DEPARTMENT OF TRANSPORT

Federal Office of Road Safety

FITTING AND WEARING OF SEAT BELTS IN AUSTRALIA

The history of a successful countermeasure

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Abstract

From 1925 when road accident data for Australia were first published till 1979, over 100 000 road users were killed and 2.2 million injured. Nevertheless, motor vehicle travel is much safer today than it was fifty years ago. Although the reasons for this improvement are not fully understood, a measure which has had a major influence in recent years has been the fitting and wearing of seat belts.

The action taken by the Australian States and Territories to ensure seat belts are worn has been one of the major road safety experiments. There is little doubt that this action has been successful both in reducing occupant casualties and in giving the lead to many other countries to introduce similar legislation.

There has been a continuous demand from within Australia and overseas for information on all aspects of seat belts. Consistent with the early history of road safety in this country, however, many of the details relating to seat belt fitting and wearing are either not recorded, fragmented or difficult to locate. This paper attempts to draw together available information on the development, implementation, evaluation and refinement of this countermeasure.

Note

This report is disseminated in the interest of information exchange

The views expressed are those of the author and do not necessarily represent those of the Commonwealth Government.

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Contents

1. Early Developments

1.1 The first fifty years

The first petrol engined car was sold in Australia in 1897.[79] Although it was not until much later that registration and accident data became available on an Australia-wide basis, there were small numbers of traffic accident fatalities occurring in these early years. For example in Victoria in 1913 there were 22 deaths from traffic accidents, which represented one for every 513 registered vehicles or one for every 605 licensed drivers.[32]

Contemporaneous with the early development of the motor car, there had been recognition overseas of the need to restrain occupants. In 1903 a Frenchman had patented a sophisticated restraint system incorporating an adjustable harness and lap belt attached at the upper anchorages to the seat back. This and other early designs were apparently intended to stop occupants from falling out of vehicles during normal travel. Belts were fitted in some of the first military aircraft for the same reason.[76]

Before 1950 few motorists voluntarily fitted or wore belts, and no vehicle manufacturer in the Australian market offered belts as options or voluntarily fitted belts in vehicles at the time of manufacture. Publicity throughout the period tended to put more emphasis on accident reduction measures than on injury reduction measures such as seat belt wearing.

1.2 The beginning of vehicle safety research

In the 1940s researchers working in the field of aviation safety established the need to adequately 'package' occupants. This principle is of fundamental importance in the modern approach to protecting vehicle occupants. The Stapp Car Crash Conferences, the first in 1955, and the Annual Conferences of the American Association for Automotive Medicine, which began a year later, proved important forums for the interchange of technical information and research results. The road safety research programs at the Cornell Aeronautical Laboratory in the U.S. and the Road Research Laboratory in the U.K. also commenced at about the same time. By 1954 the danger of ejection from motor vehicles had been identified by Cornell researchers.[61] Some preliminary research data on the effectiveness of seat belts had also become available by this time. This information enabled the Special Subcommittee on Traffic Safety of the U.S. House of Representatives to conclude in 1957 in an excellent summary report that it favoured the installation and use of seat belts.[78]

In 1955 safety belts were first offered as optional equipment in some new U.S. passenger vehicles (a move which did not occur until much later in Australia). This development in conjunction with some voluntary fitting of belts in existing vehicles by the general public and by organisations meant that, for the first time, sufficient numbers of belts were in use to provide the raw data for evaluations of the effectiveness of belts in crashes.

In February 1960 a major study by the research group at Cornell was published.[83] Large samples of occupants (933 belt wearers and 8784 non-belt wearers) were compared and it was concluded that—

> users of safety belts sustained approximately 35 per cent less 'major-fatal' grade injuries than did non-users. This reduction in injury was found to be statistically significant and not due to chance fluctuations.

In Australia in May 1959 the Senate of the Commonwealth Parliament established a Select Committee to investigate 'the best means of promoting sound road safety

practices in Australia'. In the Committee's report, dated September 1960, the results of the Cornell research program were reviewed and it was recommended that:

> The motor trade should install seat belts of an approved standard in all motor vehicles. Road safety authorities should give publicity to the advantages of wearing seat belts.[73]

Whilst the Senate Committee's recommendation had little immediate effect on the practices of the vehicle manufacturers, the 1960s did see a sustained attempt to educate the public on the value of wearing seat belts. One of the key elements of these campaigns was the publicising of the value of buying and wearing seat belts approved to the Australian standard.

1.3 The development of Australian standards for seat belts

At the national level, co-ordination in matters relating to transport, including road safety, is achieved through the Australian Transport Advisory Council (ATAC) comprising the Commonwealth, State and Territory Ministers responsible for transport.

In 1947 at its first meeting, ATAC established the Australian Motor Vehicle Standards Committee (AMVSC) to define recommended national standards for the construction, equipment and performance of all road vehicles. AMVSC recommendations adopted by ATAC became the 'Draft Regulations Defining Vehicle Construction, Equipment and Performance Standards for Road Vehicles'—commonly referred to as the 'Draft Regulations'.

In the same year ATAC established the Australian Road Safety Council originally to conduct nation-wide educational campaigns but later to examine all aspects of road safety. In September 1955 the Safety Council requested the AMVSC to report on the possibilities of introducing in-built safety features into new vehicles. The AMVSC decided that there was an immediate requirement for an Australian specification for automobile seat belts and, in 1958, referred the matter to the Standards Association of Australia (SAA) for investigation.

The SAA established a drafting committee (SF/15) which was to play a key role in developing occupant restraint standards in Australia for over a decade. A wide range of scientific, industrial and governmental organisations and departments were represented on SF/15.

Australian Standard E35—1961, *Safety belts and harness assemblies for motor vehicles*, was approved on 28 April 1961. The strength requirements for complete assemblies specified in the standard were essentially the same as laid down in the 1960 British Standard for seat belt assemblies.

Local production of seat belts had commenced in the late 1950s and it was not long before reasonable quantities of belts were being produced (Table 1). Initially the SAA tested two prototypes of each seat belt model submitted by the manufacturer and published regular lists of those makes and models which had passed the tests specified in the Standard. Following complaints that it was difficult for the public to obtain access to the lists and also that production belts did not necessarily comply with the standard, the SAA in 1966 registered a unique certification mark which could only be used by manufacturers approved by the SAA. One of the conditions of obtaining a mark was that a manufacturer had to agree to SAA inspection and testing to ensure production continued to meet the requirements of E35.

The original terms of E35 did not include technical specifications for the installation of belts and harness assemblies in vehicles. A standard for anchorages was eventually produced in 1967 entitled D11—1967, *Seat belt anchorage points.* E35—1961 became the forerunner of a range of other standards which cover items such as

static belt assemblies, retractors, webbing and child restraints. Appendix 1 contains details of these and later standards.

The standards gave the public a yardstick with which to undertake purchase of belts and also served a similar function for administrators, particularly for legislative purposes. For example, a number of States introduced legislation which banned the sale of unapproved seat belts.

Table 1
Seat belt production in Australia
('000)

Year of manufacture	*Type of belt*				
	Lap	*Sash*	*Combination*	*Other*	*Total*
1963–64	61	27	234	6	328
1964–65	83	34	316	5	438
1965–66	70	12	338	7	427
1966–67	180	48	560	7	795
1967–68	259		690	14	963
1968–69	325		671	15	1 011
1969–70	263		867	n.a.	1 130
1970–71	n.a.		n.a	n.a.	n.a.
1971–72	706	n.a.	3 020		3 726
1972–73	562	n.a	2 577		3 139
1973–74	557	n.a.	2 440		2 997
1974–75	525	n.a.	2 484		3 009
1975–76	427	n a.	1 766		2 193
1976–77	459	n.a.	1 670		2 129

Source: Australian Bureau of Statistics, Manufacturing Commodities Bulletin—Principal Articles Produced Ref. No 12 26

1.4 Early Australian and overseas research on the effectiveness of wearing seat belts

Following the initial report of the research by Cornell referred to above, there were a number of subsequent studies published in the U.S.[19,30,43,53], U.K.[56,57,62] and Sweden[9,14,55] as well as a number in Australia. The Australian papers included literature reviews[11,36,54,90], anecdotal accounts of accidents[12,60] and effectiveness studies based on both small[1,37,44,49,58,70] and large[81] samples of seat belted occupants. In addition, there was a number of studies of accidents in which no belted occupants were encountered[39,65,82] or where information regarding belt wearing may have been collected but was not presented in the study report.[25]* Although these studies used a wide range of approaches, they all reached a common conclusion that the wearing of

* The Brisbane in-depth study[47] which was published in 1971 collected data on belt fitting and wearing in 1964–65, but the information was not included in the study report.[5]

seat belts either was or would be effective in reducing occupant casualties. Brief details of each study are set out in Appendix II.

