect of vehicle dimensions, weight limits and speed restrictions. This lack

of uniformity in legislation and regulations is a matter of great concern to the transport industry. In the case of weight limitations a further complication occurs between some States where an apparent inconsistency in limits exists because of different administrative tolerances which apply before prosecutions are instigated. Appropriate mass and dimensional limits which should apply nationally have recently been the subject of intensive study.[2] The recommendations of this study are being considered by ATAC.

Other Requirements

23. The evidence indicates that there are other variations between the States and Territories in the use of safety related measures which control the operations of heavy vehicles and drivers. These include the following:

Graded driver licences
Log books to record driving hours
Vehicle inspections
Passenger limitations on buses
Regulations on the carriage of dangerous goods
Particular requirements in respect of vehicles and their equipment

24. The Committee considers that all regulations concerning roads, vehicles and drivers should be uniform throughout Australia. Variations should be permitted only in special circumstances. Uniformity could lead to better understanding of regulations and would assist the transport industry. Such uniformity may also result in improved vehicle design by enabling vehicle manufacturers to produce a smaller range of vehicles rather than the present situation where many vehicles are modified to suit local requirements, or are operated as supplied at reduced efficiency. Greater uniformity could also be expected to achieve worthwhile cost savings to vehicle manufacturers and to operators.

---

2 National Association of Australian State Road Authorities (NAASRA), A Study of the Economics of Road Vehicle Limits.

CHAPTER 3

THE NATURE AND EXTENT OF THE PROBLEM

Vehicle Types

25. The range of basic vehicle types operating in Australia is shown in Figures 1 and 2.

Figure 1: Basic vehicle types currently operating on Australian roads

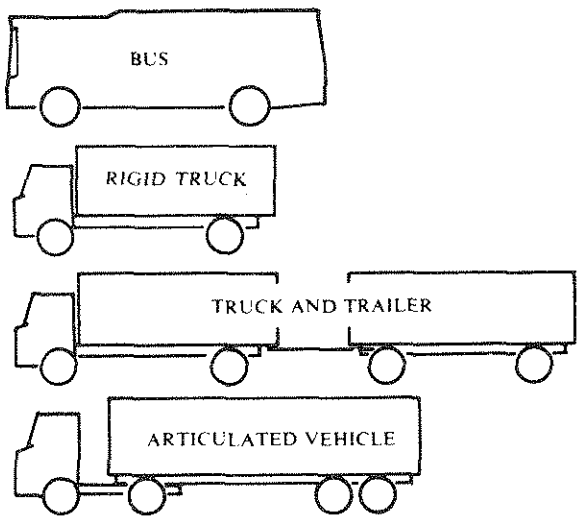
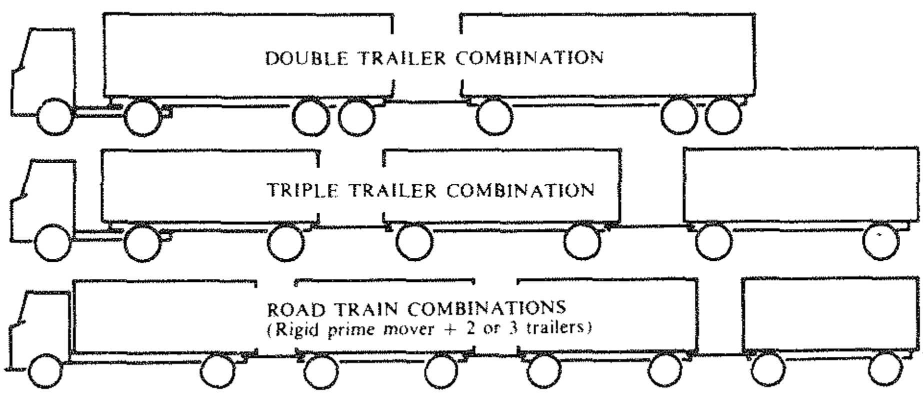


Figure 2: Vehicle types currently allowed to operate under general permits in certain parts of Australia

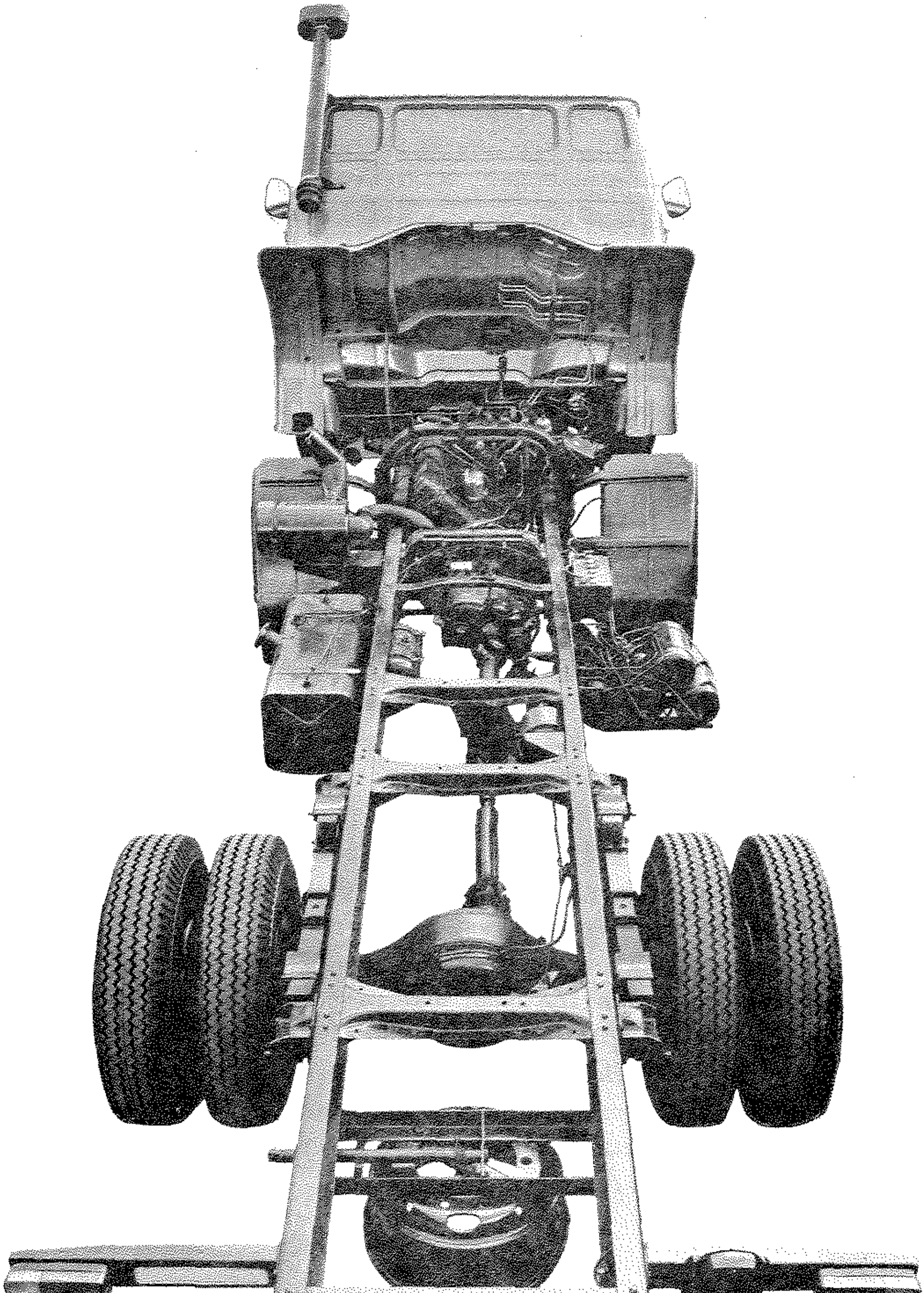


Vehicle Manufacture

26. Heavy vehicles are frequently custom-built to meet the particular needs of customers. The process by which these vehicles are manufactured commonly involves two or more manufacturing stages. Those responsible for these manufacturing stages have been loosely described within the industry as first manufacturers and second manufacturers. Original vehicle manufacturers rarely take the construction of a vehicle beyond supplying the chassis, tyres, suspension and brakes, the motive power and the driver's cabin. Second manufacturers provide bodies and trailers to convert the basic unit into a completed vehicle. Second manufacturers also provide owners with modifications to existing vehicles.

27. Basic vehicles are available with a multitude of options. Optional gear ratios, tyre sizes, engines, braking systems, cabin designs, numbers of axles, and wheelbases are offered to meet the varying uses to which the vehicle may be put. One company told the Committee that it had 348 basic vehicle options in its vehicle range, details of which are shown at Appendix 5. In this way heavy vehicle owners are able to select vehicles which suit their particular needs and are not forced to adapt or modify a vehicle after purchase. There is then a high degree of flexibility in the manufacture of heavy vehicles with manufacturers being able to cater for the full range of vehicle configurations required. As such the industry is highly competitive and highly specialised. However the Committee draws attention to the probable additional costs involved for truck purchasers and operators as a result of this wide range of options.

28. The volume of trucks manufactured in Australia is both small and predominately based on vehicles of overseas design. In 1975 truck registrations for vehicles of over 3 tonnes payload totalled only 15400 units. Of twenty-four



truck lines marketed in Australia, five were designed in the United States of America, eleven in Europe, four in Japan and four were designed in Australia. In many cases trucks are imported in kits or packs for assembly in Australia and include the design improvements, involving safety items, incorporated in European and United States design standards. These basic vehicles are assembled and then modified to suit local conditions and meet local requirements, by the original vehicle manufacturer. The evidence indicates that manufacturers, both local and overseas, were in varying degrees constantly improving their vehicles in performance and safety through programs of research and product development. It was apparent to the Committee that some tended to lead the field rather than be content to do only that required by regulation.

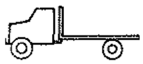
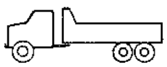
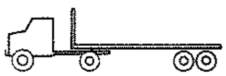
The Transport Industry

29. Evidence presented to the Committee indicates that the trucking industry plays a vital role in the Australian economy. Over 80 per cent of Australian freight is carried by trucks. Estimates of the freight and passenger transport task are provided at Appendix 6.

30. Table 1 indicates for some typical truck configurations the range of weights of goods able to be carried together with gross vehicle mass, the approximate retail price of the unit and annual distance which could be travelled. The Committee was told that the high and increasing vehicle and driver costs had contributed significantly to the increasing specialisation in truck specifications as noted earlier and to higher equipment utilisation rates. Safety requirements must be reconciled with the need for profitable and continuous operation of vehicles.

