Australian Efforts to Improve Motor Vehicle Occupant Protection

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ABSTRACT

The need to provide protection for vehicle occupants in a crash has been recognised since at least the 1950s. The importance of an occupant restraint system to prevent ejection and to prevent or reduce the severity of the "second collision" between the occupant and the vehicle interior was identified as an essential element for occupant protection. The need to reduce deceleration by controlled crumpling of the vehicle structure while maintaining integrity of the occupant compartment was also recognised as important.

This paper describes how some of the research, development and safety standards from other countries were adapted and applied to occupant protection in Australia. The contribution of Australian research and development to this process is also discussed, particularly in relation to seat belts.

Some recent efforts to improve occupant protection, including provision of consumer information about crash performance derived from real world crashes (used car ratings) and the correlation with the Australian New Car Assessment Program is also discussed.

Mention is made of a recently commenced research project to optimise protection in a side impact for the full range of crash conditions.

AUSTRALIA HAS HAD A SET OF SAFETY STANDARDS for new motor vehicles since the late 1960s and an approval system for certifying compliance since 1970. A full description of the early system is given by Vulcan and Ungers (1975).

As would be expected, some of the Australian Design Rules for Motor Vehicle Safety (ADRs) relate to reduction of the probability of crash involvement and others to occupant protection in a crash.

The current arrangements for development of the ADRs under the Motor Vehicle Standards Act 1989 are described in Appendix 1. Prior to 1989, the ADRs were formulated by a Committee with representation from the Commonwealth and State government departments, the automotive industry and some independent experts representing the relevant professions. The Chair and Secretariat were provided by the Commonwealth Department of Transport. Since 1970, draft ADRs have been subject to a 90 day period for comment from industry and other relevant organisations, prior to being endorsed by the Australian Transport Advisory Council. These arrangements differed markedly from those in use in Europe and the United States.

In 1970 it was decided that the ADRs should follow international standards unless unique Australian conditions justified departure from these standards. Consequently, 13 of the 22 ADRs which had been endorsed up to that time were amended to comply with this decision.

Appendix 2 lists those ADRs which relate to occupant protection and indicates which are similar to the U.S. Federal Motor Vehicle Safety Standards (FMVSS) or the

Economic Commission for Europe (ECE) Regulations. The few unique ADRs relate mainly to Australian experience with occupant restraint and these will be discussed in this paper.

Occupant Protective Performance

The effectiveness of several of the FMVSS on which the ADRs are based has been evaluated by Kahane (1984). Cameron (1980) has evaluated ADR22A "Head restraints", which was modified from by FMVSS 202 by adding a requirement to prevent the head restraint from being adjusted below a minimum height. He found effectiveness in reducing neck injuries for females but not males.

Since 1992 the crashworthiness of many car makes and models in Australia has been determined based on real world crash data (Cameron, et.al., 1992).

Figure 1 – Injury risk by year of manufacture (with 95% confidence limits)