Amongst these reports, there are two which were of major importance. The report by McCausland & Herbert[58] was the first in a series of at least six reports spanning the time period 1962–68, which conclusively demonstrated the value of seat belts in vehicles being operated by the Snowy Mountains Authority (SMA), often in extreme conditions of terrain and weather.

Briefly the SMA took the following steps in an exercise which was without precedent in Australia:

- investigated alternative seat belt configurations and concluded that the lap belt should not be fitted unless it was impracticable to fit a more effective type;
- developed a technical specification for the belts including a dynamic test,
- commencing in May 1960, fitted over 3000 belts (mainly diagonal) in seventy-eight different models of light and heavy vehicles, including tractors, cranes and over-snow vehicles;
- issued all drivers with a booklet setting out the reasons for installing belts and the advantages of the designs adopted;
- made the wearing of seat belts compulsory for all employees with apparently good results; for example, in the first series of twenty-one accidents, there was only one case where a belt was not worn;[58]
- carefully evaluated the effects of this action:
- widely publicised the effectiveness of the campaign;
- encouraged employees and contractors to fit belts in their own vehicles.

The other important Australian paper was an analysis of seat belt effectiveness based on police reports of nearly 40 000 casualty accidents that occurred in Victoria during 1963.[81] It was concluded that drivers wearing belts in urban accidents were 30 per cent less likely to be killed or injured. For the 7000 rural accidents, the comparable figure was 22 per cent.

For the first time, estimates of belt effectiveness using Australian data were available and the two studies provided a strong foundation for publicity and, in some States, legislative action.

1.5 Publicity campaigns and public opinion

Between 1962 and 1973 the Australian Road Safety Council distributed a monthly journal called *Report** throughout Australia and overseas. *Report* strongly lobbied for seat belt fitting and wearing and reported on many large-scale publicity campaigns. For example, a joint campaign in 1961–62 with the Life Offices' Association of Australasia involved distribution of 7 million pamphlets with premium renewal notices. Increases in sales of belts were claimed.[4] A further major campaign in September–December 1964 included distribution of 3 million posters and leaflets.[6] Again increases in sales were claimed. Numerous business companies participated in the campaigns and many fitted belts to their fleets.

Other campaigns during this period included use of seat belt messages on postmarks, advertisements on television and radio, and in the press, and extensive participation by the vehicle and seat belt manufacturing industries. Expounding the results of early Australian and overseas research was a component of many campaigns.

The publicity appears to have had most effect on changing the public's attitude to belts. A public opinion poll in late 1962 of more than 1000 persons throughout

* From August 1967, *Report* was published by the Commonwealth Department of Shipping and Transport

Australia found only 1 per cent who saw seat belts as one of the three most important road safety countermeasures.[5] Only four out of the 1057 persons interviewed felt that there should be more publicity about seat belts.

Public opinion of the safety value of seat belts changed radically during the 1960s. In March 1970 one survey conducted in New South Wales found that public acceptance of the benefits of belts was surprisingly high—75 per cent of all respondents rated belts as 'very important' or 'important' including almost two-thirds of those who never wore belts.[29]

The publicity campaigns probably also had a small positive effect on the voluntary fitting of belts but, unfortunately, appears to have had little influence on belt wearing. One study has suggested that perhaps the fundamental source of public resistance to seat belts was that many motorists did not feel sufficiently vulnerable to death or injury under normal driving conditions.[29] As the study went on to point out, this belief is not a misconception as the probability of accident involvement on a particular trip is very low. Accordingly, it is probable that continued publicity campaigns in the absence of compulsory wearing legislation would have been largely unsuccessful in raising wearing rates.

1.6 Voluntary fitting

Data on the extent to which belts were fitted voluntarily by private owners, organisations and manufacturers are sparse. The first data on Australian production of seat belts relate to 1963–64 when 328 000 belts were produced (see Table 1). This level of production was sufficient to supply a pair of belts for 7 per cent of all the cars and station wagons on the register at December 1963. At this time most belts were voluntarily fitted by owners and organisations.

During the early 1960s many large fleet owners had voluntarily fitted belts to their own vehicles. Public Service organisations which took this action included the Federal Departments of Civil Aviation, Interior, Supply, Works, Postmaster-Generals, RAAF and the Army and many State Government Departments and instrumentalities. In addition, many business companies fitted belts in their vehicles.

In 1965 in the U.S. all vehicle manufacturers were voluntarily installing at least four lap belts per vehicle, thus predating U.S. Federal requirements by two years. Prior to this date some individual States had required the fitment of seat belts e.g. Illinois—1961, Wisconsin and California—1962.[63]

In Australia the situation was somewhat different. Few of the major manufacturers fitted anchorages and belts before 1965. From 30 June 1964 the State of South Australia required anchorages to be fitted in the front outboard seating positions of all new passenger cars and derivatives.* Although anchorages could be either two or three point, the legislation eventually led to most manufacturers voluntarily fitting three point anchorages for all new vehicles sold in Australia.[93] As a consequence, the proportion of vehicles at the annual Melbourne Motor Show with anchorages (presumably in at least the front outboard seating positions) increased from about 45 per cent in 1963 to almost 100 per cent in 1966.[54] A table setting out the dates anchorages were fitted by vehicle make and model is contained in Section 22 of the Draft Regulations.[20]

From 1 June 1967 South Australia required seat belts to be installed in the front outboard seating positions of new passenger cars and their derivatives. The type of seat belt was not specified and lap belts satisfied the requirement. Unlike the anchorage requirement, the legislation did not lead to belts becoming more generally available in

* A similar requirement came into effect in Victoria on 1 October 1964.

new vehicles throughout Australia. A representative of an Australian vehicle manufacturer stated 'that the demand for seat belts was too low to justify seat belts being introduced as standard equipment and what demand there was could be satisfied by after market fitment'.[93]

Data from this period show a slow but steady increase in fitting of belts in front seats although few belts were fitted in rear seats. There is some evidence that fitting rates were lower in country areas.[45] (Details of some of the more important surveys are set out below.)

In late 1962 a questionnaire survey of over 1000 persons throughout Australia found that only 5 per cent of their passenger cars and utilities were claimed to be fitted with belts in the front seat and less than one in 300 had rear seat belts.[71] The first roadside survey was undertaken in Melbourne in May 1964 and found some 23 per cent of cars and station wagons were equipped with belts in the driver's seat.[81] In the following year 12 per cent of almost 19 000 cars surveyed throughout N.S.W. had front seat belts but less than 1 per cent had rear seat belts.[8] Also in 1965, 26 per cent of 1200 vehicles checked in Hobart were reported to have had belts but no details were available on belt type or belt location.[7] A survey in Melbourne in 1965 found 20 per cent of 14 000 passenger cars and derivatives had belts fitted for the driver and left-hand front passenger.[3] One of the reasons why the Tasmanian and Victorian data were higher than N.S.W. is that the latter included rural areas where belt fitting rates were known to be lower than in urban areas. In addition, Victoria had compulsory anchorage fitting requirements on new vehicles which may have encouraged some voluntary belt fitting.

By comparison with these surveys which were 'one-off' exercises, each October from 1964 for some years, the Road Traffic Board of South Australia undertook large-scale collection of data on fitting and wearing. Prior to the introduction of the compulsory belt fitting legislation in South Australia in 1967, the voluntary fitting rate in the driver position had reached 28 per cent of all passenger cars and derivatives in metropolitan Adelaide.[69] Trends in fitting rates in South Australia from 1964 to 1977 are set out in Table 2.

1.7 Voluntary wearing

Data on voluntary wearing rates during the 1960s are sparse. In Victoria, in 1964, 64 per cent of drivers of passenger cars and derivatives involved in casualty accidents were wearing belts where they were fitted.[81] By 1967 this figure had dropped to 50 per cent.[89] However, no contemporaneous data are available on wearing rates in general traffic in that State.

The South Australian Road Traffic Board data are set out in Table 2. From a peak in 1964, when 64 per cent of drivers wore available belts, it can be seen that during the years of compulsory fitting but voluntary wearing (i.e. 1968 to 1970), the wearing rate declined to a low of 27 per cent in 1970. Throughout this period the overall wearing rate for drivers (i.e. fitting $\times$ wearing) was increasing very slowly—10 per cent in 1964 to 16 per cent in 1970.

In Sydney wearing rates towards the end of 1970 ranged from 15–26 per cent. There were further rises in the early part of 1971 when the wearing legislation came into effect in Victoria.[33] A similar flow-on effect is reported to have occurred in South Australia.[68]

Thus, after ten years of sustained publicity and some legislated fitting requirements, the majority of vehicle occupants still did not have belts available and of those that did the majority did not wear them. The first of these problems, the non-availability of belts, was to be largely solved by the introduction of the Australian Design Rule system.

