



Australian Government
**Department of Transport and
Regional Services**

Issued by the
Administrator of Vehicle Standards
in consultation with the
**Australian Motor Vehicle Certification
Board**
comprising Commonwealth, State and Territory representatives

NATIONAL CODE OF PRACTICE
VEHICLE STANDARDS BULLETIN VSB.05
**MANUFACTURE AND INSTALLATION
OF SEATS**

Issue 3.0

Replaces VSB.05a & VSB.05b

This Code does not cover administrative requirements
imposed by State, Territory and Federal jurisdictions

This Code of Practice is intended as a guide for all
manufacturers and installers of passenger seats in vehicles

PREFACE

This Vehicle Standards Bulletin 5 (VSB.05) was prepared by the Australian Motor Vehicle Certification Board to replace the version issued in November 2003 comprising two parts, VSB.05A *Commercial manufacture and installation of additional seats* and VSB.05B *Construction and installation of additional seats by individuals*. This Bulletin specifies a range of design and performance requirement that applies to replacement or additional seats in motor vehicles that provides protection to their occupant in the event of a crash.

The major revisions in this edition of VSB.05 include:

- a) Combining the requirements in VSB.05A and VSB.05B.
- b) Removal of side-facing seats due to the risk they pose to their occupants.
- c) Introduction of shoulder marking labels to indicate the range of occupants who can use the seat based on their shoulder heights.
- d) Changes to the categorisation of Category 2 and Category 3 seats to revise the lower age ranges of occupants allowed to use the seats.
- e) Introduction of anti submarining feature(s) to be installed in seats.
- f) Removal of child safety harnesses due to difficulties in using them correctly and their likelihood of promoting submarining.

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I SCOPE

1.1 General

This Vehicle Standards Bulletin 5 (VSB.05) provides information for seat manufacturers, suppliers and installers to assist them in ensuring that seats they construct, supply and/or install provide the minimum acceptable levels of protection to their occupants.

1.2 For Used Vehicles

Replacement and/or additional seats fitted into used vehicles may be constructed and installed in accordance with this Bulletin as an alternative to meeting the Australian Design Rules (ADRs) requirements specified for them under the relevant state or territory transport legislation.

1.3 For New Vehicles

All seats, seatbelts and their respective anchorages that are installed in new motor vehicles first supplied for use in road transport in Australia must comply with the relevant ADRs.

If additional seats fitted to a new motor vehicle result in it changing from a goods carrying vehicle (Category N series) to a passenger carrying vehicle (Category MA, MB and MC), the modified vehicle must have an approved Second Stage Manufacturers plate affixed.

2 APPLICABILITY

This Bulletin may be used for the manufacture and installation of replacement or additional seats in the following types of used motor vehicles:

ADR CATEGORY	TYPE OF VEHICLE
MA	Passenger car
MB	Forward control passenger vehicle
MC	Off-road passenger vehicle
NA	Light goods carrying vehicle with a GVM of 3.5t or less
NB1	medium goods carrying vehicle with GVM over 3.5t up to 4.5t

This Bulletin must not be used for the manufacture and installation of side-facing seats due to the inherent risks such seats produce.

3 EVIDENCE OF COMPLIANCE

Seat Manufacturers and installers must obtain and retain engineering evidence that a particular seat, seatbelt, anchorage and/or installation complies with the requirements of this Bulletin.

If a Registering Authority requires evidence to demonstrate that an additional seat installation complies with the requirements of this Bulletin, the evidence must be submitted in the form of test results and engineering analysis certified by an engineer who is acceptable to the registering authority.

4 SEAT CATEGORY AND SELECTION

For the purpose of this Bulletin, additional seats are divided into three categories to allow seats to be designed for occupants of different age:

Category 1 - Seats intended for use by adults and which can be used to accommodate a child restraint.

Category 2 - Seats suitable for children approximately 4 to 12 years of age and which can be used to accommodate a child restraint (refer to Table 1 in Explanatory Section).

Category 3 - Seats suitable for children approximately 4 to 7 years of age (refer to Table 1 in Explanatory Section).