TABLE 1

HEAVY TRUCK TYPES

	Payload (Tonnes)	Gross Vehicle Mass (Tonnes)	Approximate Price * ($A '000)	Annual Kilometres ('000)
	3- 4	7- 8	$ 7- 10	16- 45
	5- 7	9-10	$11- 15	16- 35
	7- 8	11-13	$15- 18	24- 40
	11-12	18	$28- 35	16- 60
				
	14-15	24	$33- 40	16- 60
	14-17	27-29	$30- 50	80-240
	18-21	31-35	$60-115	80-320

* Includes truck, body and equipment.

Source: Evidence, p. 1178.

Accident Involvement

31. By its nature a heavy vehicle must cause more severe damage to a smaller and lighter vehicle when they are involved in a collision. A vehicle designed to carry large volumes and weights is of necessity heavy and stiff with less energy absorbing characteristics than lighter vehicles. It is also less manoeuvrable than other vehicles because of its larger physical dimensions. Statistics indicate that crashes involving heavy vehicles therefore are more likely to involve death and

vehicles (see Table 2). In terms of numbers of vehicles registered, however, the involvement rate of buses in casualty accidents is higher than for classes of vehicles other than motor cycles (see Table 2), but the risk of injury to the individual occupant is low (Table 3).

TABLE 2

CASUALTY ACCIDENT INVOLVEMENT RATES FOR VARIOUS VEHICLE TYPES, VICTORIA 1971

	Cars and Station Wagons	Light Commercial	Trucks	Buses	Motor cycles	Total
Number on Register [1]	1,131,361	136,303	92,323	5,129	28,160	1,393,276
Vehicle Km's (million) [2]	18,649.3	2,086.7	1,862.9	132.7	185.8	22,917.4
Casualty Accidents [3]	18,794	1,650	1,246	94	1,333	23,117
Casualty Accidents per '000 vehicles	16.61	12.11	13.50	18.32	47.34	16.59
Casualty Accidents per million vehicle Km's	1.00	0.79	0.67	0.71	7.17	1.00

1. As at 30 September 1971 - ABS 1971 Motor Vehicle Census.

2. . For all vehicles except buses, year ending 30 September 1971 - Unpublished data from ABS 1971 Survey of Motor Vehicle Usage.

   Note: Mileage data refer to mileage by Victorian registered vehicles.

   . For buses, year ending 30 June 1971 - ABS 1971 Bus Fleet Operations Survey.

   Note: Bus Mileage data refer to all bus mileage within Victoria. It is understood that this figure is very similar to the mileage of Victorian registered buses.

3. Year ending 31 December 1971 - Road Traffic Accidents Involving Casualties, 1971 - ABS Victorian Office.

Source: Evidence, p. 32.

TABLE 3

OCCUPANT CASUALTY RATES FOR VARIOUS VEHICLE TYPES, VICTORIA 1971

	Cars and Station Wagons	Light Commercial	Trucks	Buses	Motor cycles	Total
Number on Register [1]	1,131,361	136,303	92,323	5,129	28,160	1,393,276
Occupant Km (million) [2]	36,225	2,737	2,254	1,327	192	42,734
Casualty Accidents [3]	18,794	1,650	1,246	94	1,333	23,117
Occupant Casualties [4]	15,626	1,219	315	90	1,350	18,600
Casualty Accidents per million occupant Km's	0.52	0.60	0.55	0.07	6.96	0.54
Occupant Casualties per million occupant Km's	0.43	0.45	0.14	0.07	7.04	0.43

1. As at 30 September 1971 - ABS 1971 Motor Vehicle Census.

2. . For all vehicles except buses, year ending 30 September 1971 - ABS 1971 Survey of Motor Vehicle Usage.
   . For buses, year ending 30 June 1971. Estimated on basis of average bus occupancy per bus mile of 10, which is the average occupancy rate of buses involved in accidents in Victoria in 1971-1973.

3. & 4. Year ending 31 December 1971 - Road Traffic Accidents Involving Casualties, 1971 - ABS Victorian Office.

Source: Evidence, p. 33.

38. Table 4 indicates the relative accident severity by class of vehicle involved. The table gives the percentage of fatalities to casualties in multi-vehicle and single vehicle accidents. It can be seen from this table that the likelihood of fatal injury in casualty accidents between light vehicles and heavy vehicles, other than buses, is twice as great as in casualty accidents between light vehicles and light vehicles. However, a casualty accident involving a bus alone is even more likely to involve a fatality than a single vehicle accident

41 angle collisions
20 rear-end
6 head-on
4 side-swipe in the same direction
1 side-swipe in opposite direction
16 pedestrians
15 falls from moving vehicle
3 off road and struck fixed object
2 off road with no fixed object
1 object on roadway

42. The Committee was also given the results of a study[7] conducted on semi-trailer accidents in New South Wales in 1973 from which the following facts have been obtained:

(i) The most common form of crash was the rear-end collision. These amounted to 20 per cent of all semi-trailer crashes and were the cause of 12 per cent of semi-trailer crash fatalities. Of the eleven fatal crashes in this group, three involved the collision of semi-trailers with the rear of other vehicles, and six involved another vehicle colliding with the rear of the semi-trailer. Another involved two semi-trailers.

(ii) The next most common form of accident was the side-swipe with other vehicles travelling in the same direction (14 per cent) but involved less than 1 per cent of semi-trailer crash fatalities.

(iii) The third most common form of semi-trailer crash was of the head-on type, including side-swipes with vehicles from the opposite direction. These were the most severe type of crash and involved 42 per cent of all semi-trailer fatalities. It is interesting to note that of the thirty-nine fatal

7 Evidence, pp. 100-101.

crashes concerned, twenty-six involved other vehicles on the incorrect side of the road.

(iv) The fourth most common type of semi-trailer crash involved the vehicle running off the road. These constituted 12 per cent of semi-trailer crashes and were the second most severe type of accident with 14 per cent of fatalities.

(v) Right-angle intersection collisions occurred in 11 per cent of crashes and resulted in 11 per cent of the fatalities.

(vi) Other types of collisions and the percentage of fatalities can be listed as follows:

- collisions with pedestrians - 1 per cent of crashes; 11 per cent of fatalities.
- collisions with fixed objects - 6 per cent of crashes; 6 per cent of fatalities.
- overturning without running off the road - 5 per cent of crashes; nil fatalities.
- various manoeuvres - 8 per cent of crashes; 5 per cent of fatalities.
- collisions with parked vehicles - 4 per cent of crashes; nil fatalities.

(vii) Nearly 25 per cent of semi-trailer crashes involved no other vehicle, a higher proportion than for other vehicle types.

braking by other drivers and their failure to make allowance for it. Error on the part of the truck driver himself can not be ruled out either.

47. Heavy vehicles, particularly articulated ones are prone to certain types of accidents which do not necessarily involve driver error or mechanical failure. By virtue of design, the centre of gravity of some articulated vehicles is particularly high, and given for example, an unfavourable road camber or a shift in the load, even at quite low road speeds of under 40 kilometres per hour, such a vehicle may overturn. The Committee is satisfied that this is an area requiring extensive research in order to more fully understand the inter-relationship of the factors involved. These factors include truck design and suspension systems; and roads and load stability. Associated with this research would be consideration of the practice of overloading and the consequent demands and stresses placed on vehicles not designed to carry the additional weight in safety.

48. Jack-knifing is a cause of accidents peculiar to articulated trucks. There appear to be two types of jack-knife; one where the trailer swings on to the prime mover and the other where the prime mover swings on to the trailer.[9] Jack-knife of the first type is caused in most instances by inadequate brake balancing, where the trailer brakes are applied excessively hard causing the trailer to overcome the tyre-road friction and to swing around on the prime mover. This form of jack-knife is relatively easy to control by accelerating the prime mover.

49. Jack-knifing of the prime mover on to the trailer however tends to be instantaneous and not controllable. Under these circumstances the prime mover wheel base is very short relative to the turning point, and the jack-knife can happen both under braking or reduction of speed and under the

---

9 Evidence, p. 1323.

transition of going from a braking situation to an acceleration situation. In this latter situation there is a momentary slowing down of the prime mover relative to the trailer and the trailer pushes the prime mover into a jack-knife situation. As with the first type of jack-knife an imbalance of braking can also lead to the second type of jack-knife. Where the prime mover is more severely braked than the trailer, the trailer could also push the prime mover into a jack-knife situation. The effect of the loss of control by the driver of a jack-knifing articulated vehicle is spectacular, dramatic and quite often catastrophic where other road users are involved. The Committee was told that the ACSVD will seek to overcome the causes of jack-knifing when it prepares a design rule on trailer brakes. The frequency of roll-over and jack-knife accidents for oil company owned and operated articulated vehicles is shown at Appendix 10.

50. In regard to mechanical defects causing accidents a number of other studies have yielded results indicating that a higher proportion than the 9 per cent of accidents found in the above study (in paragraph 43) are probably caused by this factor. Tonge[10] surveyed 1535 articulated vehicle accidents in Queensland during the period 1965-67. He recorded mechanical defects present in 10 per cent of these vehicles involved in accidents. A qualified machinery inspector would only be called to fatal or serious accidents. Therefore defects in vehicles involved in less serious accidents are likely to go undetected. A roadside safety inspection in the United States of America of 46,731 property-carrying motor vehicles (trucks, highway tractors and semi-trailers) during 1969 found 23.1 per cent of these vehicles to be mechanically unsafe.[11] This figure is considered by Joubert[12] to be a closer approximation to the situation in Australia.

---

10 Evidence, pp. 1733-1744.

11 P.N. Joubert, Review of Truck and Bus Design, February 1973, (Prepared for Department of Transport), p. 16.

12 P.N. Joubert, p. 16.

TABLE 5

CASUALTIES/ACCIDENT FOR PARTICULAR TYPES OF ACCIDENT

	1970	1971	1972	1973	Weighted Average Over Years
Single vehicle	1.60	2.16	1.20	2.80	1.87
Car-Bus	1.69	1.30	1.64	1.43	1.55
Taxi-Bus	-	-	-	2.0	
Utility or PV-Bus	8.0	-	-	1.2	
Articulated-Bus	5.7	1	5	1.0	4.0
Truck-Bus	5.8	1.5	1.2	1.7	2.4
Bus-Bus	1.0	23	-	6.7	8.8

Source: E.R. Hoffman, p. 11.