Table 2
Seat belt fitting and wearing in South Australia

	1964	*1966*	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977(a)*
Vehicles fitted—driver position	15.1	28.2	46.5	52.3	60.0	66.9	68.5	74.4	77.9	82.3	84.9	94.7
Wearing rate—drivers	64.3	45.7	36 5	28.9	27.5	37.0	81.1	77.7	72.0	70.0	90 1	90.7
Wearing rate—passengers	48 0	41.9	22.5	18.9	23.1	33.2	68.5	64.6	58.3	55.8	71.3	71.0
Wearing rate—occupants	60.2	44.8	26.2	26.0	26.3	36.0	77.8	74.1	68.1	66 0	84.3	84 5

(*a*) Survey undertaken in December 1977 All other surveys undertaken in October. Data provided to Department of Transport by S.A. Road Traffic Board
Source: Road Traffic Board of South Australia Information Sheet 2d, January 1977.[70]

2. The Australian Design Rule system

2.1 The establishment of the system

In the early 1960s it became apparent that motor vehicle safety was an increasingly complex subject extending beyond the capacity of the Australian Motor Vehicle Standards Committee. Consequently ATAC, in July 1965, established the Australian Motor Vehicle Design Advisory Panel (AMVDAP)* to make recommendations for.

> reducing road deaths and minimising the extent and severity of road accident injuries to occupants, other road users and pedestrians by the production of a safer road vehicle.

It was agreed that the recommendations of AMVDAP, when endorsed by ATAC, would become the 'Australian Design Rules for Motor Vehicle Safety' (ADRs).

The first five ADRs were approved in February 1967 and, in July of that year, ATAC considered a report from the Panel concerning alternative schemes for the implementation of the ADRs. The establishment of a central certification agency to administer a type approval system received strong support from ministers and the industry. In February 1969 ATAC agreed to the establishment of a joint Commonwealth/State body for these purposes and, at the next meeting, this body was designated the Australian Motor Vehicle Certification Board. Technical and secretariat support to the Board is provided by the Federal Office of Road Safety in the Department of Transport.

2.2 ADRs for seat belts and seat belt anchorages

One of the first priorities of the AMVDAP was to develop safety standards for seat belts (ADR 4) and anchorages (ADR 5) for passenger cars and derivatives. From the outset the Panel recognised the desirability of requiring seat belts with non-detachable upper torso restraints. This contrasted with the then U.S. approach where fitting of seat belts with detachable sash straps was common.

At the time of first implementation, ADR 4 largely reflected Australian Standard E35—1965, *Seat belt assemblies for motor vehicles*. ADR 5 referenced Australian Standard D11—*Seat belt anchorage points* and was subsequently upgraded to ADR 5A. It specified the type of seat belt to be fitted to each seating position as well as the strength and location requirements for anchorages. Both Rules came into effect on 1 January 1969.

With the implementation of ADRs 4 and 5A, there was a steady increase in the proportion of vehicles fitted with belts. In Melbourne the percentage of passenger cars and derivatives fitted with belts for drivers and left-hand front passengers rose from 50 per cent in 1969 to 76 per cent in 1971.[3] The existence of a vehicle population with such a high proportion of belts fitted was an important factor in ensuring the success of the belt wearing legislation.

As can be seen from Table 3, belt fitting rates for the driver and left-hand front passenger in cars and derivatives was well over 90 per cent by 1977. Over two-thirds of rear seating positions had belts and this figure increased as older vehicles were deregistered. The ADR system made belts available to most occupants of passenger cars and derivatives. Design, comfort, installation and performance characteristics are still kept under review. The upgrading of the initial ADRs 4 and 5A is discussed later in this paper.

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* In 1970 the Panel was reconstituted as the Advisory Committee on Safety in Vehicle Design (ACSVD) and in 1983 restructured as the Vehicle Safety Advisory Committee (VSAC). The Chairman and technical secretariat are provided by the Commonwealth Department of Transport. A more detailed discussion of the operation of the Australian Design Rule system can be found in references 2 and 92.

Table 3
Seat belt fitting rates—driver only (*a*)

Location	*Type of belt*	*Fitting rate %*	*Source reference*
Melbourne			
May 1971	Lap-sash	66	24
February 1972	,,	77	24
February 1973	,,	81	24
May 1973	,,	82	15
February 1974	,,	88	24
February 1975	,,	90	24
December 1975	,,	94	15
February 1976	,,	95	24
December 1976	,,	95	15
February 1977	,,	96	24
February 1978	,,	98	24
March 1978	,,	96	15
July 1978	,,	97	15
Rural Victorian cities			
May 1971	,,	62	24
February 1972	,,	68	24
February 1973	,,	75	24
February 1974	,,	86	24
February 1975	,,	90	24
February 1976	,,	93	24
February 1977	,,	95	24
February 1978	,,	97	24
Sydney			
June–July 1972	,,	80	26
May 1974	,,	92	15
October 1974	,,	93	26
November 1975	All	97	38
November 1976	Lap-sash	97	27
Brisbane			
May 1974	,,	82	15
Perth			
May 1974	,,	79	15
March 1978	,,	91	15
July 1978	,,	91	15
Adelaide (*b*)			
October 1971	All	67	69
October 1972	,,	69	69
May 1973	Lap-sash	80	15
October 1973	All	74	69
October 1974	,,	78	69
October 1975	,,	82	69
October 1976	,,	85	69
December 1977	,,	95	69
March 1978	Lap-sash	91	15
July 1978	,,	91	15
Hobart			
May 1973	,,	74	15

Location	*Type of belt*	*Fitting rate %*	*Source reference*
Newcastle			
May 1974 . . .	„	88	15
Wollongong			
May 1974 . . .	„	88	15
Canberra			
December 1975 . . .	„	93	15
December 1976 . . .	„	96	15
March 1978 . . .	„	97	15

(*a*) For ease of presentation, these data refer to the driver position only. Fitting rates for other seating positions are known to be lower than for the driver position. A comprehensive analysis of fitting data is contained in reference 15.

(*b*) More detailed information for Adelaide is set out in Table 2.

3. The impact of legislation

3.1 The introduction of the compulsory seat belt wearing legislation

In December 1967 the Victorian Parliament passed an Act which established a Joint Select Committee on Road Safety. The first two reports of the Committee concerned vehicle roadworthiness and points demerit systems. The third inquiry of the Committee related to 'the desirability of the compulsory fitting and the compulsory wearing of seat belts in motor vehicles'.

Professor P. N. Joubert of the University of Melbourne, at the first major hearing of the Committee, strongly advocated the compulsory wearing of seat belts. His stand was supported by the Australian Medical Association, the Victorian Police Surgeon and the Royal Automobile Club of Victoria. The Committee also had access to a wide range of the published literature on seat belt effectiveness from Australia and overseas, including the classic study of Bohlin. In addition a special study was undertaken for the Committee by the Victorian Traffic Commission which concluded that belts reduced the probability of being killed in Victorian accidents in 1967 by 36 per cent.[89]

However, not all witnesses were in favour of compulsion. In a letter to a Melbourne newspaper, the Committee chairman of that period discussed the major influences on the Committee in arriving at its recommendations. He referred to 'the almost unanimous awareness by witnesses of the value of seat belts' but went on to say that 'almost without exception. these same witnesses strongly advised against compulsion on the grounds that such legislation was unrealistic, could not be enforced or was an infringement on the liberty of citizens'.[51]

Nevertheless, on the basis of the available evidence the Committee recommended in September 1969 that 'All occupants of motor vehicles should be required to wear seat belts within a maximum period of two years'.[89] The Committee also recommended that belts be fitted in all passenger cars and derivatives and that an intensive educational campaign should be undertaken.

No immediate action followed from the tabling of the report in the Victorian Parliament. Several organisations (such as the National Safety Council and the Royal Australasian College of Surgeons), individual experts and segments of the press waged a sustained campaign urging adoption of the recommendations. Strong endorsement by these groups undoubtedly was a major factor in the creation of a favourable climate of public opinion and the encouragement of legislative initiative.

On 17 November 1970 the Victorian Chief Secretary, Sir Arthur Rylah, announced that the Victorian Government had accepted the recommendation that vehicle occupants should wear seat belts. The historic legislation came into effect on 22 December almost one year BEFORE the date recommended by the Committee.

In November 1970 the New South Wales Cabinet Standing Committee on Road Safety had requested that a detailed examination be made of the feasibility of making wearing of seat belts compulsory in N.S.W. and that a comprehensive plan for implementation of such a requirement be prepared. The report which was strongly favourable to belt wearing was published in December 1970[74], and six months later the Government announced its intention to introduce legislation (which eventually came into force on 1 October 1971).

