

**AUSTRALIAN ROAD RULES
7th AMENDMENT PACKAGE 2007**

**REGULATORY IMPACT
STATEMENT**

November 2007



**Prepared by
National Transport Commission**

National Transport Commission

Australian Road Rules 7th Amendment Package 2007

Report Prepared by: **National Transport Commission**

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Abstract:	<p>Part A: The Australian Road Rules currently require the use of approved child restraints up to an age of twelve months. Beyond this age children should be restrained by an approved restraint or seatbelt which is suitable for the passenger, but this is generally misinterpreted and applied as adult seatbelts are suitable for any child passenger over twelve months old. Clearly, accident research shows that dedicated child restraint systems reduce the risk of serious injury, compared with seatbelts. This regulatory impact statement assesses whether approved child restraints should be mandated for children over twelve months of age and recommends that child restraints be compulsory for children up to seven years of age.</p> <p>Part B comprises an assessment of a small group of miscellaneous amendments to the Australian Road Rules requested by the Australian Road Rules Maintenance Group to give better effect to the intent of the Rules.</p>
Purpose:	Approval by the Australian Transport Council.
Key words:	Child restraint, injury, accident, roads rules, roundabouts, pedestrian lights, level crossings, visual display units, signage.

FOREWORD

The National Transport Commission (the Commission) is an independent statutory body established by the *National Transport Commission Act 2003*. The Commission has on-going responsibilities to develop and maintain uniform or nationally consistent road, rail and intermodal transport reforms to improve safety, productivity and environmental outcomes.

The Australian Road Rules (the Rules) were developed by the Commission's predecessor, the National Road Transport Commission, in consultation with road transport agencies, police, road safety experts, motoring organisations, local government, members of the public and other interested parties. The Rules were approved by the Australian Transport Council in January 1999, along with a maintenance strategy to ensure they reflect the needs of stakeholders and meet community expectations for road safety.

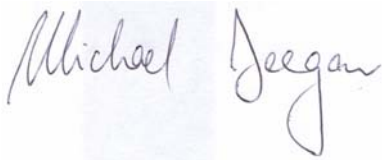
Since the national implementation of the Rules, road agencies have highlighted some aspects that require improvement and updating as well as to take account of subsequent innovations in engineering impacting on drivers. This is the seventh package of amendments to the Rules that have been developed by the Commission in line with the approved maintenance strategy.

The Commission has undertaken consultation with representatives from Commonwealth, State and Territory road transport and enforcement authorities, through the Australian Road Rules Maintenance Group, in order to identify and assess the need for the required changes. Furthermore, in relation to Part A the Commission engaged consultants (Road Safety Solutions Vehicle Design and Research Centre for Automotive Safety Research) to develop a detailed discussion paper on child restraints. That discussion paper provides the basis for Part A of this regulatory impact statement, with modifications and recommendations made by the Commission.

This regulatory impact statement, together with the proposed draft amendments, has been released for public comment. All submissions were taken into account and revisions were made where necessary. The majority of Transport Agencies Chief Executives has endorsed the amendment package.

The amendment package is now forwarded to the Australian Transport Council for approval.

The Commission acknowledges the advice and assistance of the Australian Road Rules Maintenance Group, the consultants, the Commission's Paul Salter for providing valued economic input to the regulatory impact statement and the Project Manager Greg Deimos in preparing this package of amendments.

A handwritten signature in black ink that reads "Michael Deegan". The signature is written in a cursive style and is positioned above a light blue rectangular stamp.

Michael Deegan
Chairman

SUMMARY

This regulatory impact statement is separated into two parts (Part A and Part B). Part A addresses child seat restraints and Part B deals with miscellaneous amendments to the Australian Road Rules (Rules) to address specific issues raised by the Australian Road Rules Maintenance Group.

Part A

The identified problem is that a proportion of children are being inappropriately restrained, due to either premature graduation to adult seatbelts, or premature graduation between forms of child restraint. The implication is that there are more deaths and injuries than otherwise would have been the case if children were appropriately restrained.

The identified causes of this are:

- there is a lack of knowledge and understanding regarding what constitutes an optimal transition between the child restraint devices that currently exist. This is to say, what constitutes a 'suitable' child restraint is not well understood;
- drivers do not interpret the current law as requiring the use of child restraints beyond the age of one year. This is because if the child is one year old but under 16 then the Rules (rule 266) provide two options. The first is that the child must be in an approved child restraint. The second is that the child must occupy a seat fitted with a suitable seatbelt and have that seatbelt properly adjusted and fastened. Some drivers/parents choose the second option on the belief that an adult seatbelt can be properly adjusted and fastened to suit young children. This is an incorrect assumption because adult seatbelts (by design) are meant to be used by persons who are approximately 145 centimetres tall or taller. Based on anthropometric data presented in section 6 of this regulatory impact statement, the majority of children reach this height in the age range nine to twelve years. It is without doubt that adult seatbelts are unsuitable (by design) to effectively restrain a child aged between one and seven years; and
- the level of enforcement activity and/or the level of penalties are insufficient to motivate compliance with the law.

The proposed reform aims to address causes one and two by better informing the content of existing education campaigns and by making the legal requirements more explicit and easier to understand. The third cause is to be addressed by States and Territories and is outside the scope of the national regulatory reform process. However, please note that if the third cause was the primary cause, then the National Transport Commission (Commission) would continue to promote the regulatory reform on the basis that the proposal introduces greater specificity to the regulatory requirement and accordingly can be expected to have benefits in terms of enforceability. Due to practical issues, enforceability of age requirements is preferred to other alternatives such as height and weight.

The regulatory proposal recommends passengers:

- not less than six months use a rearward facing child restraint;
- at least six months but less than four years old use either a rearward or forward facing child restraint;

- at least four years old but less than seven years old use either a forward facing child restraint or a booster seat;
- less than four years old not be placed in the front row of seats of a vehicle with two or more rows of seats; and
- at least four years old but less than seven years old not be placed in the front row of seats of a vehicle with two or more rows of seats unless all other seating positions are occupied by a passenger who is also less than seven years old.

The impact assessment undertaken in section 9 of this regulatory impact statement indicates that the proposed reform will be of net social benefit.

The Commission engaged consultants Road Safety Solutions Vehicle Design and Research for Automotive Safety Research to prepare a research paper, which provided the basis for this regulatory impact statement including advice on overseas requirements, expert stakeholders' views, anthropometry review, feasible options and a benefit cost analysis. The Commission added further advice on cost/benefits supporting the proposed recommendations.

The regulatory impact statement was released for public comment in May 2007. Submissions indicate general support for the regulatory proposal; however, some submissions suggested the proposed age of less than seven years old for prohibition from the front seat be increased to less than twelve years old. The Commission considered this change but believed:

- there was no definitive evidence that less than twelve was the appropriate age or whether it should be some other age;
- the only evidence supporting prohibition of children from the front seat is that all passengers (irrespective of age) are safer travelling in the rear seat;
- the proposed less than seven years old was in line with the current limits for booster seats; and
- an increase in the proposed age limit could place an unacceptable burden on the community. Further consultation and analysis would be needed to better understand potential impacts.

Advice that the Australian Standards pertaining to child restraints are under review was taken into consideration when determining the regulatory proposal. The Commission considers that a further review of rule 266 will be required when the revised standard is finalised. However, in the interim, the Commission recommends the proposed changes to the rule as a means of reducing the deaths and injuries associated with current practices of inappropriate child restraint.

The Commission has also received endorsement for the regulatory proposal from Transport Agencies Chief Executives with the exception of the Northern Territory who believed that implementing the regulatory proposal would create equity and accessibility issues for remote areas. Other jurisdictions, including Queensland and Western Australia who also have remote area issues, considered implementation through a staged approach to coincide with funding and education programmes would be better than providing an exclusionary provision.

The Australian Road Rules Maintenance Group also considered that including an exclusionary provision in the Rules would open the way for all States and Territories to modify the regulatory proposal which could lead to inconsistencies across the country.

Glossary

The following are the types of child restraints covered by this report. The type designations are from Australian/New Zealand Standard 1754:2004 (the Standard).

"Infant capsule" (Type A) is a rearward facing restraint for infants up to nine kilograms (or twelve kilograms). It has its own inbuilt harness system. These restraints are also known as rearward facing child restraints. They all use a top tether.

"Child seat" (Type B) is a forward facing seat for children between eight kilograms and eighteen kilograms. It has its own inbuilt harness system. These restraints are also known as forward facing child restraints. They all use a top tether.

"Booster seat" (Type E) is a device that increases the child's seated height when using a seatbelt. These restraints are also known as boosters. The Standard defines booster seats as being suitable for children between fourteen kilograms and 26 kilograms. Older style boosters were just a cushion. Recent designs have a seat back and some have side wings that support and protect the head. Some boosters use a top tether. The requirements for boosters in the Standard are under review.

"Convertible child restraint" is one that can be used in more than one mode. For example a restraint combining Type A and Type B, or combining Type B and Type E are commonly referred to as convertibles.

Part B

The Australian Road Rules Maintenance Group proposed an amendment to rectify an anomaly between rules 63, 72 and 73 and the application to roundabouts. The proposed amendments will make the give way provisions at roundabouts (with traffic lights that are not working) more consistent with roundabout rules rather than with give way rules for intersections without roundabouts.

The second proposal was raised by Western Australia and agreed by the Australian Road Rules Maintenance Group. Western Australia uses pedestrian lights on road-related areas to assist pedestrians cross railway lines in a safe manner. However, rule 231 only applies to pedestrians on a road at a level crossing and excludes a road-related area. It is intended to accommodate the Western Australian safety initiative in the Rules. This proposal also identified an anomaly in rule 235 which fails to require a pedestrian to move off a railway crossing if the warning devices begin to operate while the pedestrian is crossing the tracks or lines.

The New South Wales Police Service also raised with the Australian Road Rules Maintenance Group that it utilises mobile data terminals (visual display units) in everyday operations and requested an exemption from rule 299. The Australian Road Rules Maintenance Group canvassed and received limited feedback from other police and emergency services. Other police services also use mobile data terminals and some emergency services are either using mobile data terminals or intending to use them in the

near future. It is proposed to provide a similar exemption in rule 299 to that already contained in rule 300 for police and emergency vehicles.

The remaining two miscellaneous amendments relate to signs contained in Schedule 3; one is to remove a redundant sign (road access sign) and the other is to include another version of a school zone sign used in Western Australia.

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PART A – CHILD RESTRAINT SYSTEMS

1. INTRODUCTION

1.1 Regulatory strategy

The purpose of restraint systems is to offer protection to vehicle occupants when a crash occurs.

Initially restraint systems were designed for adults only, and laws mandating the use of restraints originally exempted all children under eight years.

Child restraint devices began appearing in Australia in the late 1960s. In-depth studies of crashes in the 1970s showed that some of these ‘child restraints’ were more dangerous than no restraint system at all. For example, some restraints appeared to elevate the child and assist the process of ejection. This information led to the development of Australian and New Zealand standards for child restraints and eventually regulation by the individual States and Territories mandating the use of child restraints approved to the standards. The standards contain design and performance requirements for dedicated child restraints that will cater for children from birth until a weight of 26 kilograms.

Currently there is no smooth continuity of effective restraint systems for children in vehicles from when they are born to when they are large enough to be provided with effective protection by rear seat adult seatbelt and airbag systems.

This regulatory proposal attempts to rectify this. It also provides potential for the development of and commitment to a long term strategy which takes account of all components of the protection system.

To achieve this, consideration was given to what constitutes optimal restraint for child occupants, and secondly to assist the decision-making process of the regulatory authorities by:

- identifying the various options for achieving optimal child restraint;
- presenting the advantages and disadvantages of these various options;
- identifying implementation issues surrounding the various options; and
- estimating the costs and benefits of the various options.

1.2 Current regulation and situation

Current Australian child restraint regulations require that children less than twelve months of age must use a dedicated child restraint. Children from twelve months to less than 16 years of age must use a suitable dedicated child restraint or a suitable seatbelt that is properly adjusted and fastened (unless exempt under the Rules). Education campaigns funded by governments encourage (and indeed recommend) the use of child restraints from the age of twelve months, but the regulations provide that an adult seatbelt can be used as an alternative to a child restraint, only if it is ‘suitable’ and is properly adjusted and fastened. Research shows that a seatbelt alone is ‘not suitable’ for any child under 140 centimetres tall (about twelve years of age).

However, the wording of the regulation is often misinterpreted to mean that a child twelve months and above can use an adult seatbelt.

There is a large body of research demonstrating that children are much safer when restrained in size-appropriate restraint systems than in restraint systems designed for adults. Australia has had dedicated child restraint systems since the 1980s and surveys indicate that a significant proportion of parents make routine use of such devices. However, recent local and international research has revealed that the use of size-appropriate restraint systems drops dramatically from the age of approximately two years so that by the age of five or six years most children are using adult seatbelts; described as premature graduation to seatbelts. Recent Australian research has also identified a significant proportion of children aged between two and four years are prematurely graduating to booster seats.

Restrained children are better protected in a crash than children using no form of restraint; however, studies investigating the scope for reducing the frequency and severity of child occupant casualties have identified practices of premature graduation as being a potential target for enhancing child occupant protection levels in Australia. Scientifically robust studies have demonstrated that children using adult seatbelts when a size-appropriate restraint could be used are significantly increasing risk of serious injury compared to children using size-appropriate restraints.

1.3 Objective and method

This draft regulatory impact statement (for consultation) considers the merit of explicitly extending the mandatory use of dedicated child restraint systems to children beyond the age of one year¹.

The objective is to reduce fatalities and serious injuries occurring due to premature graduation of children from rearward facing dedicated child restraints through to adult seatbelts.

This regulatory impact statement has been developed through:

- collection of science based expert views on what are the most appropriate restraint systems for children of different ages and sizes;
- collation of the views of organisations who have a stake or are advocates for child car occupant safety;
- review of legislation in this area in other developed countries;
- review of available Australian child occupant casualty and restraint use statistics;
- review of available information on children's anthropometry; and
- identification of bridging gaps where there might be a lack of smooth transition for children from one restraint system to the next.

¹ It is noted that implicitly this is use of child restraints beyond the age of one year is already required. However, what constitutes a 'suitable' form of restraint is not given due consideration by a proportion of drivers.

This information was then used to develop options for effecting a situation where the most appropriate form of child restraint is applied by drivers. A cost benefit analysis of the various options was then performed.

Advantages and disadvantages of the various options are discussed and recommendations are provided for amendment of the Australian Road Rules.

2. EXISTING AUSTRALIAN CHILD OCCUPANT REGULATION

2.1 Introduction

This section provides information on what the current legislation for the use of child restraint systems is in Australia and the process and information used in the original formulation of the legislation.

An attempt was made to find out how the States and Territories derived the original twelve months regulation, what material was used to support the regulation at the time, and how that regulation became adopted into the Australian Road Rules.

As there is little documented history of these processes, research primarily involved direct consultation with some of the people who had been involved in the original process. This discussion is, therefore, relatively brief and more of an anecdotal nature.

2.2 Current legislation

The current legislation requires that all children less than twelve months of age be restrained in dedicated child restraint systems in motor vehicles. The following has been extracted from the Australian Road Rules.

Rule 266 Wearing of seatbelts by passengers under 16 years old

- (1) The driver of a motor vehicle (except a bus or motor bike) that is moving, or is stationary but not parked, must ensure that this rule is complied with for each passenger in or on the vehicle who is under 16 years old.

Offence provision.

Note **Bus**, **motor bike**, **motor vehicle** and **park** are defined in the dictionary.

- (2) If the passenger is under 1 year old, and not exempt from wearing a seatbelt under rule 267, the passenger must be restrained in a suitable approved child restraint that is properly fastened and adjusted, unless the driver is exempt from this subrule under subrule (5).

Note **Approved child restraint** is defined in subrule (7).

- (3) If the passenger is under 1 year old, and the motor vehicle has 2 or more rows of seats, he or she must not be in the front row of seats.
- (4) If the passenger is at least 1 year old but under 16 years old, and is not exempt from wearing a seatbelt under rule 267:
 - (a) he or she must be restrained in a suitable approved child restraint that is properly adjusted and fastened; or
 - (b) he or she:
 - (i) must occupy a seating position that is fitted with a suitable seatbelt; and
 - (ii) must not occupy the same seating position as another passenger (whether or not the other passenger is exempt from wearing a seatbelt under rule 267); and
 - (iii) must wear the seatbelt properly adjusted and fastened.

- (5) The driver of a public minibus or taxi is exempt from subrule (2) in relation to a passenger if:
- (a) there is no suitable approved child restraint available in the minibus or taxi for the passenger; and
 - (b) if the minibus or taxi has 2 or more rows of seats — the passenger is not in the front row of seats; and
 - (c) there is not another law of this jurisdiction requiring all passengers in a minibus or taxi who are under 1 year old to be restrained in an approved child restraint.

Note **Public minibus** and **taxi** are defined in the dictionary.

- (6) For this rule:
- (a) an approved child restraint is available in the motor vehicle for a passenger if an approved child restraint is fitted in the vehicle and is not occupied by someone else under 16 years old; and
 - (c) an approved child restraint or seatbelt is suitable for a passenger if it is suitable for restraining, or to be worn by the passenger.

- (7) In this rule:

approved child restraint means a child restraint approved, for the Australian Road Rules, under another law of this jurisdiction.

2.3 Derivation of original regulations for use of child restraint systems

The earliest attribution of twelve months as an age at which it was reasonable for a child to be restrained in an adult seatbelt appears to relate back to information and education media interviews participated in by Dr Michael Henderson in the days of the New South Wales Traffic Accident Research Unit in the late 1970s. This was at a time when child restraints first started being required to be sold in accordance with an Australian and New Zealand standard and at a time when seatbelt availability and regulations were not much more than a decade old in Australia. At a media interview possibly around 1977 (personal observation Griffiths 1977) the question was put, at what age was it safe (not necessarily optimal) to put a child in an adult seatbelt; Michael Henderson reportedly replied twelve months. There does not appear to be any published research to support the original choice of twelve months.

Regarding the use of seatbelts by young children, Ian Johnston, in a 1975 Melbourne/Canberra study for the then Federal Office of Road Safety found that only about 60 percent of all children under eight were restrained by any form of restraint, not even a seatbelt. Fewer than 20 percent of under-eights had a child restraint available, with half of those being unapproved. Hence nearly any form of restraint was an improvement (Henderson, personal communications).

In the context of there being no alternative restraint, this was (and still is) the safest course of action.

It seems that this *twelve months* became translated into New South Wales regulations at some time after that.

By the time the Australian Road Rules were being compiled, twelve months was the requirement in most Australian State and Territory regulations. It is reported that no State or Territory was required to relax existing regulations to comply with the new requirements.

2.4 Identification of problem with status quo

Australian child occupants have very high restraint usage rates (approximately 95 percent). However, recent Australian research (Brown et al, 2005; Edwards et al, 2006; Charlton et al 2006) has reported many children use restraints that are not the most appropriate for their size. Research (Brown et al, 2006; Durbin et al 2003, Arbogast et al 2004) has demonstrated that this practice carries a significantly increased risk of injury compared to when a child is using the most optimal form of restraint for their size.

Approximately 500 child occupants are killed or seriously injured, and a further 2,500 sustain minor injuries in Australia (Australian State and Territory Statistics, see section 9). There is therefore significant scope for reducing these casualty figures by ensuring appropriate restraint use.

The primary problem is that children are being inappropriately restrained, due to either premature graduation to adult seatbelts, or premature graduation between types of child restraints. As stated above, this implies more deaths and injuries than would otherwise be the case if children were appropriately restrained.

The reasons why children are being inappropriately restrained include:

- there is a lack of knowledge and understanding regarding what constitutes an optimal transition between the child restraint devices that currently exist. This is to say, what constitutes a ‘suitable’ child restraint is not well understood;
- drivers do not interpret the current law as requiring the use of child restraints beyond the age of one year; and
- the level of enforcement activity and/or the level of penalties are insufficient to motivate compliance with the law.

Drivers do not interpret the current law as requiring the use of child restraints beyond one year because if the child is one year old but less than 16 years old the Australian Road Rules, rule 266(4), provides two options. The first is that the child must be in an approved child restraint. The second is that the child must occupy a seat fitted with a ‘suitable’ seatbelt and have that seatbelt properly adjusted and fastened.

Statistics about restraint usage (presented in this regulatory impact statement) indicate that some drivers/parents interpret this rule as requiring that children over 12 months need only be restrained in a seatbelt. This is incorrect; the intention underlying the use of the word ‘suitable’ is being overlooked by drivers making this misinterpretation. Adult seatbelts (by design) are meant to be used by persons who are at least 140 centimetres tall. To apply an adult seatbelt to a person under this height is not ‘suitable’ and it was intended (by the drafters of rule 266) that child passengers under this height be required to use an approved child restraint. However, the less than explicit nature of the regulatory requirement is a problem.

Education and communication activities regarding child restraints are extensive and have been developed and refined over a period of many years, however, such activities cannot be inconsistent with the law. Accordingly, drivers are made aware that rule 266(4) of the

Australian Road Rules provides two options and that it is up to drivers to make judgements about whether an adult seatbelt can be used to provide suitable protection to their child. Unfortunately, drivers make poor judgements despite the provision of advice that makes it clear that young children cannot be suitably restrained by an adult seatbelt.

The National Transport Commission is of the view that it is not the effectiveness of the communication and education activities that are undertaken by road agencies that is the problem, but rather, the problem lies with the ambiguity of the law that the education material must faithfully follow. At present, the education is saying that a child up to four years should be in an approved restraint and the legislation only requires this explicitly up to the age of one and provides an option from one to sixteen years (a subjective test left to the driver to determine). Education materials then go on to explain how to determine what constitutes a suitable restraint. Because the law is not 'black and white' the corresponding education materials are also not permitted to be so. For example, materials can't say that it is an absolute requirement to restrain children aged from one to four years in a child seat. If education materials were to do so they would be misrepresenting the law.

While it is acknowledged (above) that a cause of unsuitable child restraint may be insufficient enforcement activity and/or penalties, the issue is not relevant to what the National Transport Commission is proposing in this regulatory impact statement because the setting of penalties and the investment in enforcement activity is made at the discretion of jurisdictions. In any case, the expert opinion that the National Transport Commission is relying on (apart from its own beliefs) is that non-compliance can be attributed to a lack of knowledge regarding what constitutes suitable child restraint and a complementary misinterpretation of the legal requirement to ensure that a suitable child restraint is applied.

3. SUMMARY OF OVERSEAS REGULATIONS

This section reviews the current regulatory environment in other developed countries. Details were collected directly from international regulatory authorities and/or active child restraint researchers in each individual country.

3.1 New Zealand

New Zealand has required for several years that all children up to the age of five years be in dedicated child restraint systems.

At the time of its introduction it would appear to have been world leading regulation. Apparently, no robust surveys of current compliance with the regulations were available.

New Zealand requires that restraints be approved to the Australian and New Zealand standard, but it also allows restraints to be approved to a variety of other standards. Some of the restraints approved to other standards would not comply with some of the requirements of the Australian and New Zealand standard.

Some of New Zealand's boosters comply with European Regulation 44/03 which results in better positioning of the lap and sash parts of the seatbelt on the child.

A difficulty that New Zealand consumers face is that approximately one third to one half of its vehicle fleet does not have top tether anchorages. Parents and carers have to get anchorages retrofitted. The necessary brackets are reportedly sold by most vehicle retailers, and New Zealand vehicle safety engineers report that retrofitting is a readily available routine service.

3.2 Canada

The regulations in Canada vary from province to province.

The Province of British Columbia's regulations are typical of many Provinces. They require that children from zero to nine kilograms (approximately nine months of age) be in dedicated rear facing child restraint systems.

Children from nine to eighteen kilograms (approximately nine months to three to four years) are also required to be in dedicated child restraint systems; however, if there is no child restraint system in the car, then they are allowed to be in the **lap** part of a seatbelt.

Children from eighteen kilograms to six years of age are required to be in the **lap** part of a seatbelt.

It is reported that from 2007 the provinces of Nova Scotia, Ontario and Quebec will have laws which generally require children up to nine years of age to be in booster seats. Other provinces may be considering similar laws. This has some consistency with the trend to boosters for children up to a height of 1.45 metres in the United States.

3.3 United States of America

All United States jurisdictions have unique regulations for the use of child restraint systems, that is, there is no uniform national regulation.

A consistency is that every one of the jurisdictions requires that a child be correctly restrained in a Federal Standards approved dedicated child restraint system until the age of three years.

There is a growing trend toward jurisdictions requiring the use of dedicated child restraint systems for children over 40 pounds (eighteen kilograms). Currently, half of the States have such laws in place and nearly all have similar legislation in the process of being implemented. It is envisaged that within a year or so (i.e. by 2007/2008) most, if not all of the United States will incorporate a requirement of this nature.

There is also a new wave of consumer laws targeting children up to higher age/weight ranges of either 60 pounds (27 kilograms – six years), or 80 pounds (36 kilograms – eight years).

This is effectively a seatbelt geometry positioning booster law.

In the United States, boosters have to pass the same tests as forward facing child seats, but this is not as good as it sounds because the United States' standard does not incorporate side impact tests. The United States also does not have a child restraint system consumer program with published dynamic tests. This compares poorly with the Australian requirement where dynamic side impact tests have been part of the Australian and New Zealand standard for over twenty years. In recent years, side protection requirements were strengthened with the dynamic test, including a car door surrogate, since the 1990s.

Booster seats are currently being promoted heavily by child safety researchers and advocates in the United States. To some degree, it appears similar to the enthusiasm for booster seats which occurred in Australia in the 1980s.

The booster seats available in the United States appear to be relatively similar to the booster seats currently available in Australia. Many do not appear to be any better than those available in Australia.

Booster seats have no side impact test requirements in the United States or Australia, so there is potential for less protection in side impacts compared to child seats. However, the 2004 Australian Standard made it compulsory for side impact testing increasing side-wings for some booster seats.

With respect to enforcement in the United States mostly, the restraint policing requirements are what they call *secondary* enforcement requirements. That is, the vehicle has to have been stopped for infringing a *primary* enforcement regulation, such as speeding, before the police officer can take action on any *secondary* enforcement items.

Another relevant factor in the United States is that mandatory fitment of three point seatbelts in rear outboard seating positions, and then the voluntary fitment of three point seatbelts in the centre rear seating positions, did not occur to the same extent as in Australia. This means that a significant proportion of their family vehicles (particularly for lower socio-economic sectors) may still have two point seatbelt systems available in the rear seating positions. This might mean that some of the findings of United States based research into rear seat safety for children have to be reviewed for their relevance to Australian vehicles with a longer history of lap/sash (three point) seatbelts.

3.4 United Kingdom

The United Kingdom is a member of the European Union and is therefore influenced by European directives.

From September 2006 the United Kingdom has new requirements for child restraint system use.

Before September 2006, children from zero to three years of age were required to be in dedicated child restraint systems. It was recommended in the legislation that children from three to eleven years of age, or less than 1.5 metres high, also be in dedicated child restraint systems, but the regulations allowed the use of adult seatbelts for those children.

Since September 2006, the requirements are:

- dedicated child restraint systems for children from zero to three years of age; and
- for children older than three years of age, the regulations require the use of a dedicated child restraint system up to 1.35 metres or twelve years (whichever is reached first) for the front seat. For the rear seat the requirements have reduced the height requirement, made dedicated child restraint systems mandatory, and added an exemption for *short distance...unexpected necessity* journeys which allow the use of adult seatbelts.

In summary it appears the United Kingdom has lowered its recommended child height requirement, added a short distance exemption, but toughened up recommendations and regulations for child restraint systems in rear seats. Children between 1.35 metres (nine years) and 1.5 metres (twelve years) can now travel legally in the front seat in an adult seatbelt.

Note their rules as expressed could be interpreted to imply 1.35 metres corresponds to twelve years age, however current child anthropometry indicates a correspondence of 1.35 metres to nine years, whereas the United Kingdom regulations previous recommendation of 1.5 metres corresponds better to twelve year old child anthropometry.

This is based on the recent European Directive 2003/20/EC, which allowed the option of dedicated child restraint systems up to either 1.35 metres tall or 1.5 metres tall. Each country was allowed to choose which of the heights it introduced into its regulation.

3.5 Europe (European Union)

New regulations were introduced into Europe this year. All countries were required to have adopted the regulations at some time in 2006. There was a significant option in the regulations with respect to the upper child height limit for dedicated child restraint systems. Countries could choose either 1.35 metres or 1.5 metres.

Most countries have chosen to opt for a dedicated child restraint system requirement for children from zero to 1.35 metres (approximately nine years of age).

The alternative was to mandate the use of dedicated child restraint systems for children up to 1.5 metres tall (approximately twelve years of age).

3.6 Germany

Germany requires that children under twelve years of age or under 1.5 metres use a dedicated child restraint system.

Klaus Langwieder reported that:

- compliance is good for children up to their sixth birthday; and
- restraint usage surveys for children older than six years indicate:
 - six to ten percent – no restraint;
 - 30 percent – booster; and
 - 80 percent – adult seat belt.

3.7 France

France requires that children under twelve years of age and under 1.35 metres use a dedicated child restraint system.

3.8 Italy

Requirements state that children from zero to three years of age must use a dedicated child restraint system.

For children up to 1.5 metres in height, there is a requirement that they use an appropriate restraint. It was ambiguous as to whether an appropriate restraint might be an adult seatbelt.

It was observed that enforcement and compliance were currently low.

3.9 Spain

Children from zero to three years of age are required to be in a dedicated child restraint system.

Children from three years to 1.5 metres tall are required to be in a dedicated child restraint system if in the front seat, or may use an adult seatbelt if they travel in the rear seat.

This appears to be more rigorous than the requirements in the United Kingdom.

It was observed that enforcement and compliance were currently low.

3.10 Sweden

Regulations require that children up to 1.35 metres in height must be in an appropriate child restraint system.

Practice is that children up to two years are generally in rear facing restraints.

Sweden reports relatively lower levels of enforcement by police officers, but high levels of compliance.

3.11 Switzerland

Switzerland requires that children from zero to seven years of age be in dedicated child restraint systems approved to Economic Commission for Europe regulation 44.

For children from seven to twelve years of age (1.5 metres tall), dedicated child restraint systems are recommended by the authorities, but the regulations allow the use of seatbelts.

It is reported that good educational programs exist for parents and carers, but that there is considerable scope for stronger enforcement (personal communication Felix Walz).

3.12 Japan

Children from zero to five years of age are required to be in a dedicated child restraint system.

This potentially sounds like world leading regulation; however, it is relevant that Japan has only just introduced requirements for three point seatbelts in the rear of new vehicles. This means that a large proportion of the Japanese vehicle population only has two point seatbelts in the rear seating positions.

Their child restraint systems do not have top tether anchorages.

Both of the above significantly limit the potential effectiveness of dedicated child restraint systems and safe child restraint in the rear seat.

3.13 Israel

Israel is an active participant in the International Standards Organisation Committee for Child Restraint Systems.

Children from zero to one year of age are required to be in rearward facing dedicated child restraint systems.

Children from one to three years of age are required to be in dedicated child restraint systems, with the occupant restraint harness being provided by the child restraint system (that is, it cannot be a booster seat where the restraint is supplied by an adult seatbelt).

Children from three to eight years of age are required to be in a dedicated child restraint system, or a booster which allows the restraint part of the system to be from the adult seatbelt.

3.14 Overview

From the compilation of overseas regulations above it can be seen that fairly common requirements for developed countries are:

- children up to three or four years of age to be in dedicated child restraint systems with their own inbuilt harness; and
- children up to either 1.35 metres, 1.45 metres or 1.5 metres tall to be in a booster style seat.

Compared to Australia's requirements for restraint of children up to twelve months of age, it is very evident that Australia's requirements are lagging well behind the world's best practice.

It needs to be remembered that regulations are only one factor in broader road safety strategies which shape community practice. Ultimately it is what the community's actual practices are which will control the number of children injured on a country's road system. Some examples of road safety strategy variations in a country might have mandatory use of child restraint systems up to:

- the age of five years, but if those restraint systems are to a significantly lower standard than that prescribed in Australia, the overall effect in injury to reduction may not be much different; and
- a height of 1.45 metres, but if the regulations can only be enforced as a secondary offence, parents may not perceive much likelihood of being caught.

Whatever the variations in regulatory enforcement and education strategies, it is unavoidably evident that Australia's existing regulatory environment is lagging well behind the world's best practice.