Note: The lower age ranges for Category 2 and 3 seats are required as the seats cannot be used to cater for all children under the upper age ranges. In addition, in NSW and Victoria, children aged between 4 and 7 years old can use Category 2 and 3 seats without using a booster seat.

Category 1 seats may be used as forward or rearward facing seats in any installation as additional or replacement seats. They must comply with ADR 3/03 *Seats and seat anchorages*, ADR 4/04 *Seatbelts* and ADR 5/05 *Seatbelt anchorages* or a later version of those ADRs that may apply as of the date the seat is installed.

Note: A goods carrying vehicle fitted with additional seats becomes a passenger vehicle when the total number of its seating positions multiplied by 68kgs is 50% or more of the difference between the vehicle's GVM and its 'Unladen Mass'.

NA Category and NB Category vehicles shall only have Category 1 seats installed in them.

Category 2 seats may be used as forward or rear facing additional seats in station wagons. To ensure that Category 2 Seats are not used inappropriately by a person too large for them, they may only be installed if the head space and leg space available are sufficient to accommodate a child equivalent to a 50th percentile 12 year old child; refer to Appendix B, Table BI for these dimensions.

Category 3 seats can only be used as forward facing additional seats in station wagons. To ensure that Category 3 Seats are not used inappropriately by a person too large for them, they may only be installed if the head space and leg space available are sufficient to accommodate a child up to a 50th percentile 7 year old child, ; refer to Appendix B, Table BI for these dimensions.

5 SEAT LOCATION REQUIREMENTS

5.1 General

Careful consideration must be given to the suitability of the vehicle before additional seat(s) are installed. Aspects that must be considered include:

- is the space available in the vehicle sufficient to accommodate the additional seats and occupants? Specifications for the space required for additional seats and occupants are set out in Figure 1;
- If additional seats are to be installed in the trays of NA and NB Category vehicles – ie utilities or trucks – is adequate roll-over protection provided? In this regard, fibreglass, plastic and light steel canopies do not provide adequate roll-over protection.
- Will the additional seats be installed where there is a high probability that their occupants will be injured in a crash? For example there is a high probability that an

occupant in a rear facing seat in the rear of a small station wagon would suffer leg injuries in a rear end collision, because the occupant's legs are located in an area that will crumple as a result of the impact forces.

- Will the additional seats impose any loads on existing seats; if so, can it be demonstrated that the original seats can carry those additional loads?
- Is access to and from all seats sufficient to allow a person to enter and exit the vehicle, operate door latches, folding seat controls, etc without assistance?
- Is access to seats installed in a vehicle's load space obstructed by any load carried?
- If an existing seat is modified to improve access, e.g. by installing a folding mechanism, is evidence provided to demonstrate that the modified seat complies with ADR 03/03 (or a later version of that ADR)?
- Are fittings, including seat backs, padded to prevent injury if they intrude into the head space shown in Figure 1?
- Do the additional seats, head restraints (if fitted), and their occupants adversely affect the driver's rearward visibility? Additional rear vision mirrors may be required if rearward vision is restricted.

5.2 Interference with Existing Safety Equipment

The additional seats, relocated spare wheel, etc, must not prevent or restrict the use of existing safety devices such as seatbelts and child restraint anchorages, unless complying alternatives are provided.

Note: Child restraint anchorages are designed to withstand only those loads imposed by correctly fitted child restraints.

5.3 Relocation of Spare Wheel

If additional seats are to be installed in the spare wheel well of the vehicle, provision shall be made for relocating and securing the spare wheel.

If the spare wheel is relocated within the vehicle, the spare wheel mounting should be of sufficient strength to withstand a deceleration of 20 times the weight of the spare wheel and its mounting in the forward, rearward or sideways direction.

The spare wheel and its mounting must not cause a hazardous projection for the vehicle's occupants.

5.4 Installation Kit

Seats supplied by seat manufacturers or suppliers for installation by others must include an installation kit which must contain the following:

- **Installation Instructions**
Comprehensive and easily understood installation instructions which cover the make and model of vehicle that the seat is intended to fit. The installation instructions must be such that when correctly followed, the seat installation will comply with all the requirements of this Bulletin. The instructions must be in English and supporting diagrams must use SI Units.
- **Installation Hardware**
Installation hardware such as bolts, nuts, lock washers, spacers and backing plates sufficient to allow the seat, seatbelts, etc. to be installed correctly.