In contrast, in South Australia in November 1970, the report of the Government Committee of Inquiry into Road Safety had stated that 'The enforcement of such a law would appear to be difficult' and instead recommended greater publicity and improved belt design.[77] An earlier Government inquiry in Tasmania had reached similar conclusions.[80]

There can be little doubt that the success of the Victorian legislation in causing a rapid increase in belt usage (with little objection from most road users), and the subsequent reductions in casualties, encouraged the other States and Territories and eventually many overseas countries to introduce similar legislation. By 1 January 1972 compulsory wearing applied throughout Australia.

A comparison of the legislation in each State in terms of general requirements, exemptions and penalties is given in Appendix III. The Appendix also sets out details of additional legislation which some States introduced to ensure belts are fitted in older vehicles. All States and Territories have introduced requirements relating to restraint of young children in motor vehicles.

3.2 The effect on wearing rates

In all States the legislation had an immediate and significant effect on wearing rates. Generally, during the first month, police were instructed to educate and caution motorists rather than prosecute for non-compliance. Even during this period, wearing rates rose substantially; for example, from 25 per cent to around 50 per cent in Melbourne.[85] At the end of this period, with the initiation of enforcement, wearing rates rose to over 75 per cent and, as Table 4 shows, have generally remained high. Wearing rates tend to be lower in rural areas than urban areas and, in addition, may also be lower in some key sub-groups such as drinking drivers.[38] Unfortunately, there is little recent data for some cities and for rural areas in most States.

3.3 The role of enforcement

There appear to have been substantial variations in the level of enforcement of seat belt wearing between States. For example, in New South Wales the offence of not wearing a seat belt constituted 6 per cent of reported traffic offences, involving nearly 35 000 occupants being fined in 1974.[42] In contrast, in South Australia enforcement by the police was minimal[23,42] and wearing rates decreased between 1972 and 1975.[69]

Table 4
Seat belt wearing rates—driver only (*a*)

Location	*Type of belt*	*Wearing rate* %	*Source reference*
Melbourne			
May 1971	Lap-sash	75	24
February 1972	,,	79	24
February 1973	,,	82	24
May 1973	,,	83	15
February 1974	,,	91	24
February 1975	,,	89	24
December 1975	,,	85	15
February 1976	,,	93	24
December 1976	,,	85	15
February 1977	,,	93	24
February 1978	,,	92	24
March 1978	,,	84	15
July 1978	,,	85	15
Rural Victorian cities			
May 1971	,,	60	24
February 1972	,,	73	24
February 1973	,,	76	24
February 1974	,,	85	24
February 1975	,,	86	24
February 1976	,,	83	24
February 1977	,,	84	24
February 1978	,,	87	24
Sydney			
August 1970	All	19	Derived from Ref. 86
April 1971	,,	30	,,
June 1971	,,	32	,,
September 1971	,,	50	,,
October 1971	,,	60	,,
November 1971	,,	76	,,
February 1972	,,	75	,,
June–July 1972	Lap-sash	86 (incl. LHF)	26
December 1972	All	89	Derived from Ref. 86
February–March 1973	,,	94	,,
November–December 1973	,,	91	,,
May 1974	Lap-sash	85	15
October 1974	,,	83 (incl. LHF)	26
November 1975	All	94	38
November 1976	Lap-sash	84 (incl. LHF)	27
Brisbane			
May 1974	,,	84	15
Adelaide (*b*)			
October 1971	All	37	69
October 1972	,,	81	69
May 1973	Lap-sash	65	15

Location	*Type of belt*	*Wearing rate %*	*Source reference*
October 1973	All	78	69
October 1974	..	72	69
October 1975	..	70	69
October 1976	.	90	69
December 1977	..	91	69
March 1978	Lap-sash	84	15
July 1978	..	82	15
Perth			
May 1974	..	86	15
March 1978	..	87	15
July 1978	..	87	15
Hobart			
May 1973	..	69	15
Newcastle			
May 1974	..	84	15
Wollongong			
May 1974	..	81	15
Canberra			
December 1975	..	83	15
December 1976	..	84	15
March 1978	..	83	15

(*a*) For ease of presentation, these data refer to the driver only. Driver wearing rates are known to be higher than those of other occupants. A comprehensive analysis of wearing data is contained in reference 15

(*b*) More detailed information for Adelaide is set out in Table 2

Following an intensive enforcement program over a twelve-week period in mid-1976 in which over 6000 drivers were reported for failing to wear seat belts[13], wearing rates increased markedly[69] and have remained high.[15]

In October 1976 in Western Australia the penalty for non-compliance was reduced from $20 to $10. This change was made because police were apparently reluctant to impose the statutory $20 fine for what they considered to be a comparatively minor offence. An analysis of the effect of lowering the penalty has shown that in Perth the lowering of the penalty did lead to the issuing of more infringement notices rather than cautions.[75]

Enforcement has an important role in maintaining belt wearing rates but the nature of the relationship is little understood. Although the data from South Australia are interesting, there is still a need for a well-designed examination of the effects of enforcement on seat belt wearing.

3.4 The effect on occupant casualties

There is now an extensive Australian literature on the effectiveness of seat belt wearing. In the years immediately after the compulsory wearing legislation was introduced, studies were largely based on analyses of mass accident data usually on a State-wide basis, for example Victoria[3,22,28,52,67,85,91], New South Wales[34,87] and

South Australia.[23] These studies used a range of techniques and most attempted to isolate the effect of seat belts from other factors which may have been important. The reduction in occupant fatalities from expected trends was in the order of 15–20 per cent.[33]

The number of traffic accident fatalities in Australia was contained below the record level of 3798 in 1970, in each of the seven succeeding years, despite increases of over 1.5 million in population and 2 million in motor vehicles. Over the same period, consumption of motor spirit increased by 67 per cent and the number of licences on issue by over 30 per cent (see Table 5). Over the years 1971 to 1977, some 4200 more people would have been killed had the trend from 1960 to 1970 continued.

Table 5
Trends in traffic accident fatalities and other key indicators

	Traffic accident fatalities (a)	*Population as at 30 June (a) ('000)*	*Registered vehicles as at 30 June (a) ('000)*	*Consumption of motor spirit ('000) kilometres (b)*	*Drivers and riders licensed as at 30 June (a) ('000)*
1970 . .	3 798	12 507	4 772	8 476	4 777(c)
1977 . .	3 580	14 074	6 821	14 211	6 421(c)
% change.	–5.7	12.5	42.9	67 7	34.4

(a) **Source:** Australian Bureau of Statistics
(b) **Source:** Department of National Development
(c) Excluding Queensland

A study concluded that in New South Wales the age group from 8–29 years obtained most benefit from the seat belt wearing legislation.[86] Fatalities amongst the older age group, although lower than the trend, were not significantly less. This study also made an assessment of the effect on fatalities in both urban and rural areas. Although significant reductions were found in some time periods, seat belts did not appear to have a consistently greater effect in urban or rural areas. The lack of satisfactory exposure data limited this section of the analysis.

An investigation of occupant casualties by age and sex for Australia found that males have obtained a greater benefit than females, with the age group 17–29 having the greatest percentage reduction. The lower benefits for occupants over 50 years of age could be due to the lower wearing rates in this age group.[16]

There have been many other investigations into the effectiveness of seat belts in Australia. Reductions in the severity of head injury[48,66,84], spinal injury[17], pelvic injury[87] and many other types of injury[16,64] have been reported. Further information became available when an in-depth study in Adelaide was completed.[94]

4. Improvements to seat belt design and availability*

4.1 The need for improvements

Legislation in all States contains an obligation that the belt be properly adjusted and securely fastened. As soon as large numbers of occupants began to wear belts for the first time, it became evident that many people could not or would not adjust their belts properly. As a result the full potential of the seat belt in reducing injury was not being realised. Complaints by users about discomfort, difficulties in use and even hazardous arrangements of some belts were made to motorists' associations, governments and manufacturers. In fact a number of cases were reported where incorrectly worn or unsatisfactory belts had apparently contributed to certain types of injury.[35,38,41,72,84]

This information resulted in a sustained effort to improve the design and installation of seat belts. The implementation dates of the initial and amended Rules are set out in Table 6.

4.2 Development of ADR 5B—seat belt anchorages

ADR 5A specified requirements for the strength and location of anchorage points but gave little consideration to the comfort of the wearer. In fact a vehicle could be built to comply with the ADR whilst being unacceptable for comfort reasons for a large part of the driving population.

On the basis of an Australian[40] and United Kingdom[31] study, stricter location requirements for the upper anchorage points were specified in ADR 5B. The Rule came into effect for passenger cars manufactured on and after 1 January 1975 with the intention that the sash portion of the belt would be prevented from passing across the neck or slipping off the shoulder of most occupants. As the permissible area for the upper anchorage point in some vehicles would have coincided with structurally weak areas such as window glass, the unique concept of a breakaway sash guide was introduced into the Rule. A further new requirement specified a more restrictive angle of the lap portion of the belt in an attempt to reduce the possibility of the belted occupant 'submarining' under the lap portion of the belt.