The Australian Road Rules Maintenance Group believed the Australian Road Rules may not be keeping up with world's best practice, which led to this review.

4. EXPERT AND STAKEHOLDERS' VIEWS

4.1 Europe

Most European experts consulted thought the new European regulations were satisfactory, however, many pointed to significant scope for improvement in the area of compliance and enforcement. Generally they identified good compliance for the first two years of the child's life, and then poor compliance for children beyond that. Their personal opinion was that their current levels of restraint usage had been achieved through education and peer pressure rather than enforcement.

Sweden reported most of its children are travelling in rearward facing restraints until their second birthday; however, this was a result of earlier education programs, with there being not much in the way of enforcement by police.

In the opinion of many European experts, the broadening of mandatory child occupant legislation to include the use of dedicated child restraints in their local jurisdictions appears to have made no significant change to the way children are travelling in cars compared to the period prior to legislative change.

4.2 North America

The Children's Hospital of Philadelphia's Traumalink group is conducting possibly the most well funded ever review of the performance of child restraint systems. Their research has two main sources of data. The large database is compiled from detailed telephone interviews with occupants of vehicles involved in crashes resulting in an insurance claim. The other database is in-depth investigations of selected individual crashes where a child occupant is reported injured in the telephone interview database. Their hospital base gives them good access to quality medical data. They supplement this with surveys and partnerships with sled and crash tests. Based on all this work into the level of protection provided to children using different forms of restraint, they recommend the following:

- children should be rear facing until they are at least one year old or nine kilograms (20 pounds); and
- children should then be in dedicated forward facing child seats until they weigh eighteen kilograms (40 pounds) or the upper weight or size limit of the available child seats; and
- children up to a height of 57 inches (1.45 metres) should then be in booster seats.

It may be worthwhile to note that the above recommendations are based on their work that has illustrated a reduction in injury risk between children of specific age groups in forward facing child restraints compared to adult seatbelts and boosters compared to adult seatbelts (it is assumed they also compared rear facing to forward facing child seats). They do not appear to have compared forward facing child seats to boosters. A probable consequence of this is there is no evidence specifically related to the transition from forward facing child seats to boosters. Their recommendation for the upper limit of eighteen kilograms appears to be based on accepting the existing child restraint system type designation, rather than, say, reviewing whether there is a need to change child restraint system types and size ranges. This becomes important to keep in mind with respect to this report's ultimate recommendation for increasing size limits of forward facing child restraints.

In North America, national bodies indicated satisfaction with the current national guidelines. Regulations and their enforcement are a matter of individual provinces and states in Canada and the United States. Experts reported good take-up by the provinces and states of the national recommendations for regulation. Enforcement varied widely, and it needs to be remembered that as a generalisation in the United States, restraint wearing laws can only be enforced after the vehicle has been stopped for a different primary offence, such as speeding.

4.3 Australia

There is widespread consensus among Australian road safety advocates and child occupant protection experts that there is a need for changes to the current legislation. Local research has demonstrated that significant numbers of Australian children fail to use the most appropriate form of restraint for their size and it has been well established that this practice carries an increased risk of injury potential.

The focus of the debate among Australian experts is not whether the law should be changed, but what should the law be, and how should it be written.

4.3.1 Prince of Wales Medical Research Institute

In New South Wales the Prince of Wales Medical Research Institute has recently conducted a number of laboratory and real world studies of the performance of child restraint systems. They provided recommendations on optimal transitions but noted that not all optimal transitions may be achievable with child restraint products currently available. This is particularly true if age based definitions of optimal transitions are used.

Specifically they reported that some of the current forward facing child restraints are not large enough to accommodate all four year old children, and some current booster seats are not large enough to accommodate all eight year old children, precluding mandatory use of these restraints by a small proportion of children within these age groups. The optimal transitions, in terms of age and size (with respect to current child restraint type designations) recommended were as follows (Table 1).

Table 1. Transition

Transition	Size Range	Transition Criteria	Age Criteria
Rearward facing	Until too long for capsule (70 centimetres)	Baby is too long to fit in capsule or weighs more than nine to twelve kilograms. If using rear-facing convertible restraint, keep rear-facing as long as possible (up to twelve months).	Zero – nine months
Forward facing child seat	Eight – eighteen kilograms	Child's eye level is above the top of the back of the child seat, shoulders are above the top set of shoulder strap slots or when the child weighs more than eighteen kilograms.	Nine months – four years

Transition	Size Range	Transition Criteria	Age Criteria
Booster	Eighteen kilograms plus Eye level above back of child restraint or shoulders too wide	When the child can achieve good belt fit without the booster i.e. child's legs are long enough to have their back firmly against the seat, and their knees bend in front of the edge of the seat cushion. This ensures the seatbelt fits across the hip bones, and not over the soft abdomen. Usually, this is about 145 centimetres tall and the sash (shoulder strap) passes across the centre of the shoulder, NOT across the bottom or side of the neck.	Five years – at least eight years
Adult seat belt	Height > 145 centimetres, (and meet belt fit guidelines)		

The Prince of Wales Medical Research Institute made specific recommendations. They recommended the following two stage approach.

Immediate implementation (2007)

- Require approved child restraint systems (rear facing child restraint system or forward facing child restraint system) for children up to 36 months. This will accommodate beyond the 97th percentile of 36 month olds within the current weight specifications for Type B forward facing child restraints.
- Require approved child restraint systems or booster seat for children aged four to six (inclusive).
- Children aged seven or older who are less than 145 centimetres tall should be encouraged to continue to use booster seats until good belt fit is attained through educational campaigns.

Longer term implementation (2009)

Once changes to Australian and New Zealand Standard 1754 are completed and some time has elapsed to allow for the provision of improved restraints on the market and retirement of older restraints, the second stage of legislative change should:

- Require approved child restraint system (rear facing child restraint system or forward facing child restraint system) for children up to 60 months.
- Require approved child restraint system or booster seat for children aged five to eight years (inclusive).

The Prince of Wales Medical Research Institute went further, recommending improvements to assessment procedures within the Australian standard. Specifically these related to how well booster seats promote and maintain good belt fit for the entire range of child occupants who would be using them. They also expressed a need for more stringent requirements with respect to anti-misuse features.

4.3.2 Centre for Automotive Safety Research

Based on a recent analysis of optimum transitions, and accepting the weight limits in the current Australian Standard, the Centre for Automotive Safety Research, Adelaide University, provided similar recommendations. They recommended:

- rearward facing infant restraints for boys up to the age of seven months and for girls up to the age of nine months, or eight months overall;
- forward facing child seats with their own inbuilt harness for children up to their fourth birthday; and
- use of currently available boosters for children up to six years of age.

4.3.3 South Australia Health Epidemiology

The Director of Epidemiology from South Australian Department of Health recommended development of better child restraint systems (in this regard they have actively lobbied Standards Australia for a better category of booster seats). Their approach was to say that the injury statistics indicated a need for better restraint of child car occupants, but no specific detail was provided.

4.3.4 Monash University Accident Research Centre

The work of Monash University Accident Research Centre on child restraints has been cited elsewhere in this review.

Monash University Accident Research Centre agreed that revised regulations should require the use of dedicated forward facing child restraint systems for children up to the age of three or four years old.

With respect to regulation of use of boosters, Monash University Accident Research Centre reported that boosters suitable for children up to 32 – 36 kilograms currently exist in Europe, so did not see the need for a three year lead time to extend regulations for the mandatory use of boosters suitable for children up to the age of eight years.

They agreed that because age was the easiest criterion for parents to use, this must be an important factor, however they went on to propose that a child's seated height is the critical factor in ensuring head protection. In support of this, they cited the use of height in many places throughout the United States regulations, (e.g. Washington). They provided further citations in support of the proposition that height is the most important factor.

They concluded that regulation should be expressed in age and height.

4.4 Summary discussion

Both the Prince of Wales Medical Research Institute and the Centre for Automotive Safety Research recommended that while size is definitely the important characteristic for appropriate restraint choice, guidelines given to parents and carers may be more clearly understood if they are given in terms of age. A similar view was expressed by the Children's Hospital of Philadelphia and the Monash University Accident Research Centre thought age and height should be used.

This review ultimately recommends that age should be the criteria for forward facing child seats and seated height should be the criteria for boosters.

The discussion leading to that recommendation is discussed in detail in a later chapter.

The Children's Hospital of Philadelphia believes the currently available child restraints do a good job and they did not recommend any change.

If age based transition definitions are used, both the Prince of Wales Medical Research Institute and the Centre for Automotive Safety Research noted a need for modifying the type designations within the Australian and New Zealand Standard for Child Restraints. Based on these concerns, a detailed review of anthropometric issues has been compiled and is presented in a later chapter.

With respect to improved levels of protection, the Centre for Automotive Safety Research noted that it would be desirable to require higher levels of side impact protection from booster seats but cautioned that this might carry some disbenefits in terms of cost and the number of children that could use restraints in the rear seat of a vehicle. Similar comments were made by the Prince of Wales Medical Research Institute.

5. SHOULD REGULATIONS SPECIFY RESTRAINT USAGE BY AGE OR SIZE

5.1 Background

There are currently inconsistencies in Australian regulations and standards with respect to suitability and sizing of child restraint systems.

For example Australian and New Zealand standards for child restraint systems specify their suitability by child height and weight. In contrast, the current Australian regulations mandating the use of a child restraint in a vehicle specify an age criteria, which is twelve months.

Overseas regulations mandating the use of child restraints in vehicles specify a mix of child age, weight and height.

This is potentially confusing to parents and carers because whilst the regulations are specified in terms of age, they have to purchase child restraints by child weight or height.

The purpose of this section is to review the available material and make recommendations on what form of age or size specification will lead to the highest level of best fit or lowest level of incorrect fit.

In terms of achieving optimum compliance with a safe environment, it is desirable to make:

- the choice of the most appropriate restraint system simple for parents and carers; and
- enforcement of child restraint usage regulations practical and simple for enforcement officers.

In terms of optimising safety, the science based approach to this was to review what proportion of children will be correctly and incorrectly restrained by a regulatory system which specified restraint usage and transitions by age, weight or height.

Fortuitously in Australia, Adelaide University's Centre for Automotive Safety Research had just recently finished such a project. As this is the most recently available review, and it is of a comprehensive nature, a summary of that review follows here.

5.2 Centre for Automotive Safety Research – summary of research

Advice to parents and regulation would be much simplified if restraint selection could be specified on the basis of age. The trend in recent times has been to recommend restraint selection on the basis of a child's size (usually weight, but also height). However, there is evidence that using size is problematic because parents have difficulty remembering such advice and may not know the weight or height of their children (Edwards, Anderson and Hutchinson, 2006). Age specifications have been used less recently because it has been thought that they are too crude given the variations in size amongst children of particular ages. However, some of this variation might be handled by the current transitional weight ranges between successive restraint types. Furthermore, the magnitude of the misclassification that using age would produce, has not been estimated until recently.

Robert Anderson and Paul Hutchinson from the Centre for Automotive Safety Research at the University of Adelaide have recently analysed human growth data to estimate the effect

on correct restraint selection (based on the weight of the child) when selection is made on the basis of age (Anderson and Hutchinson, 2006). The circulation of this paper in draft form has already had considerable influence on the shaping of expert opinion in Australia. The paper is currently under review for publication in an academic journal, but the general thrust of the findings is outlined below.

Anderson and Hutchinson (2006) present a method for estimating the misclassification of children by mass, when advice is posed in terms of age, and applied it to detailed child growth data published by the Centre for Disease Control and Prevention.

They found that in Australia, guidelines instructing all parents to promote their children from an infant restraint to a forward facing child seat at six months, and then to a belt-positioning booster at four years, would mean that five percent of all children under the age of six would be using a restraint not suited to their mass. Improved co-ordination between age based advice and the selection of mass ranges covered by restraint types in the Australian and New Zealand standard on child restraints (i.e. redesigning the standard) could reduce this level of misclassification to less than one percent.

They noted the misclassification that age advice could produce is transient. The misclassification is most acute and greatest around the infant carrier-to-child seat transition, and persistent but lesser at the child seat-to-booster seat transition. The transitions are more difficult for girls; this arises because girls' masses vary more within each month cohort than do boys' masses.

The misclassification was reduced somewhat by altering the age recommendation for transition from the infant carrier to the child seat. Given the current standard, seven months of age for boys and nine months for girls was optimal. Eight months of age used for both sexes produced a similar level of misclassification.

Regarding the misclassification of children around the child seat-to-booster seat transition, Anderson and Hutchinson estimated that about one-in-five children who are in their 47th month of life may have exceeded the maximum mass of the child seat (eighteen kilograms). An examination of the growth data for the 47th month of life showed that about one half of the 'too large' children are between eighteen kilograms and nineteen kilograms, and a further quarter is between nineteen kilograms and 20 kilograms. The 95th percentile mass of 48 month old children is about 20 kilograms.

Anderson and Hutchinson note that one approach to improving the accuracy of classifying the child using their age would be to amend the design of dedicated child seats. They note that advice given to the public is seen as being consequential to the relevant standard and that this need not be the case. They argue that it is possible to optimise the requirements of the design standard based on the transition ages that are thought most appropriate. Noting that many children who would be misclassified using their age, given current design criteria, are within one kilogram of the current mass limits contained in the standard, small amendments to the standard may further minimise the misclassification when selecting a restraint according to the child's age.

Furthermore, the approach taken in the Australian and New Zealand Standard could be seen as being predicated on the basis that the restraints will be promoted on the basis of age alone, that the mass limits are not included for direct promotion or advertisement, but to cater for variations in children's sizes at a nominated transition age. It is arguable that the promotion of the actual mass ranges defeats one of the important purposes of the standard.

A potential limitation of the analysis lies in the assumption that the human growth data compiled by the United States Centre for Disease Control and Prevention represents children in the Australian population. While the use of the United States Centre for Disease Control and Prevention data is well established in Australia (e.g. Department of Human Services, State Government of Victoria, 2006) differences in the actual distribution of children's masses in Australia would affect the results of this analysis. Anderson and Hutchinson note that their results are valid for populations of children, for whose masses, the United States Centre for Disease Control and Prevention data are descriptive.

5.3 The transition from the booster seat to the adult belt

Anderson and Hutchinson restricted their study to the transition between the major classes of child restraints and did not address the transition from the booster seat to the adult belt. They note that the transition from a booster to an adult belt presents the most difficult transition of all.

“The problem comes about because the standards used in adult belt restraint design (for example, the United States Federal Motor Vehicle Safety Standard 210) are not formulated in relation to child restraint design standards, and are based around the dimensions of a 5th percentile adult female (Stalnaker, 1993). The results of a study on children's height and appropriate fit of an adult belt (Klinich et al., 1994) reflect this. Klinich determined that children were only appropriately restrained by an adult belt once they had reached 145 cm tall. If true, this implies that little dimensional transition (if any) exists between current booster seat designs in Australia and an adult belt, and it may not be currently possible to recommend a transition age except for the “least bad” advice of “not until the child has outgrown the booster”. However, given a minimum for the size of a child appropriately restrained by an adult belt, the methods outlined in this paper could be used to determine the consequences of a transition to the adult belt at any particular age.

“In other countries there has reportedly been a move to increase the size of booster seats to allow a better transition, but while booster seat use for older children remains low, the problem will persist. In Europe and North America, the height of a child (145 cm) and/or the child's age (typically 8 years) is used to suggest when progression to the adult belt should occur. However, such promotion is not without problems. For example, a cursory examination of growth charts will show that about half of all 11 year olds have not yet reached a height of 145 cm. It is exceedingly rare that a child of 8 years will be more than 145 cm: advice calling for booster seat use until the child has reached this height or until the child is 8 years of age [...] may be confusing and is certainly internally inconsistent.” (Anderson and Hutchinson, 2006)

5.4 Discussion and summary

The Centre for Automotive Safety Research review found that it is feasible to use age to specify child restraint transitions and hence future regulation in the area. However, transition from seatbelt geometry booster devices to adult seatbelts is less straightforward, and it is not clear if it would be feasible to design boosters and seatbelts in a way that would allow age to be used to specify the timing of the transition. As a consequence, the Centre for Automotive Safety Research recommends seated height as the best available indicator for appropriate restraint in an adult seatbelt.

These issues are discussed further in the following section.

6. ANTHROPOMETRY REVIEW

6.1 Objectives of this section

- To review the anthropometric data that is relevant to the restraint of child occupants.
- To compare these data with child restraint standards.
- To review biomechanical research.

6.2 Anthropometric data

6.2.1 Sources of anthropometric data

The primary source of anthropometric data for children is the Centre for Disease Control and Prevention of the United States Department of Health and Human Services. For historical reasons this is known as CDC.

United States Centre for Disease Control and Prevention publishes growth charts (stature and mass) for male and female children based on statistical surveys. These are regularly reviewed and adjusted, with the last review in 2000 (<http://www.cdc.gov/growthcharts/>).

There are no equivalent Australian databases of child growth. Subject to some precautions, the Victorian Department of Human Services uses the 2000 United States Centre for Disease Control and Prevention growth charts to assess and monitor the growth and health of Australian children (<http://tinyurl.com/ykjbbz>). Loesch and others (2000) report that a trend for increase in stature of Australian children over the past century has slowed in the past two decades, but a trend for increase in body weight has continued at a high rate (around 1.7 kilograms per decade for twelve year olds). This trend will need to be taken into account in future reviews of child restraint standards but should not significantly affect the current project.

For the purpose of assessing the suitability of restraint systems for children, it is necessary to obtain anthropometric data about other relevant dimensions such as seated height to crown of head, seated eye height, seated shoulder height and leg dimensions. These are not available from United States Centre for Disease Control and Prevention.

In 1975 and 1977 the United States Consumer Products Safety Commission (CPSC <http://www.cpsc.gov/>) commissioned surveys to establish anthropometric data for designing equipment for children. The United States Institute of Standards and Technology reports that the original subject data for the 1975 study does not exist but has made the original subject data for the 1977 study available for researchers (<http://tinyurl.com/ynyvdb>). The figure illustrates the key dimensions available from the 1977 data, in addition to stature and mass.

It should be noted that all references are to erect sitting height rather than the typical posture of a child in a car (Figure 1).

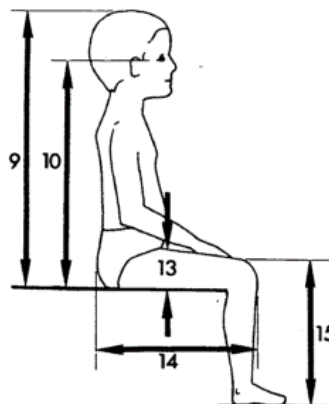


Figure 1. Measurement for Consumer Products Safety Division databases

The University of Michigan Transport Research Institute has been conducting recent research on the anthropometrics of child passengers in vehicles. Matthew Reed has provided anthropometric data for downloading (<http://tinyurl.com/ycfnuv>). Reed cautions that the 1975/77 Consumer Products Safety Division data may need to be adjusted to suit the current United States child population. In a 2003 Society of Automotive Engineers (United States) paper *Comparison of child body dimensions with rear seat geometry* and a recent Stapp paper (Reed 2006), Reed describes methods for doing this. The results of these studies are used later in this section.

Reed has also provided a database of recent anthropometric data for 62 children seated in vehicles. The University of Michigan Transport Research Institute is using these data to assess seatbelt and seat geometry for children. Results of that study are also used later in this section.

The concept of percentiles is frequently used in anthropometric research. Percentiles rank the position of an individual by indicating what percent of the reference population the individual would equal or exceed. For example, on the weight-for-age growth charts, a five-year-old girl whose weight is at the 25th percentile weighs the same or more than 25 percent of the reference population of five-year-old girls, and weighs less than 75 percent of the five-year-old girls in the reference population (United States Centre for Disease Control and Prevention description).

For design purposes, fifth percentile and 95th percentile values are typically used to indicate the smallest and largest person to accommodate, although it should be noted that one in 20 (i.e. 5 percent) would typically be equal to or smaller than the fifth percentile value and one in 20 would typically be equal to or larger than the 95th percentile value.

Due to the difficulties in defining the physical characteristics of car seats most regulations and standards that refer to seated occupants use the 'H-point'. This a virtual point that approximates the hip pivot point on the adult human body. The H-point is determined with the use of an 'H-point machine' as defined in the Society of Automotive Engineers J826 (Figure 2).



Figure 2. Use of H-point machine

Child seats tend to be more rigid than car seats and the standards usually refer to the surfaces of the restraint for measurement purposes. In the case of the Australian and New Zealand standard, height measurements are defined in the plane of the seat back; from a point 100 millimetres forward of the seat back (see Figure 10).

6.2.2 Child weight and height

Figure 3 shows data from the United States Centre for Disease Control and Prevention Growth Charts together with the weight and length limits applying to Australian child restraints. Table 3 lists the intersection of these limits with the percentile bands of the United States Centre for Disease Control and Prevention Growth Charts (see also Table 2 CDC Growth Chart child weight for age).

Table 2. CDC Growth Charts – child weight (kg) for age

	Percentile	Age									
		1	2	3	4	5	6	7	8	9	10
Male	5	8.6	10.7	12	13.5	15.1	16.8	18.7	20.6	22.6	24.8
	50	10.3	12.7	14.3	16.2	18.3	20.7	23	25.6	28.5	31.9
	95	12.4	15.2	17.4	20.1	23.4	26.8	30.8	35	40.2	45.8
Female	5	7.9	10.2	11.6	13	14.6	16.3	18.1	20	22.2	24.7
	50	9.5	12.1	13.9	15.8	17.9	20.2	22.7	25.6	28.9	32.9
	95	11.4	14.6	17.2	20.3	23.6	27.3	31.3	35.9	41.5	47.9

Table 3. Weight and length limits of the Australian Standard compared with Centre for Disease Control United States growth charts

Limit	Type of Restraint	95 percentile	50 percentile	5 percentile
9 kilograms - Boys	A Infant max, child seat min	5 months	8 months	13 months
9 kilograms - Girls	A Infant max, child seat min	7 months	10 months	16 months
70 centimetres - Boys	A Infant max, child seat min	5 months	8 months	11 months
70 centimetres - Girls	A Infant max, child seat min	6 months	9 months	13 months
18 kilograms - Boys & Girls	B Child seat max	3.25 years	5 years	7 years
14 kilograms - Boys	E Booster seat min	2 years	3 years	4.5 years
14 kilograms - Girls	E Booster seat min	2 years	3 years	5 years
26 kilograms - Boys	E Booster seat max	5.5 years	8 years	10 years
26 kilograms - Girls	E Booster seat max	5.5 years	8 years	10.5 years

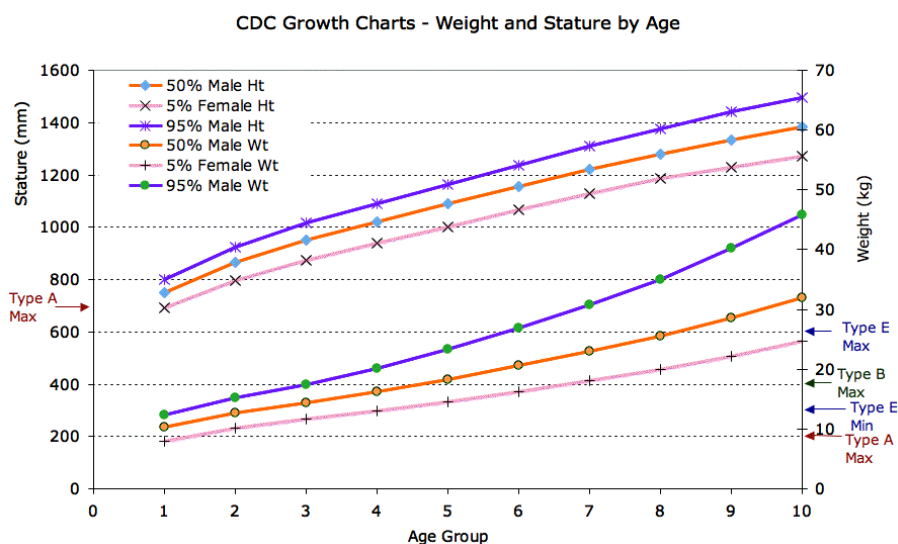


Figure 3. Growth chart data for child height and weight

These data illustrate wide range of ages that can be expected for children of the same stature or weight. As discussed, in Section 5, this can lead to confusion about the appropriate restraints to use for children.

6.2.3 Other anthropometric data

The anthropometric data are from a variety of sources and may use different measurement techniques. The data may not be representative of the current Australian child population and therefore should be regarded as indicative only.

Reed and others (2005) have made available anthropometric data on 63 United States children aged from five to eleven. Figure 4 shows the relationship between stature (standing height) and weight for these children (University of Michigan Transport Research Institute) and for the 1993 Australian Child Accident Prevention Foundation Australia study. Also shown are the current maximum weights for child seats and booster seats specified in the Australian standard and the minimum stature recommended by National Highway Safety Traffic Administration for use of adult seatbelts without a booster.

It is evident from this chart that large proportions of children exceeds the 26 kilogram limit of booster seats but are still too short to use an adult seatbelt. This issue is addressed in more detail later in this section.

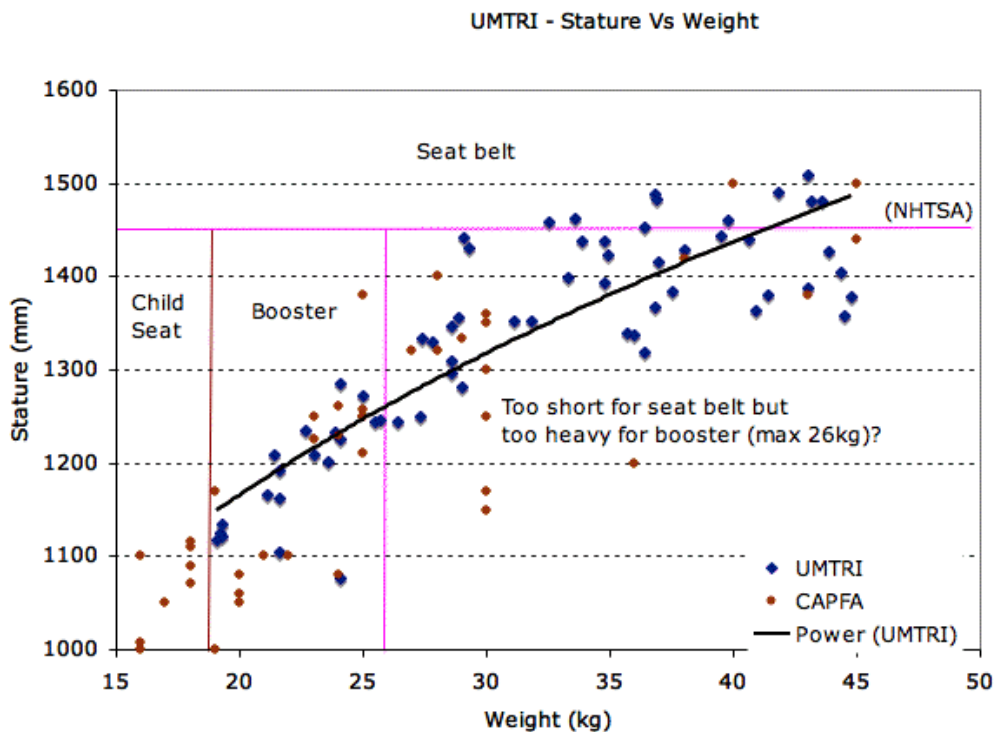


Figure 4. Relationship between weight and height with restraint criteria

These data confirm that the National Highway Traffic Safety Administration stature recommendation of 1450 millimetres covers a large age range (nine to twelve years) and that the Australian booster standard maximum weight of 26 kilograms excludes most children five years and older.

We have analysed the 1977 Consumer Products Safety Division data in order to establish whether there is good correlation between each of the key anthropometric measurements. For example, Figure 5 shows the correlation between stature and sitting height (crown of head). This analysis suggests that there is good correlation between the key anthropometric dimensions. It is therefore reasonable to use proxy dimensions for the purpose of ensuring optimal restraint usage. In effect, this is already done in the United States where the National Highway Traffic Safety Administration recommends that children under 1450 millimetres should be in boosters or child seats. In this case stature is a reasonable proxy for both sitting height (associated with sash belt fit) and buttock to popliteal length (associated with seat cushion longitudinal depth – but see item on Huang's research below). Notably eye height (above the seat) also has good correlation with these two dimensions – the potential use of this eye height measurement is discussed later in this section.

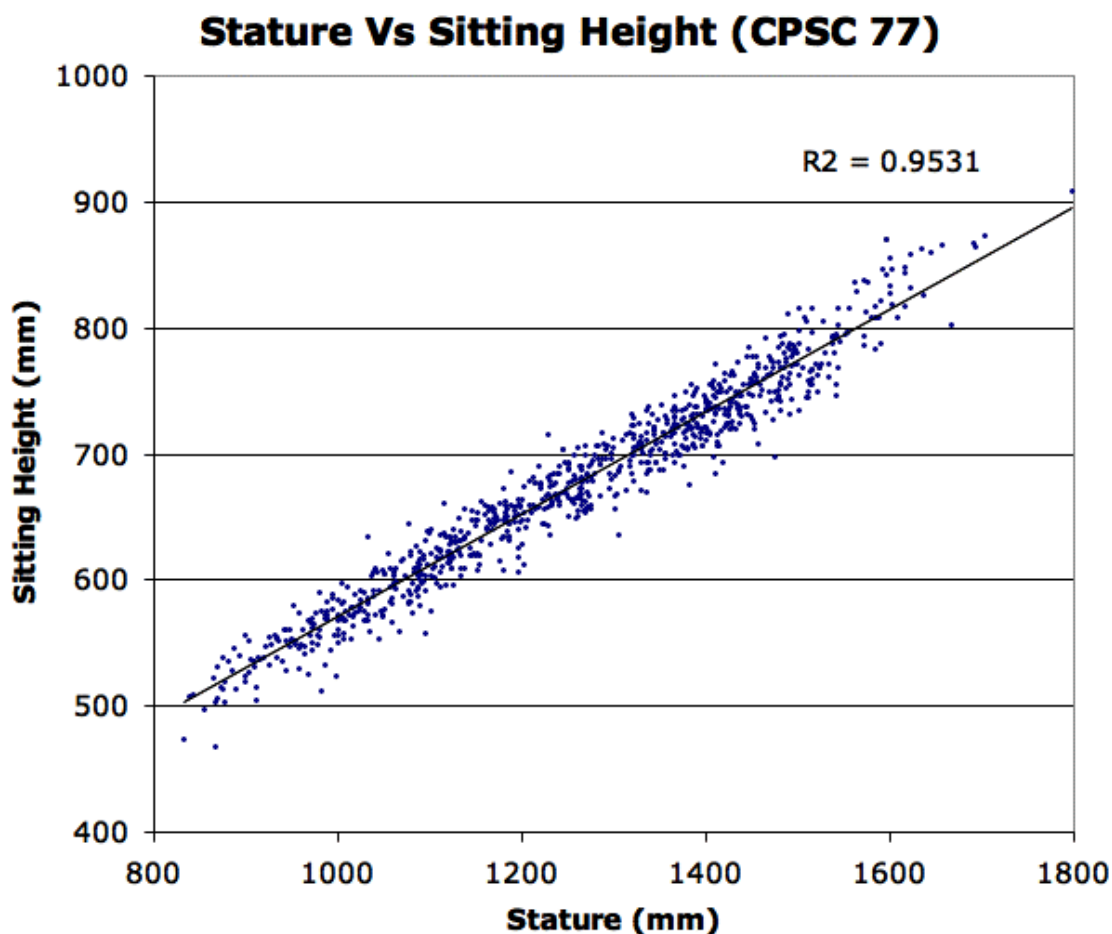


Figure 5. Correlation between stature and sitting height

These same data can give an indication of the effects of mass limits in the Australian and New Zealand standard and the number of exemptions that would be needed if an age based regulation had mass exemptions.