- Seat Label

The seat label or plate as required by the section 'LABELLING AND MARKING OF SEATS'.

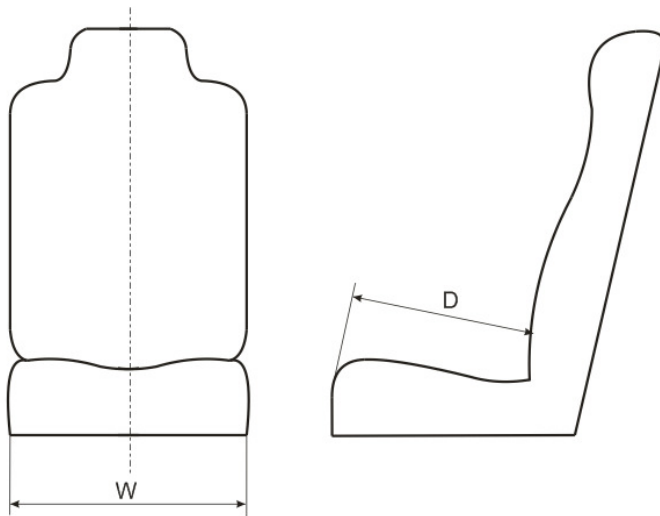
6 SEAT CONSTRUCTION

6.1 General

Seat frames must be constructed so that there are no sharp edges or projections likely to cause injury to occupants.

6.2 Seat Dimensions

The minimum seat width (W) and the maximum cushion depth (D) for each seating position must be at least that shown in Figure 1.



Dimensions	Width (W) min	Depth (D) max
Category 1 Seats	429 ¹ mm	464 ² mm
Category 2 Seats	350 ³ mm	255 ⁴ mm
Category 3 Seats	290 ⁵ mm	255 ⁴ mm

- Notes:
- 1 Represents shoulder breath of the 50th %tile Hybrid III dummy
 - 2 Represents buttock to popliteal of 50th %tile Hybrid III dummy
 - 3 Represents shoulder breath of the 50th %tile 12-year-old
 - 4 Represents buttock to popliteal of 50th %tile 4-year-old.
 - 5 Represents shoulder breath of the 50th %tile 7-year-old

Figure 1. Seat Dimensions

6.3 Space Requirements

The head space and leg space requirements specified below shall apply to each seating position and, if the seat is adjustable, must be maintained throughout the range of seat travel or adjustment.

Use the template shown in Figure 2 to determine compliance with these requirements.

With reference to Figure 3, position the template on the seat's centreline with the *Point D* contacting the seat back.

Point C on the template represents the *Seating Reference Point* and is used to locate the centre of the *Radius A* and of *Radius B*.

Note: head space and leg space may also be established from data obtained by using an H-Point Machine, as defined in SAE J826 November 1962 or SAE J826 APR 80.

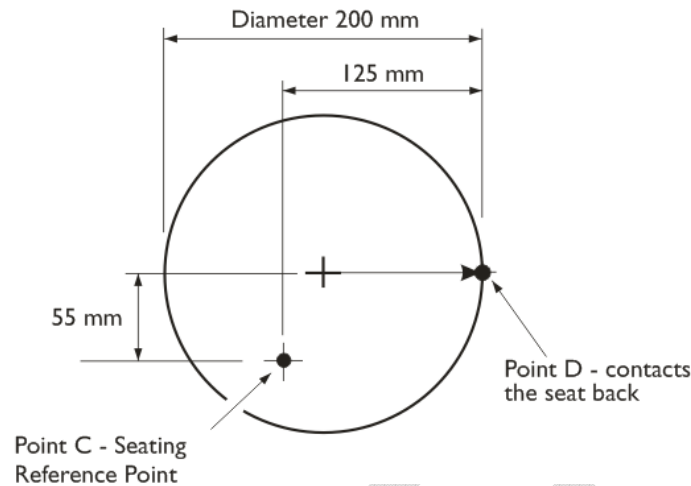


Figure 2. Template for Determining Head and Leg Space

If the seatback is adjustable, set it at the manufacturer's nominal position or if that position is unknown or not nominated, set it at 25°. Position the template on the centreline of the seat and the point D located at the contact point of the template and the seat back.