4.3 Development of ADR 4A—seat belts

Two studies[3,72] conducted in Victoria during 1971 found that seat belts were not being worn correctly; in particular, the buckle of lap-sash belts was being worn too near the centreline of the body and belts were being worn loosely.

Two approaches were taken to tackle this problem. A publicity campaign demonstrating correct wearing techniques was undertaken in all States. In co-operation with the Publicity Advisory Committee on Education in Road Safety†, the Commonwealth Department of Transport then undertook a series of studies to assess the effectiveness of this publicity program. Statistically significant, though relatively small, improvements were found in the numbers of vehicle occupants wearing their

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* A more comprehensive discussion of the upgrading of the seat belt ADRs is contained in references 10 and 59.

† The Publicity Advisory Committee on Education in Road Safety (PACERS) advised ATAC on publicity and education in road safety. In 1984 PACERS was restructured as the Advisory Committee on Promotion and Education for Road Safety (ACPERS).

Table 6
Application of Design Rules by vehicle category and date

ADR No.		Passenger cars				Omnibuses			
		Forward control passenger vehicles up to 8 seats (a) 9 seats (b)	*Other passenger cars (includes station wagons)*	*Pasenger car derivatives (includes panel vans, utilities)*	*Multi-purpose passenger cars*	*Up to 3.5 tonnes GVM up to 12 seats (c) over 12 seats (d)*	*3.5 tonnes GVM and over*	*Other vehicles up to 4.5 tonnes GVW*	*Other vehicles exceeding 4.5 tonnes GVW*
4	Seat belts—								
	Front seats	..	Jan. 1969	Jan. 1969	Jan. 1970	.	..	Jan. 1970	..
	Rear seats	..	Jan. 1971	Jan. 1971	Jan. 1971	.	..	Jan. 1971	..
4A	Seat belts	..	Jan. 1974	Jan. 1974	Jan. 1974	..	..	July 1974	..
4B	Seat belts	..	Jan. 1975	Jan. 1975	Jan. 1975	..	.	July 1975	..
4C	Seat belts	Jan. 1985 (a) Jan. 1985 (b)	Jan. 1976	Jan. 1976	Jan. 1976	*July 1983 (c) *July 1983 (d)	.. ..	July 1976	..
4D	Seat belts	Jan. 1986 (a) Jan. 1986 (b)	Jan. 1984	..	..	Jan. 1987 (c) .. (d)	.. ..	..	..
5A	Seat belt anchorage points—								
	Front seats	..	Jan. 1969	Jan. 1969	Jan 1971	..	..	Jan. 1971	..
	Rear seats	..	Jan. 1971	Jan. 1971	Jan 1971	..	..	Jan. 1971	..
5B	Seat belt anchorages	Jan. 1985 (a) *Jan. 1985 (b)	Jan. 1975	Jan. 1975	Jan. 1975	*July 1983 (c) *July 1983 (d)	.. ..	July 1975	..
32	Seat belts for heavy vehicles	..	..	..	..	..	..	..	July 1977
32A	Seat belts for heavy vehicles	..	..	..	..	..	..	..	July 1980
34	Child restraint anchorages	..	‡ July 1976	..	.	..	..	..	..
34A	Child restraint anchorages	†Jan. 1986 (a) †Jan. 1986 (b)	‡ Jan. 1985	..	..	†Jan. 1987 (c) .. (d)	. ..	..	..

*Front seats only (including the driver's seating position).
†Applicable to three rear seating positions only
‡Except those equipped with hinged or folding rear seats.

seat belts more tightly and with the buckle at the side of the hip. Full details of this study are contained in reference 50.

It was also decided, as a longer term solution, to modify the Rule to require that the buckle remain at the side of the body for all adult wearers and for all positions of adjustment. At the same time, the Rule was amended to require a dynamic test.

4.4 Development of ADRs 4B, 4C and 4D—seat belts

When endorsing ADR 4A at its meeting in February 1973, ATAC requested ACSVD to make further improvements to the comfort and ease of use of belts.

An upgraded Rule, ADR 4B, was drafted which contained a number of new requirements:

- retractor belts for the driver and outboard front passenger
- facilitation of one-handed buckle fastening in front bucket seats
- prevention of buckles slipping down between the seat cushion and back of bench seats
- provision of a stowage point for the lap-sash section of non-retracting belts in the rear to help overcome the problem of occupants tripping over slack belts whilst leaving the vehicle
- all adjusters more easily reached by an occupant when seated, and belt tightening to be a one-handed operation
- belts capable of being adjusted to suit a wider range of occupant sizes
- improvements of the resistance of buckles to wear and crushing, of plastic parts to heat and of webbing to abrasion

It was considered that emergency locking retractors should have two independent sensing devices for locking, one actuated by deceleration of the vehicle and the other by rate of reel-out of the strap. This not only provides a 'back-up' safety feature, but also allows the user to assure himself, by a simple jerk of the strap, that at least the strap sensitive mode is operating.

In July 1973 ATAC endorsed ADR 4B with the requirement for one mode of locking of retractors, for application to all passenger cars and derivatives from 1 January 1975. The requirement for dual sensing of locking was incorporated in ADR 4C which was also endorsed by ATAC in July 1973 for application to the above vehicles one year later than for ADR 4B.

Further amendments to ADRs 4B and 4C and ADR 4D were introduced. They included requirements to:

- ensure that a seat belt assembly incorporating a retractor can withstand crash loads even when the strap is fully extended and the locking mechanism is not engaged
- prohibit non-locking retractors from being used in any assembly because these could result in dangerous belt slack
- ensure that adequate instructions concerning the use of retractors are supplied with every vehicle

  (With the increasing usage of plastics in seat belts, an upgraded test was incorporated in ADR 4C to simulate temperature variations to which belts are exposed in service.)
- allow the fitting of automatic length adjusting and locking retractor seat belts to outboard non-driver seats
- provide outboard seating positions in both front and rear seats with emergency locking retractor seat belts

4.5 ADR 32 and 32A—Seat belts for heavy vehicles

In July 1977 ADR 32 came into force. This Rule requires that seat belts be provided for the drivers and outer front seat passengers of new trucks. In view of the difficulty of providing suitable upper torso restraint for truck drivers, the Rule permits the fitting of lap belts. The lap belt is intended primarily to assist the driver to remain in his seat so as to retain control of the vehicle in an emergency. It also provides protection against ejection in an accident situation. The belts must meet either the Australian, ECE or U.S. standards for car seat belts, but the strength requirements for the anchorages are lower, because in most impacts the crash decelerations of heavy vehicles are considered to be lower than those of cars.

In July 1980 ADR 32A disallowed the use of non-locking retractors when fitting seat belts as defined in the ECE or U.S. standards.

4.6 Further requirements

Motor vehicle standards throughout the world have traditionally been based on the premise that the vehicle occupant will be unrestrained. However, car occupants generally were restrained in Australia and this led to calls for review of the existing body of ADRs to determine what further improvements to the safety of belted occupants were required. Two key areas requiring attention were reduction of head impacts[35] and compartment intrusion.[38] An in-depth study conducted in Adelaide[94] provided an important data source in this regard for the Design Rule program. The need for further research was also highlighted at two major conferences on occupant restraint held in Melbourne—the Seat Belt Seminar in 1976[21] and the International Conference of the International Association for Accident and Traffic Medicine in 1977.[46]

The importance of international uniformity of vehicle standards is widely accepted and there are limitations on the extent to which Australia can adopt unique standards requiring major changes to vehicle design.[92] Nevertheless, in the past, some unique requirements have been specified for seat belts in Australia and, with the support of various European countries having compulsory wearing legislation, the long-term aim should be to amend both Australian and overseas standards to reflect the changing requirements for the protection of vehicle occupants.

It should not be forgotten that there are limits to the protective capacity of seat belts. An Australian study of fatally injured seat belt wearers concluded that 60 per cent of the crashes investigated involved forces that are not likely to be survived in popular cars of current design. This implies that attention has to be given to creating a safer operating environment and to developing effective means of behaviour modification.[88]

5. Conclusions

The fitting and wearing of seat belts has had a major influence on the safety of vehicle occupants in Australia. The Design Rule program ensures that belts are fitted in all new vehicles (except buses). The success of the Victorian compulsory wearing legislation has been a key factor in the adoption of similar legislation throughout Australia and in many overseas countries. It is estimated that between 1971 and 1977 some 4200 more people would have been killed had the trend in road fatalities from

1960 to 1970 continued. It may well be that the success of the legislation has saved the Australian vehicle owner the expense and inconvenience of seat belt interlock systems and has also greatly reduced the need for airbags.[2]

Nevertheless, much remains to be done. Occupant protection must be further improved both through refinement of the belt system and through redesign of the vehicle. Other areas requiring research include the effect of usage on belt performance, the effect of enforcement on belt wearing, the future role of publicity programs and improved protection for the younger car occupants. (See Table 6 and Appendixes for developments.)