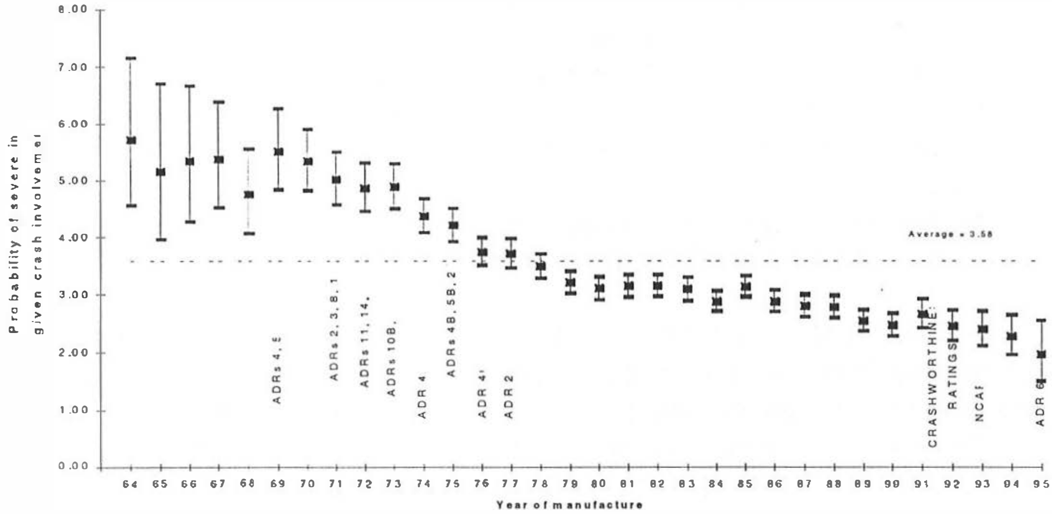


Figure 1 shows the average probability of a driver of a passenger car being severely injured if involved in a tow-away crash, by year of manufacture. This probability was derived in the same way as the crashworthiness ratings and is based on 1,077,352 drivers involved in tow-away crashes which occurred in New South Wales and 63,339 drivers injured in crashes in Victoria during 1987 to 1996. Corrections have been applied for age and sex of the driver, as well as for speed zone and number of vehicles involved in the crash. Most of the reduction occurred during the period 1970 to 1977, when the occupant protection ADRs were implemented. The average rating for post-1977 cars is 48% lower than for pre-1970 cars. This is an indirect measure of the combined effectiveness of all of those ADRs together with some further improvements which have occurred in recent years (Newstead, et. al., 1998).

Since 1992 there has been an Australian New Car Assessment Program (NCAP) based on the NCAP tests being conducted in the U.S.A. and more recently in Europe. This has provided consumers with information on which to base decisions to purchase a new car and may have influenced manufacturers to improve their rating in these tests.

Newstead and Cameron (1997) have shown some correlation between the chest loading and femur load of the test dummy in the frontal offset crash tests and the crashworthiness rating for the same cars, for a sample of 13 cars. Further work is being undertaken in this area.

SEAT BELTS

Early Studies Of Effectiveness

Some of the early studies of seat belt effectiveness, which influenced actions in Australia, are discussed below. In the United States, an analysis of data on 8,784 persons in crashes (mainly rural) investigated by the California Highway Patrol, found that the probability of major/fatal injuries for lap belt wearers in the front seat was reduced by 35%. (Tourin and Garrett 1960).

In England, Moreland (1962) used data gathered from on-the-spot investigations of crashes near the Road Research Laboratory. After controlling for vehicle damage and direction of impact, he calculated a 55% reduction in the probability of fatal/serious injury for front seat occupants wearing a seat belt. Of the 15 belts used, 8 were diagonal, 4 full harness and 3 lap/sash.

In Sweden, Backstrom (1963) studied 439 car crashes known to the police. There were 712 front seat occupants of which 424 were wearing a seat belt. Five percent of the belts used were lap/sash, 79% diagonal, 10% full harness and 6% other including lap only.

Analysis of these data showed a 54 percent apparent reduction in the probability of death or injury. The almost exclusive use of belts with upper torso restraint (94%) and the higher apparent effectiveness when compared with the Californian results should be noted.

Other important studies which showed seat belt effectiveness were conducted in Sweden by Lindgren and Warg (1962) and in the U.S.A. by Campbell and Kihlberg (1965).

In Australia, Thorpe (1964) analysed all crashes reported to the police in Victoria during 1963 (excluding those where a motor vehicle struck an unprotected road user). He calculated that in urban crashes, drivers wearing a seat belt were 30% less likely to be killed or injured in a crash. For rural crashes, the corresponding reduction was 22%, but 67% when only fatalities were considered. The type of seat belt worn was not recorded in this study, but based on sales figures, at least 70% would have been lap/sash or diagonal and most of the remainder lap only.

Herbert (1964) after reviewing the results of some overseas studies of seat belt effectiveness, reported the experience of the Snowy Mountains Authority which from 1960 had fitted diagonal belts to all its light vehicles and lap belts to heavy vehicles. All employees were required to wear their belts. He reported a 76% reduction in fatal/serious injuries for belt wearers, but this was based on only 19 crashes, of which 14 involved overturning.