56. Hoffman also draws on a study by Milne which gives more detail of the type of injury-producing accidents occurring in 1971 and 1972. The results of this study are shown in Table 6. Hoffman made the following observations on this table:

> It is noted that head-on and roll-over accidents, which are likely to be of high severity, are fairly rare (2.6% for each). 'Falls from moving vehicles' (23.7%) has implications for vehicle design and operating regulations; 'other accidents' possibly has implications for regulations on standing passengers and rigid surfaces within the bus; 'angle collisions' may have implications for improved side visibility, although this is not clear from data available. Although it is not known, it is suspected that the majority of the casualties in angle and rear-end collisions would be in the other vehicle.[16]

16 E.R. Hoffman, p. 15.

TABLE 6

MAJOR TYPES OF INJURY-PRODUCING ACCIDENTS

("Other" accidents largely consists of occupants falling within the bus and sustaining injury)

TYPE OF ACCIDENT	PER CENT OF INJURY ACCIDENTS IN 1971-72
Angle	23.7
Rear-end	11.8
Head-on	2.6
Side-Swipe (same direction)	2.6
Fall from vehicle	23.7
Overturned	2.6
Struck animal	1.3
Struck fixed object	7.9
Ran off road	2.6
Other	21.2
	100.0

Source: E.R. Hoffman, p. 14.

57. The bulk of bus injuries relate to the way in which passengers are required to embark, be carried, and disembark. These injuries do not hold implications for the general design of vehicles relating to handling characteristics as is so important with other heavy vehicles. Evidence received from the Department of the Capital Territory and the Melbourne and Metropolitan Tramways Board indicates that there are many accidents to bus passengers which are unrelated to the usual kind of road accident. The details of these accidents are shown in Tables 7 and 8. The injury rate was very low for the urban bus service operated in Melbourne. The Board informed the Committee that in 1974-75 there had been no fatalities with their buses and that the injury rate was 0.12 persons injured per million person kilometres.[17]

---

17 Evidence, p. 641.

TABLE 7

BUS INJURIES: DEPARTMENT OF THE CAPITAL TERRITORY, CANBERRA 1971-1975

Type of Accident	No. Receiving Medical Attention		No. of Injuries Recorded	
A. Non Collisions				
Dislodged from bus seat	9		23	
Lost balance while standing in bus	6		13	
Tripped on bus steps	13		22	
Caught in bus door	4		9	
Other	2		5	
Total	34		72	
	Bus Drivers	Passengers	Bus Drivers	Passengers
B. Collisions				
Failure to give way	2	1	3	8
Changing lanes	-	1	-	1
Rear-end collisions	-	13	1	15
Passing/Overtaking	1	6	1	7
Skidding/Cornering	1	-	2	-
Other	-	-	-	1
Total	4	21	7	32

Source: Evidence, p. 920.

TABLE 8

NON COLLISION ACCIDENTS INVOLVING
MELBOURNE AND METROPOLITAN TRAMWAYS
BOARD BUSES
1974-75

Type of Accident	Number of Injuries
Boarding	14
Alighting	38
Fall in bus	60
Fall from bus	7
Pedestrian struck by bus	10
Miscellaneous	2

Source: Evidence, p. 641.

58. In view of the comparative safety of bus travel efforts to implement cost-effective improvements in bus safety will need to utilize improvements of a low cost nature.

59. Notwithstanding the above evidence on the nature of most bus accidents and resultant injuries there are occasions however when there do occur bus accidents which in terms of fatalities and serious injury are extremely serious. Evidence received indicates that there are areas in the design of buses which could be improved.

60. Apart from the lack of seat belts in buses (and there are several inherent problems with these which are discussed later), it is clear that much can be done to buses to improve their structural strength and particularly the strength of seats and their anchorages. This is particularly the case with inter-urban coaches, for with buses used for urban commuter services the problems are more related to manoeuvrability and braking in heavy traffic and to the minimisation of minor injury.

61. The human element is an important component, some would claim the most important element, in all road accidents. An attempt was made to attribute blame between the driver

TABLE 9

ACCIDENTS BY MAIN CAUSATIVE FACTOR
QUEENSLAND, 1970

	Driver		Road		Vehicle mal-function		Load move-ment		Stock on road		Truck Length		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Truck/ trailer	9	2.8	5	1.5	2	0.6	0	0	4	1.2	0	0	20	6.2
Articu-lated	136	41.8	68	20.9	49	15.1	19	5.9	10	3.1	10	3.1	292	89.9
All fatals involving articu-lated vehicles	12	3.7	0	0	0	0	0	0	1	0.3	0	0	13	4.0
	157	48.3	73	22.4	51	15.7	19	5.9	15	4.6	10	3.1	325	100

Source: H.T. Wood and J.E. Cowley, p. 16.

and other causative factors in a survey[18] of truck accidents involving articulated vehicles in Queensland in 1970. The Results of this analysis are shown in Table 9. Although these figures for the driver also include the driver of the other vehicle the importance of the driver as a causative factor can clearly be seen.

62. A less detailed analysis indicating vehicle responsibility was supplied to the Committee by the New South Wales Department of Motor Transport. Analysis of 1827 cases reported by the New South Wales Police of heavy vehicles colliding with other vehicles at right-angle intersections in the twelve months prior to 31 July 1975 indicates that in 1047 (57.4 per cent) cases, responsibility for the accident was assigned to the heavy vehicle. The allocation of responsibility for the various vehicle manoeuvres is set out below:

Vehicle Manoeuvres	Heavy Vehicle Responsibility	Other Vehicle Responsibility	Total
Straight paths at right-angles to one another	737	584	1321
Right turning vehicle with through vehicle from opposite direction	98	117	215
Right turning vehicle with overtaking vehicle	38	27	65
Sundry other turns, including left turns but excluding U-turns	174	52	226
Total	1047	780	1827

18 H.T. Wood and J.E. Cowley.

63. The life and working conditions of heavy transport drivers are not ones to be envied, but nevertheless the men have a love for their work which seems to overcome all difficulties. They are a close-knit fraternity with their own folk-lore, language and loyalties, and yet while their experience and knowledge of their trade is unequalled the Committee is of the opinion that their rejection of the obviously effective safety measure of wearing seat belts is unsoundly based. The truck driver has of course great advantages in an accident situation as far as his bodily safety is concerned and this lack of vulnerability may promote a confidence which could obscure his judgment.

64. The Committee made a particular effort during this Inquiry to gain an appreciation of the drivers' problems and point of view, and while their opinions are generally respected, there are several safety areas where drivers rely more heavily upon their folk-lore than they do upon more objective findings. The Committee on one occasion visited a popular roadhouse at Yass on the Hume Highway, New South Wales, and spoke informally with drivers of heavy vehicles on a number of issues in relation to road safety. On all matters raised the drivers were forthcoming with their opinions and were of great assistance to the Committee, but on the question of seat belts they showed an attitude which is difficult to comprehend in the light of research studies. On the question of seat belts which are due to be fitted to all new omnibuses and heavy vehicles by July 1977 all drivers had severe doubts as to their value and whether or not they would wear them[19] despite the overwhelming evidence in their favour from passenger vehicle injury statistics and from the results of accident surveys such as one conducted by the New South Wales Traffic Accident Research

---

19 A similar result was found in a study of truck driver attitudes conducted by the New South Wales Traffic Accident Research Unit. This study was reported on in evidence - see pp. 108-110.

Unit (TARU). This survey[20] shows quite clearly that a truck driver has a much better chance of surviving, and a much lower chance of being injured, if he remains within the cab, and yet many drivers maintain that their best chance lies in trying to jump clear and that seat belts would only make that action more difficult.

65. There are two main categories of truck drivers, those employed by large companies on a "slip-seat" basis, i.e. they are "steerers" of vehicles who are relieved at regular intervals, and who do not have any responsibilities of maintenance, and those who are self employed driving their own trucks or who are employed by smaller operators. The Committee received evidence from several of these larger companies which were extensively involved in inter-state transport with heavy vehicles and was satisfied that many such companies endeavour to regulate the hours of driving in accordance with the legislative requirements. The weight of opinion expressed to the Committee indicated that this approach was not shared by all in the vehicle transport industry. The Committee is concerned that competitive pressures may cause smaller operators to cut costs and that these cuts may be in areas prejudicial to road safety. Drivers work long hours and while rest periods are mandatory, the control system is no guarantee that drivers are wide-eyed and alert at every moment of their journey. The high incidence of single trucks running off the road and colliding with fixed objects indicates that the control system is not always effective.

66. Vehicle manufacturers in recent years have made a concerted effort to reduce driver fatigue and provide a more pleasant work environment for the heavy vehicle driver. The problems of noise, vibration, temperature, and ventilation of many truck cabs are often very bad and do not assist the driver

---

20 M. Henderson and A. Sims, pp 5-6.

to remain alert to his task. It is increasingly being recognised that the operation of these vehicles should be as easy as possible and free from these annoyances which can quickly sap a driver's energy, patience and powers of concentration.

CHAPTER 4

ACCIDENT AVOIDANCE

67. Accident avoidance is one of two main approaches to reducing the occurrence of accidents, fatalities and casualties in the road traffic system. This chapter of the report concentrates on primary safety aspects, or the means by which accidents may be prevented from occurring. The next chapter considers secondary safety or the means of preventing or reducing injury once an accident has occurred.

68. As with passenger vehicles, the Committee has paid particular attention to the evidence received on heavy vehicle design in an endeavour to improve vehicle safety performance. There are many areas of critical importance to heavy vehicle safety and the Committee is pleased to be able to report that significant advances are being made in some of these areas.

Braking

69. Evidence indicates that there are two main areas of concern in relation to heavy vehicle braking performance. These are the inferior performance of heavy vehicles when compared with braking performance of light vehicles, and heavy vehicle handling and stability under braking.

70. While there is no direct evidence that the inability of heavy vehicles to stop as rapidly as light vehicles is the cause of accidents the results of studies previously mentioned indicate that the large number of accidents involving trucks running into the rear of cars may be due to the difference in braking ability. Many of these accidents could be avoided if light and heavy vehicles shared similar braking performance.

71. It is recognised that the increased eye height of the average truck driver compared with that of an average car driver, plus the lower speed of the average truck compared with that of the average car should enable the driver of a heavy vehicle to improve his own braking reaction time. The Committee believes however that in many instances of emergency braking neither of these factors would be an advantage.