The seat belt wearing legislation in Australia is undoubtedly one of the classic experiments in road safety. Key factors in its success were the existence of significant numbers of suitable belts in cars, a favourable community attitude and the willingness of legislators to take the decision to implement the legislation in spite of predictions from some quarters that widespread public opposition would result.

It is important that the benefits flowing from the legislation be maintained and that design requirements be upgraded to keep pace with technological developments, research findings and changing requirements for occupant protection. It is crucial that belt wearing rates and belt performance in crashes remain under continuous review. It may well be that greater pay-offs may result from improving the performance of seat belts than is potentially available from many of the other countermeasures in use or under consideration.

References

1. Adams, A. I., 'Death and injury on country roads: A study of 816 persons involved in rural traffic accidents', *MJA*, October 1967.
2. Advisory Committee on Safety in Vehicle Design, Submission to the House of Representatives Standing Committee on Road Safety, January 1975.
3. Andreassend, D. C., 'The effects of compulsory seat belt wearing legislation in Victoria', paper presented to the National Road Safety Symposium, Canberra, 14–16 March 1972.
4. Australian Road Safety Council, *Report* No. 1, April 1962.
5. Australian Road Safety Council, *Report* No. 13, April 1963.
6. Australian Road Safety Council, *Report* No. 33, December 1964.
7. Australian Road Safety Council, *Report* No. 44, October 1965.
8. Australian Road Safety Council, *Report* No. 46, December 1965.
9. Backstrom, C G., 'Traffic injuries in South Sweden, with special reference to Medico-legal autopsies of car occupants and value of safety belts', *Acta Chirurgica Scandinavica Supplementum* 308, 1963.
10. Bell, J L , 'Seat belts and anchorages—Australian Design Rules', paper presented to the Sixth International Conference of the International Association for Accident and Traffic Medicine, Melbourne, 31 January–4 February 1977
11. Birrell, J. H. W., 'The use of lap safety belts in motor cars: A review', *MJA*, vol. 1, no. 14, April 1961
12. Birrell, J. H. W., 'Safety belts for motor vehicles in Victoria: The present position', *MJA*, vol. 1, no. 3, January 1964.
13. Bishop, R , Information supplied by the Road Traffic Board to the Commonwealth Department of Transport, October 1976.
14. Bohlin, N. I., 'A statistical analysis of 28 000 accident cases with emphasis on occupant restraint value', *Conference Proceedings, Eleventh Stapp Car Crash Conference*, 1967.
15. Boughton, C., Cameron, M. H. & Milne, P. W., Compulsory seat belt wearing in Australia: Characteristics of wearers and non-wearers, Commonwealth Department of Transport, January 1980.
16. Boughton, C. J & Milne, P. W , 'Occupant restraint in motor vehicles in Australia', paper presented at the 1978 International Meeting of the American Association of Automotive Medicine and the Seventh International Conference of the International Association for Accident and Traffic Medicine, Ann Arbor, Michigan, July 1978.
17. Burke, D. C., 'Spinal cord injuries and seat belts', *Medical Journal of Australia* 2, 1973, pp 801–6.
18. Cameron, M. H. & Nelson, P. G., 'Injury patterns with and without seat belts', paper presented to the Sixth International Conference of the International Association for Accident and Traffic Medicine, Melbourne, 31 January–4 February 1977.
19. Campbell, B. J. & Kihlberg, J K., 'Seat belt effectiveness in the non-ejection situation', *Conference Proceedings, Seventh Stapp Car Crash Conference*, 1965.
20. Commonwealth Department of Transport, Draft Regulations defining vehicle construction, equipment and performance standards for road vehicles.
21. Commonwealth Department of Transport, *Proceedings of the Seat Belt Seminar*, Melbourne, 9–11 March 1976.
22. Cowley, J. E. & Raymond, A. E., 'Some aspects of the influence of legislation on road safety', paper presented to SAE—Australasian National Convention, September 1972.
23. Crimmon, J. D., Foldvary, L A. & Lane, J. C , 'The effects on casualties of a compulsory seat belt wearing law in South Australia', *Accident Analysis and Prevention*, vol. 7, no 2. June 1975, pp. 81–9.
24. Davey, W. T., Information supplied to the Commonwealth Department of Transport by the Road Safety and Traffic Authority, Victoria, June 1978.
25. Duncan, C., Ten years experience of fatal motor vehicle accidents in southern Tasmania, Report to the Tasmanian Minister for Health, August 1964.
26. Fleming, D M., NRMA survey—availability, wearing and adjustment of seat belts, National Roads and Motorists Association, 1974.

27. Fleming, D. M., NRMA survey—availability, wearing and adjustment of seat belts. National Roads and Motorists' Association, 1976
28. Foldvary, L. A. & Lane, J. C., 'The effectiveness of compulsory wearing of seat belts in casualty reduction' *Accident Analysis and Prevention*, vol. 6, no. 1, September 1974, pp 59–81
29. Freedman, K., Champion, P. & Henderson, J. M., *Seat belts: A survey of usage and attitudes*, Traffic Accident Research Unit Report, 2/71, 1971
30. Garrett, J. W. & Braunstein, M. D. The seat belt syndrome', *Journal of Trauma*, vol. 2, no. 3, May 1962
31. Gosling, A. A., The position of upper anchorage points for car safety belts. Ministry of Transport Road Research Laboratory Technical Note TN 498, May 1970.
32. Government Statist, *Victorian Year Book*, 1913–14, no. 34. Melbourne, 1914.
33. Henderson, J. M., 'Some aspects of compulsory seat belt wearing in New South Wales, Australia' paper presented to the Fifth International Conference of the International Association for Accident and Traffic Medicine, London, September 1975.
34. Henderson, J. M. & Wood, R., *Compulsory wearing of seat belts in N.S.W., Australia*, Traffic Accident Research Unit, Report 4/73, 1973.
35. Henderson, J. M. & Wyllie, J. M., 'Seat belts—limits of protection. A study of fatal injuries among belt wearers', paper presented to Seventeenth Stapp Car Crash Conference, 1973
36. Herbert, D. C., 'Safety belts in motor vehicles', *MJA*, May 1962.
37. Herbert, D. C., 'Injury reduction by diagonal and other vehicle safety belts' *MJA*, vol. 1, no. 3, January 1964
38. Herbert, D. C., Vazey, B. A. & Henderson, J. M. 'Seat belt crash performance in Australia', paper presented to the Seat Belt Seminar, Melbourne, 9–11 March 1976.
39. Hodge, P. R., 'Fatal traffic accidents in Adelaide' *MJA*, March 1962.
40. Hoffmann, E. R. & Mak, K. T. Location of upper anchorage points for lap-sash seat belts. Report prepared for the Commonwealth Department of Transport, May 1972.
41. Holt, B. W., 'Occupant injury from seat belt use', paper presented to the Road Trauma Section of the 48th General Scientific Meeting of the Royal Australasian College of Surgeons, New Zealand, 15-22 August 1975
42. House of Representatives Standing Committee on Road Safety, *Report on passenger motor vehicle safety*, Canberra, May 1976.
43. Huelke, D. F. & Gikas, P. W., 'Determination of seat belt effectiveness for survival in highway collisions', *Conference Proceedings, Seventh Stapp Car Crash Conference*, 1965
44. Hueston, J. T., Cook, R. M. & Langford, A., 'Face fractures in motor accidents', *MJA*, June 1964.
45. Interchange Relations Pty Ltd. Consumers' attitudes towards safety belts in passenger cars, October 1965
46. International Association for Accident and Traffic Medicine *Proceedings of the Sixth International Conference*, Melbourne, 31 January–4 February 1977
47. Jamieson, K. G., Duggan, A. W., Tweddell, J., Pope, L. I. & Zvirbulis, V. E. *Traffic crashes in Brisbane*, Australian Road Research Board, Special Report No. 2, 1971.
48. Jamieson, K. G. & Kelly, D. Traffic injuries in Brisbane hospitals over one decade. Report prepared for the Queensland Department of Transport, December 1973.
49. Jamieson, K. G. & Tait, A. I., *Traffic injury in Brisbane*, National Health and Medical Research Council Special Report Series No. 13, Canberra, 1966.
50. Johnston, I. R. & Cameron, M. H., The effectiveness of television publicity in modifying seat belt wearing behaviour, Commonwealth Department of Transport April 1979
51. Jona, W., Letter to the Melbourne *Herald*, 15 January 1975.
52. Joubert, P. N., 'Compulsory wearing of seat belts', paper presented to FISITA Conference, London, 1972
53. Kihlberg, J. K. & Robinson, S. J., *Seat belt use and injury patterns in automobile accidents* CAL Report No. VJ-1823-R30, Cornell Aeronautical Laboratory, December 1967
54. Lane, J. C., *Vehicle design to minimise injuries*, Paper No. 14, Australian Study Week on Road Safety Practices, Melbourne, June 1967
55. Lindgren, S. & Warg, E., 'Seat belts and accident prevention' *The Practitioner*, vol. 188, April 1962.
56. Lister, R. D. & Milsom, B. M., 'Car seat belts', *The Practitioner*, vol. 191, September 1963