The results of these early studies provided a clear direction for Australia. In a review of the literature it was concluded that:

> *"The case for all occupants of a vehicle always wearing a seat belt has been established beyond reasonable doubt. It is most desirable that the seat belts*

should comply with the Australian Standard or its equivalent.
Although the available accident statistics do not conclusively prove the superiority of upper torso restraint, they indicate that this may well be the case for front seat occupants. It should be noted that lack of proof of a phenomenon does not disprove its existence; rather it indicates the need for further information." (Vulcan, 1966)

Seat Belt Standards

The initial Australian Standard for seat belts (AS-E35-1961) was based primarily on the British Standard and included static strength tests for lap, lap/sash, diagonal belts and full harness assemblies. The 1965 revision marked the beginning of the Australian departure from Standards developed in other countries, because of local experience. It incorporated more stringent tests for sunlight degradation which in effect restricted the seat belt webbing to "high tenacity terylene" or "Nylon 666". This reflected the results of Australian experience, particularly at the Snowy Mountains Authority.
As a result of experimental research, the maximum force for push button release of a buckle where only a thumb or single finger could be applied was reduced from 45 to 25 lbf., to enable buckle release by 95% of the population.

Type of Seat Belt

The Standard specified requirements for lap only, diagonal and lap/sash belts, as well as harness assemblies. For the lap/sash belt a "running loop" was allowed, but a detachable sash was not.
In this matter the Committee resisted strong pressure from a major Australian motor vehicle manufacturer to allow lap/sash belts with a detachable sash portion, on the grounds that the parent U.S. company had found these to be more acceptable and safer than the "running loop" allowed in the Australian Standard.
The forward of the Australian Standard E35-1965 states that:

> *"Seat belts conforming to this standard will give valuable protection to the wearer in the majority of accidents if properly installed and worn tightly. Belts which effectively restrain the upper torso, i.e. diagonal belts and high-anchored combination (lap/diagonal) and harness assemblies will usually afford better protection for the head and chest than will lap belts and other low-anchored assemblies."*

This laid the foundation for ADR No. 4, which applied to the front seats of all new cars from January 1969 and to the rear seats from January 1971. It required seat belts in all outboard seating positions to provide both pelvic and upper torso restraint. This in effect banned the lap and the diagonal belt from all outboard seating positions and paved the way for effective injury reduction associated with the mandatory seat belt wearing law.
The classic study of Bohlin (1967) of more than 28,000 crashes of Volvo cars established the effectiveness of lap/sash belts with a "slip joint" beyond doubt. The design of the belt with the buckle attached to the transmission tunnel ensured that the intersection of the lap and sash portions of the belt was right round to the side of the body. Bohlin reported that the average injury reducing effect of this type of belt ranged

from 40% to 90% depending on the crash speed and type of injury.

Seat Belt Anchorages

The State of South Australia required anchorages to be fitted for the driver and front outboard passenger as from 30 June 1964 and Victoria required the same as from 1 October 1964. While only floor anchorages were specified, most Australian manufacturers also fitted an upper anchorage point. Surveys at the Melbourne Motor Show found the proportion of new cars with seat belt anchorages increased from 45% in 1965 to nearly 100% by 1966 (Lane, 1967).

Fitting of Seat Belts

Several U.S. States required fitting of seat belts (lap belt only) in the early 1960s, e.g. Illinois in 1961, California and Wisconsin in 1962. It is understood that by 1965 all U.S. automobile manufacturers were fitting lap belts to new cars. Some European car manufacturers were fitting seat belts during the 1950s.

In Australia during the late 1950s, individuals began fitting seat belts and by the early 1960s companies and government departments were doing so to their fleets. This usually involved drilling holes in the floor pan and B pillar, using appropriate reinforcement plates, bolts and sleeves supplied with the seat belt assembly.

South Australia required seat belts to be installed for the driver and front outboard passenger in new cars from 1 June 1967. Other States followed until by January 1969, it was required in all States.

Wearing of Seat Belts

Milne (1979) documented the fitting and wearing rates for seat belts in various States.The most continuous series of surveys was provided by the South AustralianRoad Traffic Board, an extract of which is shown in Table 1.