72. Theoretically, all vehicles with braking equipment appropriate to their mass should be able to attain similar braking performance.[21] The Committee was told that existing brake technology can achieve any desired brake effectiveness as has already been proved by the development in the aircraft industry of a braking system which is approximately twice as effective as that presently used by heavy vehicles. The Committee was informed, however, that improved heavy vehicle braking should be introduced gradually. Over-effective brakes carry with them undue risks of skidding and resultant loss of vehicle control as well as risks of the load shifting.

73. There are implications for the adequacy of tyres as well as important vehicle design considerations to be considered in proposals to achieve adequate braking performance. The following statement indicates the design implications for tyres and the vehicle:

> One must bear in mind that the commercial vehicle has evolved over the years as a design compromise. The vehicle structure, suspension, and brake system have been designed for a given level of average braking performance, with a capability of accepting a certain amount of overload in emergency situations. The pneumatic tires are part of this design compromise, since there isn't much point in designing high tractive capability into truck tires, at the expense of increased rolling resistance and higher wear rates, if that tractive capability cannot be matched by brake torque capabilities as constrained by

---

21 NAASRA Study Report T5, p. 37.

> brake size and brake design practice. The aim of this design compromise has been to produce vehicles which are safe and reliable within their performance range, and which are characterized by high payload/vehicle weight ratios and minimal operating and maintenance costs. To introduce a requirement for severely increased braking capability into the commercial fleet, as it has evolved, will necessarily require a re-evaluation of the design of the entire system.[22]

74. Significantly more effective braking would require among other things stronger suspensions, increased front axle strength, re-design of steering systems and better load retention procedures. Passenger restraint systems on buses may also have to be utilized.

75. The issue is one of careful implementation of known technology for while the technology is there especially from the aircraft industry, the implementation of it by the motor industry is not so easy. The Committee has already referred to the inferior braking performance of heavy vehicles when compared to lighter vehicles and to the complaints from industry regarding the inadequacy of testing facilities (see paragraph 21) from which necessary data can be obtained to demonstrate compliance with ADR 35 on heavy vehicle braking. The Committee believes that it will be possible to plan for further improvement in heavy vehicle braking performance after ADR 35 becomes effective in 1979. Overseas experience indicates that it may be foolhardy to be too precipitate in demanding braking standards which can not be reasonably attained by the industry or which may have unfortunate side effects.

76. One such example cited to the Committee several times was that of the United States' experience where the National Highway Traffic Safety Administration (NHTSA) issued the Federal Motor Vehicle Safety Standard No. 121 (FMVSS 121) which

---

[22] P.N. Joubert, p. 44.

required a heavy vehicle to stop once out of six times in a distance of 246 feet, and in a lane twelve feet wide. The problem is that while the vehicle is able to stop in the required distance, the technology has not been sufficiently refined to brake vehicles in perfect safety. The braking demands in fact call for such aggressive brakes that vehicle stability becomes a problem under normal operating conditions. It must be realised that there are many other parameters to be considered besides braking distance. There are for example a vast variety of road surfaces, and an equally vast variety of weights to be carried, both of which are vital considerations in braking performance.

77. So while the Committee is anxious to see braking performance improved as quickly as possible, it agrees that the present approach through the design rule system should be a gradual program of improvement with a close watch being kept on overseas developments. The Committee considers that improved braking systems, such as anti-lock and load sensitive proportioning systems, should be fully tested and assessed before being introduced as a legal requirement. It is essential that all innovation and advances be not only effective, but durable and relatively maintenance free. The Committee believes that this commonsense approach should always prevail.

78. As stated in paragraph 75, the Committee received complaints from the industry about ADR 35 and most of them stem from the fact that they see the standard required to be attained by heavy vehicles as being unnecessarily different to overseas standards. It is of great importance that Australian standards should, wherever possible, be kept closely in line with overseas standards for many obvious reasons, not the least of which is the fact that the manufacture of trucks is an international industry. The Committee considered this complaint and is satisfied that the standard, although slightly different from

the European one, can be justified in view of Australian conditions. This is often the case particularly in view of the more rugged and adverse road conditions to be travelled by heavy vehicles. Components of heavy vehicles need to be sturdier and less susceptible to problems caused by heat, dust and water.

79. It is this last element, water, which has been taken into account by ADR 35, for while the stopping distances required are the same as those required by the Economic Commission for Europe (ECE), the water recovery test has been carried over into the heavy vehicle ADR from the passenger car ADR. The logic is obvious - trucks go through just as much water as passenger vehicles, probably more, and therefore the effect on braking efficiency has to be taken into account. The Committee considers this provision to be an eminently sensible one and believes heavy vehicle manufacturers should be expected to comply with the standards set.

80. A matter of great concern mentioned by numerous witnesses was that ADR 35 does not extend to the braking of trailers. The failure to cover trailers means that there is no requirement for compatibility in the matching of brake systems or for balancing the brakes of a truck and trailer or prime mover and trailer. This is a serious anomaly especially when it is realised that braking regulations in Europe, on which ADR 35 was partly based, include vehicles in combination. The Committee did not receive any evidence as to why trailers were excluded. The Committee was pleased to find however that the problem has been under active investigation by the ACSVD and that a design rule may be forthcoming. The Committee is firmly convinced of the urgent need for a design rule in this area.

81. Emergency and holding brakes on all heavy vehicles are essential and have long been standard equipment. These brakes are applied and held by springs or other devices and must be released by the driver before the vehicle can move.

Australian Design Rule 35 contains standards for their efficiency as does the Draft Regulations although braking provisions of the Draft Regulations are regarded by ACVP as out of date and in need of revision. Several submissions to the Committee however recommended greater standardisation in the location of these brakes in the cabin. In an emergency situation it is essential that all drivers, regardless of the vehicle they are driving, should be able to react with instant certainty in the application of that brake. Any delay in finding the brake in a cabin with unfamiliar controls could have disastrous results. The Committee therefore recommends that both the Advisory Committee on Safety in Vehicle Design and the Advisory Committee on Vehicle Performance give consideration to standardisation of the location of emergency braking controls within the cabin.

82. The Committee received considerable evidence on the various types of retarders or auxiliary braking devices. These brakes are at present installed on vehicles by some operators in addition to the main brakes and the emergency brake. They are a non-wearing type of brake used primarily to reduce the load on the main brakes where a vehicle must travel prolonged periods on hilly or mountainous routes.

83. The three principal types of auxiliary braking are engine brakes (Jacobs type and exhaust type), hydraulic retarders and electro-mechanical retarders. The most expensive and effective retarders are the electro-mechanical types which are located on the differential side of the transmission. These retarders carry a penalty because of their size and weight and can develop problems in protracted use if electric current can not be dissipated. Hydraulic retarders are incorporated in the transmission and are regarded as effective. Engine and exhaust type retarders are similar in their effect in that they turn the engine into a compressor which retards the vehicle. The engine brake is complex and is incorporated in the engine

design while the exhaust retarder essentially involves a valve in a diesel engine exhaust pipe between the exhaust manifold and the muffler. The Committee was told that while exhaust and engine brakes are simple and relatively cheap installations their effectiveness depends on the engine engaged with the transmission.

84. The Committee was impressed with the need for auxiliary braking as these systems allow the driver three modes of braking from which he could select. In the case of load carrying vehicles additional braking systems become very necessary. This is evident from a number of studies previously mentioned where it was found that brake failures have been a significant cause of truck and single vehicle accidents. Inadequate braking systems are also considered a significant cause of the over-involvement of trucks in rear-end accidents. While the Committee acknowledges that these devices have limited braking effect in an emergency, it considers that their merit lies in their ability to decelerate a vehicle without resorting to the main brakes which are kept in reserve for occasions when greater deceleration is required. Auxiliary brakes thereby assist in alleviating the problems of brake fade which are associated with the prolonged use of the main brake system. Not all heavy vehicles however are likely to require these devices and the Committee agrees with the recommendation[23] of the recent NAASRA study that <u>further consideration should be given to the need for vehicles licensed for a gross mass exceeding 25 tonnes to be equipped with auxiliary retarding equipment</u>.

85. The Committee believes there is a need for an additional element of safety in braking required on buses which are used for long distance touring and/or in hilly terrain.

---

[23] NAASRA Study Team Report R3, October 1975, p. 78.

The Committee therefore recommends that <u>consideration be given to making auxiliary braking a requirement on all buses which may be used on long distance touring or in hilly terrain</u>.

<u>Steering</u>

86. Reliable and satisfactory operation of the steering system of a heavy vehicle is an extremely important facet of vehicle safety.

87. A matter of prime concern to the Committee was the effort required of a driver to steer the vehicle. The Committee was told that steering effort in these vehicles can vary from highly satisfactory to borderline and that the ACSVD should be asked to consider the situation and determine whether a design rule should be developed to cover the subject.

88. The two types of power steering brought to the attention of the Committee were full power steering and power-assisted steering. Many witnesses and truck drivers with whom the Committee spoke expressed a strong preference for the latter because should a true power system fail the driver would be left with no steering at all. Power-assisted steering was preferred because manual steering ability would remain should the power-assistance fail.

89. Some debate was encountered on the relative merits of manual and power-assisted steering. There is no doubt that power-assisted steering does considerably reduce the amount of effort needed to steer a heavy vehicle and has advantages in an emergency situation where front tyre failure occurs or where bad roads make safe steering difficult. Whether power steering is required by all vehicles, however, depends on the type of work being performed. One large company of inter-state hauliers informed the Committee that they had no need of power-assistance as their vehicles were only used on the major inter-capital highways where steering was very straight forward.

For other operators though, especially urban buses and other vehicles where heavy loads have to be transported on winding roads, the situation is quite the reverse. In narrow tight turning exercises it is obviously of the utmost importance that the effort needed to manoeuvre the vehicle be as small as possible.

90. Some witnesses believed that power-assistance should be made compulsory in heavy vehicles, and others went a little further by specifying that the power-assistance should be of the integrated type which was less prone to damage and more serviceable. Transpec Limited[24] pointed to the need to determine maximum steering effort criteria and suggested that a maximum tangential force on the steering wheel of 250 Newtons at a maximum vehicle speed of 5 km/hr would be a suitable standard. The company also specified that the maximum turns of the steering wheel should not exceed six turns with the vehicle having a turning radius not exceeding 12.5 metres. It was stated that available power-assisted steering systems would meet these criteria. The company was concerned however that these criteria should also apply to power-assisted steering when the source of power is removed or has failed, i.e. the steering system installed must have full manual back-up steering when a power failure takes place and the above limitations should apply under those conditions.