57. Lister, R. D. & Nielson, I. D., *The effectiveness of safety belts*, R.R.L. Report No. 16, 1966.
58. McCausland, I. & Herbert, D C . 'Road safety on the Snowy', *Australian Road Research*, December 1962.
59. McKenzie, J. A. & Milne. P. W., 'Seat belt fitting and wearing in Australia', paper presented to the Seat Belt Seminar, Melbourne, 9–11 March 1976.
60 McLean, A. J., 'Death on the roads. The influence of vehicle design'. *MJA*, vol. II, no 4, July 1966.
61. Moore, J O. & Tourin, B., A study of automobile doors opening under crash conditions. Automotive Crash Injury Research, Cornell University Medical College, August 1954.
62. Moreland. J D.. 'Safety belts in motor cars—an assessment of their effectiveness', *Ann. Occup Hyg.*, vol. 5. 1962.
63. National Highway Traffic Safety Administration, U.S A., 'Laws requiring seat belts'. *Traffic Laws Commentary*, vol. 1, no. 6, 1972.
64. Nelson, P. G . Pattern of injury survey of automobile accidents—Victoria, Royal Australasian College of Surgeons, Road Trauma Committee, Melbourne 1974.
65. O'Brien, B., 'Facial disfigurement—a plea for safety belts', *MJA*, vol. II. no. 17, October 1965.
66. Petty, P. G., 'The influence of seat belt wearing on the incidence of head injury', *Medical Journal of Australia*, vol. 2, no. 20, 1975, pp. 768–9.
67. Pratt, W. N. B., Richardson, D. F. & Yeoh, B M., 'The effectiveness of seat belts', *Medical Journal of Australia*, vol. 2, 1973, pp. 1109–12.
68. Road Traffic Board of South Australia, A review of seat belt usage in South Australia, 1964–71. 1972.
69. Road Traffic Board of South Australia Seat Belt Surveys, Information Sheet No. 2d, January 1977
70. Robertson, J. S., McLean, A. J. & Ryan, G. A , *Traffic accidents in Adelaide, South Australia*, Australian Road Research Board, Special Report No. 1, July 1966.
71. Roy Morgan Research Centre Pty Ltd, Survey on road safety publicity, Report to the Australian Road Safety Council, 1962.
72. Ryan, G. A. & Baldwin, R. J., In-depth study of seat belted accidents. Report prepared for the Commonwealth Department of Transport. 1972.
73. Senate Select Committee on Road Safety. *Report from the Select Committee appointed to inquire into and report upon road safety*, Canberra, September 1960.
74. Skinner, N , Henderson. J. M & Herbert, D. C., *Compulsory wearing of seat belts—a feasibility study*, Traffic Accident Research Unit Report 6/70, 1970.
75. Smith, D. I., Effect of lowering penalty for non-wearing of seat belts on issuing of cautions and infringement notices, Road Traffic Authority, Western Australia, Report No. 9, November 1977.
76. Snyder. R. G., 'A survey of automotive occupant restraint systems: Where we've been, where we are and our current problems', *Proceedings of the International Automotive Engineering Congress*, Detroit, January 1969.
77 South Australian Government Committee of Inquiry into Road Safety, Report on Road Safety, November 1970
78. Special Sub committee on Traffic Safety of the Committee on Interstate and Foreign Commerce, U.S. House of Representatives, Report on Automobile Seat Belts, Washington. D.C., August 1957.
79 Stubbs, P.. *The Australian motor industry*, Cheshire. Melbourne, 1972.
80. Tasmanian Government Committee on Road Safety and Traffic Accidents, Report dated February 1966.
81. Thorpe, J. D., 'The use and effect of car seat belts in Victoria', *Australian Road Research*, June 1964
82. Tonge. J. I., O'Reilly, M. J. J., Davison, A. & Derrick, E. H., 'Fatal traffic accidents in Brisbane from 1935 to 1964', *MJA*, November 1964.
83. Tourin, B & Garrett, J. W., Safety belt effectiveness in rural California automobile accidents. Automotive Crash Injury Research of Cornell University. February 1960.
84 Trinca, G. W. & Dooley, B. J., 'The effects of mandatory seat belt wearing on the mortality and pattern of injury of car occupants involved in motor vehicle crashes in Victoria', *Medical Journal of Australia*, vol. 1, no. 22, 1975, pp. 675–8.

85. Ungers, R., 'The introduction of compulsory seat belt wearing laws in Australia and their effect', paper presented to the Traffic Safety Conference, Ottawa, 23–24 May 1974.
86 Vaughan, R G , 'Seat belts—some aspects of compulsory wearing in N S.W., Australia', *Proceedings Institution of Mechanical Engineers*, vol. 191, 3/77, 1977, pp. 31–8.
87. Vaughan, R. G., Wood, R. & Croft, P. G., 'Some aspects of compulsory seat belt wearing', *Proceedings 7th Conference of the Australian Road Research Board*, Adelaide, 1974.
88. Vazey, B. A. & Holt, B. W., *In-depth analysis of fatalities to wearers of seat belts*, Traffic Accident Research Unit Report No 2/76, July 1976.
89. Victorian Joint Select Committee on Road Safety, Report upon an investigation into the desirability of the compulsory fitting and the compulsory wearing of seat belts, 1969.
90. Vulcan, A P., 'Review of the relative merits of various types of motor vehicle seat belts', *Australian Road Research*, June 1966.
91 Vulcan, A. P., Ungers, R. & Milne, P. W., 'Australian approach to motor vehicle safety standards', paper presented to the Fourth International Congress on Automotive Safety, San Francisco, July 1975.
92. Yeend, F E , The Australian Design Rules—a review of the development and administration of the system, October 1976
93 Youds, R. L. A., 'State of the art of seat belts and future trends, the Australian scene, Part I', paper presented to the Seat Belt Seminar, Melbourne, March 9–11, 1976
94. McLean, A. J & Robinson, G K , 'Adelaide in-depth accident study, 1975–1979'—a series of reports on the results of the study conducted by the University of Adelaide Road Accident Research Unit.

APPENDIX I

Development of SAA Standards relating to restraint design and installation

Name of Standard	*Endorsement date*	*Comment*	*Responsible SAA Committee*
Seat belts			
E35—1961 Safety belts and harness assemblies for motor vehicles	28 April 1961	1. Strength requirements largely based on British Standard BS3254:1960 2. Did not specify installation requirement 3. No dynamic test requirement	SF/15 Car Seat Belts
E35—1965 Seat belt assemblies for motor vehicles	15 July 1965	1. Increased test requirements and included a sunlight degradation test 2. Included more detailed requirements for belt fitting and use 3. In June 1967 standard amended to include requirements relating to the certification mark scheme	SF/15 Car Seat Belts
E35, Part I—1970 Seat belt assemblies for motor vehicles	Created by an amendment dated March 1971	1. Upgraded test requirements and improved ease of adjustment and buckle location 2. Removed all references to diagonal belts	SF/15 Car Seat Belts
E35, Part II—1970 Seat belt assemblies (including retractors) for motor vehicles	24 June 1970	1. Was the first Australian standard for retractors	SF/15 Car Seat Belts
AS2596—1983 Seat belt assemblies for motor vehicles	9 November 1982	1. Metricated and updated E35, Parts I and II 2. Specifies dynamic testing for all seat belt assemblies 3. Establishes a standard for replacement part assemblies and for special application units 4. Includes dual sensitive emergency locking retractors for installation in new vehicles 5. Establishes test geometry for attachment points	AU/8 Adult Seat Belts
Seat belt anchorages			
D11—1967 Seat belt anchorage points	3 May 1967	1. Established technical requirements for the location, dimensions and strength of belt anchorage points	SF/15 Car Seat Belts

Webbing			
E47—1968 Webbing for restraining devices for occupants of motor vehicles		1. Information in this standard was originally included in E35—1965 2. Rewritten as a separate standard to include requirements for child restraints	
E47—1971 Webbing for restraining devices for occupants of motor vehicles	25 June 1971	1. Introduced three new classes of webbing and amended test requirements	AU/8 Motor Vehicle Restraints
AS1753 1975 Webbing for restraining devices for occupants of motor vehicles—metric units	14 March 1975	1. Introduced two new classes of webbing and abrasion requirements 2. Metricated E47—1971	AU/23 Webbing for Seat Belts
Child restraints			
E46—1970 Child restraining devices for passenger cars	6 February 1970	1. Included requirements for construction, design and testing, and instructions for installation, use and marking 2 Also included requirements for restraining devices for car seat squabs and cushions	SP/15 Car Seat Belts
AS1754—1975 Child restraints for passenger cars and derivatives	17 March 1975	1. Included many additional requirements such as dynamic testing, easier adjustment and installation, and additional energy absorbing materials 2. Scope of standard widened to include net-type enclosing restraints for use with bassinets, a rearward facing chair with harness and reclining child restraints	AU/22 Child Restraints