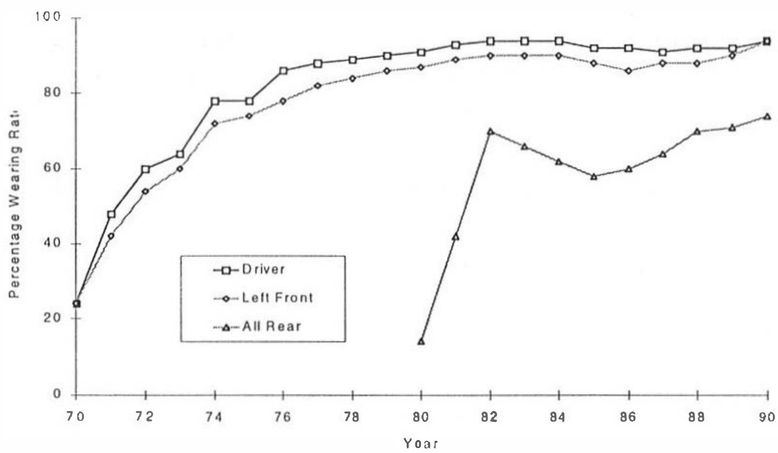
Table 1 Seat belt fitting and wearing in South Australia (Milne, 1979)

	Vehicles fitted – driver position	Wearing rate – drivers (where fitted)	Wearing rate - passengers
1964	15.1	64.3	48.0
1966	28.2	45.7	41.9
1968	46.5	36.5	22.5
1969	52.3	28.9	18.9
1970	60.0	27.5	23.1
1971	66.9	37.0	33.2
1972	68.5	81.1	68.5
1973	74.4	77.7	64.6
1974	77.9	72.0	58.3
1975	82.3	70.0	55.8
1976	84.9	90.1	71.3

It is interesting to note as the fitting rate increased from 1964 to 1970, the percentage of drivers who wore their belts decreased from 64.3% to 27.5%, presumably because those who had fitted belts themselves during the early years were more likely to wear them than those where the belt was supplied. Nevertheless, the percentage of all drivers who wore a belt (the product of columns (2) and (3)) increased from 9.7% to 16.5%. The large increase in wearing rate from 1971 to 1972 reflects the introduction of compulsory wearing legislation in South Australia.

The first State to introduce compulsory wearing of seat belts when they were fitted, was Victoria in December 1970. The effect of this legislation on wearing rate, immediately and in the longer term, is shown in Figure 2. The legislation resulted in an 18% reduction in both deaths and serious injuries among vehicle occupants during its first year (Vulcan, 1995).

Figure 2 – Seat belt wearing rates in Victoria by seating position 1970-1990



Effect of Seat Belt Wearing Law on Standards

The introduction of the seat belt wearing law in Victoria resulted in a considerable number of complaints regarding discomfort, generally associated with the sash portion of lap/sash belts. In a few cases the situation was so extreme that exemptions from the law had to be granted. The main problems were the sash portion of the belt passing across the neck or face of the wearer or slipping off the shoulder.

A study was commissioned immediately to determine an area for the location of the upper anchorage which would allow comfortable seat belt wearing for both males and females in the 5th to 95th percentile range, but such that the belt should maintain contact with the body. The study involved measurements of comfort by subjects seated in four different vehicles and on a car seat in the laboratory. The requirements for upper anchorage location in ADR5A had been based on the British Standard BS AU 48. This Standard was amended to take into account research carried out by Gosling (1970) and published as BS AU 48a: 1971, after the Australian study had commenced.

Both the British and the Australian studies (Hoffman and Mak, 1972) found that the boundaries of the acceptable area for the upper anchorage depended on the distance between the side wall and the driver (becoming larger and further towards the rear for greater distances to the side wall) as shown in Figure 3. Even after eliminating the most restrictive of the subjects tested, the Australian study found an acceptable area much smaller than that allowed in BS AU 48a: 1971. Both were considerably more restrictive than ADR5A "Seat belt anchorages" and FMVSS 210.

Figure 3 – Upper anchorage locations – acceptable areas in 20cm and 40cm side planes