91. There is no unanimity on the advantages of power-assistance, and in fact some witnesses saw some serious disadvantages in it. Criticisms included reduction in the "feel" of the road, and the dangers of drivers having to alternate between vehicles with different types of steering.

92. It is interesting to note that in Europe power-assistance is mandatory in many cases. In West Germany, for

---

[24] Evidence, p. 1559.

example,[25] all buses with a permissible front axle load over 4.5 tonnes must be fitted with power-assisted steering. It is further specified that a steering effort of 25 Kg (60 Kg in case of failure of power-assistance) must not be exceeded when the vehicle is negotiated into a circle of 12 metres radius at a speed of 10 km/hr.

93. The Committee favours power steering in all heavy vehicles, especially those in urban areas and with a weight exceeding 4.5 tonnes on the front axle. However without further research into the cost/benefit of such a direction, the Committee is unwilling to recommend that the extra expense to an already expensive vehicle be made mandatory.

94. Steering is greatly affected by the load carried on the front axle and the Committee considers that with the possible introduction of higher permissible loads on steering axles following the NAASRA study manual steering may become impractical. The Committee has noted that power-assisted steering is becoming more common on vehicles with heavily loaded front axles and that manufacturers are increasingly fitting these systems as original equipment on their vehicles. Power failure with these systems is not uncommon and in the event of a failure the driver may not have sufficient strength to steer the vehicle. The Committee therefore recommends that <u>the Advisory Committee on Safety in Vehicle Design specifies maximum steering effort in a design rule</u>.

<u>Suspensions</u>

95. Suspension systems are designed to provide a smoother ride for a vehicle than would otherwise be obtained, by reducing the vertical forces caused by irregularities in the road surface. Suspension systems therefore are affected by the vehicle's load and the nature of the road but also have an

---

25 Evidence, p. 1924.

effect on driver comfort and the extent of damage to the road and the vehicle.

96. The Committee is aware that suspension failures have been known to cause a number of accidents due to drivers losing control when the failure causes a sudden change of direction. The Committee was told that the main form of failure involved the breaking of the main spring leaf and that quite often the weakness could not be detected. A rough road or the burden of extra weight when cornering is often sufficient to cause the fatigued metal to snap. Other sources of failure could more reasonably be overcome by improved maintenance and component design.

97. The Committee was also disturbed by a practice which occurred reasonably frequently in the past concerning the use of truck chassis for buses. The stiffer suspension employed in a truck chassis results in a rougher ride for bus drivers and passengers, and leads to premature deterioration of the vehicle due to bumping, twisting and vibration. The Committee regards this as undesirable and was pleased to note that the practice has now almost ceased.

98. The suitability and adequacy of suspension systems and the effect of these systems on both the roads and the vehicle is the subject of a research project currently being conducted by the Australian Road Research Board. A test site at Seymour, Victoria has been used to make an evaluation of a large number of heavy vehicle suspensions. At this stage no results from this study are available except to say that the use of some types of suspension should be discouraged.

99. The load sharing capability of suspension systems has important implications from the point of view of protecting roads. The Committee was told that Draft Regulations are being prepared by ACVP to ensure that vehicles have an approved

suspension system. The introduction of such regulations to the extent that the load carried by the various wheels is equalised ensures better tyre grip which should assist in achieving better braking.

<u>Tyres</u>

100. Tyres are vital to the safety operation of all road vehicles. Unlike other vehicles however, the cost and running economy of heavy vehicle tyres are of great importance to operators and to some extent place a restriction upon some of the measures which could be taken in this area to improve vehicle safety. Tyres are expensive and must combine all the qualities of long wear, reliability, strength, good road holding ability and must be capable of being retreaded a number of times. The Committee was concerned to determine whether economy of operation was allowed to prevail to such an extent that the safety of the vehicle may be jeopardised.

101. Tyre manufacturers claimed that heavy vehicle tyres are safe when operated within their recommended service limitations. Manufacturers suggested that the most effective way to avoid accidents which could result from tyre failure would be for regulation authorities to ensure that vehicle users maintain and operate tyres according to the manufacturers' recommendations particularly those detailed in the Australian Tyre and Rim Association's Standards Manual which specifies loads and inflation pressures for the various operating conditions, including physical dimensions and rim fitment. Adequate care and maintenance of tyres ensures the maximum service from tyres and this depends on operational and maintenance factors such as speed, loading, inflation, vehicle condition and operating environment.

102. The main sources of damage to tyres which increase the risk of failure are heat generation in the tyre and damage to the tyre casing in the operating environment. Heat

generation is exaggerated if the vehicle is operated with under-inflated tyres, at high speed, or the vehicle is over-loaded. In these conditions rubber compounds are weakened and tread and ply separation in the tyre may occur. In extreme cases of gross failure of the tyre structure a blow-out will occur. Inadequate tread depth also affects the likelihood of tyre failure.

103. The Committee received limited information on the role of tyre failure in accident causation. A number of studies have indicated that the contribution of tyre failure to truck accidents is small. A common problem faced by such studies however is that police accident reports are used to provide the data and it is often very difficult in the compilation of these reports to determine whether a tyre deflation took place before, or during an accident.

104. The part played by tyres in the handling and stability of heavy vehicles is considerable. Many accidents commence where there is a breakdown in the grip between tyre and the road, particularly when skidding commences. The Committee was therefore concerned with the claims by a number of witnesses that heavy vehicle tyres have been developed to a lesser extent than car tyres. It was claimed that heavy vehicle tyres have been developed with an emphasis on long service life, rather than road holding ability. In particular, truck tyres were stated to have poor traction properties in cornering and braking compared to car tyres, that the simpler tread pattern is one of the reasons for poor wet weather traction of truck tyres, and that braking performance varies with the load being carried.

105. A number of submissions stated that there should be a design rule on truck tyres. The Committee was informed that at present insufficient research has been done in this area to enable a suitable design rule to be formulated. A start has

been made in a study[26] by Sweatman and Joubert which was supported by the Australian Department of Transport, into tyre safety performance characteristics. This study made specific recommendations for a tyre research program at an estimated cost of $1.3 million.

106. The Committee does not wish to elaborate on Sweatman and Joubert's work except to say that their recommendations deserve the highest consideration. Tyres for all vehicles are a critical safety element and until a great deal more knowledge is made available, improvement in tyre technology is going to be very slow. The Committee therefore recommends that a program of research be implemented with a view to the drafting of an Australian Design Rule on heavy vehicle tyres.

107. In the interim there are some areas of tyre safety which can be supervised more closely and with which the transport industry would have little cause for complaint. In the first place the Committee agrees with the proposal put by a number of organisations representing heavy vehicle operators, that the minimum tread depth requirement presently specified in Draft Regulation 802 be increased from one-sixteenth of an inch (1.5mm) to three-sixteenths of an inch (4.75mm). The Committee was told that increased tread depth would be advantageous in inclement weather conditions and was desirable from the point of view of ensuring that tyre cases were in a suitable condition for retreading.

108. The Committee recommends that retreaded tyres should not be fitted to the steering wheels of high speed or heavy service vehicles. Evidence indicates that there is a strong tendency for truck operators to use new tyres only on the steering wheels and to use retreaded tyres elsewhere. This is

---

26 P.F. Sweatman and P.N. Joubert, Tyre Safety Performance Characteristics: Review and Recommendations For Research, May 1976. (Prepared for the Department of Transport.)

essentially a commonsense approach as the casing of a tyre is always best when new.

109. Quality of retreading is a matter which has been under consideration by a number of authorities as they recognise that retreaded tyres are not as suitable, long-wearing or safe as new tyres. The Committee was told that the Standards Association of Australia had prepared a standard on retreading. It is recommended that the Advisory Committee on Vehicle Performance prepare a Draft Regulation requiring retreaded tyres in use on vehicles to meet as a minimum the Australian Standard on retreading.

110. The Committee during the course of its Inquiry encountered some differences of opinion as to the safety and economic merits of radial and cross-ply tyres for heavy vehicles and as a result has not made a definitive recommendation. Radial tyres are potentially longer wearing, have better traction, are less prone to heat build-up, and reduce vibration from the road to the driver when compared with cross-ply tyres. The higher initial cost and greater susceptibility to damage under Australian conditions however make radial tyres less attractive to heavy vehicle operators. The particular weakness of radials is that they have soft walls but with improvements in this aspect it is likely that Australian heavy vehicle owners will increasingly join the world-wide trend towards the use of radials.

111. The last aspect of tyres the Committee wishes to mention is the practice of re-grooving of tyres. This has long been outlawed on passenger vehicles, and is only practised on low speed urban bus tyres which have been manufactured with additional rubber with the specific possibility that re-grooving could be done when the original tread has been worn away. The Committee, like many of its witnesses has reservations about this technique of prolonging the life of a tyre

for while it can be safe on urban buses where speeds and loads are not excessive, the same can not be said for other uses.

Couplings for Articulated Vehicles

112. The coupling of an articulated vehicle between the prime mover and the trailer is a vital element in the safe operation of these vehicles and is one which in the Committee's opinion is worthy of more attention than it is currently receiving. Known popularly as "fifth wheel assemblies" they are not normally fitted by the prime mover manufacturer but are fitted after delivery by trailer manufacturers or operators themselves. The lack of enforced standards for these assemblies and their installation has led to widespread undesirable and unsafe practices. These practices have included insecure fitment of assemblies, inadequate ratings for loads being carried, use of inferior material in pivot pins which consequently wear quickly, and the use of certain types of assembly with no provision for roll stabilization of the trailer by the prime mover. Similarly, couplings for the less frequently used free-standing "dog" trailers in Australia are not covered by standards.

113. There are standards applicable to fifth wheel assemblies but they are not enforced. The Standards Association of Australia has recently completed a set of standards on these assemblies covering installation, approved types and test requirements.[27] The Committee therefore recommends that appropriate action is taken to provide for the enforcement of Australian Standards AS 1771-1975, AS 1772-1975, and AS 1773-1975.

---

[27] AS 1771-1975: Recommendations on Installation Practice for Fifth Wheel Couplings.

AS 1772-1975: Recommendations on Applications for Common Types of Fifth Wheel Assemblies.

AS 1773-1975: Test Requirements and Criteria for Fifth Wheel Assemblies.