Table 4. Estimated percent of population exceeding certain weights

1977 CPSC Data			Estimated Australian population	
	Age (years)	% Exceeding	Number exceeding	out of
Exceeding 18kg (Type B limit)	2	0.0%	0	247899
	3	3.2%	8192	256001
	4	37.8%	97954	259140
Exceeding 20kg (Possible Type B limit)	3	1.6%	4096	256001
	4	14.6%	37834	259140
	5	31.9%	83033	260293
Exceeding 22kg (Possible Type B limit)	3	0.0%	0	256001
	4	6.1%	15807	259140
	5	14.3%	37221	260293
Exceeding 26kg (Type E limit)	4	0.0%	0	259140
	5	2.2%	5726	260293
	6	5.9%	15359	260332
	7	31.8%	84509	265752
Exceeding 32kg (Possible Type E limit)	5	0.0%	0	260293
	6	3.0%	7809	260332
	7	2.3%*	6112	265752
	8	27.4%	73606	268636
	9	41.2%	113302	275006
Exceeding 36kg (Possible Type E limit)	6	0.0%	0	260332
	7	1.1%	2923	265752
	8	11.3%	30355	268636
	9	21.6%	59401	275006

* Less than six year old – possibly due to the sample sizes (ranging from 62 to 91 per age group)

Several overseas jurisdictions specify restraint requirements relative to the stature of the child rather than age (as proposed elsewhere in the regulatory impact statement age based requirements will be used in the Australian Road Rules). Table 5 and Figure 6 set out the results of an analysis of the 1977 Consumer Products Safety Division dataset to determine stature by age.

Table 5. Stature by Age (1977 Consumer Products Safety Division data)

Age	Stature (m)				
	<1.35	1.35+	1.4+	1.45+	1.5+
7	97%	3%	0%	0%	0%
8	77%	23%	3%	2%	0%
9	44%	56%	24%	6%	0%
10	14%	86%	56%	22%	6%
11	2%	98%	86%	50%	18%
12	0%	100%	96%	84%	60%

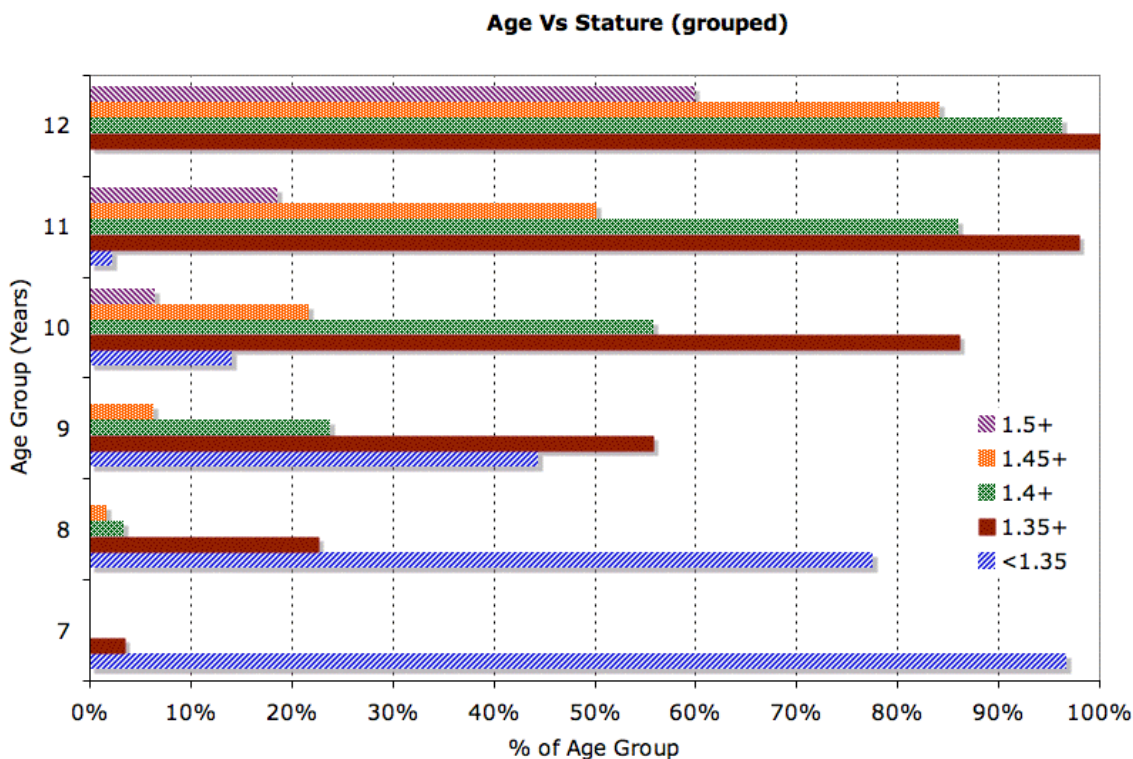


Figure 6. Percent of children exceeding given stature for each age group

6.3 Biomechanical research

The work of Reed and others (2005) builds on previous studies of child anthropometrics and restraint use. Klinich and others (1994) conducted some of the research that led to National Highway Traffic Safety Association’s 1450 millimetres stature recommendation. This provided documentation showing that the longstanding problem of excessive cushion depth has not been fixed. Excessive cushion depth causes children to slouch and the lap

portion of the seatbelt to ride up over the abdomen (Figure 7). This can result in serious abdominal and sometimes lower spinal injury.



Figure 7. Illustrations from Klinich (1994) and Huang (2006) showing slouched posture and lap belt riding up to abdomen

Bidez and others (2001) point out that a gap in protection exists for children who have outgrown booster seats but are still too small for an adult seatbelt. They support this conclusion with case studies of injured children.

Parenteau and Viano (2003) give illustrations of misuse of adult seatbelts and boosters, particularly when children fall asleep. They suggest side wings for lateral head support, measures to reduce slouching and an adjustable "sleep mode" for child restraints.

Arbogast and others (2004) analysed crash data to determine predictors of abdominal injury risk in children. They concluded that the risk of four to eight year olds was "virtually eliminated with the use of a child restraint or belt-positioning booster".

Malott and others (2004) conducted sled tests with six year old dummies to evaluate the protection provided by booster seats and lap/sash seatbelts. They concluded that improved designs were needed for side impact protection. They cautioned that the Hybrid III dummy's neck lacked biofidelity and tended to show a higher risk of injury than is reflected in real-world data.

Huang and Reed (2006) investigated the issue of knee length and seat cushion depth. They found a substantial mismatch between seat design and occupant characteristics. Mean seat cushion depth was found to be 471 millimetres for cars (seat cushion depth 20 millimetres). On average, male upper legs (buttock to popliteal length) do not reach this length until age fifteen. The mean of seventeen year old females is just 450 millimetres. The mean of females who are eighteen years or more is just 480 millimetres which indicates that typical rear seats are too big for almost half of the adult female population.

Bilston (2006) is currently undertaking a research project in Australia that is similar to the Huang/Reed research but is looking at sash belt positioning in addition to seat cushion depth. Initial (as yet unpublished) results support the conclusions of Huang and Reed – that for typical vehicles, seat cushion depth is likely to be excessive for children who are twelve years of age, leading to slouching and increased risk of abdominal injury. In regard to sash belt positioning the research is in reasonable agreement with the National Highway Traffic Safety Administration recommendation of a minimum stature of 1450 millimetres.

Figure 8 illustrates the problem with rear seat cushion depth, using data from Huang and Bilston. For reference, the BPL dimensions of dummies specified in Economic Commission for Europe regulation 44 are also shown. Bilston refers to ergonomic sources which recommend that, for comfort, a seat cushion depth no more than 95 percent of the buttock to popliteal length. This means that a greater proportion of the population than illustrated would be too small for current rear seats in cars.

Huang and Reed (2006) use statistical distributions of buttock to popliteal length, rear seat occupant age and car seat dimensions to better estimate the proportion of the population who are too small for rear seats in current cars. This confirms that most rear seats are too big for most occupants of these seats.

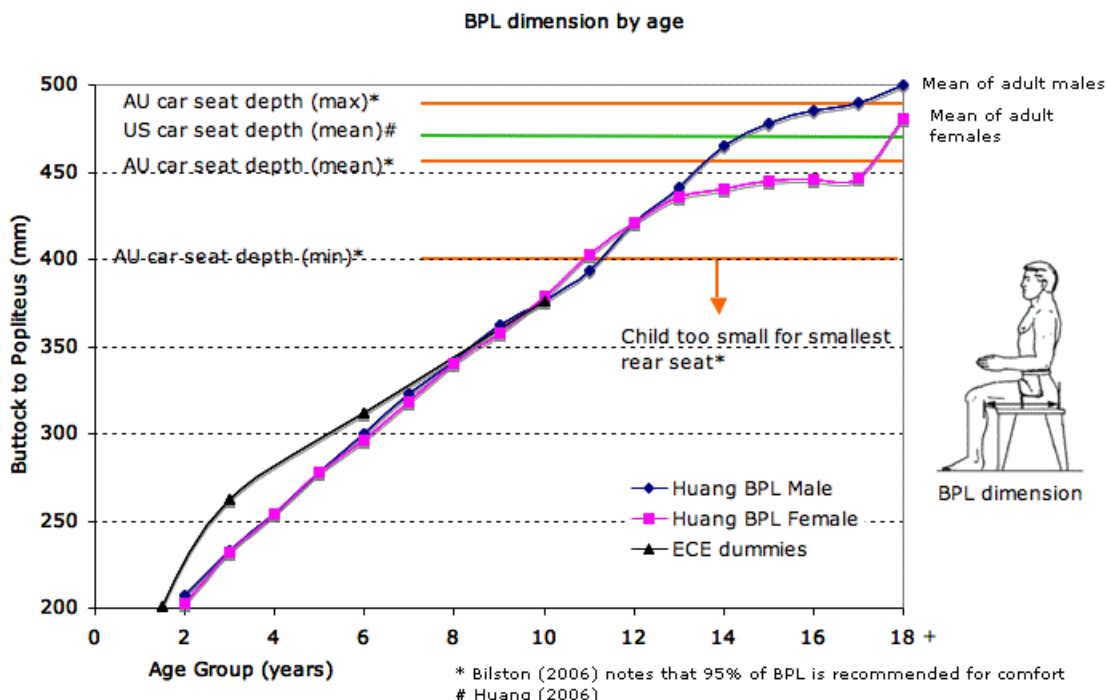


Figure 8. Rear seat cushion ergonomics

It could be suggested that an Australian and New Zealand Standards Type C restraint – a ‘forward facing harness without chair, suitable for children whose mass is within the range fourteen kilograms to 32 kilograms’ might bridge this gap. However, most child restraint experts do not favour accessory harnesses for the following reasons:

- Accessory harnesses have the lap part of the adult seatbelt threaded through them. This results in the lap part of the belt being lifted up off the pelvis when the shoulder straps of the harness are tightened for normal adjustment or loaded in a crash. When the lap belt is lifted up it loses engagement with the child’s pelvis. The lap belt then directly loads the abdomen where serious injury to abdominal organs can result. On some occasions this can load through to the lower spine and cause significant spinal damage.
- The need to correctly thread the lap portion of the seatbelt is a potential source of misuse.

6.4 Ergonomic issues associated with child restraint standards

The Australian and New Zealand standard primarily categorises restraints by the weight of the child. Table 3 sets out the age ranges for these breakpoints. Figure 4 illustrated the gap in protection for children who weigh more than 26 kilograms (too heavy for a booster) but are too short for a seatbelt (stature under 1450 millimetres). The eye height criteria are discussed in the next section.

Table 6 sets out the results of an analysis for 1977 Consumer Products Safety Division United States data for children aged two to twelve, to determine the most appropriate restraint:

- A. Weigh eighteen kilograms or less (child seat optimal).
- B. Weigh >eighteen kilograms but seated eye height <540 millimetres (too heavy for child seat but too short for booster).
- C. Weigh eighteen kilograms to 26 kilograms and seated eye height 540 – 650 millimetres (booster optimal).
- D. Weigh >26 kilograms but seated eye height <650 millimetres and stature <1450 millimetres (too heavy for booster but too short for seatbelt).
- E. Seated eye height 650 millimetres plus or stature 1450 millimetres plus (seatbelt optimal).

Table 6. Analysis of appropriate restraint, based on weight, stature and eye height

	2	3	4	5	6	7	8	9	10	11	12
A. CHILD SEAT OPTIMAL	100%	97%	63%	32%	12%	2%	0%	0%	0%	0%	0%
B. TOO HEAVY FOR CHILD SEAT BUT TOO SHORT FOR BOOSTER	0%	3%	35%	55%	55%	26%	13%	2%	0%	0%	1%
C. BOOSTER OPTIMAL	0%	0%	2%	11%	30%	43%	24%	16%	10%	1%	0%
D. TOO HEAVY FOR BOOSTER BUT TOO SHORT FOR SEAT BELT	0%	0%	0%	2%	6%	31%	65%	74%	72%	55%	17%
E. SEATBELT OPTIMAL	0%	0%	0%	0%	0%	0%	2%	7%	18%	44%	83%
SAMPLE SIZE	35	64	83	93	69	89	63	98	82	93	108

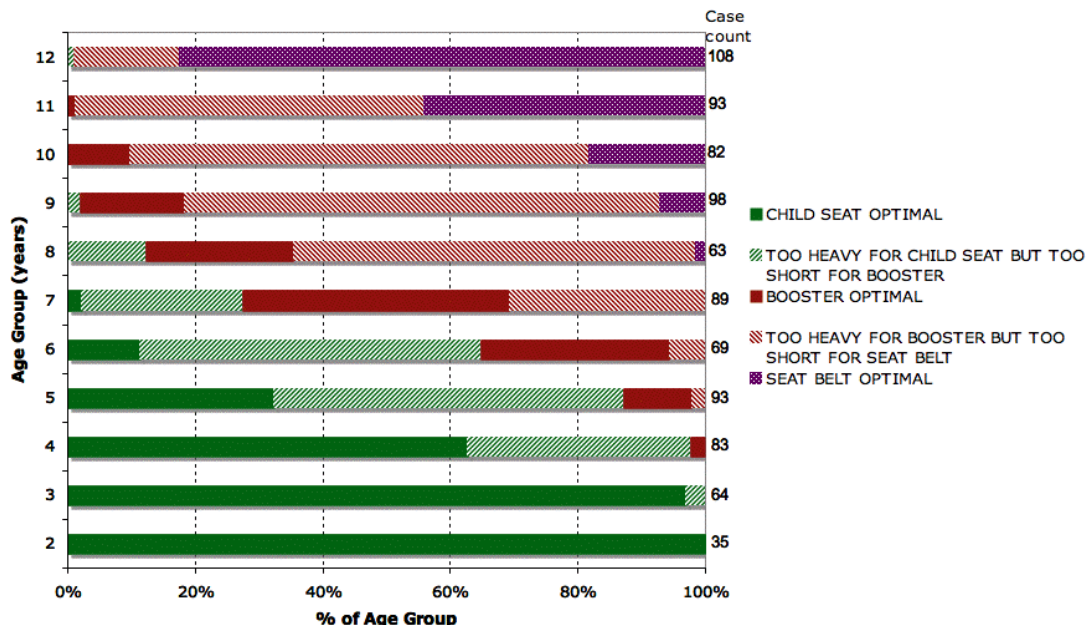


Figure 9. Analysis of restraint type by age group (United States data from 1997)

This analysis indicates that most children aged between seven and eleven are too short for a seatbelt and should be in a booster seat, if one was available for their size.

Further analysis was carried out to determine the effects of some of the weight limits in Australian and New Zealand Standard 1754.

Table 7. Estimate of children with weight between 14kg and 18kg (overlap between Type B and Type E)

Age 2	Age 3	Age 4	Age 5	Age 6
31%	67%	55%	32%	12%

Table 8. Estimate of children with weight between 26kg and 36kg and stature less than 1450mm

Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
2%	3%	28%	49%	58%	48%	39%	11%

The cases in Table 7 would be affected if the upper limit for boosters was raised from 26 kilograms to 36 kilograms. Note there are also cases where weight exceeded 36 kilograms but the child was too short for a seatbelt; these make up the balance of row D in Table 6.

6.5 Shoulder strap slot height

Australian and New Zealand Standard 1754 set requirements for the height of the shoulder strap slots (Figure 10). The standard requires the product to be marked with the words ‘The shoulder straps must be in slots which are nearest to the child’s shoulders, but not more than 25 millimetres below the child’s shoulders’. This means that a forward facing child seat (‘Type B’ restraint) can have the topmost slots at a minimum of 350 millimetres above the seat base and that a child with a shoulder height of no more than 375 millimetres could use that child seat.

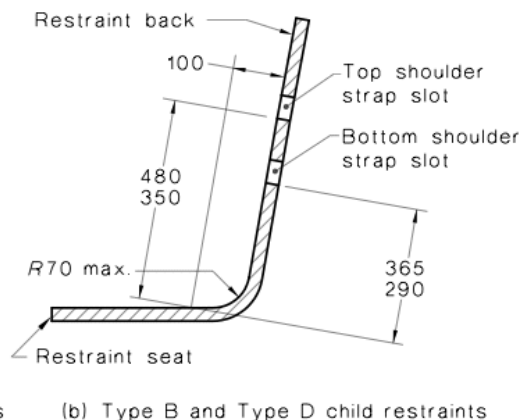


Figure 10. Extract from AS/NZS 1754 showing shoulder strap slot heights for a child seat (copyright Standards Australia)

Figure 11 illustrates the likely anthropometric distribution of the seated shoulder height of children, based on the 1977 Consumer Products Safety Division database and Economic Commission for Europe regulation 44 dummy dimensions.

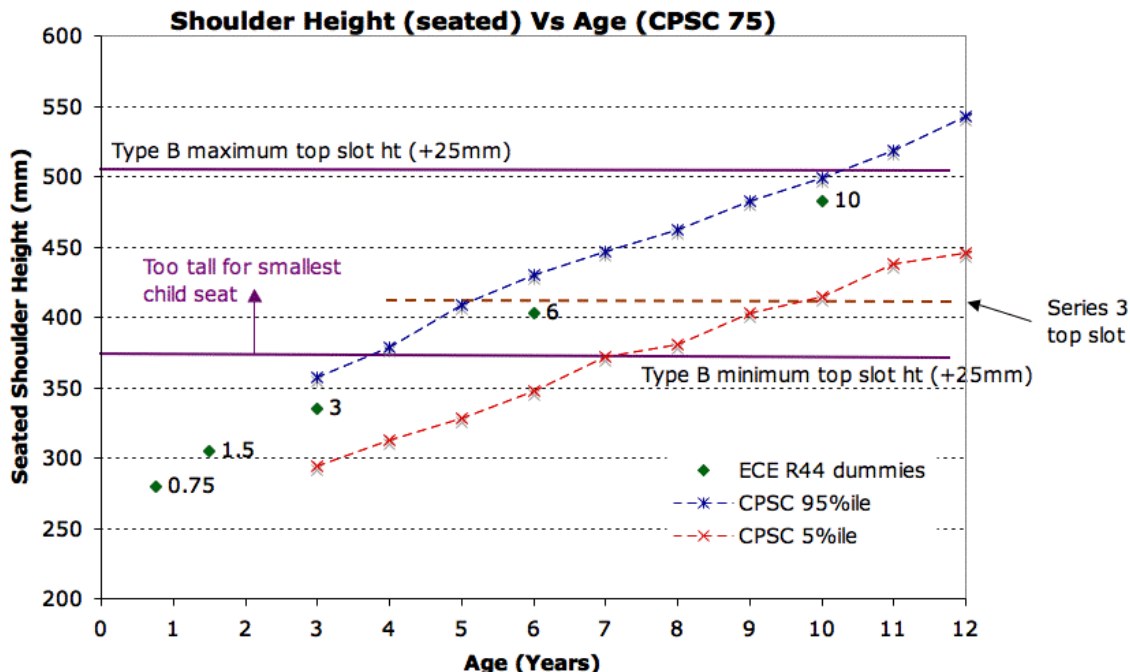


Figure 11. Seated shoulder height for children

The horizontal line at 375 millimetres shows the maximum child shoulder height for a child seat that is built to the minimum value permitted in the Standard. This spans an age range from three and a half years to six and a half years (95th percentile to fifth percentile respectively). Note that more detailed anthropometric data would be needed to accurately determine these points.

It is unlikely that any Australian child seats are being designed to this minimum requirement (Bilston 2006 advises that a more detailed analysis of Australian child restraint dimensions is being conducted). However, one concern expressed by experts is that, with child restraints that convert from rearward facing to forward facing, there is pressure to keep the design as compact as possible due to the limited space in rearward facing mode. This compromise could result in the child seat being unsuitable for large three year olds and about one third of four year olds. This could be rectified by changing the standard to require a minimum top slot height of 390 millimetres, to cater for the 95th percentile five year old (with an estimated shoulder height of 410 millimetres). Further anthropometric research would be needed to refine detail of this proposal.

6.6 Head support in rear impact

Australian and New Zealand Standard 1754 require that Type B restraints (child seat with integrated harness) ‘accommodate a TNO P6 dummy’. No clear guidance is given on satisfactory ‘accommodation’ of the dummy.

To prevent serious neck injury it is important that the centre of gravity of the head be no higher than the top of the child restraint (along the centreline). Eye position is a reasonable proxy for head centre of gravity. In the case of the TNO P6 dummy the seated eye height is 536 millimetres. It is therefore preferred that any Type B restraint be at least 536 millimetres from the seat cushion to the top of the seat back.

Figure 12 shows an analysis of child eye heights against approximate measurements of three Australian child restraints. It should be noted that seated eye height is for erect posture and that child restraint heights are measured parallel to the seat back (as illustrated in Figure 10). This results in a more optimistic outcome than the actual situation of the child and seat being reclined, as illustrated in Figure 13. Alternatively the erect heights could be adjusted by angle of the seat back to a length corresponding to seat back length.

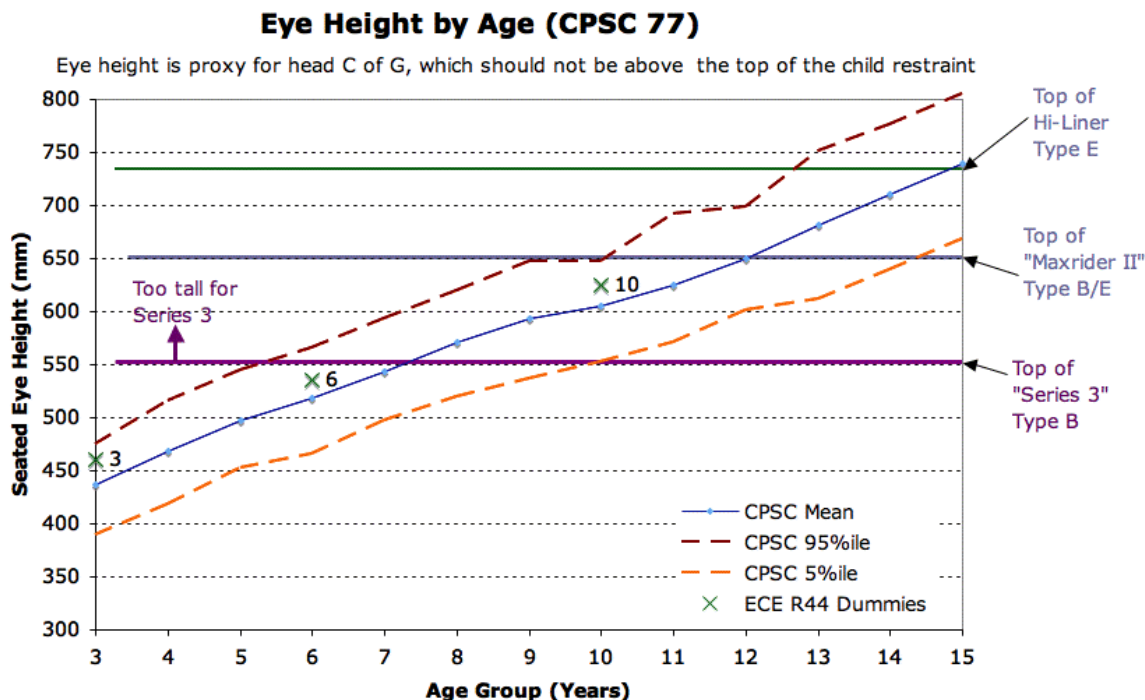


Figure 12. Child restraint back height and child eye height



Figure 13. Illustration of less favourable geometry with inclined seat and child

Pending the outcome of Bilston's current research, Figure 12 suggests that a typical child restraint with a height of 550 millimetres is marginally suitable for the TNO P6 dummy but would probably accommodate a 95th percentile five year old. A Maxirider II convertible child seat/booster with a height of 650 millimetres would probably accommodate a 95th percentile ten year old.

6.7 Key findings from anthropometric research

1. The move from rearward facing capsule/convertible to forward facing child seat generally takes place between six to nine months and occurs when the infant is too long

- (tall) for the restraint or exceeds the nine kilogram limit of the Australian and New Zealand standard.
2. Optimally, children should stay in a child seat (with integrated five or six point harness) until at least their fifth birthday. However, 50 percent of children five years of age are likely to exceed the eighteen kilogram weight limit of the Australian and New Zealand standard (five percent of three year olds weigh more than 17.3 kilograms).
 3. Some current designs of child seats (particularly convertibles) may be inadequate for many children older than two years. There is a need to make the standard more stringent to ensure that child seats are suitable for older children. In the meantime it may not be practical to regulate the use of child seats beyond three years of age.
 4. The current Australian and New Zealand Standard requirement that boosters be labelled that they are suitable for children from fourteen kilograms to 26 kilograms may be encouraging parents to use boosters for children as young as two years of age, based on the lower weight limit of fourteen kilograms. This is clearly inappropriate.
 5. Optimally, children who are too big for a child seat should use a booster seat until they are at least 1450 millimetres tall. Typically most children do not reach this height until they are about twelve years of age.
 6. The current Australian and New Zealand Standard requirement that boosters be labelled for a maximum child weight of 26 kilograms means that most children between the ages of eight years and twelve years have no optimal restraint. In addition, about five percent of six year olds weigh more than 27 kilograms and so are too heavy for a standards approved booster seat. There is an urgent need for the Australian and New Zealand Standard requirements for booster seats to be reviewed to cater for older children. Standards have work underway for a new category of boosters to fill this gap. The new 36 kilogram requirement will cater for 95 percent of eight year olds.
 7. There is a need for improved side impact protection with booster seats. This would also assist with the problem of children slumping sideways when they fall asleep. *The current Australian Standards Committee work on boosters aims to fix this problem.*
 8. Because of the risk of abdominal and lower spinal injury, accessory four point child harnesses ('Type C' restraints) are not recommended. *For the reasons given elsewhere in this report, some experts believe there is good reason to remove accessory harnesses as approved restraints.*
 9. In Australia and the United States more than half of rear seat occupants are children. There is a strong case for improving the design of rear seats to better cater for children. New Car Assessment Programme frontal crash tests should include a dummy representing an older child in the rear seat.
 10. Current designs of rear car seats have excessive seat cushion longitudinal depth which means nearly all children who are twelve or under will slouch forward in order to bend their knees over the front of the seat. This results in the lap portion of the seatbelt riding up over the abdomen of the occupant – with greatly increased risk of serious abdominal injury. Seat cushion depth could be reduced substantially without causing discomfort to adult occupants (in fact, most adult females would benefit from reduced seat cushion depth).

11. Rear seat upper seatbelt anchorages should be better designed for older children – more stringent requirements for upper anchorage location and adjustable anchorage height should be considered. Three point seatbelts should be required in all seating positions.
12. There is good correlation between anthropometric dimensional measurements related to restraint use and general measurements such as stature. This means that dimensions which are easy to enforce/encourage can be used as a proxy for dimensions which are directly related to restraint system compatibility. Weight is less well correlated and is a less suitable proxy for anthropometric dimensions that ensure good restraint compatibility (it is possible that the reference to weight in the Australian and New Zealand Standard is associated with loads generated during dynamic testing rather than being associated with restraint compatibility).

6.8 Implications

The current eighteen kilogram limit for forward facing child seats means that it would create conflict between the legislation for the mandatory use of these restraints beyond the third birthday and the standard which says Type B child restraints are only suitable for children up to eighteen kilograms. As all the seats are tested with a six year old TNO P6 dummy weighing 22 kilograms, it is unlikely to be a safety issue, however the legislation would lead to confusion because it conflicts with standards instructions on packaging and user manuals. Furthermore, if ‘appropriate restraint’ were to be defined as a reference to the standard, and legislation picks up that reference, children weighing more than eighteen kilograms may be regarded as inappropriately restrained in a Type B child seat as the standard limits a Type B restraint to eighteen kilograms. The standard will need to be revised to cater for heavier children in order to cover older age groups. However, it should be noted that a child between eighteen kilograms and 26 kilograms in a restraint may not be a safety issue as restraints are tested to 26 kilograms. The problem here would be that the restraint would not be legally regarded as an ‘appropriate restraint’ as the standard only recommends use up to eighteen kilograms.

Similarly, the 26 kilogram limit for booster seats means that it may be unreasonable to legislate the mandatory use of these restraints beyond the sixth birthday since about one third of seven year olds exceed 26 kilograms (see Table 4). The Australian Standard is being reviewed to cater for older children.

7. THE CONCEPT OF A "RIDE HEIGHT LINE" FOR REAR SEAT OCCUPANTS

7.1 Objectives of this section

- To investigate an anthropometric method for determining whether children are tall enough to use an adult seatbelt.

There are common community uses of safe height indicators. The Plimsoll line is a marking system at the waterline of a ship's hull to ensure the ship is not overloaded.

Some fairgrounds use a height template with a sign reading something like 'You must be this tall to go on this ride'.

These systems work because the regulatory 'height mark' is immediately available to both the users and enforcers.

For older children height is the best indicator of restraint suitability.



Figure 14. Plimsoll line

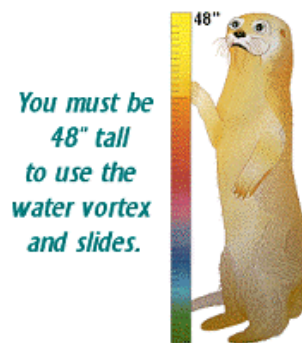


Figure 15. Height template (Fairfax country)

This section explores the possibility of installing in the rear seat area of a vehicle a marking system that indicates a minimum height for using a seatbelt. The intention is that the child should use a booster to provide suitable seatbelt geometry if they do not meet the height limit.

One advantage of this approach is the children can gauge themselves whether they meet the criterion. From an injury biomechanics perspective seated eye height appears to be the

optimal variable to use for this purpose. This is because a child's eye height corresponds to the centre of gravity of their head and should not be above the top of the back of the restraint (see Figure 26).

It would be preferable if the same height limit could be used for children using a booster seat and seatbelt. Australian boosters typically increase seated height by about 110 millimetres (subject to Bilston research – pending).

It is considered that the marking system should:

- Aim to keep most children under ten years of age in a child seat or booster (assuming that suitable products are available for the larger children).
- Align (if possible) with the European and National Highway Traffic Safety Association's recommendations that children should have a standing height of at least 1.35 metres to 1.5 metres (or similar requirement) in order to use a seatbelt without a booster.
- Aim to keep most children under five years of age in a child seat with integrated harness (assuming that suitable products are available for the larger children) rather than a booster with seatbelt.
- Involve a simple and objective method of measurement and a readily available method of determining the location of appropriate marks on vehicles.

7.2 Correlation between seated eye height and stature

This analysis is subject to the caution that it is based on United States data from 1977 and the measurements were taken with the child's back vertical rather than in a car seat.

Figure 16 shows the correlation between seated eye height and stature, based on United States data for children aged three to twelve (Consumer Products Safety Division 1997).

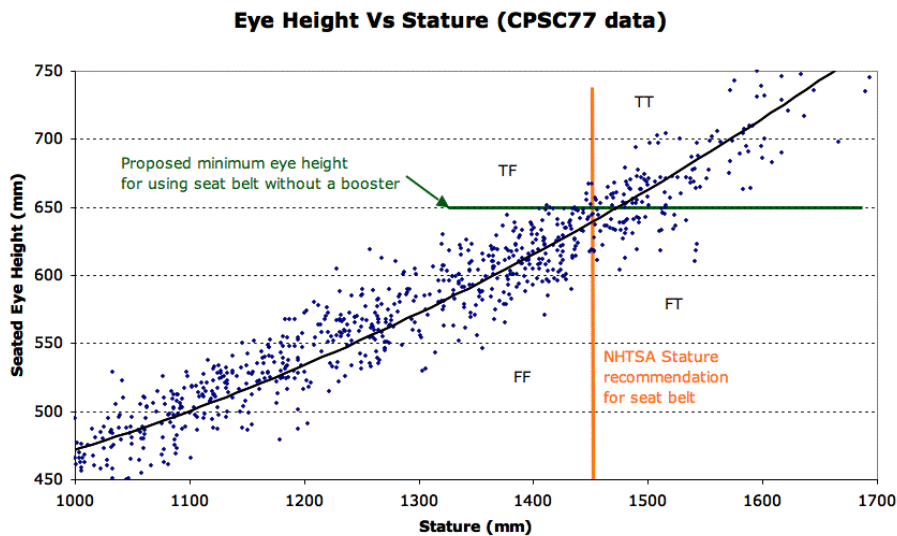


Figure 16. Seated eye height and stature

A seated eye height of 650 millimetres matches the national Highway Traffic Safety Association's recommendation reasonably well.