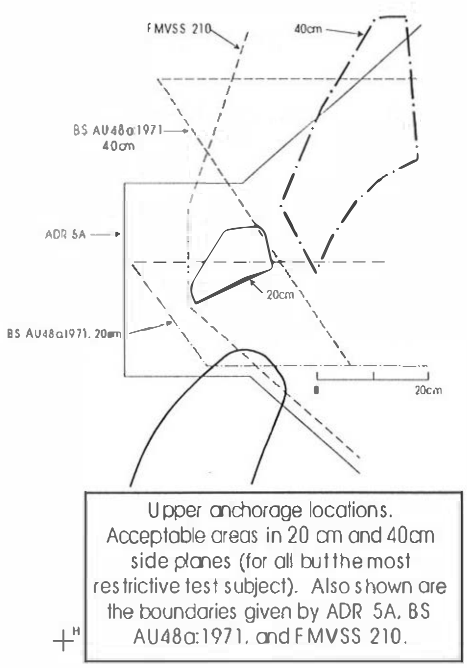
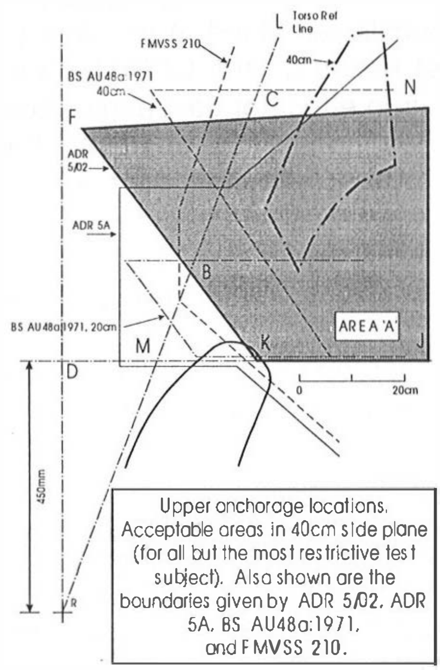


Figure 4 – Upper anchorage locations – acceptable areas in 40cm side plane



After considering submissions by industry about the difficulty of locating the upper anchorage in some vehicles, a much larger permissible area for the anchorage location was allowed in ADR 5B, as shown in Figure 4. It is pleasing to see that many manufacturers are now providing adjustment for the upper anchorage location to improve comfort.

The need to facilitate putting on and adjusting the seat belt also prompted several requirements in the ADR 4B "Seat belts". These included requirements to ensure that both the buckle and the tongue portion of the belt were readily accessible by an occupant when seated.

Effects of crash investigations on seat belt standards

In order to determine any shortcomings of seat belts in severe crashes, Ryan and Baldwin (1972) studied vehicle occupants severely injured or killed, who were believed to have been wearing a belt. In 15 of the 16 cases where measurements could be made by inspection of the vehicle, the belts were judged to have been too loose and in

15 out of 16 cases the buckle was judged to be too far forward. Roadside observations rated seat belt adjustment as unsatisfactory (excessive webbing looseness or buckle being too far forward or both) for 50% of drivers. The study concluded that maladjustment of seat belts was associated with injury in crashes. It was recommended that measures be taken to ensure that seat belts cannot be worn in other than an optimum manner.

The results of this study and others led to the requirement in ADR4A that it shall not be possible to adjust the buckle so that the intersection of the lap and sash portions of the seat belt are closer than a specified distance from the centreline of the dummy. The specified distance varied from 125 mm to 200 mm depending on the size of the dummy and whether it was an adjustable or fixed seat. This led to seat belt designs in which the buckle remained at the side of the body, irrespective of seat adjustment. A dynamic test based on the ECE sled test and dummy was also introduced in ADR4A, which came into effect for passenger cars in January 1974.

The need to facilitate adjustment and reduce slack also led to the requirement for emergency locking retractors for outboard front seats in ADR4B as from January 1975 and later for rear outboard seats.

The requirement in ADR 4C for emergency locking retractors to lock based on independent sensing of webbing strap acceleration in addition to sensing of acceleration of the retractor body, was based in part on the need to enable wearers to test for themselves that the retractor will lock. The pioneering work of Aldman (1963) regarding the test requirements for these retractors was also important in this regard.

Child Restraint Anchorages

The Australian Standard for Child Restraints was originally introduced in 1970 and upgraded as AS1754-1975 "Child restraints for passenger cars and derivatives". In order to facilitate attachment of the upper tether strap which is required for all child restraints, ADR 34 "Child restraint anchorages" was implemented from July 1976. This unique ADR requires an upper anchorage suitable for attachment of a child restraint for each rear seating position. This has resulted in child restraints being installed in rear rather than front seats.

DEVELOPMENTS DURING PAST TEN YEARS

Frontal impact protection

During the period 1977 to 1988 there was relatively little regulatory action regarding occupant protection. In 1988 the Federal Office of Road Safety commissioned the Monash University Accident Research Centre to undertake a study of modern (post 1981) passenger car crashes in which at least one occupant was injured severely enough to be admitted to hospital. Analyses showed that front seat occupants who wore lap/sash belts sustained serious injuries to the head, face, chest and lower limbs from contacts with the windscreen, header, steering assembly and instrument panel in frontal crashes. There were also some chest and abdominal injuries from loading by the seat belt. (Fildes, et. al., 1992). The authors considered that apart from structural improvements, more effective restraint systems, more forgiving instrument panels, knee bolsters and supplementary airbags are likely to be successful countermeasures against many of these injuries.