APPENDIX II

Early Australian papers on vehicle safety

Author(s) and year of Publication	*Reference*	*Study description*
Adams, 1967	1	Examined data on 816 occupants either killed or injured in 320 accidents in rural areas in New South Wales, Queensland, South Australia and Victoria during 1965 and 1966.
Birrell, 1961 . .	11	Reviewed the available literature from the Cornell research program and presented some anecdotal data on the use of belts by the Victorian police.
Birrell, 1964 . .	12	Reviewed Australian and overseas literature and presented data from four accident cases.
Duncan, 1964 . .	25	Examined data on 158 vehicle occupant fatalities (and 164 other road user fatalities) occurring in southern Tasmania between 1954 and 1964. Each case was assessed to determine the extent to which seat belts would have reduced injury. The methodology of this assessment is not described.
Herbert, 1962 . .	36	Briefly reviewed overseas literature and discussed various aspects of seat belt design and occupant protection.
Herbert, 1964 .	37	Reanalysed data from the nineteen serious accidents involving twenty seven occupants reported by McCausland and Herbert, 1962 (Ref. 58). The accidents occurred between July 1960 and August 1962.
Hodge, 1962 . .	39	Series included sixty seven vehicle occupants fatally injured in accidents in and around Adelaide between July 1959 and April 1961. Post mortems were performed in all cases.
Hueston, Cook & Langford, 1964	44	Series consisted of 114 patients with major facial fractures.
Jamieson & Tait, 1966.	49	Series included consecutive admissions to Brisbane hospitals or death of 524 vehicle occupants (and 476 other road users) between January 1962 and May 1963.
Lane, 1967 . . .	54	Surveyed available Australian and overseas literature.
McCausland & Herbert 1962	58	Presented data on twenty serious accidents involving thirty one occupants. All serious accidents involving Snowy Mountains Authority vehicles between July 1960 and August 1962 were included. This was the first report in a series describing the effectiveness of the SMA seat belt program. The last report in the series was published in 1968
McLean, 1966 . .	60	Discussed some preliminary findings and presented details on a limited number of cases from the Adelaide in-depth study (Reference 70).
O'Brien, 1965 . .	65	Series consisted of 153 vehicle occupants injured between 1961 and 1964.
Robertson et al., 1966 .	70	In-depth study of 408 accidents in Adelaide during 1963 and 1964. The sample included 1029 car occupants.

Author(s) and year of Publication	*Reference*	*Study Description*
Thorpe, 1964	81	Presented data on the fitting of belts in cars and station wagons in Melbourne and examined nearly 40 000 casualty accidents occurring in Victoria during 1963 to assess the effectiveness of belt wearing on driver injury.
Tonge et al., 1964	82	Sample comprised 2214 fatalities occurring in Brisbane between June 1935 and May 1963. There were 612 drivers and car passengers.
Vulcan, 1966	90	Surveyed Australian and overseas literature.

APPENDIX III

Seat belt wearing and retrofitting legislation by States and Territories

	Exemptions							
Basic requirement	*Reversing*	*Medical*	*Min. age*	*Max. age*	*Local deliveries*	*Other*	*Penalty*	*Retrofitting requirement*
N.S.W. 'No person shall, while occupying a seat position in a motor car to which a seat belt has been fitted for the seat position, drive or travel, upon a public street, in that motor car unless wearing that belt and the belt is properly adjusted and securely fastened' —Regulation under the Motor Traffic Act	X[6]	X	1[1]	70[4]	X	Taxi drivers, front seat occupants of taxis if no retractor belt fitted, certificate from Commissioner of Motor Transport	$50	From April 1973 belts have to be fitted in the front seats of cars and derivatives first registered on or after 1 January 1965
Vic. 'A person shall not be seated in a motor car, that is in motion, in a seat for which a safety belt is provided unless he is wearing the safety belt and it is properly adjusted and securely fastened' —Motor Car Act	X[6]	X	1[2]		X	Certificate from Road Traffic Authority	$200 max.	From July 1971 belts have to be fitted to the front seats of all cars (first registered on or after 1 January 1951), prior to the issue of a roadworthiness certificate (which is required on change of ownership) From February 1974 belts have to be fitted in the front seats of all cars manufactured after 1 October 1964

Basic requirement	*Exemptions*						*Penalty*	*Retrofitting requirement*
	Reversing	*Medical*	*Min. age*	*Max. age*	*Local deliveries*	*Other*		
Qld 'A person, when occupying in a motor vehicle a seat position to which a seat belt has been fitted, shall not drive or travel, upon a road, in such motor vehicle unless he is wearing such seat belt properly adjusted and securely fastened' —Regulation under the Traffic Act	X[6]	X	1		X	Certificate from Commissioner for Transport	$10 and 1 demerit point	
W.A. 'A person shall not, while occupying a seat position in a motor vehicle to which a seat belt has been fitted for that seat position, drive or travel upon a road unless he is wearing that seat belt and the seat belt is properly adjusted and securely fastened' - Road Traffic Code	X	X	1	70[4]	X		$40 plus 2 demerit points	
S.A. 'A person shall not be seated in a motor vehicle that is in forward motion in a seat for which a seat belt is provided unless he is wearing the seat belt and it is properly adjusted and securely fastened' —Road Traffic Act	X	X	1		X	Passenger in emergency vehicle, certificate from Road Traffic Board, persons wearing child restraints	Up to $1000[3]	From 1 January 1967 seat belts were required in the front seats of all new passenger vehicles

Basic requirement	*Exemptions*						*Penalty*	*Retrofitting requirement*
	Reversing	*Medical*	*Min. age*	*Max. age*	*Local deliveries*	*Other*		
Tas. 'No person shall be seated in a motor vehicle that is in motion, in a seat for which a seat belt is provided, unless— (a) that person is wearing a seat belt; and (b) that seat belt is properly adjusted and securely fastened' —Regulations under the Traffic Act	X[6]	X	1[9]		X	Certificate from Registrar of Motor Vehicles	Max $200[3]	
A.C.T. 'If at any time while a prescribed vehicle the driving position of which is fitted with a seat belt is being driven forward, or has its engine running, on a public street, the person occupying the driving position[5] of that prescribed vehicle does not have that seat belt securely fastened around him or, having it fastened around him, does not have it appropriately adjusted, that person is guilty of an offence' —Motor Traffic Ordinance	X[6]	X	1[1]	70[4]	X	Certificate from Registrar of Motor Vehicles or from any other appropriate jurisdiction in Australia, defendant can also establish that failure to comply was not unreasonable	$40	

Basic requirement	*Exemptions*						*Penalty*	*Retrofitting requirement*
	Reversing	*Medical*	*Min. age*	*Max. age*	*Local deliveries*	*Other*		
N.T. 'Where a motor vehicle, the driving seat of which is fitted with a seat belt, is being driven forward on a public street or in a public place and the person occupying the driving seat[5] of the motor vehicle does not have that seat belt securely fastened around him, or having it fastened around him, does not have it appropriately fastened, that person is guilty of an offence' Traffic Ordinance	X[8]	X[8]	1		[8]	Certificate from Registrar of Motor Vehicles	$200 or 6 months imprisonment[3]	

Notes:

1. All children under 8 riding in passenger cars and derivatives must
   wear a suitable child restraint or adult seat belt where available
   —or where none is available the child must ride in the back seat
   the driver of the vehicle is responsible for seeing that children 12 months to 13 years of age are correctly restrained (A.C.T., N S W , N T), 12 months to 17 years in Victoria, and 12 months to 7 years in the other States.
   An adult seat belt is considered suitable if the child is older than 12 months.
2. Children under 8 can ride only in the front seat of passenger cars and station wagons if they are properly restrained by a child restraint or safety belt.
3. The Traffic Infringement Notice or on-the-spot fine is $40 in Victoria, $25 in S.A., $20 in N.T and $40 plus 2 demerit points in Tasmania.
4. Passengers only.
5. A similar requirement applies to passengers.
6. Drivers only.
7. Children under 8 can only ride in the front seat of a passenger car or derivative if they are properly restrained by an approved child restraint.
8. The Registrar of Motor Vehicles issues exemptions for medical reasons and also to persons engaged in local deliveries. In addition it is understood that police do not enforce wearing when a vehicle is reversing.