Table 9 sets out the results of an analysis of the 155 children aged nine to twelve who meet either the eye height (650 millimetres) or the stature (1450 millimetres) limit.

Table 9. Comparison of eye height with stature

AGE	9	10	11	12	All
TF. MEETS EYE HT. BUT NOT STATURE	29%	7%	2%	2%	4%
FT. MEETS STATURE BUT NOT EYE HT.	43%	47%	39%	26%	33%
TT. MEETS BOTH	29%	47%	59%	71%	63%
SAMPLE SIZE	7	15	41	91	155

Subject to the applicability of the data to Australia, this analysis suggests that the proposed eye height criterion is more stringent than the standing height limit. About one third of children who meet the minimum standing height would not meet the minimum seated eye height (quadrant FT).

7.3 Eye height and age

Figure 17 shows eye height by age, with percentile bands for age groups. This indicates that choosing a seated eye height of 650 millimetres would match the average size of a twelve year old. This eye height crosses the 95th percentile line at nine years old.

With a booster adding 110 millimetres to seated height, the 650 millimetres proposal would be close to the average size of a seven year old. This eye height crosses the 95th percentile line at four and a half years.

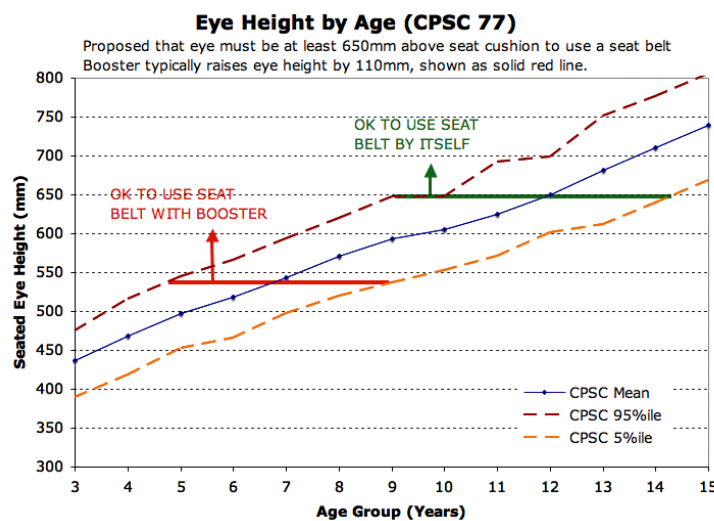


Figure 17. Seated eye height and age group

It would be necessary to specify a method for determining where the seated height limit mark should be located relative to the seat cushion in individual vehicles.

7.4 Type and location of marking

To achieve the above aims in a regulatory environment will require a measuring tool that can be called up in regulation or standards. There are two existing internationally accepted test dummies which represent 50 percent of ten year old children. These are the TNO P10 and the Hybrid III ten year old. The cheapest and most readily available of these is the Anthropomorphic Test Dummy TNO P10. For this reason it was concluded the TNO P10 test dummy was the most appropriate measuring tool. Its overall equivalent standing height fits between the European recommended 1.35 metres to 1.5 metres and the United States recommended 1.45 metres.

Whilst there is one view that Australia could accept the most stringent (highest) height there is another view that suggests the casualty data does not support the extension from 1.35 metres to 1.5 metres.

The acceptance of the TNO P10 as a test dummy representing 50th percentile children became the determining factor in this review. It does not achieve the approximate 650 millimetres seated eye height of a 95th percentile nine year old, but it appears to be the best available tool. It adds consistency in that it is likely to be the most appropriate sled test dummy.

With respect to the practical use of a ride height line, those who need to use it for assessment and enforcement in the field will be parents, carers and policemen.

If the TNO P10 test dummy is to be the measuring tool for regulation, then the seated reclined eye height of the TNO P10 test dummy needs to be the tool by which ride height line is determined in vehicles.

It is recommended that this be the subject of a new Australian Design Rule requiring a ride height line, where that ride height line is determined by the positioning of the TNO P10 test dummy in a reclined manner on the seat cushion and marking the eye height as the ride height line.

It is further recommended that organisations such as roadside service car clubs and fitting stations could be encouraged to offer services which retro-market ride eye height lines on existing vehicles.

It is therefore feasible to apply a sticker to the window, perhaps a fixed pane on the rear door. Alternatively the lining on the inner aspect of the 'C' pillar may be a suitable location. Either location should be selected to be readily accessible to carers and enforcement officers.

Given the trends in America and Europe towards anthropometric height criteria for determining the transition point from boosters to adult seatbelts, such a rule is likely to be of interest to overseas rule makers with the potential for harmonisation appearing good.

8. IDENTIFICATION AND ANALYSIS OF FEASIBLE OPTIONS

8.1 The process

Feasible options are both regulatory and non-regulatory.

The primary non-regulatory option is to continue with education campaigns (that have been successful in the past) amended to reflect new knowledge about what constitutes optimal child restraint and the timing of transitions between different types of restraints. As indicated in section 2.4, the effectiveness of the non-regulatory option is impeded by the vagaries of the existing law that the education materials must faithfully represent.

The regulatory options that are available are dependent upon whether:

- new regulations are constrained to using existing approved child restraint systems; or
- regulations can be constructed that will be associated with amendments to the existing child restraint Type Designations as set out in the Australian and New Zealand Standard for Child Restraint Systems.

The latter requirement would effectively require the use of products still in development. This should not necessarily be viewed as a deterrent because there are significant precedents in Australia for regulations for vehicle occupant restraint systems which were not yet commercially available at the time the regulations were written. For example:

- mandating integrated seatbelts and seat systems to all new coaches from 1994; and
- mandating top tether anchorages to all new vehicles from 1976.

However, this is not the approach followed by the regulatory proposal.

As stated at the outset of this report, the review set out to identify what regulatory strategy was required to provide a smooth continuity of effective restraint systems for children in vehicles from when they are born to when they are large enough to be provided with effective protection by rear seat adult seatbelt and airbag systems.

From this process it has emerged that a ‘complete’ strategy would desirably include changes to the Australian and New Zealand Standard for Child Restraint Systems and a new Australian Design Rule.

The available anthropometric and injury data identified the preferred hierarchy of child restraint systems that would provide practical safe levels of protection to children as they grew. Furthermore most experts agreed that age defined guidelines (and legislation) are likely to be the easiest for parents and carers to ensure good compliance. Recommended optimal restraint is therefore:

Rear facing infant restraints

Zero up until at least seven to nine months for most infants or until the infant will no longer fit in the restraint.

Forward facing child seats with integrated six point harness

Up until at least child's fifth birthday or until they no longer fit in the seat (assumes changes to current standard).

New generation booster seats	Up until a standing height of 1.35 metres to 1.5 metres or until they no longer fit in the booster seat.
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However, it has become clear that dedicated child restraints currently available in Australia do not allow for these optimal restraint recommendations since the Type Designations in the Australian and New Zealand Standard are defined by weight ranges and the weight ranges do not align well with weight for age anthropometric data.

To achieve optimal restraint of child occupants using age defined transitions the Australian and New Zealand Standard requires the following modifications:

- For child seats (Type B devices), the upper mass limit would need to be extended from eighteen kilograms to 22 kilograms to accommodate nearly all children at their fourth birthday. As all of the currently approved child seats are dynamically sled tested with a TNO P6 test dummy weighing 22 kilograms, this modification is seen as an adjustment to the standard which is unlikely to require the development or use of completely new products.
- Extension of the upper mass limit for booster seats from 26 kilograms to 36 kilograms. In reality this means completion of a draft modification currently in circulation allowing for a new category of booster to accommodate nearly all children at their eighth birthday and 50 percent of children up to their tenth birthday. This new standards work is already well underway. The early draft includes width limits on the boosters which are intended to allow the fitting of three boosters in a row on the rear seat of most cars.

The content of the Australian and New Zealand Standard are not within the control of governments. Such standards are developed by the private sector, through organizations such as Standards Australia. Government representatives are often involved in the process but no single party (public or private sector) has control – standards are developed by consensus. The immediate implication, when considering feasible regulatory options available to achieve optimal child restraints, is that regulatory options must treat existing standards as a given and not assume that standards will change to what is desired, and within the timeframe in which it is desired. This is simply because the determination of these standards is outside the control of governments. Accepting this as a fact, the ‘staging’ of regulatory reform has been considered (see section 8.5) as a means of waiting to see whether the desired changes to standards manifest before making further regulatory changes necessary to support achievement of optimal child restraint.

8.2 Parameters that could be covered by regulation

Table 10 sets out the parameters that could be considered for the purpose of regulating child restraint use and identifies the strengths and weaknesses of each.

Table 10. Parameters that could be considered for regulation of child restraints

Parameter	Strengths	Weaknesses	Comments
Age	<p>Easy to define by regulation</p> <p>In common use</p> <p>Most parents/carers know a child's age</p>	<p>May not be easy to determine for enforcement purposes</p> <p>Likely to be exemptions for large children</p>	<p>Suitable as a primary method of regulation, provided there are exemptions</p> <p>Would link in well with education messages</p>
Weight	<p>Easy to define by regulation</p> <p>Aligns with categories in the Australian Standard</p>	<p>Difficult to enforce (cannot easily weigh child by the roadside)</p> <p>Most parents/carers would not know child's weight</p> <p>Not well correlated with size (and therefore fit of the restraint)</p>	<p>Not suitable as a primary method of regulation but could be used for exemption purposes</p>
Stature (standing height)	<p>Easy to define by regulation</p> <p>Good indicator of fit of the restraint</p> <p>Used for guidance in USA</p> <p>Use for regulation in Europe</p>	<p>Currently difficult to enforce (cannot easily measure child by the roadside)</p> <p>Most parents/carers would not know child's height</p>	<p>Not suitable as a primary method of regulation but could be used for exemption purposes</p>
Seated eye height	<p>Very good indicator of fit of the restraint</p> <p>Could be relatively easy to enforce (if vehicles are marked with a 'Ride Height Line')</p> <p>Child can self-assess when seated</p>	<p>Most parents/carers would not know child's eye height unless there was an indicator in the vehicle</p> <p>Lack of restraints designed for larger children (and weight limits of the Standard)</p>	<p>Possible primary method of regulation if there are improvements to the Standard and vehicles are marked with a 'Ride Height Line'</p>
Seated height (to crown of head), Seated shoulder height, seated ear height etc	<p>Similar to seated eye height but less applicable and possibly more difficult to measure</p>		

Research conducted by the Centre for Automotive Safety Research indicates that regulations specifying child restraint usage by age (rather than by height or weight) will

result in the least proportion of children being inappropriately restrained. It is noted, however, that this research did not cover the transition from booster seats to adult seatbelts.

Optimal restraint by a seat and seatbelt system is highly dependent upon factors such as:

- length of the child's lower leg compared to length of seat base (can the child sit comfortably at the back of the seat without their lower leg being partially supported by the front of the seat cushion);
- angle of the sash part of the seatbelt across the child's upper torso, neck and shoulder (the seatbelt sash needs to pass over the centre of the shoulder so that it does not either load the child's neck or slip off the shoulder); and
- angle of the lap parts of the seatbelt relative to the child's pelvis (does the belt load downwards, or can it ride up over the child's pelvis into the abdomen).

For all the above reasons, the transition between booster and adult seatbelt would optimally be regulated by child's seated height.

If it is regulated by its relationship to a child's standing height as in Europe and the United States, it cannot take into account that some children have short upper torsos and long legs, whereas other children have long upper torsos and short legs. For this reason we recommend against using standing height. Elsewhere this report recommends a resolution of this issue through the use of a regulated 'ride height line'. In this report's earlier section 7, 'ride height line' corresponded to the seated reclined eye height of a TNO P10 test dummy. Also in section 7 there was discussion, and some modification to the dimensions, to fit with existing measuring tools which can be called up for regulatory use, hence the TNO P10.

The present reality is that the 'ride height line' does not exist and, if it is incorporated into the Australian Design Rules, it will take many years (the lifecycle of the Australian passenger vehicle fleet) to have it available to all parents, such that they can use it to aid their decision making regarding the most appropriate form of child restraint. The option to retrofit ride height lines to all vehicles in the existing Australian passenger vehicle fleet was rejected as a feasible option due to the considerable cost involved in doing so. In the interim therefore, the feasible option is to mandate the use of boosters to a minimum age of 7 years (given the current limitations of the booster standards).

8.3 Transitions between different forms of dedicated restraints

8.3.1 *Transition from Rearward Facing to Forward Facing*

Biomechanically the most appropriate restraint for infants is a rearward facing restraint which when loaded in a front-on crash, rotates to a near vertical position so that the loads the child's back and head. This kind of loading is less likely to cause injury because there are no concentrated loads on the webbing straps and the restraint system for the baby's head is the shell of the restraint, not the baby's neck.

Overseas authorities recommend that the transition age out of rearward facing restraint should be at an age of twelve months, or two years, or sometimes older.

As discussed elsewhere in this report, Australia has a long history of smaller infant restraints which children tend to outgrow at ages ranging between five and ten months.

It is acknowledged that all occupants are offered better protection by being rearward facing and having loads taken in a distributed manner over the whole rear of the torso, and at near to right angles to the spine. The need for this manner of loading was all the more important in the United States and Europe because they do not have the long history of using top tether straps to limit forward rotation and displacement of the child restraint.

If Australia were starting from scratch, and if it had no experience with the development of forward facing child restraint systems for infants between six and twelve months, then use of rearward facing restraints until the child was twelve months old would be the recommended option.

Because Australia has had use of top tether straps since the late 1970s, there has been more than 25 years of experience with infants in forward facing child seats between the ages of six and twelve months. In depth reviews of crashes involving children in that age range, have not identified any problems, particularly with neck injury.

The experience of children in that age range in forward facing child seats in Europe and the United States has been different. They have reported occurrences of serious neck injury. Closer reviews of the individual cases indicate this has usually been associated with some head impact of the part of the vehicle interior, usually the rear aspect of the front seat (Brown and others 2002).

In summary, when using Australian child restraint systems with top tethers, there does not appear to be any compelling evidence to **regulate** that children should remain in rearward facing restraints until the age of twelve months.

We hence recommend transition when the child no longer fits current rear facing restraints which is in the range of seven to nine months for most children.

8.3.2 Transition from forward facing child restraint to booster

This report's anthropometric data review found about one third of four year olds (up to fifth birthday) and more than half of five years olds (up to sixth birthday) exceed the eighteen kilogram limit for child seats and yet they are too short for a booster with seatbelt. Many children in these age groups are also too tall for 'compact' designs of convertible restraints.

About three percent of three year olds exceed eighteen kilograms and a similar proportion is likely to be too tall for 'compact' restraints. Therefore, provided there are exemptions for heavy and tall children, it is feasible to immediately regulate for children up to three years old (i.e. up to the fourth birthday) to be restrained in current designs of child seats. If the standard was later amended to cater for larger children up to 22 kilograms, then the regulation could be extended to four year olds (i.e. up to their fifth birthday).

Based on the limited anthropometric data currently available, the standard's requirements for child seats would desirably be amended so that:

- The maximum occupant weight is increased from eighteen kilograms to 22 kilograms. This is the 95th percentile value for males at their fifth birthday.
- The maximum top slot height is increased to 390 millimetres. The 95th percentile value for shoulder height of males at their fifth birthday is 410 millimetres but the slot can be 25 millimetres lower than the shoulder.

- A new requirement for a minimum height of the restraint back is introduced. A minimum of 550 millimetres would be appropriate – the 95th percentile value for seated eye height of children at their fifth birthday.

Development of the standard, and introduction of the improved products, would be assisted by a regulation that gave a timeframe for use of these improved child seats.

Subject to an eighteen kilogram weight limit, Canada requires children to use a child seat (Type B restraint) up to their fifth birthday. Most United States jurisdictions, the United Kingdom, Italy, Spain and Israel require child seats up to the fourth birthday. Most other countries surveyed encourage the use of child seats up to the fourth birthday but do not mandate it.

Most national and international experts supported use of child seats up to the fourth birthday and saw good reasons to extend this to the fifth birthday, if suitable designs of child seats were available.

Whilst the current standard has an upper mass limit of eighteen kilograms for forward facing child seats, the lack of a commercially available eighteen kilogram test dummy means that all of the child seats are crash tested with a 22 kilogram TNO P6 test dummy. What this means is there should not be a safety issue if children weighing up to 22 kilograms were allowed to, or were required by regulation to remain in forward facing child seats until their fifth birthday.

Currently, if the regulation was changed to mandate forward facing child restraint systems for children up to their fifth birthday, many children would exceed the mass of eighteen kilograms, and this would be in conflict with the advice associated with Australian Standards categories.

Not only would this be potentially very confusing to parents, but it may open scope for unwanted litigation.

The implication is that it is not feasible to set a mandatory requirement to restrain a child in a child seat until age five unless (if and when) the standard is changed in accordance with what has been recommended above. In the interim, it is only possible to mandate the use of child seats to the age of four years. .

8.3.3 Transition from booster seats to adult seatbelts

About one third of seven year olds and two thirds of eight to ten year olds exceed the 26 kilogram limit for boosters and yet are too short for a seatbelt without booster.

About six percent of six year olds are too heavy for a current booster (they exceed 26 kilograms). Provided there were exemptions for heavy and tall children, it would be possible to immediately regulate for children up to six year olds to be restrained in current designs of booster seats (i.e. up to their seventh birthday).

When the standard has completed its current development to cater for larger children (preferably at least 36 kilograms), it will be feasible to regulate for children up to eight year olds (i.e. up to the ninth birthday) to be in booster seats. Only about two percent of eight year olds are tall enough to be optimally restrained by a seatbelt. A further thirteen percent exceed 36 kilograms but are too short for a seatbelt. Most of the remaining 85 percent should be in a booster seat.

There is hence a strong case to require that boosters be designed to cater for larger children and the regulations concerning booster seats could then be based on seated height. In section 7 the use of a ‘ride height’ criterion is discussed and recommended.

It is recommended that:

- the current work program of the Australian Standards committee to develop boosters for a larger age range be encouraged by calling up these boosters in future regulation;
- the maximum occupant weight is increased from 26 kilograms to 36 kilograms. This is the 95th percentile value for males at their eighth birthday, or 50th percentile of ten year olds; and
- a regulatory test device of the TNO P10 test dummy is suggested.

There are several options as to how we could proceed with mandatory use of boosters.

One option would be to mandate the use of currently available boosters generally suitable for children up to their seventh birthday along with the initial requirement for use of dedicated child restraint systems for children up to their fourth birthday.

The benefit of this approach is that it would immediately improve the level of protection offered to children up to their seventh birthday assuming it was enforced and complied with. The disbenefits of this approach are that it would compel parents to buy these booster seats in the short term. With the change to bigger boosters in a timeframe of say three years, parents and carers would then feel they had been offered flawed or misleading advice by authorities and could be resistant to buying a new generation of boosters which offer protection to children up to their ninth birthday.

Consumer organisations (such as automobile associations) could foreseeably offer organised resistance to the cost and complexity of this approach. This would be likely to result in a longer term gap in the level of protection offered to children between their seventh and ninth birthday. The high availability of the smaller boosters may lead to their inappropriate use for older children.

The new regulations could have a first stage which required the use of child seats up to a child's fourth birthday, followed by a second stage to be introduced several years later which required the use of the new larger category of boosters up to the size equivalent of a 50th percentile ten year old child.

The benefits of this approach are that it would provide a strong incentive for restraint manufacturers to develop boosters catering to this older size range. It would also mean that parents only had to buy one booster seat, rather than a small booster now and a larger one later.

Mandating one kind of booster in the short term and then another larger kind within two to three years could result in cost and confusion to parents and carers.

The disbenefit of this approach is that it does not immediately offer improved protection to children between their fourth and sixth birthdays.

As discussed earlier, a highly relevant factor is that work has started on drafting a new standard for boosters that will cater for a larger size range of children.

For the above reasons, particularly the latter, there is one perspective that current boosters should not be regulated in the first stage until this standards work is completed.

We discussed three options for this transition age/size.

The first option was to wait (two to three years) for the new larger boosters then regulate transition at size equivalent to ninth birthday to suit the new boosters (note this will also accommodate 50 percent of ten year olds).

The second option was to regulate a transition size/age at the seventh birthday based on the boosters available now, and then a year or two later increase the transition age/size to size equivalent of ninth birthday (note this will also accommodate 50 percent of ten year olds).

The third option was to regulate transition at seventh birthday based on the boosters available now and to not have a second stage.

8.4 Exemptions

One of the primary goals of any legislation should be to minimise the need for exemptions. Current mismatch between the weight ranges of different restraint types as specified by the standard and the ages associated with what most experts would agree to be optimal transitions would result in the need for exemptions.

As a generalisation, exemptions can tend to make compliance more difficult for parents and carers. Exemptions also make enforcement more difficult. This can be to the extent that exemptions are so difficult for parents and police to understand that there are too many impediments to conduct a serious enforcement regime.

An enforceable environment would be one where exemptions were rare and where those required were medical (letter from a general medical practitioner), not requiring assessment by an enforcement officer.

For example, if forward facing child restraint system were required for all children to the fifth birthday, many would not fit current seats, so exemptions would be required for, say, 20 percent of the population. If police had to identify exemptions on size, it would become too difficult to enforce.

Current problems with the mismatch of the Australian Standard's Type designations defined by weight means that legislation using age might result in parents being told to put larger children in forward facing child restraint system contrary to the restraints instructions for an upper size limit.

As discussed earlier there is potential for confusion if parents are told to use boosters from age three till six years old and several years later they are told to limit use of your old boosters and now use new boosters from age five until eight years old.

8.5 Recommended options for consideration

A numbers of options were compiled based on comments from experts and stakeholders.

Table 11. Options for regulating child restraint use

Option	Implementation	Stage 1	Stage 2
0	Multi Stage (non-regulatory)	Make necessary amendments to education campaigns to reflect new knowledge and encourage necessary changes to standards	Subject to changes in standards, amend advisory materials accordingly.
1	Single Stage	Mandate appropriate use to 7 th birthday, mandate transitions	
2	Multi Stage	Mandate appropriate use to 7 th birthday Mandate transitions	Subject to changes in standards, extend requirement to 9 th birthday
3	Multi Stage	Mandate appropriate use to 4 th birthday	Subject to changes in standards, mandate transitions and extend to 9 th birthday
4	Multi Stage	Mandate appropriate use to 3 rd birthday	Subject to changes in standards, mandate 'optimal' transitions and extend to 9 th birthday
5	Multi Stage	Mandate use of forward facing child restraint system to 3 rd birthday	Subject to changes in standards, mandate use of forward facing child restraint system to 5 th birthday. Mandate use of booster from 5 th birthday to a seated height limit equivalent to 9 th birthday.

Advantages and disadvantages of each of these options are set out below.

8.5.1 Option 0 – single stage (non-regulatory) make necessary amendments to education campaigns to reflect new knowledge and encourage necessary changes to standards

Advantages

- Provides information to parents on most suitable form of restraint for all children up to their seventh birthday. Given past behaviours, it can be expected that this will result in some changes in child restraint usage.
- Can be immediately achieved with current restraints.
- Could reduce current premature graduation to adult seatbelts.
- Could reduce current premature graduation from forward facing child restraint systems to booster seats.

Disadvantages

- Continues to restrain, by vagaries of existing law, that educational materials must faithfully represent.

- Parent will treat this information as ‘advisory’ and will not be compelled to put into practice. Accordingly, as observed in the past, compliance with the optimal child restraint practices will be less than that which occurs when there is a mandatory requirement.
- Does not provide incentive to resolve current technical limits on upper mass for forward facing child restraint systems.
- Does not provide incentive to extend upper range of boosters (gap in safe restraint for children seven to ten years of age).

8.5.2 Option 1 - single stage introduction of mandatory use of appropriate restraint by all children up to seventh birthday

Advantages

- Requires improved protection immediately for all children up to their seventh birthday.
- Can be immediately achieved with current restraints.
- Could reduce current premature graduation to adult seatbelts.
- Addresses current premature graduation from forward facing child restraint systems to booster seats.

Disadvantages

- Does not provide incentive to resolve current technical limits on upper mass for forward facing child restraint systems.
- Does not provide incentive to extend upper range of boosters (gap in safe restraint for children seven to ten years of age).
- May be difficulties for families with three children under seven fitting three restraints (current high back boosters are too wide, newer ones are required to have narrower profile).
- Does not address transition to adult seatbelts based on current estimates of seated heights when good seat belt fit can be achieved.
- A small number of children aged under seven who exceed the current 26 kilograms upper weight limit for boosters may require exemptions. This means the restraint strategy does not contain an action to fix up the known gap in safe restraint for children between the ages of seven and ten. A further review of the regulations would be required at some later date.
- There are no incentives to enhance the standards for child restraints including increase upper mass range for forward facing child seats, raise transition age from forward facing child seats to boosters, and develop and use booster seats suitable for children up to approximately ten years of age.

8.5.3 Option 2 - two stage with immediate introduction of mandatory use of appropriate restraint by all children up to seventh birthday, inclusive of mandated transitions between forward facing child restraint systems and booster seats; and second stage where use of booster seat is extended to ninth birthday

Advantages

- Could offer improved protection to children up to seventh birthday in the short term.
- Could reduce premature graduation to adult seatbelts.
- Premature graduation from forward facing child restraint systems to booster seat addressed.
- Addresses booster seat/seatbelt transition by age.
- First stage can be achieved with current restraints.

Disadvantages

- May be confusing in that there will be changes in what parents will be required to do between Stages 1 and 2.
- May be difficulties in the short term for families with three children under seven fitting three restraints (current high back boosters are too wide).
- Does not address transition to adult seatbelts based on current estimates of seated heights when good seat belt fit can be achieved.
- May require 'repurchase' of larger forward facing child restraint systems for families with children aged three at the start of Stage 2 and/or larger boosters for families with children aged seven at the start of Stage 2.

8.5.4 Option 3 - two stage with immediate introduction of mandatory use of appropriate restraint by all children up to fourth birthday; second stage where transitions from forward facing child restraint systems and booster seats are mandated and use of booster seat is mandated to ninth birthday

Advantages

- Could offer improved protection to those children up to fourth birthday who are using adult seatbelts in the short term.
- Could reduce premature graduation to adult seatbelts for children up to fourth birthday in short term.
- Premature graduation from forward facing child restraint systems to booster seat addressed in the longer term.
- Addresses booster seat/seatbelt transition by age.
- First stage is achievable with current restraints.

Disadvantages

- Does not offer improved protection to children beyond fourth birthday in short term.
- Will require exemptions for children too large for the seats.
- May be confusing in that there will be changes in what parents will be required to do between Stages 1 and 2 (with respect to forward facing child restraint system/booster transition).
- Premature graduation from forward facing child restraint systems to booster seat not addressed in the short term.
- May be difficulties in the short term for families with three children under seven fitting three restraints (if high back booster is being used).
- Does not address transition to adult seatbelts based on current estimates of seated heights when good seatbelt fit can be achieved.
- May require ‘repurchase’ of larger forward facing child restraint systems for families with children aged three at the start of Stage 2 and/or larger boosters for families with children aged seven at the start of Stage 2.

8.5.5 Option 4 - two stage with immediate introduction of mandatory use of appropriate restraint by all children up to third birthday; second stage extending mandatory use of appropriate restraint to ninth birthday

Advantages

- Could offer improved protection to children up to third birthday who are currently using boosters and adult seatbelts in the short term.
- Second stage is simply an extension of the first stage.
- Could reduce premature graduation to booster seats and adult belts of children up to third birthday in short term, and up to ninth birthday in longer term (if standard is modified).
- Addresses booster seat/seatbelt transition by age.
- First stage can be achieved with current restraints.

Disadvantages

- Does not offer improved protection to children beyond third birthday in short term.
- Does not address premature graduation to adult seatbelts of three – nine year olds in short term.
- Potentially contains no motivation for standards to be improved.
- May require ‘repurchase’ of larger boosters for families with children aged seven – eight at the start of Stage 2.
- A method of enforcing minimum age for adult seatbelt transition is required (carry child photo identification with age).

8.5.6 Option 5 - two stage with immediate introduction of mandatory use of forward facing child restraint systems by all children up to third birthday; second stage extending mandatory use of forward facing child restraint systems to fifth birthday and booster seat use from fifth birthday up to a seated height of 0.75 metres (TNO P10 seated Anthropomorphic Test Dummy height)

Advantages

- Offers improved protection to children up to third birthday who may be using booster seats and adult belts in the short term.
- Second stage is simply an extension of the first stage.
- Likely to reduce premature graduation to booster seats and adult seatbelts of children up to third birthday in short term, and up to fifth birthday in longer term.
- Addresses booster seat/seatbelt transition by seated height.
- Contains motivation for modifications to standard (and Australian Design Rule).

Disadvantages

- Does not offer improved protection to children beyond third birthday in short term.
- Does not address premature graduation to adult seatbelts of three to nine year olds in shorter term.
- May be confusing in that forward facing child restraint system age requirements are extended in second Stage.
- A method of enforcing minimum height for adult belt transition is required (seated ride height line marked in vehicles).

8.5.7 Notes on options 1 to 5

To make it clear, the reader needs to note that options one to five are additional to option zero, that is, under each of the options one to five, educational campaigns will be amended to reflect new knowledge and the National Transport Commission will write to Standards Australia to encourage them to review the child restraint standards and make the necessary amendments.

8.5.8 Notes on enforcement

In relation to all the above options (1 to 5) age is assumed to be an attribute that can be observed and used as a trigger for enforcement purposes. Given that existing regulatory requirements are specified in age related terms this is the status quo. However, it needs to be acknowledged that there are some practical difficulties specifying regulatory requirements in relation to child restraint in terms of the child's age. While it is a reasonable requirement for an adult to have identification identifying the persons age, this can not be said for children. Accordingly there is question about how these proposed age related requirements will be enforced.

The practicality of enforcing age related regulatory requirements was considered as part of the review. Police representatives involved in the review indicated they were comfortable with the proposal to enforce an age requirement and provided advice regarding how the requirements would be enforced on the ground.

In practice it is found that parents do not lie about the age of their children, or are easily found out by a simple line of questioning if they attempt to do so. In the latter case, and in circumstances where there is doubt about the age of a child, an infringement notice can be issued and retracted if the parent is able to substantiate that the child's age is above the regulatory limit. In all cases it needs to be understood that the police officer will only query the child's age when it is apparent that the child is inappropriately constrained given the positioning of, for example, an adult seatbelt on the child's body. It can be seen that by adopting this method, the absence of identification cards for children does not pose insurmountable problems in enforcing the age related regulatory requirement.

9. BENEFIT COST ANALYSIS

This section considers the costs and benefits of the regulatory options in quantified terms so far as is possible. Sections 9.1 to 9.13 establish the ‘envelope’ of potential benefits and costs associated with bringing into effect the optimal child restraint arrangements articulated in section 8 and establishes the framework by which regulatory options defined in section 8 can be evaluated. Section 9.14 evaluates the regulatory options. Section 9.15 considers how sensitive the results are to various assumptions. The results are discussed in section 10.

9.1 Overview of methodology

9.1.1 Benefits

The benefits to be obtained from ensuring appropriate restraint use by child occupants can be estimated by combining police reported accident statistics with results of in-depth research into children injured in car crashes. The steps are:

- Obtain police-reported accident statistics from each Australian State and Territory.
- Address a lack of information about degree of injury (serious or minor) with New South Wales data by assuming the same distribution as the other jurisdictions (by age of casualty).
- Address a lack of information about type of restraint (child restraint or adult seatbelt) for most jurisdictions by assuming a similar (but smoothed) distribution to Tasmania.
- Estimate the annual casualties by type of restraint (child restraint, adult seatbelt or unrestrained).
- Determine the effectiveness of child seats and booster seats, compared with adult seatbelts.
- Estimate the proportion of children who are using child seats compared with booster seats.
- Estimate the savings if the casualties wearing adult seatbelts had been using a child seat or booster seat.