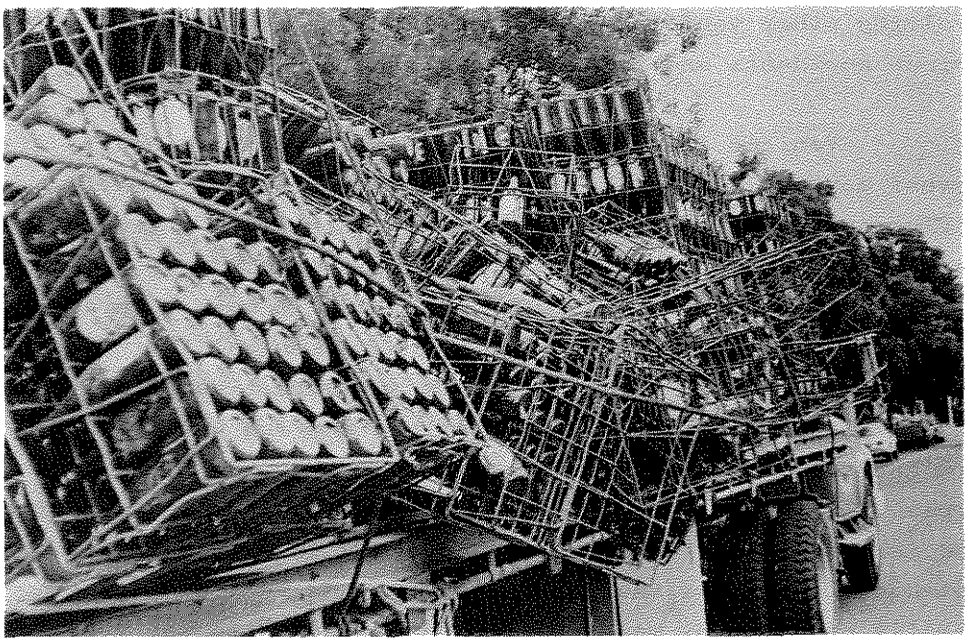
Loading

114. *The correct loading of heavy vehicles is vitally* important and has already been mentioned in this report in conjunction with several other aspects of heavy vehicle safety. Not only does the load have an effect on braking ability, tyre performance and general vehicle handling, but it can be directly responsible for accidents, particularly single vehicle accidents involving overturns of articulated vehicles. The Committee notes however that while the sight of a heavy vehicle with either its load imbalanced or unrestrained is not uncommon it did not receive evidence of accident data which indicated inadequate loading is a significant source of accidents involving other vehicles. However there is a potential for serious accidents and fatalities arising from this source.

115. Vehicle loads must be sufficiently restrained to prevent movement under the forces arising from the vehicle passing over road undulations, changing direction or when it is being braked or accelerated. It requires much more force to stop a load which has started moving, than it does to prevent the movement in the first place. It is essential that the load is restrained to prevent movement in any direction relative to the vehicle. Friction between the load and the vehicle platform can not be relied on to make a load secure. Dynamic forces will tend to exceed such frictional forces and render a load insecure. It is therefore necessary to provide additional restraint to prevent the load moving. This restraint is normally provided by means of lashings secured to the vehicle chassis or by various baulking arrangements such as headboards, bulkheads and chocks.

116. A number of authorities have been giving attention to the problem of cultivating safe loading practices. One approach to the problem has been to provide appropriate training for drivers. The National Road Transport Industry Training Committee is assisting employers in the provision of training

on correct loading practices. Several State authorities have produced and made available to drivers information on safe loading practices.



117. One of the problems in this area is that the loading of vehicles is very loosely controlled. State legislation requires only that loads must be secure. There are no standards applicable to the lashings or other methods of securing a load and until recently there have been no guidelines on correct loading techniques. Drivers have therefore had to learn by experience. While reasonable securing procedures can be developed by drivers with experience in handling the same or similar loadings the same can not be said of drivers who have to secure a wide variety of cargo. The Committee finds great value in having training programs on appropriate load securing techniques for both loaders and drivers of heavy vehicles and also for police officers who are required to determine whether a load is satisfactorily secured.

118. The Queensland Department of Transport has produced a useful booklet entitled "Recommended Code of Practice for the Safety of Loads on Road Vehicles". This booklet has been presented to ATAC for critical review in the hope that it will form the basis of a national loading code. The Committee agrees that a uniform code in this area is of national importance and considers that greater efforts should be made at the Commonwealth level to ensure the prompt development of such a code. The Committee therefore recommends that the consideration being given by the Advisory Committee on Vehicle Performance to the development of a national code of safe loading practice be expedited.

119. An area of loading practice which is most important and significant in terms of road safety, is the practice of over-loading. Evidence before the Committee and studies which have been conducted indicate that over-loading of heavy vehicles is very significant particularly on vehicles in the various multiple axle groups and that this practice extends to all States. It appears as though over-loading of vehicles is uncommon on routes which pass weighbridges operated by the

registration authorities, but is extremely common outside these routes as the economic benefits are great in relation to the penalties and the chances of detection. Many operators regard the maximum carrying capacity of their vehicles as being set by the absolute load limit of their tyres, which at very high tyre pressures may allow increased loads from 50 per cent to 100 per cent greater than the legal limit. Vehicles have been purchased with load ratings and power ratings far in excess of what is economically viable at the legal load limit and it would therefore appear that they were intended to be over-loaded.[28] By proper standards and control of these matters the range of options provided by vehicle manufacturers could also be reduced thereby effecting savings in the cost of manufacture.

120. Each heavy vehicle is designed to carry a certain maximum load. The Gross Vehicle Mass (GVM) of the vehicle is matched to the strength of the chassis, axles, suspension and tyres as well as to the vehicle's brakes, engine performance and gear ratios. Vehicle manufacturers also allow an arbitrary over-load factor based on the vehicle's operating characteristics in the various markets and on the consequences of a component failure due to over-load. Manufacturers expressed concern to the Committee however, that many of the vehicles operating below the axle load limits placed on heavy vehicles by State authorities (shown at Appendix 4) are permitted various administrative tolerances above the vehicle manufacturers' rated GVM. These tolerances apply before prosecution is carried out for over-loading offences. Vehicle manufacturers considered that the tolerance should be in the opposite direction, namely below GVM and not above it. It was claimed that if this was to be the case manufacturers could specify the maximum GVM with confidence. Load losses caused by having to load vehicles below the GVM would be recovered and the

---

[28] NAASRA Study Report T5, p. 35.

safety of the vehicle and its components maintained. The Committee therefore finds considerable merit in the suggestion by one witness that vehicle manufacturers should attach a plate to a vehicle specifying the GVM and individual axle load ratings and that it should be illegal to exceed any of these plated ratings. The overstressing of critical components due to overload could be eliminated if such a system were to operate.

121. The Committee recommends that action be taken by relevant enforcement authorities to prevent the failure of critical vehicle components by ensuring that vehicle manufacturers' recommended load ratings are not exceeded.

122. The Committee also considers that if ATAC's recommendations on NAASRA's proposed mass and dimensional limits can alleviate this problem of over-loading then there could be some reduction in the estimated 9 per cent or more of heavy vehicle accidents caused by mechanical failure.

123. Some operators are more aware of the economic advantages of good loading practice as well as its road safety benefits, and have preferred to use enclosed vans which have the advantage of ensuring a higher degree of load stability. This of course is not always possible for there are many cargoes whose nature prevents them being carried in this way. Table-top trays on articulated and rigid trucks can not be avoided for certain types of goods, but the Committee wishes to stress the need for the better containment of loads, particularly those more prone to movement during the course of a trip.

124. Load shift can be both the cause of an accident and the result of an accident and it is this second possibility that the Committee now wishes to briefly discuss. The sudden application of brakes or sudden deceleration caused by impact

can cause a load to move forward with the result that the driver himself may be imperilled. Safety features in this situation which were canvassed by the Committee were the provision of a load barrier or front bulkhead on tray-tops, platforms or vans of sufficient strength to prevent forward movement of most loads, and the greater strength of truck cabins. The Committee was told by one witness that load barriers as used overseas are effective for this purpose but a need for them had not been demonstrated in Australia. It was also stated that in certain types of collision the trailer could be as dangerous as the load to the occupant of the truck cabin. Such barriers would also impose a weight penalty on operators with a possible reduction in the maximum load a vehicle could carry. In view of these factors and the lack of sufficient accident data to justify a requirement for load barriers the Committee is unwilling to recommend in favour of these barriers. The Committee however recommends that <u>the Advisory Committee on Safety in Vehicle Design when considering the strength of truck cabins in relation to load movement problems also review the need for load barriers</u>. The Committee understands that the strength of truck cabins is on the forward work program of ACSVD.

125. Certain cargoes such as fluids present special transportation problems. Fluids are not stable when being transported, thereby impairing a vehicle's stability in cornering and making greater demands upon brakes and suspension. When the fluid is inflammable or otherwise dangerous these behavioural aspects have more serious implications with the result that the carriage of dangerous goods has received very close scrutiny from all relevant authorities. Tanker construction and safety is strictly supervised and that part of the industry engaged in transporting such cargo is very aware of the dangers involved.

126. A great deal of effort has gone into regulating the carriage of dangerous goods and the Committee has been most impressed during this Inquiry with the attention being paid to tanker safety. In 1971, ATAC through its Advisory Committee on the Transport of Dangerous Goods, drew up and adopted the "Model Code for the Transport of Dangerous Goods by Road". This Code has been accepted by industry, but all States have not yet brought their regulations into line with the Code. The States already have a great deal of this Code in force by virtue of existing regulations, but unfortunately, it is an area over which many authorities exercise some control, and not always with a high degree of compatibility. One example cited to the Committee was in relation to the construction of tankers where in order to assist with vehicle stability it is desirable to keep the centre-of-mass height in a tank as low as possible. This has not been possible however as the standards determined for measurement by the National Standards Commission require a higher tank.

127. Apart from this one example it does appear that the industries associated with the carriage of dangerous goods do co-operate very effectively, especially in safety related matters. The oil companies in particular appear to be very aware of their responsibilities and have made every effort to standardise their operations and their emergency procedures.

Vision

128. There are three main aspects of vision that the Committee wishes to discuss. These are the heavy vehicle driver's field of vision, vehicle lighting and the visibility of heavy vehicles to other road users.