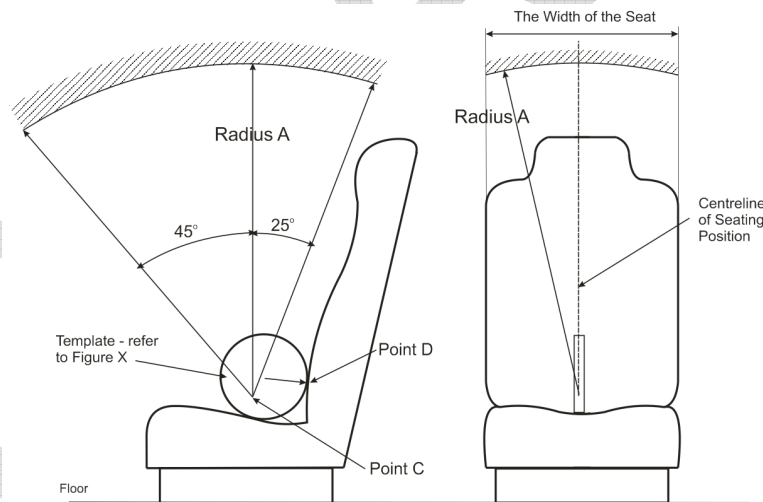


Figure 3. Head Space

6.3.1 Head Space

No part of the vehicle body or component of the roof installation may project below the shaded zone shown in Figure 3.

The head space is defined as an area contained within:

- a vertical plane at each end of the seat cushion perpendicular to vehicle's y axis, and
- a surface formed by an arc of *Radius A* extending between a line 45 degrees forward of a vertical plane through point C and 25 degrees rearward of a vertical plane through point

C. The minimum requirement for *Radius A* for each particular seat category must be at least that shown in Table I:

DIMENSION	CATEGORY OF SEAT		
	1	2	3
Radius A	898 mm ¹	803 ² mm	700 ³ mm
Radius B	560 ⁴ mm	490 ⁵ mm	400 ⁶ mm

Table I. Minimum requirements for head and leg spaces

- Notes:
- 1 Seated Height from H Point of 50th %tile Hybrid III Dummy plus 100mm allowance for rebound
 - 2 Seated Height from H Point of 5th %tile Hybrid III Dummy plus 100mm allowance for rebound
 - 3 Seated Height from H Point of Hybrid III 6-year-old Dummy plus 135mm allowance for rebound
 - 4 Knee length from H Point of 50th %tile Hybrid III Dummy plus 100mm allowance for seatbelt elasticity
 - 5 Knee length from H Point of 5th %tile Hybrid III Dummy plus 100mm allowance for seatbelt elasticity
 - 6 Knee length from H Point of Hybrid III 6-year-old Dummy plus 113 mm allowance for seatbelt elasticity

6.3.2 Leg Space

No part of the vehicle body, vehicle equipment or another seat may project into the shaded leg space shown in Figure 4.

The leg space is defined as an area contained within:

- a vertical plane at each end of the seat cushion perpendicular to the vehicle's y axis, and
- a plane 45 degrees forward above the horizontal plane through point C; and
- a plane 15 degrees rearward of the vertical plane (relative to the direction that the seat is facing) tangential to an arc of *Radius B* and extending down to the floor.

The minimum requirement for *Radius B* for each particular seat category shall be that specified in Table I.

The width of the leg space provided for each seating position must be not less than the minimum seat width specified for each seating position.