9.1.2 Costs

The costs are derived from:

- Surveying the retail prices of child restraints and deriving a typical purchase cost for each type of restraint.
- From usage surveys, estimating the proportion of children in each age group who are inappropriately restrained (mostly wearing an adult seatbelt instead of using a booster seat or child seat).
- Applying these proportions to the Australian child population to estimate the number of child seats and booster seats that would need to be purchased.

- Estimating the total cost of these purchases.

9.1.3 Comparative analysis over the lifecycle

Having quantified costs and benefits, a comparative analysis is undertaken by:

- Accounting for child population increase of 265,000 per annum (consistent with Australian Bureau of Statistics forecasts) and accounting for age increases for the rest of the population considered in the previous year of the comparative analysis.
- Quantifying the cost implications as a proportion of the population of children turn one (necessitating the purchase of a child seat) and five (necessitating the purchase of a booster).
- Adopting the estimated benefits for year one of the comparative analysis as a proxy for the foreseeable benefits that can be attributed to the regulatory reform in future years (rationale discussed in section).
- Adopting a ten year lifecycle to assess the merit of the regulatory reform (rationale discussed in section).
- Discounting future estimates of costs and benefits using a discount rate of six percent.

9.2 Accident statistics

Summaries of police reported accidents where a child occupant under eleven years of age was injured in a car or car derivative were obtained from every Australian State and Territory. Reporting formats and depth of detail varied considerably, and so a database was developed to consolidate the data and enable predictions of national trends to be made. Table 12 sets out the broad statistics from this process.

All jurisdictions except New South Wales were able to split injuries into serious (hospital admission) and minor (treated but not admitted). It was assumed that the New South Wales distribution would be the same as the remaining jurisdictions. Table 13 shows the estimated annual casualties based on this assumption (numbers have been rounded).

Table 12. State and Territory child occupant casualties during five years

CASUALTIES DURING 5YR		AGE											
STATE	DEGREE OF INJURY	0	1	2	3	4	5	6	7	8	9	10	All
ACT	FATAL	1							1				2
	MINOR		3		6	5	5	6	7	4	5	4	45
99-04*	SERIOUS		1	1	2	1		1		2	1	2	11
	SUBTOTAL	1	4	1	8	6	5	7	8	6	6	6	58
NSW 00-04	FATAL	7	3	8	6	8	5	3	2	2	6	2	52
	INJURY	204	219	250	294	299	310	314	338	352	388	354	3322
	SUBTOTAL	211	222	258	300	307	315	317	340	354	394	356	3374
NT 01-05	FATAL		2	4		2	1		3	1			13
	MINOR		13	9	8	2	5	5	9	6	12	8	77
	SERIOUS		5	4	7	8	4	10	8	7	5	5	63
	SUBTOTAL	#	20	17	15	12	10	15	20	14	17	13	153
QLD 01-05	FATAL	7	5	5	6	1			1	1		2	28
	MINOR	123	100	116	174	175	177	243	226	227	204	227	1992
	SERIOUS	47	47	50	59	50	53	63	54	72	71	97	663
	SUBTOTAL	177	152	171	239	226	230	306	281	300	275	326	2683
SA 01-05	FATAL		4	1	1	2	0	1	1	0	1	1	12
	MINOR		73	56	76	80	71	91	78	90	100	127	842
	SERIOUS		8	8	6	9	11	12	8	11	11	8	92
	SUBTOTAL	#	85	65	83	91	82	104	87	101	112	136	946
TAS 01-05	FATAL			1	1					2			4
	MINOR		42	20	29	29	25	28	37	28	25	24	287
	SERIOUS		5	4	1	3	6	2	1	4	1	6	33
	SUBTOTAL	#	47	25	31	32	31	30	38	34	26	30	324

CASUALTIES DURING 5YR		AGE											
STATE	DEGREE OF INJURY	0	1	2	3	4	5	6	7	8	9	10	All
VIC	FATAL	9	4	1	4	1	3	1	2		2	2	29
	MINOR	151	182	232	245	261	268	302	325	336	331	356	2989
	SERIOUS	26	27	37	48	64	54	39	55	60	62	73	545
	SUBTOTAL	186	213	270	297	326	325	342	382	396	395	431	3563
WA	FATAL	0	2	0	1	3	2	1	1	2	2	0	14
	MINOR	3	300	229	251	250	237	250	237	261	268	298	2584
	SERIOUS	2	36	39	35	39	37	33	39	39	39	40	378
	SUBTOTAL	5	338	268	287	292	276	284	277	302	309	338	2976
NATIONAL	FATAL	24	20	20	19	17	11	6	11	8	11	7	154
	INJURY	556	1061	1055	1241	1275	1263	1399	1422	1499	1523	1629	13923
	TOTAL	580	1081	1075	1260	1292	1274	1405	1433	1507	1534	1636	14077
NATIONAL ANNUAL AVERAGE	FATAL	4.7	4	4	3.1	3.1	2	1.1	2	1.1	2	1.1	28.2
	INJURY	110	211	210.2	247.1	254.2	251.1	279.1	284.2	298	303.1	325.1	2773.1
AVERAGE	TOTAL	114.7	215	214.2	250.2	257.3	253.1	280.2	286.2	299.1	305.1	326.2	2801.3

* Converted to five year equivalent

Under one year may be coded with one year group

Table 13. Estimated annual child occupant casualties in Australia

CASUALTIES	AGE											
	0	1	2	3	4	5	6	7	8	9	10	All
FATAL	4.7	4	4	3.1	3.1	2	1.1	2	1.1	2	1.1	28.2
SERIOUS INJURY	23	32	37	41	45	43	41	43	50	50	59	464
MINOR INJURY	87	179	173.2	206.1	209.2	208.1	238.1	241.2	248	253.1	266.1	2309.1
ALL	114.7	215	214.2	250.2	257.3	253.1	280.2	286.2	299.1	305.1	326.2	2801.3

These estimates can be expressed as percentages for the purpose of estimating the effects of changes to child restraint laws.

Table 14. Estimated distribution of injuries by age group

CASUALTIES	AGE											
	0	1	2	3	4	5	6	7	8	9	10	All avg
FATAL	3%	2%	2%	1%	1%	1%	0%	1%	0%	1%	0%	1%
SERIOUS INJURY	20%	15%	17%	16%	17%	17%	15%	15%	17%	16%	18%	17%
MINOR INJURY	75%	83%	80%	82%	81%	82%	84%	84%	82%	82%	81%	82%

Care should be exercised in interpreting Table 14 as it suggests that the fatality rate is highest for infants. However, research shows that injury outcomes for this group tend to be polarised (Brown, Griffiths & Paine 2002. page 34). In general, infant capsules and child seats provide exceptional protection in all but the most severe crashes and their occupants are less likely to be injured in the majority of crashes that cause injury to other occupants. If an injury does occur to an occupant of a child restraint, it is more likely to be serious due to the crash severity.

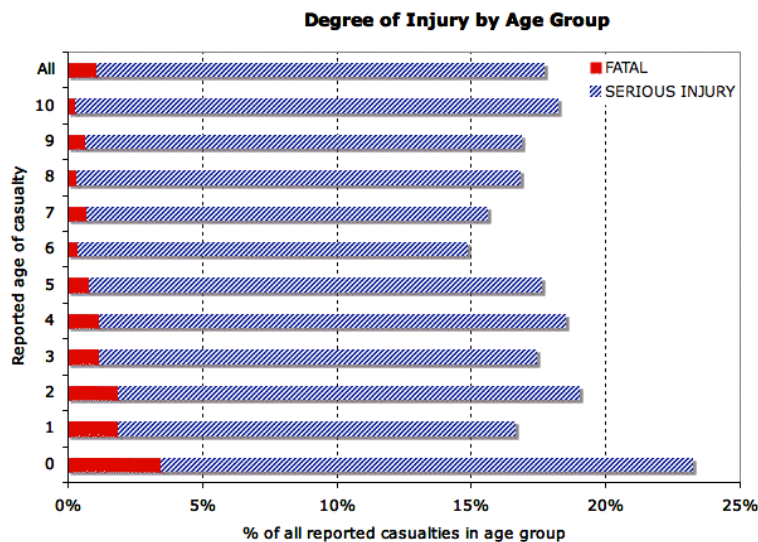


Figure 18. Predicted degree of injury by age group

9.3 Proportion using adult seat belts

Only Tasmania distinguished between casualties wearing adult seatbelts and those wearing child restraints. A total of 324 cases were available. Figure 19 shows the restraint usage for these cases. ‘Child restraint’ includes infant capsules, child seats and booster seats. Note that, when divided into age groups, the sample sizes are small.

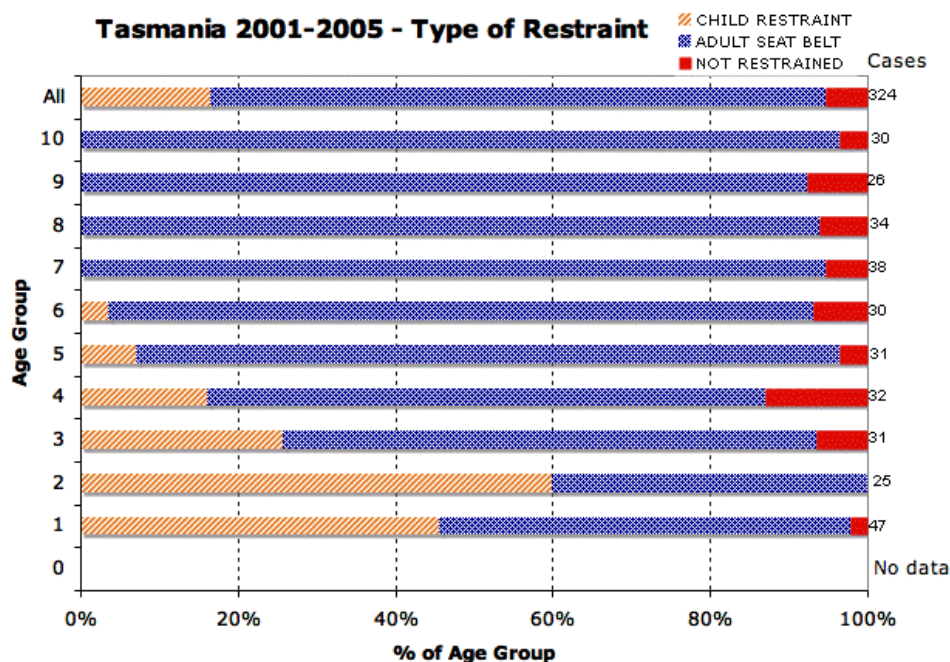


Figure 19. Tasmanian restraint use by age group

For comparison, a 1993 in-depth Child Accident Prevention Foundation Australia study of children in New South Wales car crashes recorded details about the type of restraints used (Henderson 1994). A total of 130 cases of injured children were available. Figure 20 sets out details of the Child Accident Prevention Foundation Australia Study.

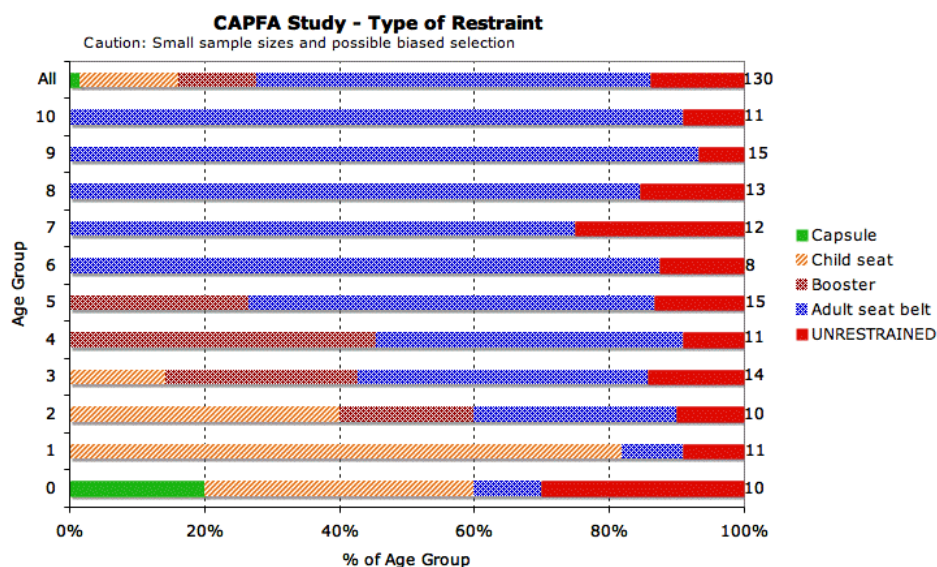


Figure 20. Child Accident Prevention Foundation Australia study

As with the Tasmanian data, the Child Accident Prevention Foundation Australia sample sizes are small. Also there is likely to have been some bias towards the more severe crashes.

Figure 21 shows the injury rates for the Child Accident Prevention Foundation Australia Study.

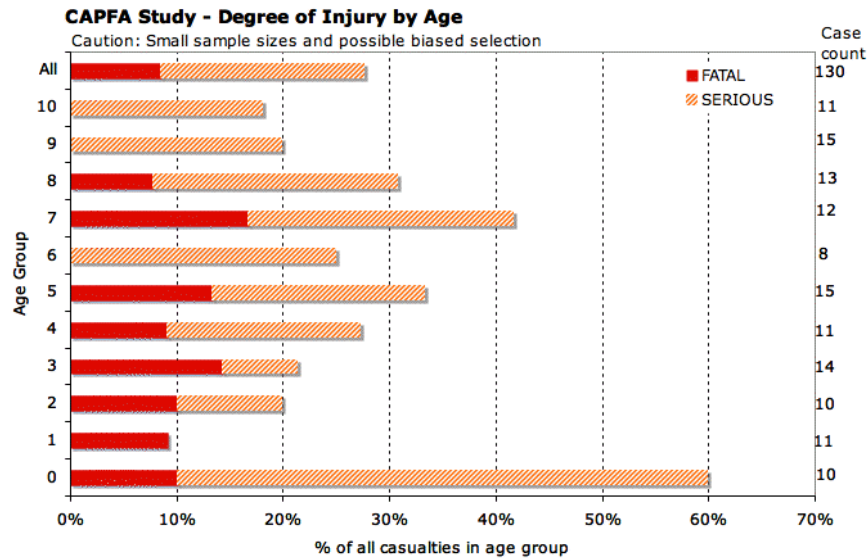


Figure 21. Child Accident Prevention Foundation Australia study injury rates

The results of observational surveys are described in the next section. It is not appropriate to apply these survey results to the estimates of injury rates because some types of restraints are known to be more effective than others.

The actual injury data from Tasmania and Child Accident Prevention Foundation Australia has therefore been combined to produce an estimate of the proportion of children injured in each type of restraint.

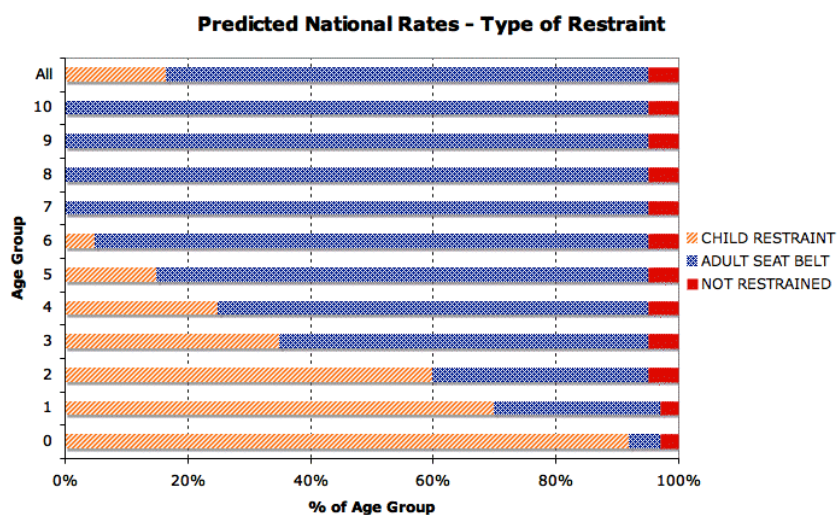


Figure 22. Predicted restraint usage by age group

Table 15. Predicted national restraint usage for injured child occupants

RESTRAINT TYPE	AGE											All
	0	1	2	3	4	5	6	7	8	9	10	
ADULT SEATBELT	5.0%	27.0%	35.0%	60.0%	70.0%	80.0%	90.0%	95.0%	95.0%	95.0%	95.0%	78.5%
CHILD RESTRAINT	92.0%	70.0%	60.0%	35.0%	25.0%	15.0%	5.0%	0.0%	0.0%	0.0%	0.0%	16.5%
NOT RESTRAINED	3.0%	3.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

Combining Table 13 and Table 15 gives an estimate of the annual national child casualties by type of restraint. This assumes serious and fatal injury cases have the same distribution as minor injury cases. Due to the difference in effectiveness between types of restraint this is likely to result in an underestimate of serious/fatal cases for younger children (up to five) wearing adult seatbelts.

Estimates of the benefits of increased use of child restraints that are based on this assumption will therefore be conservative.

Table 16. Estimated annual casualties by type of restraint

ESTIMATED ANNUAL CASUALTIES		AGE											
DEGREE OF INJURY	RESTRAINT	0	1	2	3	4	5	6	7	8	9	10	All
FATAL	ADULT SEATBELT	0.2	1.1	1.4	1.8	2.1	1.6	0.9	1.9	1.0	1.9	1.0	15
	CHILD RESTRAINT	4.4	2.8	2.4	1.1	0.8	0.3	0.1	0.0	0.0	0.0	0.0	12
	NOT RESTRAINED	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	1.4
SERIOUS INJURY	ADULT SEATBELT	1.2	8.6	13.0	24.6	31.5	34.4	36.9	40.9	47.5	47.5	56.1	342
	CHILD RESTRAINT	21.2	22.4	22.2	14.4	11.3	6.5	2.1	0.0	0.0	0.0	0.0	100
	NOT RESTRAINED	0.7	1.0	1.9	2.1	2.3	2.2	2.1	2.2	2.5	2.5	3.0	23
MINOR INJURY	ADULT SEATBELT	4.4	48.3	60.6	123.6	146.3	166.4	214.2	229.0	235.6	240.4	252.7	1721
	CHILD RESTRAINT	80.0	125.3	103.8	72.1	52.3	31.2	11.9	0.0	0.0	0.0	0.0	476
	NOT RESTRAINED	2.6	5.4	8.7	10.3	10.5	10.4	11.9	12.1	12.4	12.7	13.3	110
ALL		114	215	214	251	257	253	280	286	300	305	326	2802

The rows titled ‘adult seatbelt’ indicate the annual national casualties that may be influenced by encouraging the use of child restraints instead of adult seatbelts (assuming that booster seats are suitable for children up to eight years of age):

- Fatal – twelve cases per year.
- Serious injury – 237 cases per year.
- Minor injury – 1228 cases per year.

This takes into account the fact that the use of adult seatbelts for children under the age of one year represents an existing level of non-compliance with the existing articulation of the regulatory requirements (to use a child capsule up to age of one year). The establishment of

new more explicit regulatory requirements pertaining to the period beyond the age of one year is not assumed to have an impact on this. The required remedy in this instance (at a cost) is education, encouragement and/or enforcement (the latter perhaps being the most important).

The rows titled “not restrained” indicate the cases that may be influenced by encouraging the use of any restraint:

- Fatal – 1.4 cases per year.
- Serious injury – 22 cases per year.
- Minor injury – 110 cases per year.

Again, the establishment of more explicit regulatory requirements pertaining to the period beyond the age of one year is not assumed to have an impact on this. The required remedy in this instance (at a cost) is education, encouragement and/or enforcement.

Importantly, this analysis suggests that there is much greater potential for reducing child occupant casualties through ensuring the use of the most appropriate restraint, rather than through only addressing cases of unrestrained children.

It is noted that data relating to casualties that have occurred when a ‘child restraint’ has been in use hides the premature graduation between child seats and boosters. Section 9.6 estimates current usage of child seats versus usage of boosters. This information is used to calculate potential savings associated with avoiding a premature graduation between child seats and boosters relative the optimal transition determined as an outcome of the review (sections 3 to 7).

9.4 Effectiveness of adult seat belts compared with child restraints

There are no robust statistical studies that provide an estimate of the effectiveness of Australian child restraints, compared with adult seatbelts. Nevertheless, crash sled and crash barrier tests show very high injury protection compared to adult seatbelts. This appears to be consistent with real world studies. Recent statistical studies by the Children's Hospital of Philadelphia (United States) provided the following estimates of effectiveness.

Table 17. United States estimates of child restraint effectiveness

Reduction, compared with adult seat belt	Type of restraint		
	Forward facing child seat (1-4 yrs) Arbogast 2004 et al	Booster (4-7 yrs) Durbin 2003	Child seat or booster (2-6 yrs) Elliott 2006
Fatal	-	-	28%
Serious injury	78%	56% *	-
Minor injury	Nil	-	-

* Clinically significant injuries as reported by parents.

It is notable that the Arbogast (2004) study found no significant difference for minor injuries. Also it is not immediately evident why the effectiveness in fatal cases is less than that in serious injury cases but this may be due to the higher severity typical of these crashes and that serious injuries are replaced by minor injuries.

In recent years, the types of child restraints (particularly child seats) used in the United States have more closely matched those used in Australia in that they incorporate a top tether. Caution should be used in using the results of earlier overseas studies (where top tethers were not in use) to Australia.

9.5 Types of child restraint in use

The Australian injury data do not distinguish between child seats and boosters. As a result it is difficult to determine the potential savings associated with avoiding a premature graduation between child seats and boosters. An observational study conducted in New South Wales in 1998 determined child ages (Paine 1998). Reasonable sample sizes were available from ages one to three and found that child seat use dropped from 100 percent to 92 percent over this age range (the remainder being booster

seats). A child seat was reported to be used for one six year old but there were too few cases to draw conclusions in the four to six age ranges. Table 18 shows the assumed rate of use of each type of child restraint for the purpose of estimating the benefits of encouraging these devices.

Table 18. Estimated ratio of child seat to booster by age

AGE (yrs)	0	1	2	3	4	5	6	7	8	9	10
BOOSTER	0%	0%	2%	8%	50%	50%	100%	100%	50%	0%	0%
CHILD SEAT/ CAPSULE	100%	100%	98%	92%	50%	50%	0%	0%	0%	0%	0%

9.6 Estimated savings if child restraints are used up to age eight

Applying the effectiveness from Table 17 to the adult seatbelt cases in Table 16 gives the following estimates of savings from measures which result in an appropriate child restraint being used instead of an adult seatbelt.

Table 19. Estimated annual savings from using child restraints instead of seatbelts

Casualties	Age											
	0	1	2	3	4	5	6	7	8	9	10	All
Fatal Saved	0.1	0.3	0.4	0.5	0.6	0.4	0.3	0.5	0.3	0.0	0.0	3.4
From	4.7	4	4	3.1	3.1	2	1.1	2	1.1	2	1.1	28.2
Serious Saved	0.9	6.7	10.1	19.2	24.6	19.3	20.7	22.9	26.6	0.0	0.0	151
From	23	32	37	41	45	43	41	43	50	50	59	464
Minor* Saved	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
From	87	179	173.2	206.1	209.2	208.1	238.1	241.2	248	253.1	266.1	2309.1

- Some minor injury savings could be expected but there is no research to quantify this.

Estimated savings from use of child seats or boosters

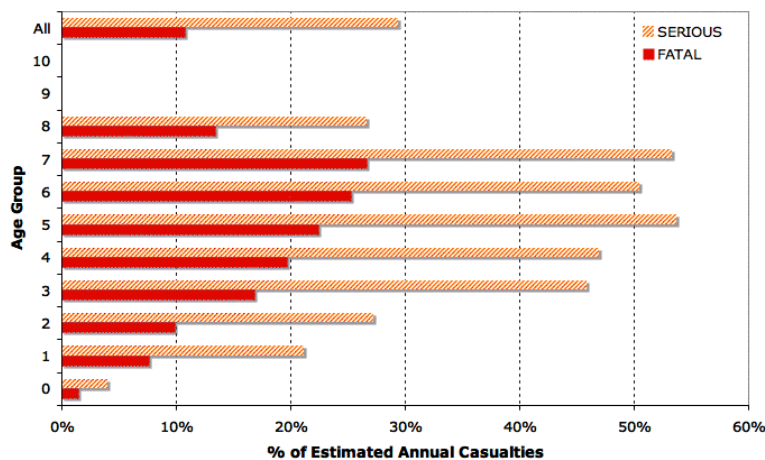


Figure 23. Estimated annual savings from the use of child seats or booster seats

Based on this analysis it is estimated that, if fully successful, measures which result in an appropriate child restraint being used instead of an adult seatbelt would save:

- in excess of three child occupant fatalities (twelve percent of estimated annual fatalities); and
- 151 serious injuries to child occupants (thirty percent of estimated annual serious injuries).

In addition to these savings is the potential savings associated with avoiding a premature graduation from child seats to boosters. As there is no empirical differentiation between the effectiveness of child seats and boosters in relation to the avoidance of fatalities, the only quantification of potential benefits possible in this area relates to the avoidance of serious injuries. By applying the usage data (child seat versus boosters) assumed in Table 18 and the difference between effectiveness estimates (Table 17) to data relating to serious injuries borne by children wearing child restraints (Table 16) the contents of Table 20 have been calculated.

Table 20. Estimated savings from avoiding premature graduation to booster seats

	AGE					
	0	1	2	3	4	Total
Estimated annual savings by avoiding premature graduation to booster seats		0.1	0.4	1.6	1.2	3.3

This information is provided as an indication that the benefits associated with avoiding a premature graduation, while being real, are small relative to effecting a change away from adult seatbelts as a form of restraint for children under the age of 9 years. The estimates presented in Table 20 are sensitive to the usage rates assumed in Table 18.

9.7 Costs of encouraging appropriate use of child restraints

9.7.1 Retail prices

Table 21 sets out the results of a survey on retail prices of child restraints in Australia. It is usual for the cheapest products to have higher sales. This will reduce the average price, based on sales compared with an average price based on a model count. The resulting 'deemed price' is based on the mid-point between the average price for all models and the minimum price.

Table 21. Retail prices of Australian child restraints

Type	Description	Model Count	Average price (model count)	Minimum Price	Deemed price
A	Capsule	4	250	225	\$237
AB	Infant convertible	16	303	200	\$251
B	Child seat	5	203	170	\$186
BC	Booster convertible	1	305	305	\$305
C	Booster with back	9	120	90	\$105
CC	Booster cushion	3	53	48	\$50
D	Harness	2	48	38	\$43

Since the price of booster seats is substantially lower than that of child seats it is necessary to determine the proportion of each for costing purposes. This can be derived from surveys of child

restraint use. Costs would be reduced if rental schemes were refocussed to meet the demand for additional child restraints.

It is possible that mandating the use of child restraints will have an effect on the market for child restraints, and in turn, the price at which they can be purchased. A detailed analysis of the market for child restraints has not been undertaken. That aside, it can be said that the direct effect of the regulatory change would be to (on an on-going basis) marginally increase the demand for child seats (one percent) and significantly increase the demand for boosters (approximately 50 percent - refer to Table 27). The review has not sought, nor obtained production information from manufacturers or suppliers that would enable it to estimate the elasticity of supply. Without this information it is not possible to determine whether price will increase or remain largely unaffected (for example, due to greater economies of scale in production). Based on what information is known, the effect of mandating the use of boosters could reasonably be expected to put some upward pressure on prices (particularly for boosters). A sensitivity test taking into account the foreseeable variability in the cost of child seats and boosters is undertaken in section 9.15.

9.8 Surveys of child restraint use

Very few Australian surveys have obtained reliable information about child restraint usage by age of child. Observational (roadside) surveys have difficulty determining the age of the occupant. Interview surveys, where parents are asked about the age of the child, are more useful. Two recent published surveys are relevant to this project:

- "*A survey of drivers' child restraint choice and knowledge in South Australia*" (Edwards 2006) – 357 drivers were interviewed and data obtained for 586 child occupants aged from birth to ten. Published in May 2006 by the Centre for Automotive Safety Research.
- "*Factors that influence children's booster seat use*" (Charlton 2006) - 690 parents responded to a questionnaire and data were obtained for 988 child occupants aged from four to eleven. Published in April 2006 by Monash University Accident Research Centre.

In addition, the Prince of Wales Medical Research Institute recently conducted a telephone survey that obtained restraint usage information for 613 children up to age ten (Bilston et al 2006, in press).

The Centre for Automotive Safety Research and the Prince of Wales Medical Research Institute surveys are regarded as the most applicable to an analysis of costs by age group. Details of the results of these studies are set out in Table 22 and Table 23 and Figure 25 and Figure 26.

Table 22. Restraint use in South Australian survey

Age	Capsule	Child Seat	Booster	Adult Belt	None	Count
0	41%	59%				24
1		84%	5%	11%		19
2		68%	29%	3%		38
3		38%	43%	17%	2%	42
4		9%	54%	35%	2%	162
5		2%	32%	65%	1%	91
6		2%	20%	75%	3%	64
7			18%	82%		56
8			4%	91%		45
9			3%	97%		31
10				100%		14
						586

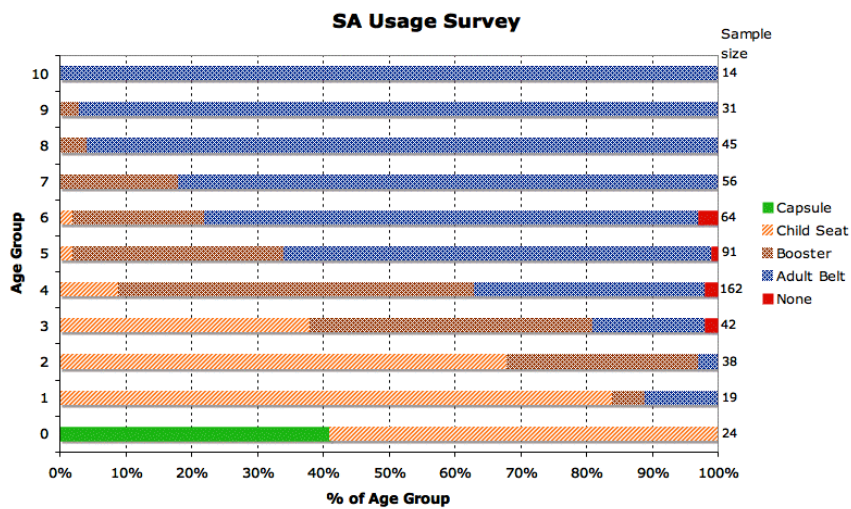


Figure 24. Restraint use in South Australian survey

Table 23. Restraint use in Prince of Wales Medical Research Institute survey

Age	Capsule %	Child Seat %	Booster %	Adult Belt %	Harness %	Count
0	64	34	2			56
1		94	4			49
2		69	24	1	5	74
3		42	54	5		65
4		13	73	12	1	67
5		9	50	41		58
6			33	67		69
7			20	78		55
8			5	95		42
9			2	96		45
10				100		33
						613

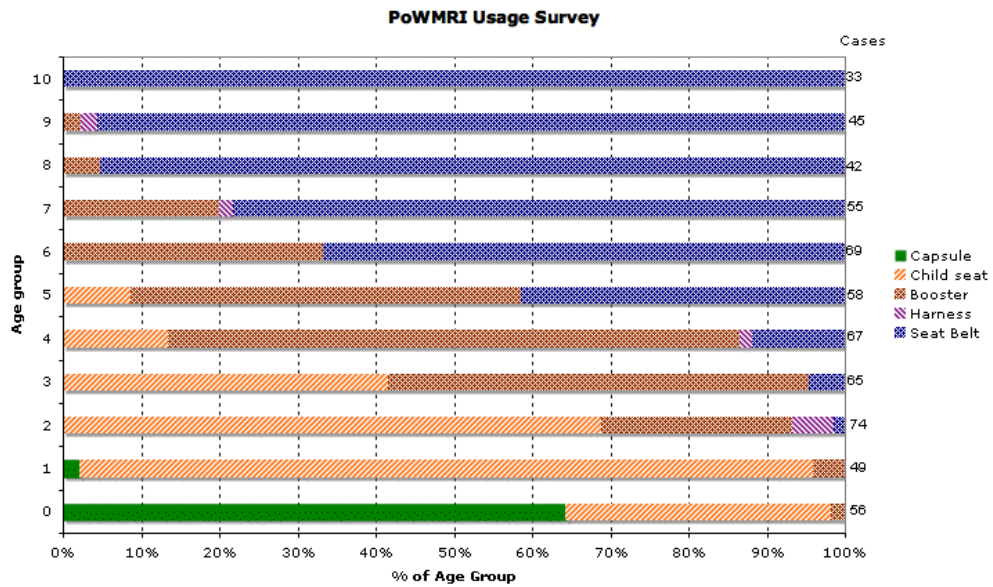


Figure 25. Restraint use in Prince of Wales Medical Research Institute usage survey

9.9 Number of cases where an adult seatbelt should be replaced by a child restraint

Figure 26 shows the proportion of children who are considered to be inappropriately restrained by an adult seatbelt. The ‘deemed inappropriate’ values are based on the average of the Centre for Automotive Safety Research and the Prince of Wales Medical Research Institute data up to seven years old and half of the average for eight year olds. Nine and ten year olds are deemed to be appropriately restrained in adult seatbelts (Brown et al 2006 note that current booster designs may not be suitable for children of this age).