A further study of the likely benefits and costs of various countermeasures to reduce injury in frontal crashes using harm analysis found that a package of measures consisting of a driver airbag, energy absorbing steering wheel, seat belt pretensioner and webbing clamp, improved seat belt geometry and seat pan, plus knee bolsters was likely to save around 25% of total vehicle occupant trauma at an estimated benefit/cost ratio (BCR) of 1.5:1 (Monash University Accident Research Centre, 1992).

The estimates for individual measures is shown in Table 2.

Table 2 BCR and percent total harm for countermeasure benefits

Item	Likely BCR outcome	Percent reduction vehicle occupant harm *
Fullsize driver airbag (electronic)	0.77	15.1%
Fullsize driver airbag (electro-mech)	1.15	14.9%
Fullsize passenger airbag (electro-mech)	0.18	2.4%
Maximum facebag (electro-mech)	0.98	11.5%
Minimum facebag (electro-mech)	0.58	6.8%
Seatbelt pretensioner (seat)	0.8-1.1	2.7%
Seatbelt pretensioner (shoulder)	0.46	1.6%
Seatbelt webbing clamp	1.1-3.5	1.2%
Improved belt geometry & seats	7.30	1.7%
Seatbelt warning device	4.1-7.2	3.4%
Energy absorbing wheel	3.2-16.0	1.9%
Vertical & lateral column intrusions	unknown	1.8%
Padded upper areas	0.3-0.4	0.7%
Improved lower panels	1.8-18.0	2.6%
Knee bolsters	2.9-4.3	5.3%
Reduced floor and toepan instrusions	unknown	4.4%

*Harm is defined as the total cost of a specific category of injury and is calculated by multiplying the frequency of that injury by its cost.

After crash testing of seven Australian produced cars and a further three crash tests on one car fitted with enhanced safety systems, supplemented by laboratory tests on a range of new occupant protection features, ADR 69 "Frontal occupant protection" was formulated. It included the barrier crash test requirements and injury parameters of FMVSS 208, but with one major modification; that the seat belt must be fastened. This was in recognition of the fact that in Australia approximately 95% of front seat occupants wear their seat belt (Federal Office of Road Safety, 1993). This concession allowed manufacturers to design their airbags to deploy "less aggressively" in a manner which optimises protection for the belted driver and at a higher threshold impact speed, when the seat belt alone cannot provide total protection.

Evaluation of these "supplementary restraint systems" for one model of Australian passenger car showed fewer chest injuries of all severities and a trend towards fewer head, face and abdomen/pelvis injuries (Fildes, et.al., 1996c). Subsequent analysis has shown a reduction in a measure of overall injury severity (ISS) and average cost of injury.

This author is somewhat puzzled that the (justified) modification to the FMVSS test procedure which requires the seat belt to be fastened, was made without a counterbalancing requirement to encourage seat belt wearing by the remaining 5% of non-wearing front seat occupants. These non-wearers comprise some 20% of front seat occupant fatalities and injuries. Even if a seat belt interlock is unacceptable, it has been estimated that a seat belt warning device such as operation of the 4-way hazard flasher system (or other visible and auditory warning device) if a front seat occupant is unbelted, would result in a benefit/cost ratio of 4.1-7.2 and would lead to a 3.4% reduction in vehicle occupant trauma (Monash University Accident Research Centre, 1992). Alternatively disabling the car's audio system, air conditioning or heating if the driver's belt is not worn, may be a powerful incentive for seat belt wearing.

Frontal Offset Impacts

Further analysis based on harm reduction has been undertaken to estimate the likely additional benefits of a frontal offset Standard, using the requirements of the proposed EEVC offset impact standard (Lowne, 1994). The crash test was taken to be a 40% overlap on the driver's side, with a deformable barrier at an impact speed of 56 km/h. Injury criteria using two Hybrid III 50th percentile dummies were specified for the head, neck, chest, femur, tibia as well as limits on intrusion of the steering wheel and column.