129. The driver's field of vision has a major influence on operational safety of heavy vehicles. In comparison to lighter vehicles however the field of vision from heavy vehicles is inferior in several important areas. Rearward

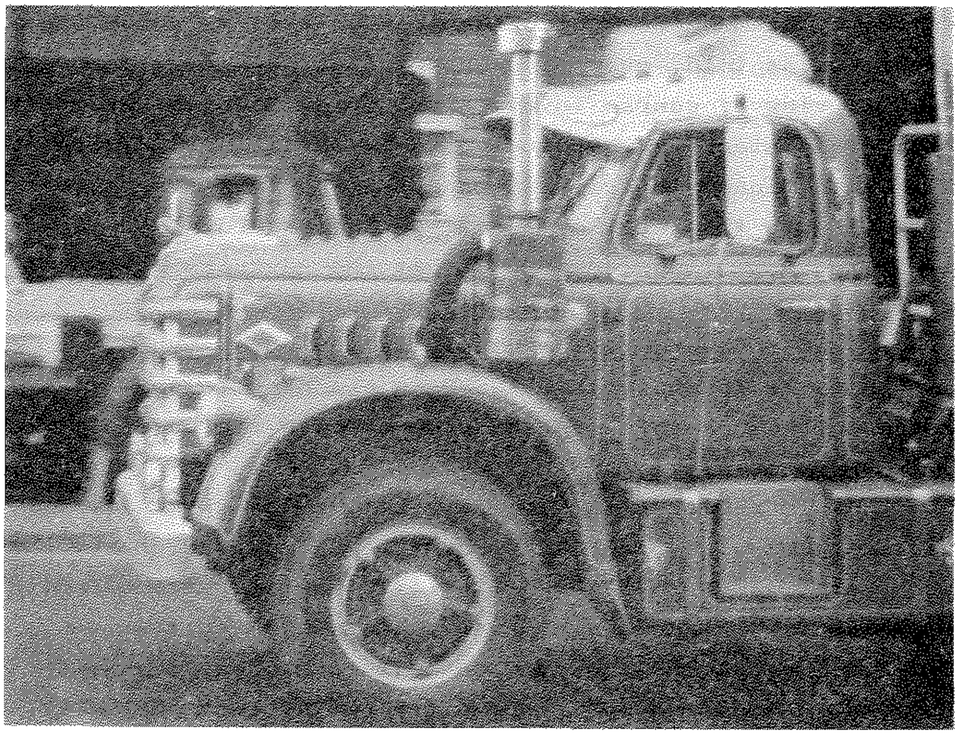
vision by the use of large mirrors, achieves only a partial field of vision and often does not allow a driver to see what is immediately behind. Vision is often poor or blind to the nearside because of the height of the bottom line of windows and additional mirrors are sometimes fitted to compensate for this deficiency.

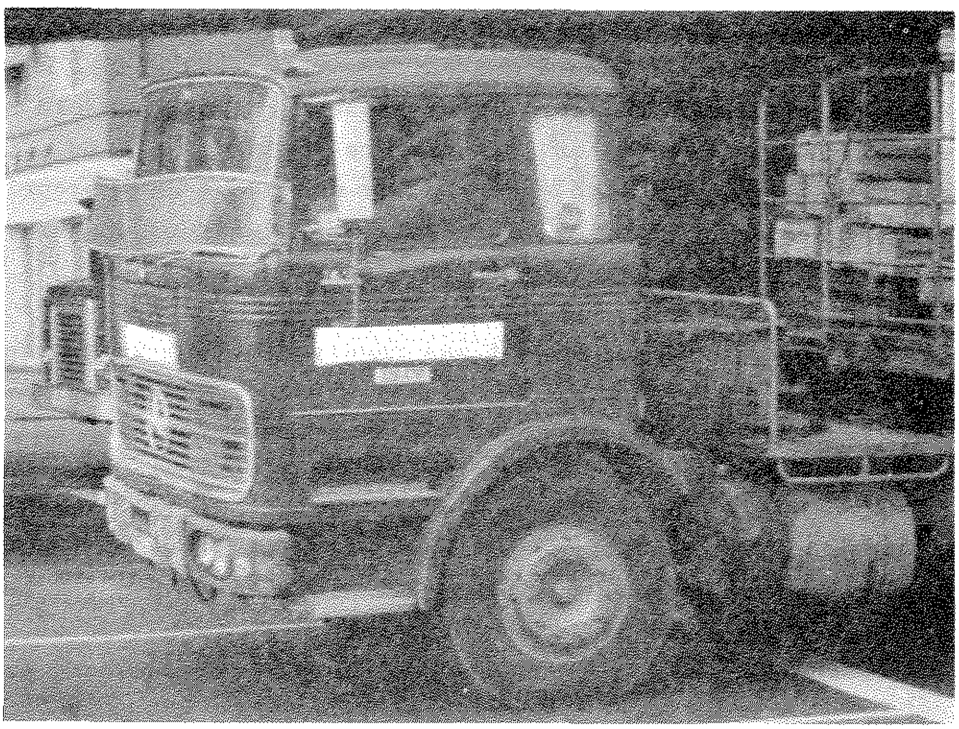
130. The use of mirrors however, creates another problem, especially the large "west coast" type which are now more commonly used. While necessary for rear and nearside vision they are large and disrupt the driver's forward vision, particularly to each side. The photographs opposite clearly show the reduction in field of vision caused by these and other attachments to the vehicles.

131. If the vehicle is of the bonnetted type, then forward vision is again restricted by the bonnet. Heavy vehicles of the cab-over-engine type have obvious advantages as far as forward vision is concerned but given this and the extra advantage provided by heavy vehicles' height above the roadway, rear vision remains unchanged. The Committee was told of experiments which have been made in Sweden involving the use of closed-circuit television to improve a driver's vision of the area immediately behind the vehicle. While effective for this purpose the cost of using this method is considerable.

132. In buses the driver's vision may be restricted for a number of reasons. He may be positioned a considerable distance from the front and side windows, the bus may have wide "A"-pillars or composite windscreens, and front door configurations can create significant blind spots.

133. The Committee considers that the principles established in consideration of forward vision standards for cars should be applicable to heavy vehicles. Economic Commission for Europe regulations based on research in the United States of America





prescribe maximum obscuration angles for pillars which, the Committee was told, are being accepted world-wide. The maximum field of view of course involves a compromise with the vehicle's structural integrity which needs to be sufficient to cope with crash situations. Bearing in mind that accidents have been attributed to the large obscurations to forward, rear and side vision the Committee recommends that the Advisory Committee on Safety in Vehicle Design prepare appropriate design rules on forward and rearward fields of vision for heavy vehicles. The Committee is aware that ACSVD is planning to investigate the need for such rules in the area of rear vision for trucks.

134. In relation to vehicle lighting the Committee was informed that clearance lights have been improved and enlarged over recent years to offer better illumination with minimum susceptibility to damage. However it appears that there is room for improvement in relation to lamp globes. Several submissions received by the Committee urged that globes be made more durable. Submissions also pointed to the need for clarification and standardisation of lighting requirements throughout Australia to provide simple and uniform rules and enable more effective policing. Uniformity of presence lighting would have a direct safety benefit in that drivers would be able to recognise a heavy vehicle more readily and adopt an appropriate response to it in traffic. The Committee therefore supports the need for standardisation in this area.

135. Considerable comment was received by the Committee on various methods to improve the visibility of heavy vehicles to other road users. One proposal was that heavy vehicles be required to operate in the daytime with their lights on, these lights being switched on automatically with ignition. Studies in the United States of America have indicated that when buses and cars had used their headlights at all times there was an 11 per cent improvement in accident rate. It is not known however whether the continuous use of headlights would be as

effective if all road vehicles were to adopt the practice. There could also be a problem for drivers in following vehicles in distinguishing when a vehicle was braking the the daylight.

136. The frequency and severity of rear-end accidents involving cars and other light vehicles crashing into the rear of heavy vehicles has led to consideration of the relative effectiveness of under-run barriers as a requirement on trucks and either improved lighting or reflective marker plates on the rear of these vehicles. It is to be hoped that two studies currently being conducted by TARU will provide much of the information on which these issues might be determined.

137. One project is investigating the de-lethalisation of truck trays and has involved a series of laboratory crash tests. This study is due to be completed in June 1977. The second project due for completion in 1978 is an in-depth study of urban and rural accidents involving heavy vehicles, covering accidents to which an ambulance has been called. Findings from these projects should contribute significantly to the knowledge available for consideration of various requirements concerning heavy vehicle design and use.

138. Evidence received indicated that there was considerable diversity of opinion on the relative merits and desirability of implementing mandatory requirements for fitment of under-run barriers and rear marker plates. A decision on whether or not under-run barriers should be used is a matter which is considered in the next Chapter under the heading of secondary safety since it presumes that an accident will occur and ignores the possibility of the primary safety approach, namely increasing visibility in order that accidents may be avoided.

139. The primary safety approach has been tried with some success in the United Kingdom. Research had indicated that drivers were failing to observe, particularly at night, the

presence of trucks in their path and that improvement in the conspicuity of the rear-ends of heavy vehicles should reduce the occurrence of head-to-tail collisions. In November 1971 heavy vehicles in the United Kingdom were compulsorily required to have rear markings of alternate oblique stripes in contrasting colours which were reflective and fluorescent. These markings were to comply with the British Standard (BSAU 152) of manufacture. A subsequent study in November 1972 compared accidents for the twelve months of the phased introduction period following the regulation to twelve months after full implementation. This study showed a reduction in accidents involving parked vehicles of 28.6 per cent and for moving vehicles 7.1 per cent. Significant reductions were recorded for parked vehicles in the following categories; dark, no street lighting (46 per cent), under street lighting (39 per cent) and daylight parked vehicles (10.2 per cent). The study also concluded following a cost benefit analysis that the measures taken had been extremely cost effective.

140. In the case of West Germany the authorities compromised following objections from operators on a regulation issued in 1975 requiring heavy vehicles and trailers to provide their own light source when parked within built-up areas during hours of darkness. Operators were allowed to use reflective warning signs (minimum size of 423 mm by 423 mm) with red warning strips (minimum 100 mm width) which could be attached only when the vehicle is parked. An evaluation of the effectiveness of this approach was not available. With regard to moving vehicles the Committee was told that Technical Committees of ECE and EEC are currently considering how the rearward image of commercial vehicles could be made more conspicuous.

141. Experience throughout the world indicates that only on a mandatory basis will even the best road safety requirements become effective. This experience was borne out in New Zealand

when in November 1970 the Ministry of Transport issued a recommended practice for safety marker plates to be used on a permissive basis. In the subsequent four years almost no vehicles were marked.