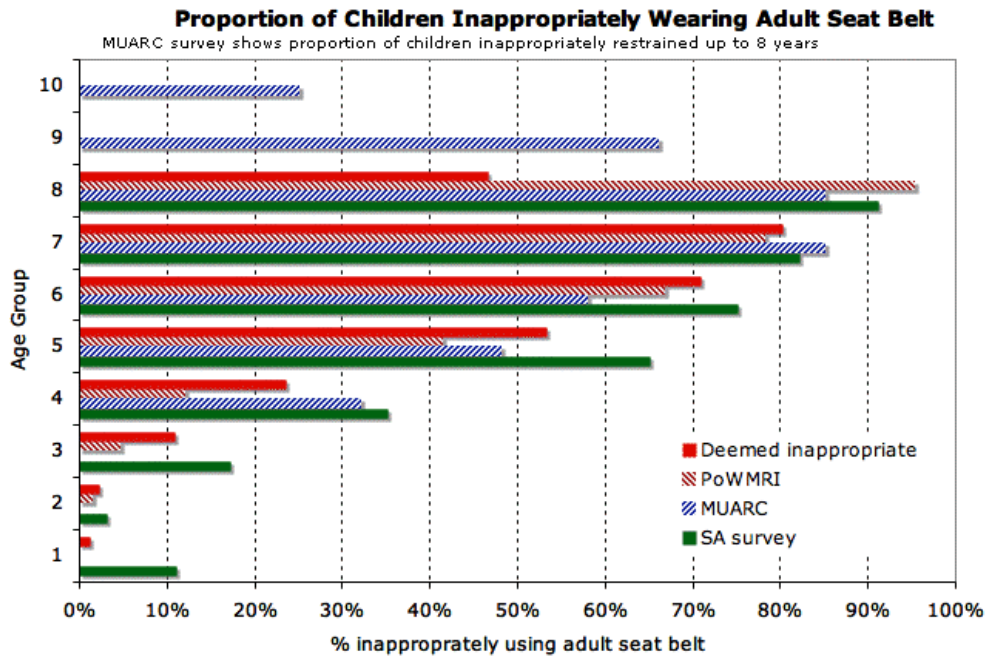


Figure 26. Proportion of children considered to be inappropriately restrained

For the purposes of this analysis it is assumed that:

- Children from one to four who are currently using just an adult seatbelt should be using a child seat.
- Children from five to seven who are currently using just an adult seatbelt should be using a booster seat. Half of eight years olds with adult belts should also be using a booster seat.

Table 24. Proportion of children inappropriately using adult seatbelts

Age	Should be in child seat %	Should be in booster %
0	0	
1	1	
2	2	
3	11	
4	23	
5		53
6		71
7		80
8		47
9		
10		

9.10 Number of cases where a booster seat should be replaced by a child seat

It is assumed that children who are from one to four years of age who are currently using a booster seat should be using a child seat.

Table 25. Proportion of children inappropriately using booster seats

Age	Should be in child seat %
0	1
1	5
2	27
3	48
4	64
5	
6	
7	
8	
9	
10	

9.11 Estimated costs

Table 26 sets out the most recent available population statistics for Australia. This is based on data from the Australian Bureau of Statistics.

Table 26. Child population for Australian States and Territories

Age	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Australia
0	84814	61692	49354	17222	24472	5740	3566	4151	251036
1	83497	60403	48369	17375	23936	5865	3657	4003	247171
2	82395	60651	49325	17724	24256	6019	3517	3935	247899
3	86240	60696	51992	17947	25329	6316	3411	4024	256001
4	87011	62254	51830	18358	26001	6213	3307	4119	259140
5	87002	61910	52210	18751	26324	6623	3284	4154	260293
6	86542	63036	52570	18774	25987	6028	3334	4018	260332
7	88515	64292	53473	19040	26572	6385	3214	4202	265752
8	89009	64475	54368	19535	27045	6551	3380	4217	268636
9	90535	66391	55604	20122	27589	6904	3422	4393	275006
10	90667	66600	55720	19863	27818	6844	3336	4367	275265
All	956227	692400	574815	204711	285329	69488	37428	45583	2866531

Applying the restraint usage proportions of Table 24 and Table 25 to the national populations in Table 26 gives the following estimates of the number of children that would be more appropriately restrained in a child seat or booster seat.

Table 27. Estimated number of cases where an extra child seat or booster seat is needed

Age	Australian Population	From seatbelt to child seat @ \$186.00	From booster to child seat @ \$186.00	From seatbelt to booster @ \$105.00	Cost
0	251036		2241 (1%)		\$416,826
1	247171	2471 (1%)	11223 (5%)		\$2,547,084
2	247899	5393 (2%)	66095 (27%)		\$13,296,768
3	256001	27667 (11%)	123963 (48%)		\$28,203,180
4	259140	60820 (23%)	164727 (64%)		\$41,951,742
5	260293			138448 (53%)	\$14,537,040
6	260332			184401 (71%)	\$19,362,105
7	265752			212843 (80%)	\$22,348,515
8	268636			126258 (47% ^a)	\$13,257,090
9	275006				\$0
10	275265				\$0
All	2866531	96,351	368,249	661,950	
Cost		\$17,921,286	\$68,494,314	\$69,504,750	\$155,920,350

Notes:

1. It has been assumed that about half of eight year olds are of an appropriate size for an adult seatbelt. Although some children older than eight should be in boosters this tends to be balanced by those under eight who are too big for current designs of booster seat.
2. The 368,249 booster seats currently used by children four and under would be available for use when these children are older. It is realistic and defensible to take into account the future foreseeable savings from not having to purchase new booster seats at the point in time when it is appropriate for the child to make use of the booster purchased in the past. This is a resource cost saving that is accounted for in the lifecycle analysis (section 9.13) in order to give a realistic overview of the benefits and costs associated with the proposed change to the status quo regulatory arrangements.

Based on this analysis, it is estimated that about 460,000 extra child seats and 662,000 extra booster seats would be needed to appropriately restrain child occupants in Australia. The estimated cost to purchase this equipment is \$156 million.

Added to this would be the incremental cost of modifying educational and enforcement campaigns to reflect the new regulatory requirements that are established to give effect to optimal child restraint. These costs mainly relate to re-printing of advisory materials, making of new advisory media, minor re-training of enforcement officers and the cost of undertaking 'grass roots' communications to ensure that parents are aware of the new regulatory requirements. It is estimated that these changes will cost, across Australia, approximately \$4 million. It is considered that this estimate needs to be further refined.

A total cost of \$160 million (first year post implementation) could therefore be attributed to establishing enforceable obligations for optimal child restraints up to the age of nine years old.

It should be emphasised that these costings take into account that a large proportion of parents are voluntarily purchasing and using suitable child restraints in the absence of laws that explicitly require

them to do so. Indeed, the usage statistics indicate (when considered over the lifecycle) that child seats are being purchased by a large proportion of parents (in fact 99 percent) and used when the child is between the ages of one and two (this is implicitly indicated in Table 27). Having absorbed the capital cost already, observed behaviour is that parents are prematurely transitioning to boosters, or of more concern, to adult seatbelts. Considered in the context of this interpretation of available statistics, the effect of requiring use of child seats and boosters may not imply a significant number of new purchases of child seats, but rather, will imply a change to poor child restraint practices, mainly the premature graduation from child seats to boosters or adult seatbelts. For the sake of conservatism, the number of child seats required to be purchased (in year one following the regulatory reform) has not been discounted by estimates of child seats already purchased (used when child between age of one and two), which are available to be used in future when the child is aged between three and five.

9.12 Valuing safety

It is estimated that the expenditure indicated above would save 3.4 fatalities and 151 serious injuries to child occupants each year.

For the purpose of evaluating potential safety improvements that can be achieved, the assessment has adopted the use of estimates of the cost of road traffic crash casualties prepared by the Bureau of Transport Economics (2000) and updated by Connelly and Supangan (2006) such that they are expressed in 2003 Australian dollars:

- \$1,832,310 per fatality.
- \$397,000 per serious injury.
- \$14,183 per minor injury.

The BTE² adopted a ‘Human Capital’ based approach to compute the ‘economic losses’ (the actuarial term for lost earnings only) associated with road traffic crashes. In addition the BTE used actuarial data from three compulsory third-party personal insurance schemes to produce estimates of the costs associated with lost quality of life. The BTE estimates for the effects of casualties are higher than those that would be produced by a strict application of a human capital approach but are lower than that would be produced using a willingness to pay approach.

Leung and Guria (2006) attempted to distinguish between the ‘value of statistical life’ of children compared with adults, based on a New Zealand survey. However, the analysis was inconclusive. They note a recommendation from a 2003 European workshop to use the same value as adults until child-specific values are available.

Brown and others (2006) note that there are indications that some children are hospitalised for relatively minor injuries as a precaution and therefore caution should be used when analysing police reported accident statistics.

Applying the inflation rates in Table 28, the findings of Connelly and Supangan have been converted into 2006 Australian dollars, as listed below.

² Bureau of Transport Economics, 2000. Road crash Costs in Australia. Report 102.

Table 28. Annual changes in Consumer Price Index, all groups for years 2004-06

Year	Inflation: ABS all groups 6401.0
2004	2.35%
2005	2.675%
2006	3.55%

Accordingly the estimate of the cost per road traffic crash casualty in Australia, in 2006 Australian dollars is:

- \$1,993,892 per fatality.
- \$432,009 per serious injury.
- \$15,434 per minor injury.

These are the figures used to value safety benefits in the following sections.

9.13 Lifecycle analysis of benefits and costs of optimal child restraint

The approach to evaluating the costs and benefits of giving effect to optimal child restraint is necessarily considered over a lifecycle. Compliance costs and benefits will not only be borne in the first year of implementation. Costs and benefits will accrue as the population of children grow and the existing population gets older and make transition through various forms of child restraint.

9.13.1 Changes to occur over the lifecycle

The following is provided as a description of the foreseeable cost and benefit implications arising from implementation of optimal child restraint (relative to the status quo):

Year one

Cost of purchasing new child seats and/or boosters in order to comply with new regulatory requirements pertaining to child restraint. Benefits of switch from adult seatbelt to suitable child restraint for year one is applicable.

Year two

Cost of child seats for those turning one year old. Cost of boosters for those children turning five. This cost needs to be net of those who are switching back to a booster previously purchased in advance of the articulation of the new regulatory requirements. Benefits of switch from adult seatbelt to suitable child restraint for year one is assumed to be reproducible in year two.

Year three

Cost of child seats for those turning one year old. Cost of boosters for those children turning five. This cost needs to be net of those who are switching back to a booster previously purchased in advance of the articulation of the new regulatory requirements. Benefits of switch from adult seatbelt to suitable child restraint for year one is assumed to be reproducible in year three.

Year four

Cost of child seats for those turning one year old. Cost of boosters for those children turning five. This cost needs to be net of those who are switching back to a booster previously purchased in advance of the articulation of the new regulatory requirements. Benefits of switch from adult seatbelt to suitable child restraint for year one is assumed to be reproducible in year four.

Year five

Cost of child seats for those turning one year old. Cost of boosters for those children turning five. This cost needs to be net of those who are switching back to a booster previously purchased in advance of the articulation of the new regulatory requirements. Benefits of switch from adult seatbelt to suitable child restraint for year one is assumed to be reproducible in year five.

Year six and beyond

Cost of child seats for those children turning one year old. Cost of boosters for those children turning five. Benefits of switch from adult seatbelt to suitable child restraint for year one is assumed to be reproducible in year six and beyond.

9.13.2 Qualifications

- Consistent with previous sections, the above assumes that the more explicit articulation of the regulatory requirement only impacts on those who have misinterpreted the existing rule and are non-compliant with the requirement to apply ‘suitable’ restraint to children under 16 years of age.
- The above lifecycle analysis is likely to overstate lifecycle costs due to the fact that most families consist of more than one child (average family is 2.4 children). There is no reason to believe that child seats and boosters purchased for use by one child cannot be reused by younger siblings. However, there would be a limit to this as (a) it depends on the difference of age between siblings as to whether additional purchases can be avoided; and (b) over time older child seats and boosters will become outdated, that is, they would fail to meet the contemporary standards at a future point in time. Due to the complications involved, this has not been taken into account in the analysis. If accounted for, the effect would have been to discount the number of purchases required in the future, which would have reduced future foreseeable costs.
- The analysis is clearly sensitive to the assumption that benefits applicable to year one can be reproduced in future years. The benefit stream is a prediction based on observation of past accident data. It would be ideal to be able to predict how those results would change as time moves forward but the complications in doing so are significant given the uncertainty of impact of factors such as:
 - growth in congestion;
 - changes to method of transport utilised;
 - changes to demographics; and
 - changes to travel behaviour etc.

With that in mind, it is reasonable, and indeed defensible to continue to use the benefits stream estimated in year one as a proxy for the benefit stream in future years. This is particularly the case given that there is no foreseeable change in influencing factors that would indicate that the

occurrence of accidents involving children will either increase or decrease, or that (independent of the proposed regulatory intervention) child restraint practices will change.

- The avoidance of minor injuries associated with using suitable child restraints instead of using adult seatbelts has also not been quantified. Accordingly the quantum of benefits used to justify the options for regulatory change in the following sections can be argued to be a conservative representation of the true savings associated with making changes towards optimal child restraint.

9.13.3 Quantification and comparative analysis

The dollar value of benefits associated with adoption of suitable child restraint is indicated in Table 29. This table applies the values articulated in Table 28 and multiplies them by savings in casualties estimated in section 9.6.

Table 29. Summary of quantified benefits

<u>Summary</u>	<u>Number</u>	<u>Value</u>
<i>Estimated Savings in fatalities associated from using suitable child restraints instead of adult seatbelts</i>	3.3	\$6,587,818.91
<i>Estimated savings in serious injuries by using suitable child restraints instead of adult seatbelts</i>	150.0	\$64,817,822.16
<i>Estimated savings in serious injuries associated with premature graduation between child seats and boosters*</i>	3.3	\$1,432,664.04
		\$72,838,305.11

*not included in comparative analysis

The information contained in Table 29 and Table 27 is combined in Table 30 to provide a comparative analysis of cost and benefits over a ten year period assuming implementation of the requirement occurs in 2007. Table 27 indicates the initial implementation costs associated with implementing optimal child restraint. The costs borne beyond the first year of implementation are explained above (year 2 to year 6 and beyond). These costs and benefits are discounted over time using a real discount rate of six percent. The results forthcoming are not sensitive to changes in the discount rate that is adopted.

Table 30. Comparative analysis of costs and benefits over a ten year period

	Year										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Estimated Benefits	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$69,844,480	\$698,444,802
PV of estimated benefits (6%)	\$69,844,480	\$65,891,019	\$62,161,339	\$58,642,772	\$55,323,370	\$52,191,859	\$49,237,602	\$46,450,568	\$43,821,291	\$41,340,840	\$544,905,141
Estimated Costs	\$155,920,350	\$10,043,376	\$14,653,191	\$20,729,331	\$26,490,891	\$27,434,001	\$27,669,306	\$27,669,306	\$27,669,306	\$27,669,306	\$365,948,364
PV of estimated costs (6%)	\$159,920,350	\$9,474,883	\$13,041,288	\$17,404,746	\$20,983,267	\$20,500,281	\$19,505,769	\$18,401,669	\$17,360,065	\$16,377,420	\$312,969,738
										Net Present Value	<u>\$231,935,404</u>

Table 30 clearly indicates that there is significant net social benefit associated with achieving optimal child restraint. It should be noted that in the period after the first cycle of children (2012 - when a one year old first affected by the change turns nine) the present value of annual incremental benefits associated with the change are far in excess of annual incremental costs. This observation provides a clear justification for the reform beyond the initial adjustment cycle.

9.14 Economic analysis of feasible options

Table 11 in section 8.5 indicates the feasible options identified by experts and stakeholders consulted during the process of the review. Table 31 sets out the estimated savings and costs of each of these options using the benefit costs analysis framework established over the preceding sections.

9.14.1 Notes on non-regulatory option

Existing educational campaigns ask parents to consider what restraints are required given the size of the child and their observations about the adequacy of adult seatbelts when used to restrain their child; does the seatbelt cut across the neck of the child? Is there a possibility that the child will slip under the seatbelt? If so, then a child restraint is required. These campaigns are at a State and Territory level and normally instigated by road agencies and other child care facilities. They may be presented via the internet, distribution of pamphlets, presentations at locations such as child care centres and other community groups. The establishment of child restraint fitting stations also provides an opportunity to further educate parents/drivers on the correct use of restraints. Most road agencies also have a call centre that answer questions on road rules, registration and licensing. These centres also provide a valuable outlet for information about restraint usage.

Under option zero the nature of the educational campaigns will change such that it provides more definitive age related advice to parents along the following lines; 0 to 1 year old use a child capsule; one to four year old use a child seat; and four to seven year old use a booster (assumes standards remain constant).

For young children aged one to three year old to be restrained using an adult seatbelt is fundamentally at odds with existing advisory educational campaigns. Use of adult seatbelts in this age category can therefore be seen as a direct indicator of non-compliance with what are perceived to be 'advisory', as opposed to mandatory, child restraint requirements. It is envisaged that the effect of changes to educational programs (independent of any regulatory change) will have no effect on this observed behaviour. However, it is expected that new advice to parents will avoid a proportion of the observed premature graduation to boosters and premature graduation to adult seat belts in the four to seven age group.

There is data on which to calculate the benefits of avoiding a premature graduation to boosters, but there is no data on which to calculate the proportion of premature graduation to adult seatbelts that would be avoided due to the more definitive advice being provided to parents (noting the absence of a perceived compulsion to do so).

It has been assumed, for the purpose of the analysis, that the average of the non-compliance observed in the one to four age groups (seven percent see Tables 22 and 23) can be applied to the four to seven age groups. This is likely to serve as a conservative estimate of the level of non-compliance with advisory recommendations in the four to seven age groups given that parents are observed to become less particular about child restraints as the child gets older and the risk of ineffective restraint is perceived to decline.

It should of course be noted that any change to observed behaviours (attributable to this non-regulatory option) is not costless. The cost of purchases made in response to changes to advisory recommendations is attributable to the non-regulatory option.

Table 31. Costs and casualty savings of the options

Option	Estimated casualty savings per year	PV of Estimated cost for implementation over 10 year cycle	Net Present Value over 10 years
Phase 1: Amend existing education materials advising appropriate restraint up to 7 th birthday	1.7 fatalities and 75 serious injuries (\$35 million)	\$258 million	\$19 million
Phase 2: subject to changes in standards, amend education materials advising appropriate restraint up to 9 th birthday	0.8 fatalities and 46 serious injuries (\$21 million)	\$33 million	\$130 million
Appropriate restraint up to 7th birthday	2.5 fatalities and 97 serious injuries (\$47 million)	\$277 million	\$88million
Phase 1: same as Option 1	"	"	"
Phase 2: Children from 7th birthday to 9th birthday required to be in a booster (after booster standard is upgraded)	0.8 fatalities and 50 serious injuries (\$23 million)	35	\$140million
Phase 1: Appropriate use to 4th birthday	2.4 fatalities and 93 serious injuries (\$45 million)	\$272 million	\$78 million
Phase 2: Children from 4th birthday to 9th birthday required to be in a child seat or booster (after booster standard is upgraded)	0.9 fatalities and 53 serious injuries (\$25 million)	\$45 million	\$149million
Phase 1: Appropriate use to 3rd birthday	2.4 fatalities and 85 serious injuries (\$41 million)	\$270 million	\$54million
Phase 2: Children from 3rd birthday to 9th birthday required to be in a child seat or booster (after booster standard is upgraded)	0.9 fatalities and 45 serious injuries (\$25 million)	\$47 million	\$151million
Phase 1: Child seat (or capsule) to 3rd birthday	2.4 fatalities and 85 serious injuries (\$41 million)	\$270 million	\$54million
Phase 2: Child seat to 5th birthday & booster to size limit (assume 9th birthday) - after child seat and booster standards upgraded	0.9 fatalities and 45 serious injuries (\$25 million)	\$47 million	\$151million

Table 31 indicates that all options are justified on benefit/cost grounds.

Since both the benefits and costs are proportional to the number of children who are successfully moved into more appropriate restraints this analysis also indicates that a partially successful implementation would also be cost effective.

Given the anthropometric limitations of current child restraint designs, a staged approach to regulation is recommended as the most appropriate. However, the difficulty and concern arises in respect to how and when the second stage of regulatory reform will be triggered. The implicit assumption in respect to all the multi-stage options listed above is that the second stage of regulatory reform will occur when and if current Australian standards are modified to reflect the findings of the review. Changes to these standards are at the discretion of Standards Australia, subject to the processes that have been established by that organisation. Changes to these standards are outside the direct control of the Governments of the Commonwealth, States and Territories. The implication is that changes may not be made, or at minimum, there is likely to be a delay of an unspecified period. Such delay would also delay the implementation of the second stage of the proposed regulatory reform. This is an important consideration in interpreting the above results.

The results of the quantitative analysis indicate that net present value can be maximised by undertaking either Option 2 or Option 3. However, this interpretation of the results does not factor in the uncertainty of the delay between the stages and the associated opportunity cost (in terms of fatalities and serious injuries that could have been saved). For example, the decision to proceed with Option 3 in preference to Option 2 would result in an opportunity cost of 1.3 fatalities and 58 serious injuries (that could have been saved by requiring boosters from ages four to seven years of age) for each year that Phase 2 of Option 3 is delayed. Option 2 does not suffer from the same drawbacks. Accordingly Option 2 is preferred (noting that option 1 is phase A of option 2).

In closing it should be noted that, what is defined as a suitable child restraint is defined by the Australian Standards due to the reference made to the Australian standards by the individual States and Territories in their regulations. Compliance with the existing (and any future) regulatory requirements requires use of a child restraint that meets the relevant Australian Standards. Accordingly, changes to these standards will have cost implications that need to be managed in a pragmatic way irrespective of which regulatory reform option is chosen. It is recommended that jurisdictions give consideration to this issue and the potential to transition the enforcement of new standards (post promulgation) over a period of time that enables children to move between child restraint categories. Such an approach is likely to minimise the compliance cost impacts of a change to relevant standard(s).

9.15 Indirect effects of the proposed reform

Submissions received in response to the release of the draft regulatory impact statement questioned the extent of the impact of proposed changes to rule 266 on families that contained three or more children under the age of four years, and equally, the extent of the impact on families that contained three or more children under the age of seven years. Concerns were raised about the feasibility of fitting three child restraints across the back seat of a vehicle and the impact this may have on motor vehicle choice. The proposed prohibition of children under the age of seven years sitting on the front seat could also foreseeably have some impact on motor vehicle choice.

In response to these concerns, the initial point to be made is that the regulatory requirement contained in the newly drafted rule 266 will not change (in substance) relative to the status quo, however, due to the improved, more explicit, articulation of the requirements, it is expected that compliance will improve. In other words, under the existing rule 266, it is already a requirement to ensure that children aged four years or under are restrained with

the assistance of child seats or boosters (depending on driver judgements about the suitability of applying each type of restraint to the child passenger in question). It is foreseeable that some parents (those that previously were not compliant with the implicit requirements of rule 266), will for the first time, consider the (now more explicit) need to accommodate three child restraints in the back seat of their vehicle. This may force some parents to reconsider their choice of car.

A standard family car such as a Ford Falcon, Holden Commodore or Toyota Camry has sufficient space to accommodate three child seats on the back seat. However, some medium cars and the majority of small cars do not have sufficient space. Note that it would be possible to accommodate a mix of child seats and boosters in a small or medium size car because there is a slim line booster on the market. This is why it is important to focus consideration of the potential effect of the regulatory requirement (noting that it is not a new requirement in substance) on families with three or more children under the age of four years old, that is, those families that need to accommodate three child seats on the back seat.

In determining the size and scale of these potential impacts the key questions are:

- how many families must give consideration to this issue and respond accordingly;
 - how many are not complying at present;
 - due the limited space in the back seat of the current vehicle, how many will have to trade in their existing vehicle and purchase a new one that will enable them to become compliant with the requirements of rule 266; and
 - in such circumstances, what are the likely cost implications.

Table 32. Count of Families with Children – State/Territory of Enumeration

Place of enumeration	Families	Families with 3 or more children under 4	% of total	Families with 3 or more children under 7 years old	% of total
New South Wales	1,068,484	3,129	0.29%	24,480	2.29%
Victoria	805,518	2,114	0.26%	17,126	2.13%
Queensland	610,958	2,169	0.36%	15,775	2.58%
South Australia	238,011	560	0.24%	4,498	1.89%
Western Australia	306,737	844	0.28%	6,967	2.27%
Tasmania	74,756	199	0.27%	1,634	2.19%
Northern Territory	28,459	177	0.62%	1,163	4.09%
Australian Capital Territory	52,534	138	0.26%	1,014	1.93%
Other Territories	376	0	0.00%	9	2.39%
Australia	3,185,833	9,330	0.29%	72,666	2.28%

Australian Bureau of Statistics, 2006 Census of Population and Housing, © Commonwealth of Australia, 2007

As indicated in Table 32, a very low percentage of families (0.29 percent) contain three or more children under the age of four years. Of those that do, other statistics presented in this regulatory impact statement (summarised in Table 24) suggests that at worst, the proportion of children under four years old inappropriately wearing adult seatbelts is 11 percent. If it is assumed, as indicated by the statistics, that 11 percent is the level of non-compliance with the need to use child seats, then the maximum number of families

that will now (due to improved clarity of requirements) have to consider the feasibility of accommodating three child seats on the back seat is 11 percent of the total count of families with three or more children under the age of four years³. Eleven percent of the total count of families with three or more children under the age of four years is approximately 1026 families across the country. Of these, the question is how many are impeded from becoming compliant due to the characteristics of their current motor vehicle (insufficient space to accommodate three child seats). Unfortunately, census data does not capture information about the size of cars owned by households. Accordingly, there are limitations on the extent to which the National Transport Commission can be precise about the number of families that are currently non-compliant and would be impeded from becoming compliant because of the characteristics of their existing motor vehicles. Assuming the worst case (that all 1026 families that are currently not compliant are impeded from become so), and assuming a net cost of \$10,000⁴ associated with acquiring a new vehicle that is suitable (purchase price minus trade-in), the maximum cost implied by a one-off improvement in compliance is in the order of \$10 million. Such an additional cost, could it be substantiated, would be insufficient to cast doubt over the net benefits associated with any of the options articulated and subsequently assessed in Table 31.

9.16 Sensitivity analysis

There is a need to undertake a sensitivity analysis on the results articulated in Table 31 given foreseeable levels of non-compliance with the regulatory requirements, and given possible impacts of purchase price increases.

Compliance with mandatory requirements has historically been very high. A reasonable sensitivity test to undertake would be to assume the level of non-compliance observed with the existing regulatory requirement (to appropriately restrain a child under twelve months). However, this is a pointless exercise given that the level of non-compliance was found to be nil in the surveys that were used as inputs to the analysis. For the analysis to remain consistent there is also another constraint; for option zero it has been assumed that there will be seven percent non-compliance with advisory information provided to parents. Clearly this represents a lower bound for the estimated benefits of the regulatory options. To suggest otherwise would be to suggest one of two things:

- (a) seven percent non-compliance with advisory information is too optimistic (a possibility); or
- (b) that non-compliance would be encouraged by making a requirement mandatory.

If the normal proposition is accepted, that making a requirement mandatory and applying sanctions where there is non-compliance encourages compliance, then (b) can be ruled out; this leaves (a).

In considering whether seven percent is the right number, it is important to note that there is proportionality between costs and benefits. If behaviour changes towards more optimal child restraint, benefits accrue in terms of casualties avoided (fatalities, serious injuries, and minor injuries) and costs are borne when restraints are purchased. The costs are one-

³ Note that there is no way of knowing whether families with three or more children under four, are more or less compliant than the average.

⁴ This reflects the net difference between the purchase price of a small/medium car and the purchase price of a standard large sedan. This estimate is likely to be conservative given that the difference in purchase prices of used vehicles is not as significant as when these motor vehicles are new. Small/medium sized vehicles tend to hold their value better than large sedans, that, in relative terms, lose value quicker in terms of resale.

off and the benefits accrue over the period of use. The question arises, is there a minimum number of parents/drivers that need to make the switch to appropriate child restraint for the reform options to at least 'break even'. There are fixed costs associated with each of the reform options (\$4 million for amendments to education and enforcement) so the answer is yes. To determine the break even amount it is necessary to firstly calculate what child seats and boosters are worth to individual children over the term of their use. Secondly, sum these benefits, subtract the purchase price and use the residual to divide the quantum of the fixed costs. The remaining figure is the number of children that need to switch from adult seatbelts to appropriate child restraints in order for the reform to break even.

Table 34 indicates the value of casualty risk avoided per child by using child restraints over the age profile nought through to seven years old. By summing the benefits of a child seat and a booster, subtracting the purchase price the net benefit per child can be determined. By taking the fixed costs of the reform (\$4 million) and dividing this by the net benefit per child figure, the break even number of children required to make the switch can be determined. The result is that approximately 1500 children need to switch from adult seatbelts to appropriate forms of child restraint in order for the reform option to break even and for there to be a net benefit to society. This is less than 20 percent of the residual population that should be making use of child restraints instead of adult seatbelts. The National Transport Commission is confident that any of the proposed reform options will be effective in influencing at least this many people to change.

Table 33. Value of casualty risk avoided by choosing to use appropriate forms of child restraint

		AG E								Total
Estimated Annual Savings due to child restraint		0	1	2	3	4	5	6	7	
Fatal	Adult seatbelt to child seat		\$240.83	\$144.74	\$36.28					\$421.85
Fatal	Adult seatbelt to booster					\$19.28	\$6.45	\$2.72	\$4.98	\$28.46
Serious injury	Adult seatbelt to child seat		\$1,136.44	\$811.22	\$299.26					\$2,246.91
Serious injury	Adult seatbelt to booster					\$174.58	\$60.11	\$48.39	\$46.48	\$283.08
			<u>Value of child seat</u>		\$2,668.76					\$2,980.30
							<u>Value of booster</u>		\$362.99	

*calculations are a product of observed risk realised, divided by residual population using adult seatbelts, multiplied by value of casualty avoided

As indicated in section 9.7, the achievement of optimal child restraint requires the purchase of a marginal increase in the number of child seats and a significant increase in the purchase of boosters. Accordingly, if the proposed options are successful in achieving the objectives, an increase in demand for child seats and boosters can be expected to place upward pressure on prices. Table 34 indicates that the true value of child restraints to the residual population that do not use them are far in excess of their purchase cost, meaning that if the purchase price does increase by a large quantum (relative to current purchase prices) the investment in this equipment still represents good value. An increase in purchase price will, however, increase the break even level of influence that reform options must achieve in order for any of them to be of net social benefit.

10. RECOMMENDATIONS

10.1 Recommended option

Various options for regulation were outlined in Section 8, noting that each option has different benefits, costs, and ease of implementation and enforcement.