The Harm reductions, additional to those achieved from implementation of ADR 69 "Full frontal impact occupant protection" were estimated as 15-21% of frontal harm. The lower value assumed 100% fitting of driver airbags before this offset impact standard was implemented, while the higher value assumed only 70% airbag fitting. Further calculations for an impact speed of 60 km/h estimated harm reductions of 17-23% (Fildes, et.al., 1996a). For comparison with the benefits reported above for ADR 69, these percentages correspond to 9.4% and 13.3% of total vehicle occupant harm.

Side Impact Protection

The benefits of implementing a dynamic side impact test for Australian passenger cars have been calculated using the harm reduction method. It was estimated that the reduction in harm which could be expected from implementation of ECE Regulation 95 (for protection in a lateral collision) was about 10% larger than that expected from implementing FMVSS 214 (side door strength – dynamic test) (Fildes, et.al., 1996b). The Australian Federal Office of Road Safety has subsequently announced that ADR 72/00 "Dynamic Side Impact Protection", to be introduced in 1999, will allow compliance with either FMVSS 214 or ECE Regulation 95.

This together with other research led to the development of a proposal by the Federal Office of Road Safety for a harmonised dynamic side impact standard, utilising a combination of requirements and test procedures taken from each of these Standards, but with a BioSID dummy.

The estimated benefits of this "hybrid" standard when applied to the whole of Australian passenger cars was 4.5% reduction in total vehicle occupant harm, compared with revised estimates of 3.7% reduction for FMVSS and 3.9% for ECE Regulation 95 (Seyer, et.al., 1998)

Further research and consultation on developing an agreed harmonised regulation on dynamic side impact protection has been agreed. The Australian Federal Office of Road Safety has been designated as co-ordinator of this international co-operative research program.

Research has recently been commenced at the Monash University Accident Research Centre to develop a method for optimising side impact protection over a wide range of real world side crash conditions, including impact speed, direction and location, as well as occupant characteristics such as sex, size and age. This is a co-operative research project involving major grants from the Australian Research Council, Federal Office of Road Safety, General Motors Holden, with additional support from the Australian Automobile Association and Autoliv. It has the potential to provide significant improvements in occupant protection.

FUTURE PROGRESS

An important element in development of further improvements in occupant protection will be improved knowledge of human tolerance to applied forces, contact pressure or acceleration for the whole range of occupant ages and sizes, with particular emphasis on children on the one hand and the deterioration with increasing age on the other. This should enable more sophisticated modelling of the human/vehicle interactions under various crash conditions. Eventually crash testing using anthropomorphic dummies may be required primarily to calibrate models of the vehicle structure.

When this stage has been reached, there will be a need to re-examine the role of vehicle safety standards, as they may inhibit the optimisation of safety performance over the whole range of real world crashes. Possibly consumer information about performance over the whole range of real world crashes will become more important in promoting advances in occupant protection than merely complying with standards representative of a few "worst case" crashes. Progress in such a direction would require the sharing of information about design parameters and crash performance between manufacturers, government and consumer associations. It would also benefit from international co-operation and may only be feasible initially for the more highly developed nations, with minimum performance standards remaining to provide a "safety net".

The Role of Biomechanics

In the past the role of the expert in biomechanics of impact has been to contribute to improvements in development of occupant protection, given a prescribed impact speed and crash configuration. In the context of "vision zero", namely to move towards a road transport system designed for zero fatalities or serious injuries, the biomechanics expert can play a wider role. This would be to advise on the maximum velocity change that can be tolerated in an impact, given the limits of vehicle design imposed by physics and taking into account the type of crash and the road environment. Hence, it is the biomechanics of impact which should be considered to determine the maximum safe speed for a particular road environment, taking into account the presence or absence of unprotected road users, separation of opposing traffic streams, presence of roadside hazards and future developments in automatic crash avoidance.

CONCLUSIONS

1. Considerable progress has been made in Australian vehicle occupant protection by implementing safety standards for new vehicles. Most of these have been adopted from the corresponding FMVSS and ECE Regulations, but those relating to occupant restraint have been developed for Australia, largely as a result of the unique situation relating to Australia's early adoption of seat belt and child restraint use laws.

2. Future optimisation of occupant protection may require departure from the traditional standard setting approach and would benefit from co-operation between manufacturers, governments and consumer groups, preferably internationally.