142. In 1972 Clause 410 of the Draft Regulations was approved by ATAC and provided for adoption by States of rear marking plates. This Draft Regulation is shown at Appendix 11. The Regulation was drafted on the understanding that manufacturers and operators wished to fit these markings and was not made a mandatory requirement by States. The Committee was told that sections of the transport industry had requested ACVP to have this regulation made mandatory. There has been a certain reluctance on the part of ACVP however to pursue this matter due to lack of local evidence on heavy vehicle accident involvement. The Committee however formed the view based on the United Kingdom experience, that the implementation of this desirable regulation should not be delayed.

143. The Committee recommends to the Commonwealth Government that <u>the Draft Regulation on rear marking plates be immediately adopted in the Territories and that all States be urged to similarly act on this matter</u>.

144. A number of other methods have been suggested to the Committee to reduce the threat of collision between what are often low speed heavy vehicles and high speed light vehicles. These include better highway lighting, separate lanes for slow-moving vehicles, training drivers to remain alert, and making slow-moving vehicles more conspicuous. Two methods of improving the conspicuousness of heavy vehicles which were frequently mentioned in evidence were the use of bright coloured tarpaulins on trucks and trailers and the use of warning lights when vehicles were moving slowly. The use of coloured tarpaulins would be a useful and effective safety feature. The Committee suggests that the ACVP give consideration to this proposal.

145. There were contrary points of view on the desirability of warning lights on slow-moving vehicles. Some witnesses considered that such lights on urban buses, for instance, would not be beneficial and might be confusing to other motorists. Others considered that there is merit in the proposal and point to the requirement in some States of the United States of America that slow-moving vehicles use hazard warning flashers when driving at less than specified minimum speeds. The Committee did not receive sufficient information to form an opinion on this matter.

146. Road spray in wet weather is a problem which restricts the driver's vision as well as the visibility of other vehicles by covering rear markings and lights with mud and slush. Road spray arises from two sources, that which is self-induced by a vehicle and that caused by other vehicles. Road spray caused by other vehicles usually affects the front of the following vehicle and the best solution at present appears to be a well designed windscreen and washing system. Attempts at aerodynamic solutions have so far not been successful.

147. The self-induced road spray usually affects the side and rear portion of the vehicle especially in the case of rectangular front vehicle surfaces which result in significant vacuum at the side and rear of the vehicle. Vehicle bodies constructed in aerodynamic fashion are less affected. In some cases aerodynamic means can be used as a way to reduce the effect of self-induced road spray. A totally satisfactory solution to the problem has not been found.

148. Until a satisfactory solution is found it will be necessary to ensure that the rear of all vehicles be kept clean and visible. The Committee realises there may be difficulties with this, but considers that it is really little different to the current requirement that head-lights, tail lights, and

windscreens be kept clean. Just as these items are cleaned by drivers en route, then so might the other rear markings.

149. Some manufacturers have given some consideration to the effect of this soiling, as well as to the whole problem of road spray thrown up by heavy vehicles onto other road users, thus obscuring their vision. Road authorities have also been studying various road surfaces to see whether better surfaces could be developed which reduce the amount of moisture on the road.

150. Mercedes-Benz for example, have designed their latest model of truck cab aerodynamically to provide air currents around the cab to keep windows and headlights clear. Buses are provided with deflectors at the rear to reduce dirt build-up on rear windows and lights (see Figure 3). The rear of other heavy vehicles are not as conducive to this as are the rear of buses, and there are immense problems in being able to contain road spray within the wheel arch and mudguards. The extent to which this problem can be solved seems to be very limited but the Committee believes that if the rear of heavy vehicles were better marked and illuminated then the problem would be considerably alleviated.

Driver Comfort

151. Driver error and fatigue play a significant role in heavy vehicle accidents and therefore the comfort of the driver and the ease with which he can control his vehicle are worthy of greater attention. Drivers of all physical sizes should be able to reach all controls while belted, read all the instruments in minimum time with least chance of error, and controls should be labelled and positioned for efficient operation. Heavy vehicle manufacturers are aware of these requirements and increasing attention is being paid to the driver's working environment.

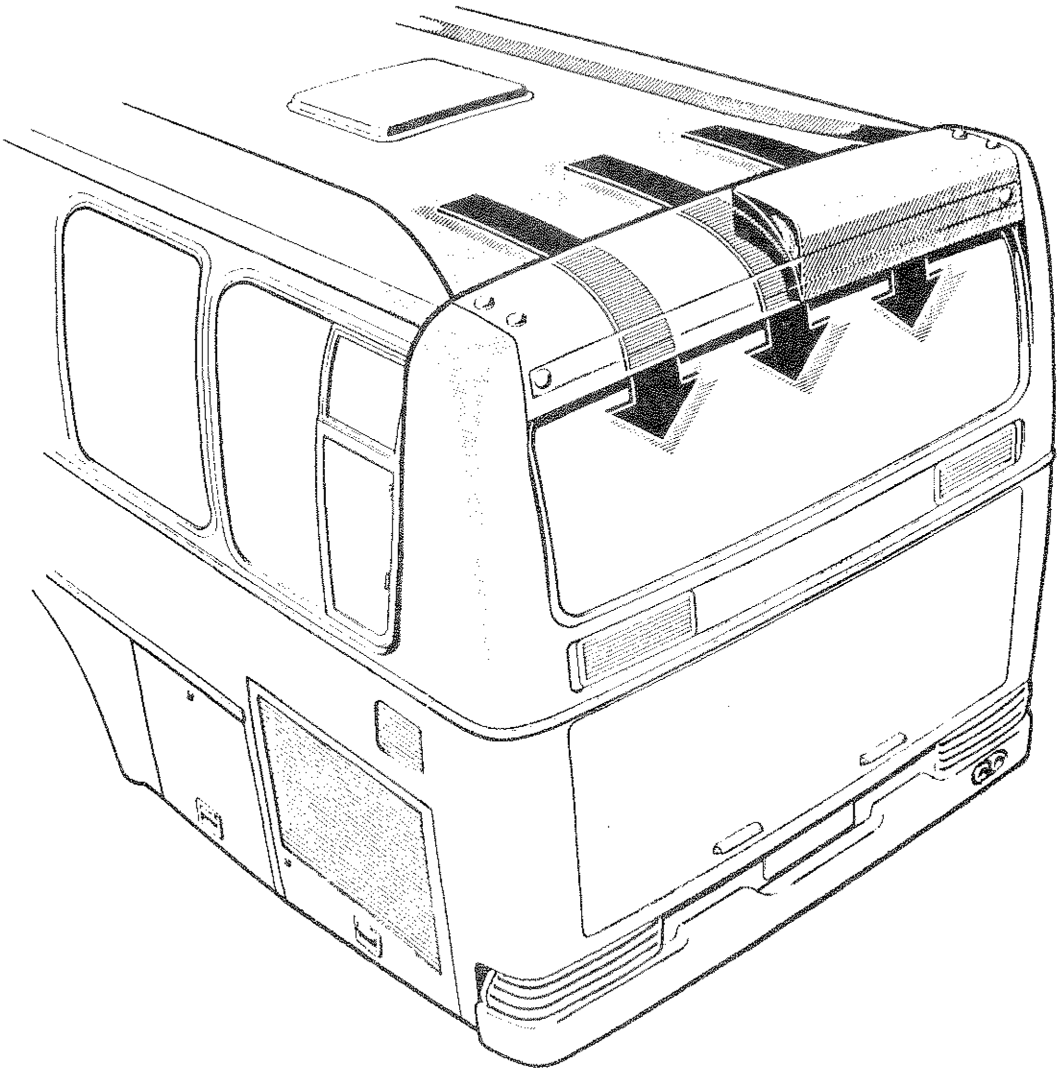


Figure 3: Air deflectors reduce the amount of dirt accumulation on the rear of a bus

152. *Seating and the position of the driver at the wheel* are also important for reasons other than driver comfort. Their arrangement must be such that a driver's view of the road is unrestricted and his leg and arm motions in steering, braking and shifting gears should also be unrestricted. The seat must be comfortable over long distances and must be able to protect the driver from vibration and movements which are peculiar to trucks. The Committee believes that manufacturers should take account of the need for driver comfort in designing seats for heavy vehicles. The seats must be fully adjustable and should be designed to suit all drivers regardless of their size.

153. Ease of control is important not only because excessive effort can induce driver fatigue, but can also seriously impede him in an emergency situation or make control difficult on unfavourable roads. The effort needed to steer, brake, and shift gears should therefore be minimised and the location of foot pedals and gear levers should be such that minimal shifting of the torso position is necessary.

154. Instrumentation before the driver should be designed in such a way that he is not distracted by it but can gain his information of vehicle performance and be adequately warned with the minimum of effort. Gauges should be placed in clearly visible positions and should be easily read. The instrumentation should also be designed without sharp edges in accordance with the same principles of passenger protection as are applied to passenger vehicles.

155. The Committee was told however that instrumentation layout and dashboard design vary widely in different makes of vehicles and that this can lead to confusion and lack of familiarity when converting between different vehicles. The Committee believes that this is a matter to which vehicle manufacturers and ACSVD should give serious attention. It is understood that a standard instrument layout has been introduced in the United States of America.

156. Associated with seating and driver comfort have been attempts by some manufacturers to reduce the amount of vibration passing from the road, through the suspension and into the cabin. Possible solutions to this problem include the use of soft springs in the suspension, the use of radial ply tyres to reduce high frequency vibrations, and the use of separate cabin springs. This latter method involves the installation of a separate suspension for the truck cabin which effectively removes the cabin from the rigid truck chassis and has the advantage of removing occupant comfort from considerations of vehicle suspension design. The Committee sees great advantages in this latter innovation which has been taken up in an ECE Regulation. *The Committee recommends that* *a design rule on the springing of cabins be introduced as soon as possible*.

157. Noise is a special problem faced by heavy vehicle drivers and is a source of fatigue which is being considered by several manufacturers. Australian Design Rule 28 already deals with the external noise levels of heavy vehicles but something also needs to be done in regulating internal noise levels. A great deal of research already exists showing the dangers of high noise levels upon workers, and the Committee firmly believes that heavy vehicle drivers should be no exception. Despite the assertion of one witness that such regulation would be premature at this stage, the Committee recommends that the Advisory Committee on Safety in Vehicle Design investigate and keep under review the level of noise to which heavy vehicle drivers are subjected and the need to specify permissible levels of internal noise in a design rule.