Based on the information contained in the previous sections of this report, the National Transport Commission recommends Option 1 – single stage introduction of mandatory use of appropriate restraint by all children up to their seventh birthday. To achieve this the Commission recommends the following:

1. That the Australian Road Rules be amended to require:
 - rearward facing restraints with an inbuilt harness be mandated for passengers from naught to under six months of age;
 - rearward or forward facing restraints with an inbuilt harness be mandated for passengers above six months to under four years of age; and
 - forward facing restraints with an inbuilt harness or booster seat (together with an adult seatbelt) are mandated from above four years to under seven years of age.
2. That the Australian Road Rules Maintenance Group monitor Australian Standards' modification of the upper mass limit of forward facing child seats with inbuilt harness (Type B) so that if and when their upper mass range is extended to 22 kilograms, it may consider mandating the use of a rearward facing restraint (Type A) or a forward facing child seat (Type B) with inbuilt harness to the fifth birthday.
3. When the standard is published for the new type booster seats, consider mandating its use from the fifth birthday to a minimum upper torso stature that approximates a nine year old. Test tool to be TNO P10 Anthropomorphic Test Dummy which represents 50th percentile ten year old children.

To assist the adoption and enforcement of the above recommendations, the following actions are also recommended:

1. The Australian Road Rules Maintenance Group and appropriate agencies write to the Australian and New Zealand Standards organisation requesting an investigation into the possibility of:
 - an extension of the upper weight range limit for Type B restraints (forward facing child seats with inbuilt harness) to a mass of 22 kilograms, with the aim of allowing most children up to their fifth birthday to use this restraint type; and
 - expediting the development and publication of the new type booster style standard to cater for children up to their ninth birthday, as measured by the Hybrid III ten year old test dummy.
2. The Australian Road Rules Maintenance Group and appropriate agencies write to the Australian Department of Transport and Regional Services requesting an investigation into the possibility of the development of a new Australian Design Rule to incorporate a 'ride height line' in the rear seat of all new passenger vehicles sold in Australia. The ride height line is to be established by sitting a Hybrid III ten year old test dummy in the seat.

3. That the Australian Road Rules Maintenance Group encourages relevant organisations to develop programs and facilities for the retrofitting of ride height lines in existing vehicles.

10.2 Important notes

The research indicates that better optimisation of appropriate restraints would require larger dedicated forward facing child seats. The necessary action is for Australian and New Zealand Standard to investigate the possibility of the development of an extended or new standard for larger child seats. To assist and expedite this, it is necessary that the relevant authorities (through the Australian Road Rules Maintenance Group) request the Australian Standards to consider:

- dedicated forward facing child seats to cater for most four year olds (i.e. children up to their fifth birthday); and
- boosters to increase their starting and finishing size range improve the level of protection provided by booster seats and enhance the regulatory assessment of booster seats.

To encourage Australian Standards to expedite this work programme, it will assist if the Australian Road Rules Maintenance Group clearly commits to regulating use of the child seats with extended upper limit and new style boosters with extended age range and enhanced safety systems. In other words, the relevant authorities can expedite the process by committing to mandating the early use of the extended standard so that Australian Standards has a strong incentive to prioritise development of the relevant aspects of the standard.

Indicative cost-benefits of these options are outlined in Section 9, and both are justified on cost-benefit grounds.

The recommended option has the advantage of immediately mandating improved protection for children aged from twelve months to their seventh birthday. No changes to child restraint products are required and there would be a significant change to real world practice because many young children are currently inappropriately restrained in booster seats or seatbelts (about 60 percent of three-year-olds and 29 percent of two year olds (Table 23)). It is estimated that about three percent of these children (up to fourth birthday) exceed the current 18 kilogram limit for Type B child seats under the Standard and provision may need to be made for exemption, based on body mass. If the standard is amended to cater for 22 kilogram children (recommended in Stage 2) then exemptions will be very rare for this age group (Table 4).

10.3 Child passengers in front seats

A further amendment is required to be made to the Australian Road Rules to protect child passengers and to ensure rules relating to child passengers are consistent, thus providing less confusion for parents when deciding whether it is safer to position a child in the front row of seats or the rear row of seats.

Rule 266(3) prohibits a child passenger less than one year old from being carried in the front row of seats if the motor vehicle has two or more rows of seats. This rule is currently consistent with other provisions of rule 266 which require children less than one year of age to be in an approved child restraint. Rule 266(3), if it remains unchanged, will not be consistent if the other provisions of rule 266 are modified in accordance with the regulatory proposal.

The regulatory proposal requires children less than four years of age to use a child restraint with an inbuilt harness. The Third Edition Australian Design Rules requires the fitment of child restraint anchorages to motor vehicles and allows, but does not require, the fitment of anchorages to the front seat (other than the driver's seat). As a child restraint with an inbuilt harness requires the use of child restraint anchorages, which are mandated only for the rear seat by the Third Edition Australian Design Rules, many motor vehicles would not have the capacity for proper fitment of child restraints in the front seat.

Therefore, an additional change to rule 266(3) is needed to:

- make it consistent (in a practical sense) with the other provisions of rule 266;
- support the design requirements of the device; and
- provide safer travel for children in this age group by avoiding confusion for parents who may be misled into believing that a child over twelve months of age, but under four may be legally carried in the front seat when it is not possible to install a child restraint in a way that meets the requirements of the regulations.

The regulatory proposal therefore recommends children less than four years of age be prohibited from sitting in the front seat of a motor vehicle.

It is also proposed that rule 266(3) be further amended to prohibit child passengers less than seven years of age from being carried in the front row of seats, unless all other seating positions are occupied by another child also less than seven years of age.

Substantial research data, primarily from the United States of America, suggests that children less than thirteen years of age should not occupy the front seat of a motor vehicle. This recommendation seems to be, at least in part, based on the injuries associated with airbag inflation when a crash occurs. However, the Australian Standards for airbags require a slower inflation rate and larger vents, which make a far softer impact than those used in the United States.

Australian airbags are supplementary to the primary restraint system of seatbelts and it would appear that if the seatbelt is suitable for the passenger, the airbag should not cause additional injuries in the event of a crash to small adults or children. However, there remains considerable concern about the safety of children in the front row of seats. Under the regulatory proposal the age group from four years of age to less than seven years of age is required to use a child restraint or booster seat (in combination with a seatbelt). Although it is uncertain whether front or rear seat occupancy will provide greater safety, in general passengers are at lower risk on injury in rear seats, regardless of age.

10.3.1 Results of consultation

Public submissions unequivocally supported the prohibition of children less than seven years of age from travelling as passengers in the front seat of motor vehicles. However, some submissions suggested this age be increased to include children ranging from eight years to sixteen years. The most common proposal was for children less than twelve years to be confined to the rear seat. The origin for this reasoning appears to stem from the fact that adult seatbelts are generally not thought to be suitable for a child less than 140 centimetres in height, which is typically reached when a child is about twelve years of age. However, this does not take into account the possibility that a booster seat could be used by a child sitting in the front seat (thereby positioning the child such that the adult seatbelt in the front seat is an effective form of restraint).

The National Transport Commission considers that the proposal for prohibition of children less than seven years of age from the front seat is consistent with the use of boosters and further relies on the provisions of rule 266(4) for ages from seven years to less than sixteen years, in that the restraint or seatbelt must be suitable for the passenger. The lack of evidence to show that airbags cause more danger than that sought to be prevented, and the variance in ages proposed by public submissions, suggests that there is confusion on any age different to that being proposed. Additionally, 72 percent of submissions received support the proposal.

Points put forward in public submissions proposing the banning of children from the front row of seats included:

- anthropomorphic and crash-based evidence, as outlined in the regulatory impact statement, that children less than twelve years are not afforded adequate protection from an adult seat belt alone;
- the proposals will mandate approved child restraints for children less than seven years of age and seatbelts will provide protection for children twelve years of age and above, this leaves children aged seven to less than twelve years still at greater risk of injury as passengers in motor vehicles;
- children between seven and twelve years will continue to be at risk until many future developments occur which will take some time, such as, review of Australian Standards, development of larger boosters for older children, promoting their acceptance to the public and mandating their use;
- crash testing for vehicles to meet the Third Edition Australian Design Rules 69/00 (Full Frontal Impact Occupant Protection) and 73/00 (Offset Frontal Impact Protection) is conducted using Hybrid III dummies, which represent the 50th percentile average male of height 168 centimetres and weight 77 kilograms. This is significantly different to the anthropomorphic dimensions of a child aged less than twelve years of age;
- there is ample crash-based research evidence to show that children are safer seated in the back rather than in the front row of seats⁵. Seating children in the rear seat until they are able to be seated correctly in an adult seatbelt is recommended by road safety experts⁶ and is already a common practice;

⁵ • Durbin, D.R., Chen, I., Smith, R. et al, Effects of seating position and appropriate restraint use on the risk of injury to children in motor vehicle crashes, *Pediatrics* 2005; 115: e305-e309.

• Henderson, M., Brown, J, Griffiths, M., Children in adult seat belts and child harnesses, Report No. CR 173, Federal Office of Road Safety, Canberra 1997

• Brown, J., Bilston, L., McCaskill, M., Identification of injury mechanisms for child occupants aged 2-8 in motor vehicle accidents, motor Accidents Authority NSW, Sydney, 2005

• Corneli, H.M., Cook, L.J., Dean, J.M., Adults and children in severe motor vehicle crashes; a matched pairs study. *Ann Emerg Med* 2000; 36: 340-345.

• Newgard, C.D., Lewis, R.J., Effects of child age and body size on serious injury from passenger air-bag presence in motor vehicle crashes, *Pediatrics* 2005; 115: 1579-1585

⁶ • Reeves, K.N., Zurynski, Y.A., Elliot, E.J., and Bilston, L, Seatbelts and the law: how well do we protect Australian children? *Medical Journal of Australia* 2007; 186(12): 635-638

• Prince of Wales Medical Research Institute, Child Restraint Guidelines
<http://www.powmri.edu.au/research/injury/road/children.htm> accessed Nov 2006)

- mandating to less than twelve years rather than seven years would cost nothing and have no adverse impacts if provisions are included for circumstances where the rear seats are already occupied by other children;
- there have been no submissions specifically objecting to this proposal, nor any evidence produced in counter argument, while more than a quarter of submissions to the National Transport Commission, unprompted, suggested extending the age at which children should be prohibited from sitting in the front seat;
- there has been no justification provided for the seven year old cut-off age, apart from consistency with the mandatory restraint requirements, while there is ample evidence for a twelve year old cut-off based on anthropomorphic, vehicle design, research and crash data;
- there is no reason not to take this opportunity to improve the safety of children aged seven to less than twelve years in motor vehicles in this amendment package by prohibiting them from sitting in the front row of seats (in vehicles that have two or more rows, unless the rear seats are already occupied by other children), while awaiting further future developments for improved occupant protection for this age group;
- the recent Medical Journal of Australia article by child restraint experts (Reeves, Zurynski, Elliot and Bilston, MJA 2007 186(12):635-638) overviewed legislative and safety-related literature in relation to child restraints and summarised available evidence including from simulated crash tests, cross-sectional studies, case series, case-controlled studies and observational studies that assessed restraint-use behaviour, as well as crash and injury surveillance data. Based on all of the evidence collated and reported, the second of the five key recommendations was that "Children are safest travelling in the rear seat of a vehicle." The authors cite five recent cross-sectional studies assessing the effect of seating position on injuries; all concluded that the rear seat is the safest place for children. The authors noted that "Despite this evidence, and the recommendation that children less than twelve years should travel in the rear seat [Prince of Wales Medical Research Institute reference cited], only one of Australia's states and territories prohibits the use of child restraints in the front seat [NSW RTA cited].";
- the submission of the Australian Paediatric Surveillance Unit (which includes researchers from the University of Sydney, University of New South Wales, Children's hospital Westmead, Prince of Wales Medical Research Unit and the Royal Children's Hospital Brisbane) welcomed the proposals and provided evidence from both overseas and Australia that injuries are more common and more severe in children sitting in the front seat. In an Australian Paediatric Surveillance Unit study, 22.7 percent of children (aged between four and ten years) were injured while sitting in the front seat. In a review of child passenger deaths reported to the National Coroners Information System that is currently being conducted (unpublished data) approximately 20 percent of children who were killed (aged between three and twelve years) were sitting in the front seat;
- the submission of Lynne Bilston from the Prince of Wales Medical Research Institute, applauded the proposal as a major step forward in protection for child occupants in Australia, but it was noted that the recommended ages for mandatory restraints (up to seventh birthday) were the highest that could be reasonably adopted with current Australian restraints, but fall short of best practice. Noting the good quality research, both domestic and international, that children needed to be 145 centimetres tall (eleven

years of age for the average child) to get a good fit from an adult seatbelt alone, it was concluded that it is clear that children aged seven to eleven years (or up to thirteen years depending on the child's size) are at an elevated risk of injury due to poor seatbelt fit, and that this needs to be addressed as a matter of urgency;

- the submission of Kidsafe, the Child Accident Prevention Foundation of Australia overall strongly supported the measures and the principle of requiring rear seating positions but had reservations about the particular benchmark age. Kidsafe noted that research indicates that adult seatbelts do not provide optimal protection for those shorter than 140 and that this would indicate that children under ten years would not be optimally restrained in the front seat. In addition, some jurisdictions and manufacturers stipulate that children under twelve should not travel in the front seating position where there is an airbag, and Kidsafe saw no reason to reduce this level of protection;
- the submission of the Royal Automobile Club of Victoria supported in principle the proposal of mandating the use of child restraints and the development and commitment to a long term strategy. However, it believed the proposed amendment to rule 266(3) that would prohibit child passengers less than seven years from being carried in the front seat should be reconsidered because the current proposed amendment is not in line with child restraint research that suggests the optimal age for sitting in an adult seatbelt is twelve years and older; and
- the submission of the Royal Automobile Club of Queensland noted on page 85 of the regulatory impact statement that stakeholders' opinions indicate that rear seat travel is safer for children and that overseas data suggest children under 13 years should not occupy a motor vehicle's front seat, as well as the Queensland Injury Surveillance Unit Injury Bulletin No 96, *Children as Passengers in Motor Vehicle Crashes (2007, p7)*. "There is good evidence that children less than twelve years of age are at increased risk of sustaining injury when travelling in the front seat compared to the rear. Current recognised best practice recommends rear seat travel for children less than twelve years of age." The Club recommended children less than twelve years of age should be prohibited from the front seat unless all of the rows behind are occupied by passengers who are also less than twelve years old.

The National Transport Commission considered the above points and makes the following comments.

Accepting the anthropometric evidence in the regulatory impact statement (unchallenged) that an adult seatbelt is not suitable for most children less than twelve years of age, rule 266(4) states that a child between one and less than sixteen years of age must use a suitable child restraint or a suitable seatbelt. If the seatbelt is not suitable (and it is unlikely to be so if the child is less than twelve years of age), then the child cannot be carried as a passenger in the vehicle, unless using a suitable child restraint. This will require the driver to ensure the child is appropriately restrained by either a suitable restraint or a suitable seatbelt. It is incorrect to imply that children between the ages of seven years and less than twelve years are not catered for in the existing rules.

The observation to be made is that many of the submissions, including some of those noted above, make an argument for laws mandating the use of appropriate child restraints rather than making an argument for children being seated in the back instead of the front. It needs to be acknowledged that a booster can be used in the front seat and that a child on a

booster seat can be appropriately restrained in the front seat⁷. Bearing this in mind, the question is then, what is the argument for prohibiting children from the front seat.

The National Transport Commission's view is that there is no persuasive evidence to indicate that specifically seating children in the rear seats instead of the front seat will produce a better safety outcome. The overwhelming evidence⁸ is that it is safer for most passengers to sit in the rear seat (not just children). The Smith and Cummings study being referred to indicated that the safety aspects for the age groups studied (zero to twelve years, thirteen to 29 years, 30 to 59 years) were very similar for a seating position with no airbag where the passenger was either restrained or unrestrained in the front seat. That is, for all those age groups it was far safer to use the rear seat. There was, however, an increase in safety risks for passengers over 60 years old travelling in the front seat.

The study also indicated that the safety risk for passengers zero to twelve years of age in the front seat of a vehicle fitted with an airbag was considerably greater than for the other age groups. It is worthy of note that this is a United States study using United States standards for airbags that are significantly different to standards in Australia.

It should also be noted the age group studied was between zero to twelve years inclusive, and there is no age breakdown within this group to identify what age group is the most susceptible. For example, could children zero to twelve months of age have a higher incidence of death or injury due to their fragility, or is the age group from twelve months to four years more susceptible to injury? Also there was no indication whether the seatbelt used was in conjunction with some other child safety device.

Given the absence of evidence that children are specifically more susceptible to death or injury in the front seat, the National Transport Commission does not believe it can support a proposal to increase the age of prohibition on children from the front seat beyond that which is proposed. Indeed, it is a reasonable observation to make that, for the same reasons, it is difficult to justify the proposed prohibition on children between the ages of four and seven from the front seat (using a booster). At least in the latter case, it is possible to make reference to the fact that the proposal has been subject to public scrutiny and is strongly supported. In contrast, the proposal to prohibit children less than twelve years of age from the front seat is an untested proposition (albeit clearly supported by some). The reason why there were no submissions specifically objecting to the proposal to prohibit children less than twelve years from the front seat is because this was not the proposal, nor was it an alternative proposal, in the regulatory impact statement.

For the record, 28 percent of submissions suggested raising the age from seven years to a higher age which ranged from eight years to sixteen years; an even smaller percentage suggested age twelve as the break point. This also meant that 72 percent of submissions supported the proposal. Additionally, submissions did not recommend "at least 12 years" but did suggest an increase which ranged from eight years to sixteen years. Of those that made specific comment on the prohibition from the front seat only 47 percent suggested twelve years, 23 percent specifically opposed the prohibition at any age and 23 percent suggested an increase to other ages.

⁷ Noting the limitation of booster seats currently available. i.e. that they are not suitable for children over 26kg in weight.

⁸ Passenger seating position and the risk of passenger death in traffic crashes: a matched cohort study – K.M.Smith and P.Cummings

10.3.2 Impact of proposed prohibition of children under the age of seven from the front seat on family motor vehicle choice

Concerns were raised about the potential impact of the proposed rule on family motor vehicle choice. The potential effect of the prohibition on children under seven years of age being seated in the front seat is to require those families with four children under seven to change from a large standard vehicle to a vehicle with a second row of seating in the back (either forward or rearward facing).

The expectation of the National Transport Commission is that in two parent families the new requirement will not be instrumental in forcing a change in the family's vehicle. Instead, in a two parent family the presence of four or more children itself is instrumental in having to acquire a vehicle with two rows of seating in the back (due to the need to accommodate two parents in the front). The exception, however, is in the case of single parent families with four children under the age of seven years. Census data (refer to Table 33 below) indicates that in Australia there are approximately 1000 single parent families with four children under the age of seven years. In the case of these families, it is foreseeable that the effect of an absolute prohibition on children under seven years being seated in the front seat would be to force the acquisition of a vehicle with two rows of seating in the back.

The proposal is not to implement an absolute prohibition. The proposal is to require children under seven years of age to occupy a seating position in the back if there is a seating position that is not being occupied by another child occupant under the age of seven years. In other words, children under seven are expected to be seated in the back unless there is no option but to seat them in the front. In practice, children under the age of four years cannot be seated in the front seat because child seats require a top tether to be tied to a fixed point and there is no capacity to do this in the front seat of motor vehicles. So, the specific exemption that has been written into the drafting of the proposed rule will permit children aged between four and seven to sit in the front using a booster, but only in circumstances where all three back seats are being used by other child occupants under the age of seven (using either child seats or boosters, depending on their age). This in-built characteristic of the proposed rule will avoid there being significant impact (in the form of a need to purchase a new motor vehicle) on single parent families with four children under seven years.

Table 34. Number of couple and single parent families with three or four children under the age of seven years

Place of enumeration	Family composition by Number of children present aged under 7 years					
	Couple family with children		One parent family		Total	
	Three children	Four Children	Three children	Four children	Three children	Four children
New South Wales	19,255	1,762	2,806	391	22,061	2,153
Victoria	14,095	1,208	1,496	158	15,591	1,366
Queensland	12,130	1,292	1,877	281	14,007	1,574
South Australia	3,610	288	498	59	4,108	347
Western Australia	5,632	497	682	85	6,314	581
Tasmania	1,230	121	235	29	1,465	150
Northern Territory	761	138	202	40	963	178
Australian Capital Territory	843	66	93	4	936	69
Other Territories	9	0	0	0	9	0
Australia	57,565	5,372	7,889	1,047	65,454	6,419

Australian Bureau of Statistics, 2006 Census of Population and Housing, © Commonwealth of Australia, 2007

10.3.3 Other potential impacts of proposed prohibition of children under the age of seven from the front seat on family motor vehicle choice

Other impacts that have not been considered, and are not quantifiable, are those that relate to car pooling. An increase in the age for prohibition from the front seat to less than twelve years of age may cause many families, child care groups and neighbours to reconsider the manner in which they assist each other with the transportation of children to and from school, sports and other entertainment venues.

10.3.4 Summary

The National Transport Commission cannot support a proposal to increase the age of prohibition on children from the front seat beyond that which is proposed. The National Transport Commission proposes that this rule be reconsidered when the review and update of child restraint standards is completed by Standards Australia.

11. DESCRIPTION OF PROPOSED AMENDMENTS

Rule 266(1) of the Australian Road Rules requires the driver of a motor vehicle (except a bus or motor bike) that is moving, or is stationary but not parked, to comply with rules 266(2) to 266(7) for each passenger who is in or on the vehicle who is under 16 years old.

It is proposed to amend rule 266 in the following way:

- in subrule (2): delete the reference to a passenger who is under one year old and include a requirement for a passenger:
 - from naught to under six months old to use a rearward facing child restraint with an inbuilt harness;
 - six months old to under four years old to use either:
 - > a rearward facing child restraint with an inbuilt harness; or
 - > a forward facing child restraint with inbuilt harness;
 - four years of age to under seven years of age to use either:
 - > a forward facing child restraint with an inbuilt harness; or
 - > a booster seat.
- In subrule (3) substitute:
 - A passenger who is under 4 years old must not be in the front row of a motor vehicle that has 2 or more rows of seats.
 - A passenger who is 4 years old or older, but is less than 7 years old, must not be in the front row of a motor vehicle that has 2 or more rows of seats unless all of the other seats in the row or rows behind the front row are occupied by passengers who are also under 7 years old.
- Subrules (4), (5) and rule 267(1B) and (1C) be amended to reflect the above changes.

12. IMPACT ASSESSMENT

The Australian Road Rules (the Rules) were implemented nationally from December 1999, and were largely based on State and Territory law; nevertheless, some changes to previous practices had to be accepted by all governments. The Rules resulted in the elimination of the vast majority of previous differences, leaving only a small number that provide for local variations. As part of the maintenance strategy, these variations will be reduced as practices in jurisdictions become more uniform. The consideration of these amendments forms an integral part of the maintenance strategy, assuring operable and consistent model legislation.

The principles of safety, traffic efficiency, stability and reduced administration cost on which the Rules were based have been taken into account during contemplation of the proposed amendments. No significant adverse impact from adoption of the amendments has been identified during the review process undertaken by the Australian Road Rules Maintenance Group.

Sections 8 and 9 discuss the impact of the proposal.

13. COSTS

The cost of the regulatory proposal to require appropriate child restraint to the age of seven years implies the purchase and use of child seats and boosters that would otherwise not

have been purchased and used voluntarily by parents. As explained in section 9.13, the costs need to be considered over the lifecycle. In the first year, there is a cost implication for all parents that have a child between the age of one and seven and who are not using a child restraint or are not using a 'suitable' child restraint such that they are acting in compliance with the new regulatory requirements. In subsequent years the cost implications are limited to those parents that have children who turn one (the proxy age where the transition from rearward facing to forward facing child seat occurs) and those parents that have children who turn four (the proxy age where the transition between child seat and booster occurs).

In the first year the cost of purchasing new child restraint systems is explained by the following table:

Table 35. Costs and population

Age	Australian Population	From seatbelt to child seat @ \$186.00	From booster to child seat @ \$186.00	From seatbelt to booster @ \$105.00	Cost
0	251036				
1	247171	2471	11223		
2	247899	5393	66095		
3	256001	27667	123963		
4	259140			94413	
5	260293			138448	
6	260332			184401	
7	265752				
8	268636				
9	275006				
10	275265				
All	2866531	35,531	201,281	417,262	
Cost		\$6,608,766	\$37,438,266	\$43,812,510	\$87,859,542

Added to this is the incremental cost (estimate of \$4m) of making changes to educational and enforcement programs and materials in order to reflect the new regulatory requirements.

As indicated in Table 31, over the lifecycle the present value of costs is \$277m. However, this is more than outweighed by the present value of benefits such that the net present value is \$88m.

14. RECOMMENDATION

It is recommended that the proposed amendment as stated in section 11 of this draft Regulatory impact statement be considered for adoption into the Rules.

15. CONSULTATION

In preparing these amendments, consultation has been undertaken between the National Transport Commission and representatives of all Commonwealth, State and Territory road safety, traffic, road transport and enforcement authorities, in order to identify and agree to the required changes.

Wider consultation, with relevant bodies such as motoring associations and road users, has been undertaken through this public consultation process.

15.1 Summary and response to public submissions

The National Transport Commission received 56 submissions as a result of the public consultation stage of the amendment process.

Of the 56 submissions, only four (7 percent) did not support the child restraint proposal for the following reasons:

- querying subsidies (was the government going to reimburse parents for the cost of additional child restraints?);
- disappointment that the National Transport Commission did not take the opportunity to increase the proposed age of six months for rearward facing child restraints to twelve months;
- the proposed rules could be inequitable and difficult to enforce;
- given the expenditure, education will be better;
- a law of jurisdiction option should be considered so that jurisdictions may opt not to adopt the proposals; and
- no consideration has been given to vehicles that cannot fit three restraints across the seat.

A summary of the issues raised and responses to each are provided in the following sections.

15.1.1 Rule 266(2) proposed amendment recommended that passengers less than six months old must use a rearward facing child restraint:

- of the 56 submissions received nine (16 percent) suggested the proposed age of six months should be raised to twelve months;
- five of those nine suggested a weight limit should accompany the age limit, although the weight limits recommended ranged from nine kilograms to 13.5 kilograms; and
- one submission suggested the age limit be increased from six months to four years.

Reasoning behind the submissions recommending an increase from the proposed six months included:

- Children who are six months old but of a lower weight, who would still benefit from a rearward facing child restraint would graduate to a forward facing child restraint which may not be appropriate for the child's weight.
- The United States require children to use a rearward facing child restraint until the child has reached a weight of 13 kilograms to 15.75 kilograms and Australia should require the same.
- Some children would exceed eight kilograms at four months, but at that age children still lack neck and head control and should not be in a forward facing restraint.
- The United States require rearward facing child restraints to twelve months and nine kilograms, there seems nothing to support the proposed six months.

Response to submissions

This proposal should be seen as providing a minimum standard for the restraint of children. For instance whilst the proposal mandates that children be restrained in a rear facing capsule for the first twelve months, there is nothing to prohibit parents from continuing to carry their children in such a way for a longer period of time, subject to the ability of the capsule to sufficiently carry the child. A further example is that a parent is not restricted from continuing to seat their child in the rear passenger seats after the mandated seven years of age, as sitting in the rear seat is safer for any passenger.

Section 8.3.1 states that a rearward facing child restraint is the most appropriate type of restraint for infants, which in a front-on collision offers best protection for an occupant's neck and head. It is also recognised that overseas authorities recommend that the transition age from a rearward facing child restraint to a forward facing child restraint be at twelve months or two or more years. It is also stated that Australian infant restraints are generally smaller than their overseas counterparts and Australian children tend to out-grow Australian restraints between five months and ten months old.

The regulatory impact statement also advises that, unlike Australia, overseas countries' child restraints do not have a long history of top tether straps which limit forward rotation and displacement of the child restraint. The comment is also made that top tether straps have been in use in Australia since the 1970s and studies have not identified any problems, particularly with neck injuries, with children between six and twelve months. The consultant to the National Transport Commission advised that there was no compelling evidence to regulate that children should remain in rearward facing child restraints until the age of twelve months in Australia, and accordingly recommended that seven to nine months be the age that children should use rearward facing child restraints.

Section 6.2.1 advises that in Australia, a trend in the increase of body weight in children is continuing at a high rate (Loesch and others 2000). Section 6.7 also recommends the transition from a rearward facing child restraint to a forward facing child restraint should be between six to nine months or when the child is too long or exceeds the nine kilogram design weight limit as required by the Australian and New Zealand Standards.

Section 6.2.2 refers to child weight and height; Tables 2 and 3 depict growth rates for children. Table 3 indicates that 95th percentile of boys reach nine kilograms at five months of age and seven months of age for girls, whereas, 50th percentile of boys reach nine kilograms at eight months and ten months for girls.

The National Transport Commission considered the submissions and recognises there may be benefits keeping children in rearward facing child restraints to a later age. However, it would be incongruous to regulate the use of rearward facing child restraints when they are not, by design, suitable for older children. Table 2 shows that at twelve months of age only the 5th percentile of children could use a rearward facing child restraint with a nine kilogram weight limit.

The National Transport Commission acknowledges submissions regarding an extension of the age limit for rearward facing child restraints and confirms the proposed age will be reviewed if and when the Australian and New Zealand Standards raise the design weight for these devices.

The National Transport Commission believes its recommendation of six months for rearward facing child restraints would produce best possible coverage of children having regard to weight restrictions on device design. Additionally, 47 of the 56 submissions (84 percent) supported the recommendation in the regulatory impact statement. Accordingly, the National Transport Commission does not propose to amend the recommendation for rule 266(2).

15.1.2 Inclusion of new rule 266(2B), four years or older but less than seven years to be in a forward facing child restraint or a booster seat:

Of the 56 submissions received four (12 percent) suggested a change to this proposal:

- booster seats should also have a minimum weight limit of 20 kilograms;
- that a child should remain in a booster until the age of eleven years or until the child reaches 145 centimetres in height;
- a child should use a booster between the ages of four and twelve years;
- a child should remain in a booster until the child reaches 135 centimetres to 145 centimetres in height; and
- provisions should be included for the use of an approved harness.

Of the four proposals to change the recommendation, it is clear that there is no definitive alternative as suggestions range from weight, age and height and vary in each one of those categories.

Reasoning behind the submissions included:

- perhaps a minimum weight should be on a booster;
- adult seatbelts should not be used until a child reaches a height between 140 centimetres and 145 centimetres, and the majority of seven year olds will not be this height;
- boosters should be used until a child reaches a height between 135 centimetres and 150 centimetres in line with the European Union's standards;
- age is the criteria for forward facing child restraints but height should be used for boosters;

- the 95th percentile for height in seven year old children is only 131 centimetres, suggesting that most seven year olds will be less than the recommended age for adult seatbelts.

Response to submissions

Section 8.3.3 states that:

- 33 percent of seven year olds;
- 66 percent of eight to ten year olds; and
- six percent of six year olds;

exceed the 26 kilogram limit of the current range of booster seats.

Section 6.2.2, Table 2 shows that the 95th percentile of six year old boys weigh in at 26.8 kilograms and 27.3 kilograms for girls. Whereas the 95th percentile of boys at seven years is 30.8 kilograms and girls 31.3 kilograms.

Table 5 shows that 96 percent of children reach 140 centimetres at the age of twelve; this may ideally relate to adult seatbelt usage, but at the age of twelve years children would far exceed the maximum weight limit of the current range of booster seats. Table 2 shows that only the 5th percentile at the age of ten years would be under the current 26 kilogram limit.

The regulatory impact statement at section 8.3.3 recommends that six year olds (less than seven years of age) be required to use booster seats with an additional provision to allow the child to graduate to an adult seatbelt if the child is either too tall or heavy for the booster; the proposed recommendation does just that.

There has been no additional information provided to sway the National Transport Commission to alter its recommendation at present with the exception of recognising a harness. It is proposed to incorporate an additional provision in the proposed rule 266(2B). Additionally, 93 percent of submissions supported the proposal. It should also be noted that rule 266(4) will require a passenger seven years old but less than sixteen years old to be appropriately restrained by a suitable approved restraint or by a suitable seatbelt properly adjusted and fastened.

15.1.3 Proposed amendment to rule 266(3) to prohibit children travelling in the front seat:

Of the 56 submissions received, sixteen (28 percent) suggested a change to this proposal which included:

- the prohibition on seven year olds should be raised to eight years;
- the prohibition on seven year olds should be raised to fourteen years; and
- the prohibition should be raised to twelve years.

The proposal comprises two parts, the first being that children under the age of four years cannot travel in the front seat of a motor vehicle that has two or more rows of seats. The second part prohibits a child from four years of age but less than seven years of age from travelling in the front seat of a motor vehicle that has two or more rows of seats, unless all

other seats in the rows behind the front row are occupied by passengers who are also under seven years old.