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How the Australian Design Rules are Developed *

The Federal Office of Road Safety (FORS) develops the Australian Design Rules in conjunction with the National Road Transport Commission (NRTC) within a consultative process involving:

- State and Territory Governments
- Australian Automobile Association
- Motorcycle Riders Association
- Federal Chamber of Automotive Industries
- Road Transport Forum

As a result of the close involvement of all of these organisations, the development of the Australian Design Rules is able to draw on major government, professional and other groups who have established credentials in the road safety area.

In addition, FORS works closely with overseas agencies in America, Japan and Europe to ensure that Australia adopts the latest international practices.

This follows from the government's policy to harmonise, wherever possible, with international standards. In this context, some two-thirds of the ADRs are currently aligned with international standards.

Under the agreed standards development framework with the NRTC, every new ADR must be justified with a Regulatory Impact Statement (RIS) which sets out the costs and benefits as well as other options for a new ADR. The RIS accompanies any draft ADR for public comment for a 90-day period. In special circumstances, this comment period may be abbreviated but usually not less than 60-days, which is in line with Australia's obligations under the General Agreement on Tariffs and Trade.

Following the close of public comment, the comments received are summarised and considered as to whether the ADR needs to be changed. Depending on comments received, this may require further discussions with stakeholders. The finalised package is then referred to the NRTC to forward to all Transport Agency Chief Executives (TACE) for endorsement. TACE members are essentially the State and Territory jurisdictions responsible for transport safety issues. TACE members must respond within one month.

Following the close of TACE comment, the NRTC prepares the package for Ministerial Council endorsement. The State and Territory Ministers responsible for transport safety issues have two months to respond.

If there are no objections, the NRTC advises FORS and a package is sent to the Minister of Transport & Regional Development to determine the ADR(s) as national standards. Once signed the ADR(s) are gazetted in the Commonwealth Gazette. Upon gazettal, the ADR(s) become law.

* Information provided by the Federal Office of Road Safety.

Australian Design Rules for Motor Vehicle Safety

Summary of rules which relate to occupant safety *

Australian Design Rule (original implementation date)	ECE similarity †	FMVSS similarity †	Comment
ADR 2 - Side Door Latches and Hinges (1971)	R11+	206+	& check door locking mechanism
ADR 3, 3A - Seat Anchorages (1971)	R17+	207+	additional test where seat loaded by restraints
ADR 4, 4A, 4B, 4C – Seatbelts (1970)	R16/04+	-	Unique, mandatory wearing demands higher standard particularly user convenience
ADR 5A, 5B - Anchorages for Seatbelts & Child Restraints (1970)	R14/02+	-	Mandatory wearing demands better placed anchorage
ADR 8 - Safety Glazing Material (1971)	R43	-	Different test methods
ADR 10A, 10B - Steering Column (1973)	R12	203,204	Test on R.H. drive
ADR 11 - Internal Sun Visors (1972)	R21/01+	-	Low cost method of reducing head injuries
ADR 17 - Fuel System (1975)	-	Fed. Motor Carrier Safety Reg 3+	Trucks over 4.5 tonnes
ADR 21 - Instrument Panel (1973)	-	201	
ADR ,22 22A - Head Restraints (1972)	R25/01+ R17/03+	202+	Lower limit of adjustment is specified
ADR 29 - Side Door Strength (1977)	-	214 (pre 1990)	
ADR 34 - Child Restraint Anchorages and Child Restraint Anchor Fittings (1976)	-	-	Unique attachment provisions for child restraints Now included in ADR 5/02
ADR 59/00 - Omnibus Rollover Strength (1992)	R66/00	-	
ADR 66/00 - Seat Strength, Seat Anchorage Strength and Padding in Omnibuses (1992)	R80/00+	-	
ADR 68/00 - Occupant Protection in Buses (1994)			Unique requirement
ADR 69/00 - Full Frontal Impact Occupant Protection (1995)		FMVSS208 (restrained only)	
ADR 72/00 - Dynamic Side Impact Occupant Protection (1999)	R95/01	FMVSS214 Dynamic	
ADR 73/00 – Offset Frontal Impact Occupant Protection (2000)	R94/01	-	

* Rules relating to crash avoidance or emission control have been omitted.
† Numbers indicate corresponding ECE Regulation of FMVSS
+ Indicates that ADR contains additional requirements