Reasoning behind the submissions include:

- the proposal should be in line with international best practice;
- there is ample evidence to suggest children less than twelve should be in the rear seat. This is supported by a recent Queensland study which suggested front seats should only be occupied by passengers over twelve years (140cm);
- airbag manufacturers also recommend children less than twelve sit in the rear seat;
- the Regulatory impact statement also contains evidence to support this increase;
- adult seatbelts should not be used until a child has attained a height of 140 centimetres to 145 centimetres and many seven year olds will not reach this height;
- the Australian Paediatric Surveillance Unit study showed that 22.7 percent of children were injured while sitting in the front seat (between four and ten years old).

Response to submissions

It appears the main argument to raise the proposed age to prohibit children in the front seat to twelve years relates to airbags. Section 10.3 of the regulatory impact statement discusses this issue and recognises the difference between Australian airbag standards and those from overseas. The report referenced in one of the submissions from Queensland also uses two overseas studies and does not take into account the difference in standards. The submissions did not produce additional evidence specifically relating to Australian airbag use.

15.1.4 Potential impact of proposal on motor vehicle choice

The second issue mentioned in the submissions by four respondents (7 percent) was that of not being able to fit three child restraints across the rear seat of an average car. Although the respondents mentioned a concern with fitment, three still supported the regulatory proposal. An additional section (9.15) has been included to explain this issue and assess its significance.

15.1.5 Additional issues raised in submissions

- One jurisdiction stated that, while the road safety aims of the amendments have unequivocal support, it considered the changes proposed may be inequitable and extremely difficult to enforce. The jurisdiction considered that rather than imposing further rules, better outcomes may be achieved through the development of an education programme. Furthermore, the jurisdiction requested that if the proposals were to proceed they should be qualified by a law of a jurisdiction to allow for local circumstances.

The National Transport Commission acknowledges that some remote communities may have difficulty initially complying with the proposed changes. However, jurisdictions can stage implementation of the proposals so that they coincide with targeted education plans developed and executed by the jurisdictions. Where jurisdictions considered funding for the provisions of restraints, a staged implementation of the proposals will also assist those allocating funds, similarly it will assist families plan their budgetary needs.

An example of staged implementation can be found throughout the history of the Australian Road Rules. For example, the 4th Amendment Package approved in 2003 has yet to be implemented by at least two jurisdictions and the 5th Amendment Package approved in June 2006 (including seatbelt amendments) has yet to be implemented by any jurisdiction. A staged or delayed implementation will not set any precedent.

In contrast, providing jurisdictions with the ability to create or tailor their own provisions or exempt themselves from elements of the proposal would be a negative precedent. It could lead to implementation and regulatory inconsistencies among jurisdictions, add to the cost of the reform (for example such an approach would affect the creation of a uniform media or education campaign and make it more convoluted and expensive) and it would send the community the wrong message that child safety in motor vehicles is not a national issue – an erroneous belief.

The National Transport Commission (supported by the Australian Road Rules Maintenance Group) is opposed to and disagrees with the view that jurisdiction specific provisions be included in the proposal.

- One submission commented that the impact of the well-meaning proposals may turn out to be counter-productive, as many organisations that provide transport services to children may not be able to comply with the proposed rules.

The submission argued the definition of “bus” in the Rules is problematic because a bus is not required to have anchorage points and that the term “bus” is not adequately defined. Firstly, rule 266(1) excludes a bus from the operation of the remaining provisions of the rule. This has always been the case for the Rules as it was considered the driver of a bus could not reasonably control children less than sixteen years of age on the bus, especially while the bus was in motion.

Secondly, for the purposes of the Rules, jurisdictions have provided clear definitions for the term “bus”. In Victoria for example, the Road Safety Act 1986 under section 3 defines a “bus” as being a motor vehicle built mainly to carry people and which seats twelve or more adults (including the driver). The National Transport Commission does not believe that the term “bus” is inadequately defined and further believes that there should not be any confusion with what constitutes a bus.

If the vehicle is not a bus by definition then it is a motor vehicle and rule 266 applies.

The submission raised the issue of an organisation purchasing a bus that was not required to have seatbelts or child anchorage points and then removing some of the seats so that the vehicle could be driven on a “car” category licence, rather than the appropriate “bus” licence. The modification of the vehicle for licensing purposes would then create other problems in relation to seatbelt use.

The National Transport Commission recognises the original version of the Rules only required children older than one and less than sixteen to be restrained if there was a restraint or seatbelt available in the motor vehicle. However, this provision was modified by the 5th Amendment Package (approved in June 2006) which required this group of children to be restrained in an approved restraint or suitable seatbelt properly adjusted and fastened unless exempt under rule 267. The modification was introduced to ensure better protection was offered to children when travelling in motor vehicles.

The applicable exemption provided under rule 267 is that a person is exempt from wearing a seatbelt if the seating position is not fitted with a seatbelt and there is no

requirement for the seating position to be fitted with a seatbelt. However, this exemption does not apply to a child less than twelve months old. One of the intentions underlying the rule is clearly to require children to whom rule 266(2) applies, to be restrained.

As this proposal affects rule 266(2), (3) and (4) it is to be expected that the exemptions under 267(1A) and (1B) will also be effected in order to be consistent with the aims of the proposal. Again a staged implementation plan by jurisdictions will assist organisations to adapt to the proposed changes.

16. IMPLEMENTATION

The National Transport Commission is now seeking endorsement of the proposed amendments and this Regulatory Impact Statement from Transport Agencies Chief Executives. The amendment package will then be forwarded to the Australian Transport Council for approval before being incorporated into the Rules. States and Territories will include the approved amendments in their local laws as required by their own regulatory framework.

17. REVIEW

In accordance with the maintenance strategy approved by the Australian Transport Council, members of the Australian Road Rules Maintenance Group will continue to monitor the application of the Rules in their individual States and Territories to ensure their effective operation. Proposals for any future amendments may need to be considered on the basis of experience with the application of particular provisions, or the identification of new provisions that may be required.

18. COMPETITION STATEMENT

The proposed amendments would have no adverse impact on competition or trade.

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PART B

20. INTRODUCTION

Part B of this regulatory impact statement assesses proposals raised by the Australian Road Rules Maintenance Group for changes to the Australian Road Rules (the Rules) nationally. The proposed changes have been developed through the Australian Road Rules maintenance strategy (endorsed by the Australian Transport Council in 1999).

21. PROBLEMS AND OBJECTIVES

The Rules endeavour to provide a definitive guide to how road users should behave on Australia's roads. Changing times demand the Rules be constantly scrutinised to ensure they remain current and do not limit the flexibility required to encourage innovative engineering techniques with the potential to improve road safety and traffic flow. The Rules also cater for the need of the police and emergency services and endeavour not to impinge on their operational practices, with certain safeguards.

The Australian Road Rules Maintenance Group has identified a number of areas that require attention. These areas are:

- Where traffic lights at an intersection are not working, drivers are required to give way in accordance with rule 72 and 73; however, rule 72 does not apply to an intersection that is a roundabout. The amendment proposes to state that if traffic lights at a roundabout are not working, drivers are required to comply with rule 114 rather than rule 72.
- Right turning vehicles have impact on Victoria's tram network by queuing on tram lanes while waiting to turn. Tram lanes are special purpose lanes under the Rules and as such, queuing is permitted up to a maximum distance of 100 metres. It is proposed to amend rule 158 to reduce the permitted distance to 50 metres.
- The New South Wales Police Service requested the Australian Road Rules Maintenance Group to exempt police vehicles from the requirements of rule 299 (use of visual display units). The maintenance group made enquiries with other police services and emergency services regarding the proposal. It appears other police services also use visual display units in their day to day operations and rely on the general exemption provisions under rule 305. Some emergency services advised they used visual display units, while others thought the Rules should accommodate the use of such technology. It is proposed to include an exemption for police and emergency vehicles similar to that contained in rule 300.
- In Western Australia pedestrians crossing railway tracks are assisted by traffic lights at footpaths that cross railway lines. However, the current rule 231 only applies to pedestrians on a road and excludes road-related areas such as footpaths. It is proposed to include a rule to accommodate the Western Australian safety initiative for pedestrians crossing railway lines.
- During discussions regarding Western Australia's proposal to accommodate pedestrians at level crossings on road-related areas, it was identified that rule 231 did not require pedestrians to move off railway lines or tram tracks if the warning devices activated after the pedestrians began crossing; it is proposed to remedy this anomaly.

- The maintenance group has been advised by road agencies that two road access signs in Schedule 3 are redundant, so it is intended to delete the signs from the Rules.
- Western Australia has introduced another version of the school sign and requests that this version of the sign be given regulatory effect. It is therefore intended to include that version of the sign in Schedule 3.

Proposed solutions to each of these problems will be discussed separately, along with their respective rationale and impact on road users, if any. The objective these proposals seek to achieve is to ensure that the Rules remain clear, consistent, current and effective in:

- providing uniform regulations throughout Australia for all road users; and
- enhancing mobility and safety.

22. PROPOSALS AND ALTERNATIVES

Each of the proposals discussed below are intended to be given effect by way of legislative amendments to the Rules, to ensure national uniformity and consistency in road rules is maintained.

The main alternatives to the preferred approach are:

1. Do nothing, therefore maintaining the status quo. This will not address the anomaly identified in the legislation and will not adequately accommodate technological advances and safety initiatives, and a possible outcome of not making the proposed amendments is a worsening of the level of trauma by a deterioration of compliance.
2. Implement education programmes to support the current provisions. As with the previous option, this option will not remove the legislative deficiencies.
3. Adopt the proposed changes, thus providing an emphasis on compliance and modifying education programmes to reflect the changes.

The changes are seen as necessary and desirable by representatives from Commonwealth, State and Territory road safety, traffic and enforcement authorities. If the changes are not made, jurisdictions may face pressures that could lead to individual modifications being applied, to the detriment of providing a homogeneous set of laws.

22.1 Proposed amendment to rules 63, 72 and 73 – giving way

Rule 63 provides advice to drivers on what to do at an intersection where the traffic lights are not operating or are only partly operating. The maintenance group identified an anomaly in subrule (3) as it applied to roundabouts.

A roundabout is an intersection and if the roundabout has traffic lights that are not working or only partly working and there is no *traffic light stop sign* at the roundabout, rule 63(3) states that the driver must give way to drivers and pedestrians in accordance with rules 72 and 73. However, rule 72 does not apply to a roundabout and rule 73 applies to T-intersections which excludes a roundabout by definition.

It was considered that rule 63(3) should include a reference that if the intersection was a roundabout then the driver must give way in accordance with rule 114 (giving way at roundabouts). Alternatively, roundabouts could be excluded from the operation of subrule (3).

22.1.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of amending relevant road law information materials, however, amendments designed to clarify existing rules are not likely to incur significant costs because the substance and intent of the existing laws remain unchanged.

22.1.2 Benefits

The proposal would remove an anomaly with the Rules and provide drivers a more consistent approach when negotiating roundabouts. There appear to be no disadvantages in implementing this change.

22.2 Rule 158 – Exceptions to driving in special purpose lanes etc.

Rule 158 outlines when the driver of any vehicle may drive for the permitted distance in a bicycle lane, bus lane, tram lane, transit lane, or truck lane. The permitted distance is defined in subrule (4) as being 50 metres for a bicycle lane and 100 metres for all other lanes.

The proposal is to change the permitted distance for tram lanes to 50 metres so as to reduce the impact on tram operations caused by vehicles travelling and queuing in tram lanes.

Tram operations are generally not affected by vehicles that are moving in tram lanes. However there are significant impacts due to vehicles queuing in tram lanes. Under the current road rule, traffic is permitted to travel and queue in the tram lane for up to 100 metres. Amending the road rule permitted distance to 50 metres will limit the queue length to 50 metres. This will provide significant benefits to tram priority at a number of tram lane locations in metropolitan Melbourne.

It is proposed to amend subrule (4) to define a permitted distance for tram lanes to be 50 metres.

All tram lanes (full time and part time) in metropolitan Melbourne are in speed zones of 40, 50, or 60km/h. There are limited opportunities for drivers to travel at the speed limit as the tram lanes are in the inner suburbs where traffic speeds are often lower than the speed limit, particularly during morning and evening peak hours.

The VicRoads *Road Design Note: RDN 2-6 Car Deceleration Distances* provides information on the distances that cars need to decelerate when travelling at a certain speed. An extract of this Design Note is provided in the table below.

Table 36. Car deceleration distances (level ground)

Speed (km/h)		Deceleration Length (m)
Start	End	
50	0	60
50	20	54
60	0	80
60	20	74

It is noted that deceleration distances shown in the above table are slightly greater than the proposed permitted distance for tram lanes of 50 metres. To comply with the proposed road rule, a driver would need to begin decelerating before entering the tram lane. However, this will not be a frequent occurrence as traffic speeds are often below the speed limit on tram routes in the inner metropolitan Melbourne areas.

Reducing the permitted distance to 50 metres will make it easier to enforce road rule 158 as an offending driver will only need to be observed for a distance of 50 metres.

To assist in the operation of the 50 metre permitted distance for tram lanes, traffic management measures will be considered to indicate the location where drivers can enter the lanes, particularly at the approach to signalised intersections.

It is acknowledged that a change to a 50 metre permitted distance for tram lanes does not provide a consistent approach for tram lanes and other special purpose lanes (excluding bicycle lanes). However, it is considered that the benefit to trams outweighs the argument for consistency.

Changing the permitted distance for tram lanes from 100 metres to 50 metres and having drivers abide by the road rule will reduce the delays to trams by reducing the queue length at a number of locations on tram lanes. Provided that there is publicity about the road rule change, along with traffic management measures to advise drivers where to enter the tram lane prior to a signalised intersection, there should be a noticeable reduction in delays to trams caused by queuing vehicles in tram lanes.

As part of the *Driving with Trams** project undertaken by VicRoads in 2005, there was consultation with key stakeholders on this and other tram related issues.

**Driving With Trams is a project that reviewed traffic management, road rules, standards and guidelines from trams in metropolitan Melbourne.*

22.2.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of amending relevant road law information materials, however, amendments designed to clarify existing rules are not likely to incur significant costs because the substance and intent of the existing laws remain unchanged.

22.2.2 Benefits

Victoria's tram network should benefit by a possible reduction in delay times caused by vehicles turning right at intersections. This benefit would lead to reduced delays for

commuters, especially during peak travel times. Motorists should not be inconvenienced as they may still queue in the lane next to the tram lane.

22.3 Rule 235 – Crossing a level crossing

Rule Subrule (1) prohibits a pedestrian crossing a level crossing other than at a pedestrian facility or within 20 metres of the crossing if there is no facility. Subrule (2) prohibits a pedestrian crossing a railway line or tram tracks at a level crossing if warning devices are operating. However, there is no provision that requires a pedestrian to leave the railway lines or tram tracks if the warning devices are activated while the pedestrian is crossing. The proposed new rule 235A would ensure the safety of pedestrians while recognising that a train or tram cannot slow or stop as quickly as a motor vehicle, nor can it change its path.

22.3.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of publicising the changes and amending relevant road law and information materials.

22.3.2 Benefits

The likely benefit will provide a clear direction to pedestrians that, should warning devices be activated by an approaching train or tram while they are crossing, they must depart the crossing quickly. The inclusion of such a provision in rule 235 will also provide consistency with the proposed rule 235A.

22.4 New Rule 235A – Crossing a pedestrian level crossing that has a red pedestrian light

Rule 235 provides instructions for pedestrians when crossing railway lines at level crossings. Rule 120 defines a level crossing which excludes a road-related area. To enhance pedestrian safety at rail crossings, Western Australia is installing pedestrian lights on footpaths (either adjacent to a road or away from a road) that cross railway lines; however, rule 235 does not mention pedestrian lights. Rule 231 (crossing a road with pedestrian lights) applies to an intersection or another place on a road and applies to a pedestrian crossing the intersection or road. This does not accommodate the situation faced by Western Australia. Additionally road-related area is excluded from rule 231.

It is proposed to change the Rules to provide that a pedestrian facing a red pedestrian light on a footpath that crosses a railway line must stop and not proceed while the light is displayed.

The National Rail Safety Strategy (approved by ATC August 2003) stated that over 60 percent of deaths at level crossings involve pedestrians (including cyclists and others using mobility devices). The Strategy also references a report, “*Analysis Of Australian Grade Crossing Accident Statistics*”⁹ which provides there are approximately 9,400 public railway level crossings in Australia; approximately 2,650 (30%) have 'active' protection, 6,060 have 'passive' protection and the remainder have other control or protection. Active protection includes signals and/or gates and passive protection includes signs or markings.

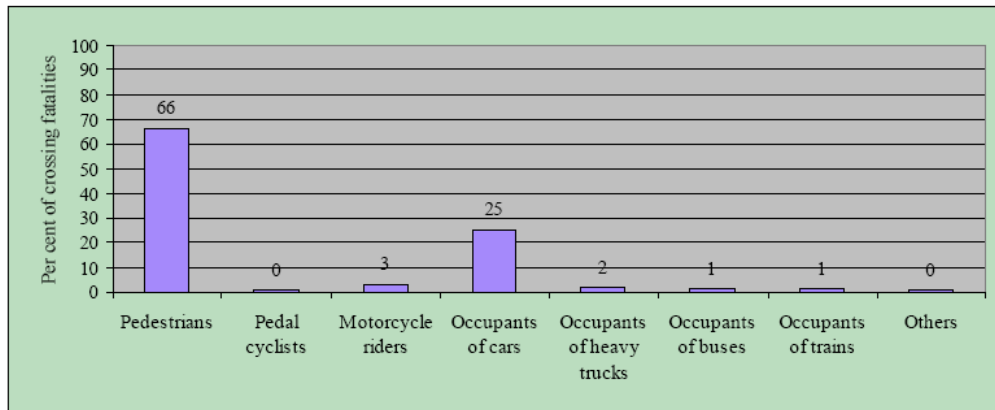
It is uncertain whether these railway level crossings include places where access to cross the railway line is provided by the authority, but not being at a road or public street. These

⁹ Ford G. and Matthews A., Proc. 7th International Symposium on Railroad Highway Grade Crossing Research and Safety, Monash University, February 2002.

pedestrian level crossings would generally be located between railway stations or roads where access is obtained from a footpath or shared path other than at a road.

The Australian Bureau of Statistics report on Level Crossing Accident Fatalities¹⁰ provided the following diagram:

Level crossing accident fatalities by their mode of transport, Australia, 1997-2002



Note: Percentages rounded. One pedal cyclist and one other person (mode of transport unknown) were fatally injured in level crossing accidents in the period.

Figure 27. Level crossing accident fatalities by their mode of transport, Australia 1997-2002

The report further stated that from 1997 to 2002 a total of 146 pedestrians were killed when struck by a train at a level crossing. Again there is some uncertainty whether these included fatalities at pedestrian level crossings not at a road.

The Department of Transport and Regional Services report Rail Accidents in Australia (report 108) estimates the cost of a fatality in 1999 to have been \$1.9 million and a serious injury \$27,000 (excluding property and other costs). The report also concludes that in 1999 there were 33 pedestrian fatalities involving trains; fourteen at level crossings and nineteen at other sites. However, it is uncertain whether the “at other sites” were pedestrian level crossings or resulted from trespass incidents.

Based on the estimates provided in 1999, the cost of pedestrian fatalities exceeded \$62 million.

22.4.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of publicising the changes and amending relevant road law and information materials. There will be no requirement on States and Territories to install pedestrian lights so any installation costs should not be aligned with these changes.

22.4.2 Benefits

This proposal supports a safety initiative being implemented by Western Australia. Although the proponents are unable to provide statistical information on benefits and

¹⁰ <http://www.atsb.gov.au/publications/2004>

whether pedestrians would actually comply with the instruction of a red pedestrian light in these circumstances, if States and Territories were to follow the Western Australian lead, they should be given the benefit of nationally consistent offence provisions that enables the requirement to be enforceable. It can be reasonably assumed that some pedestrians will comply with the red pedestrian light and therefore a collision may be avoided which would result in a considerable saving in costs and time to the rail industry.

22.5 Rule 299 – Television receivers and visual display units in motor vehicles

Rule 299 prohibits a person driving a motor vehicle that has a television receiver or visual display unit in or on the vehicle, operating while the vehicle is moving, or is stationary but not parked, if any part of the image on the screen is visible to the driver from the normal driving position or is likely to distract another driver.

Exceptions are provided in subrule (2) for a bus driver if the visual display unit displays a destination or other bus sign, or if the visual display unit is part of a driver's aid, or if the vehicle is otherwise exempt under another law of the State or Territory.

Driver's aids include such things as closed circuit television security cameras, dispatch systems, navigational or intelligent highway and vehicle system equipment, rear-view screens, ticket-issuing machines and vehicle monitoring devices.

The New South Wales Police Service approached the maintenance group requesting a change to rule 299 that would exempt police services from the operation of the rule; the exemption would be similar to the exemption for police in rule 300 (using a hand-held mobile phone).

New South Wales police vehicles are fitted with visual display units so that the vehicle operator(s), including the driver, can receive job allocations, licensing and registration information and other confidential information applicable to police operations. Other police services (Victoria and Queensland) also have visual display units fitted to some or all of their police fleet for effective and efficient police operations. Other police services advise that they are or may be moving toward the same or similar technology in the future.

Some emergency services were also canvassed (ambulance and fire brigade) and advice received was that some services used visual display units while others thought the devices may be utilised in the future.

The New South Wales Police Service is concerned that the visual display unit used in its police fleet may not be equivalent to the examples provided in rule 299 for a driver's aid and it does not consider reliance on rule 305 (exemption for drivers of police vehicles) is appropriate for everyday operations.

The proposed amendment is aimed at allowing police and emergency services to use equipment they have installed in their respective vehicle fleets that provides each service a better means of communication with officers in the field which results in a better service to the public. It is assumed fitment of equipment is in line with vehicle standards and serious consideration has also been given to occupational health and safety laws.

There is no available evidence suggesting the proposal will reduce the impact rule 299 has on road safety.

22.5.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of amending relevant road law. There will be no requirement on police or emergency services to install visual display units, so any installation costs should not be aligned with these changes.

22.5.2 Benefits

This proposal supports initiatives undertaken by police and emergency services to provide the best possible equipment to their vehicle fleet, therefore allowing each agency to provide a better and more efficient service to the community. Benefits provided to police and emergency services by the installation and use of visual display units is across the whole gambit of their individual functionality and it is difficult to align specific benefits against road safety alone. However, there appear to be no disbenefits in progressing this proposal.

22.6 Schedule 3 – Other permitted traffic signs

State and Territory traffic engineers, through the Australian Road Rules Maintenance Group, have advised that the following two *road access* signs in Schedule 3 are redundant and are no longer in use. The proposed amendment seeks to remove these signs from the Rules and as they are no longer in use there will be no impact on road users.



Figure 28. Road access sign

22.6.1 Costs

It is likely that some costs will be incurred by transport agencies in the process of amending relevant road law; however, these costs are expected to be minimal, as the proposed amendment will be made along with other changes to the Rules and not in isolation.

22.6.2 Benefits

The proposal will have no impact on road safety, but it will assist in keeping the Rules relevant and contemporary.

22.7 Schedule 3 – Other permitted traffic signs

Western Australia has advised the Australian Road Rules Maintenance Group that its traffic engineers have developed a new school zone sign that it believes will better serve their local purpose.

The inclusion of an additional school zone sign in the Rules should not reduce road safety nor would it cause confusion to road users. It is intended to include this sign in Schedule 3.



Figure 29. School zone sign

22.7.1 Costs

The only costs imposed by this amendment are those that accompany the making of amendments.

22.7.2 Benefits

The proposed sign will assist in the identification of school zones and therefore alert drivers to the lower speed which will provide a safety level for children crossing roads in these areas.

23. DESCRIPTION OF PROPOSED AMENDMENTS

To give effect to the proposed amendments the following rules will be amended:

- Section 22.1 – in rule 63 insert a new subrule (4);
- Section 22.2 – amend rule 158(4)(a);
- Section 22.3 – amend note in rule 235 and insert new subrule (2A);
- Section 22.4 – insert new rule 235A after rule 235;
- Section 22.5 – insert a new paragraph after rule 299(2)(b);
- Section 22.6 – amend Schedule 3; and
- Section 22.7 – amend Schedule 3.

24. IMPACT ASSESSMENT

The Australian Road Rules were implemented nationally from December 1999, and were largely based on State and Territory law; nevertheless, some changes to previous practices had to be accepted by all governments. The Rules resulted in the elimination of the vast majority of previous differences, leaving only a small number that provide for local variations. As part of the maintenance strategy, these variations will be reduced as

practices in jurisdictions become more uniform. The consideration of these amendments forms an integral part of the maintenance strategy, assuring operable and consistent model legislation.

The principles of safety, traffic efficiency, stability and reduced administration cost, on which the Rules were based, have been taken into account during contemplation of the proposed amendments. No significant adverse impact from adoption of the amendments has been identified during the review process undertaken by the Australian Road Rules Maintenance Group.

25. COSTS

Given the nature of the amendments (with the exception of child restraints), a formal benefit cost analysis is inappropriate and in most cases impractical. Data to quantify impacts in each case are not available, and the corrective nature of most of the proposed amendments does not warrant quantitative evaluation.

Individual States and Territories will determine the extent to which particular changes will need to be publicised and revisions made to information materials and relevant publications. The costs of doing so are considered to be significantly outweighed by the benefits of precise and contemporary law.

26. RECOMMENDATION

It is recommended that the proposed amendments as described in this draft regulatory impact statement be released for public comment.

27. CONSULTATION

In preparing these amendments, consultation has been undertaken between the National Transport Commission and representatives of all Commonwealth, State and Territory road safety, traffic, road transport and enforcement authorities, in order to identify and agree to the required changes.

Wider consultation, with relevant bodies such as motoring associations and road users will be undertaken through this public consultation process.

28. IMPLEMENTATION

Following consideration of public submissions, the National Transport Commission will forward the proposed amendments and regulatory impact statement to Transport Agencies Chief Executives for endorsement. The amendment package will then be forwarded to the Australian Transport Council for approval before being incorporated into the Rules. States and Territories will include the approved amendments in their local laws as required by their own regulatory framework.

29. REVIEW

In accordance with the maintenance strategy approved by the Australian Transport Council, members of the Australian Road Rules Maintenance Group will continue to monitor the application of the Rules in their individual States and Territories to ensure their effective operation. Proposals for any future amendments may need to be considered on

the basis of experience with the application of particular provisions, or the identification of new provisions that may be required.

30. COMPETITION STATEMENT

The proposed amendments would have no adverse impact on competition or trade.

31. SUMMARY AND RESPONSE TO PUBLIC SUBMISSIONS FOR PART B

Of the 57 submissions received on the total regulatory impact statement, only ten included comments on Part B.

Of those ten submissions all agreed with the proposals generally stating that they should improve safety and understanding of the rules.

Two of the submissions also made comment about the proposed change to rule 158 suggesting that:

- dotted lines could be used;
- other treatments currently being used should be adopted rather than adopting the proposed change;
- queried the stopping distance allowed if the proposal were to be adopted; and
- the proposal will create inconsistency in the rules with other permitted distances for special purpose lanes.

It is true there are a range of traffic management measures that can be used to reduce delays to trams at signalised intersections. Some measures are more effective than others depending upon the particular intersection characteristics. Reducing the distance that vehicles can travel in a tram lane to 50 metres is considered to be another appropriate measure that can be incorporated into the design of intersections with trams and improve tram priority.

The proposed change to Rule 158 does not necessarily mean that the length of the traffic queue at signalised intersections will be limited to 50 metres, as most part-time tram lanes are set back from the intersections a calculated distance so as to maintain intersection capacity. The allowable queue length would become the set back distance plus 50 metres. Part time tram lanes and their set back distance are being reviewed as part of the ThinkTram program. This may lead to altering the set back distance of the part time tram lane to achieve a queue length that is an appropriate balance between traffic capacity and tram priority.

The information in the regulatory impact statement about deceleration distances was included so as to be fully transparent about this particular issue. It explains how the deceleration distances are slightly greater than 50 metres, and to comply with the proposed road rule, drivers travelling at 50 or 60 km/h would need to begin decelerating in the adjoining traffic lane. This is a common situation on the road network as there are many right turn lanes that are not long enough to accommodate all the deceleration, and drivers need to reduce their speed while travelling in the adjoining traffic lane. The regulatory impact statement also points out that traffic speeds on tram routes will often be below the posted speed limit and the submission by the Royal Automobile Club of Victoria

acknowledges this. The safety concerns raised in this context are therefore not considered to be an issue.

While it is acknowledged that a change to a 50 metre permitted distance for tram rules does not provide a consistent approach with other special purpose lanes, with the exception of bicycle lanes. The regulatory impact statement also points out that traffic management measures will be considered to indicate where drivers can enter tram lanes particularly at signalised intersections, that publicity should increase awareness of the rule, and that the benefit to trams outweighs the argument for consistency. This position is still maintained.

Two submissions commented on the proposed rule 299 saying:

- the proposal should apply to all service vehicles, not just police and emergency services; and
- visual display units should only be fitted in accordance with the Australian Design Rules.

There has been no approach from any service (local government) agency for an exemption from rule 299. The submission also stated that most service orientated organisations could benefit from this technology. This implies at this time there are no such organisations with the technology. Should requests for exemptions from rule 299 be made by organisations other than police and emergency services, the National Transport Commission will review the rule and act on advice provided by the Australian Road Rules Maintenance Group. At this time there is no evidence that the current rule or the proposal will affect the operations of said organisations, therefore, it is not proposed to modify the proposal.

In relation to the second issue, the Australian Design Rules only apply to new vehicles, not in-service vehicles where the fitment of visual display units will actually occur. Fitment of the devices will need to meet the vehicle standards unless the organisation fitting the devices has an exemption issued by the relevant road agency. Additionally, occupational health and safety issues will also need to be considered. The National Transport Commission believes there are sufficient parameters concerning the fitment of equipment to vehicles in place and it is not necessary to include yet another provision in the Australian Road Rules.

32. PUBLIC SUBMISSIONS RECEIVED

1. Tracey Collins
2. Laura Bower (Secretary Kyle David Miller Foundation USA)
3. Damian Snell
4. Bruce Hester
5. Jenny Olson
6. Gillian Webber
7. Ainsley Sherry
8. Caroline Brown
9. Charmaine Cooper (Road Safety Officer)
10. Paula Hibert
11. Leanne Perry

12. Kimberly Breece
13. Sam Kenny (City of Charles Sturt)
14. Kylie Docherty
15. Michele Fuge
16. Ron Shanks
17. Jeff Mead
18. Chris Kerle
19. Jane Smith
20. Richard Figar
21. Noel Broadhead
22. Sarah Walters
23. Catherine Werner
24. VicRoads
25. Marion Johnstone
26. Luke Wilson
27. Ruth Barker (Emergency Paediatrician Mater Children's Hospital)
28. Graeme O'Dea (Royal Automobile Association of South Australia)
29. Fiona Duncan
30. Leanne Wright
31. Jody Caudro
32. Sue Gregory
33. Monica Whear (Royal Australasian College of Surgeons)
34. Ian Patterson (Office of Fair Trading Queensland)
35. Hazel O'Dea
36. Robert Mesaros
37. Road Traffic Authority New South Wales
38. Western Australian Local Government Association
39. Lorraine Harding (Nursery Product Consultancy)
40. John Dombrose (Manager Vehicle Standards Western Australia)
41. John Wikman (Royal Automobile Club of Queensland)
42. Yvonne Zurynski (Australian Paediatric Surveillance Unit)
43. Lynne Bilston (Prince of Wales Medical Research Institute)
44. Colin Jordan (Royal Automobile Club of Victoria)
45. Mike Lumley (Britax Childcare Pty Ltd)

- 46. Patricia Lagan (Western Australian Police)
- 47. Kidsafe
- 48. Office of Road Safety Department of Premier and Cabinet Western Australia
- 49. Acting Director Transport, Department of Planning and Infrastructure Northern Territory
- 50. Gary Dolan (Colac Otway Shire)
- 51. Childcare Queensland
- 52. Queensland Ambulance Service
- 53. Transport Accident Commission (Victoria)
- 54. South Australia Police
- 55. Julian Humphrey
- 56. Martin and Leanne Kuchlmayr
- 57. John Tillack