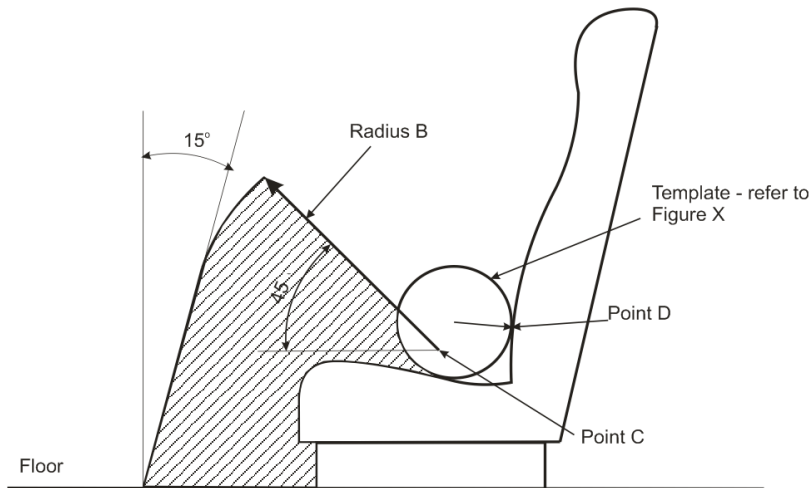


Figure 4. Leg Space

6.4 Anti Submarining Feature

To ensure the seat occupant's pelvis does not slide under the lap portion of the seat belt (a phenomenon called as submarining), each seat design shall incorporate an anti-submarining feature. This could be one of the following two features:

- An anti-submarining ramp/pan where the front edge of seat cushion has a separate bolster enhanced by a pressed steel pan at least 1mm thick and contoured to provide the support necessary for the seat's front bolster to be effective. The dimensions of the ramp are specified in the following ratios:
 - $Z/X = 1/3$
 - $Y/X = 1/4$

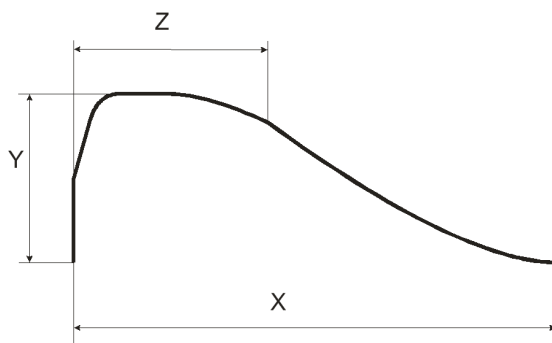


Figure 5. Dimensions of anti submarining ramp/pan

- An anti-submarining strap can be incorporated into the design of existing stocks of Category 2 & 3 seats.

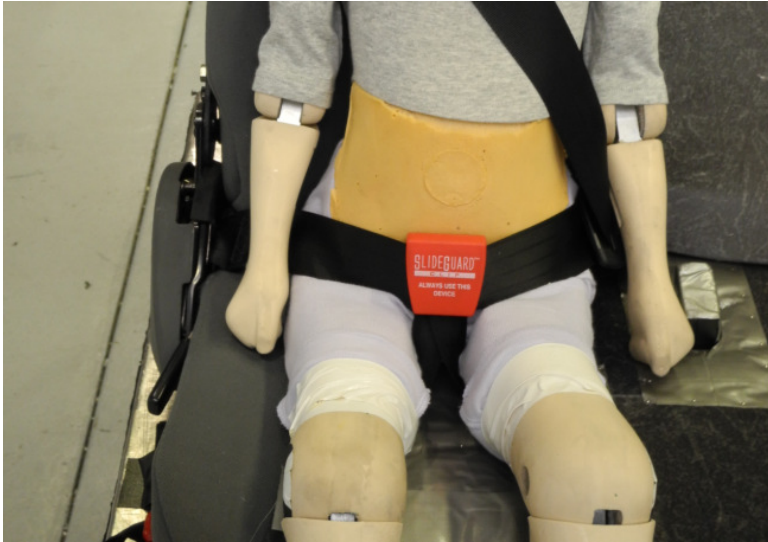


Figure 6. An example of anti submarining strap

6.5 Seat Belt

Used seatbelts must not be used for any installation undertaken in accordance with this Bulletin.

New seatbelts must be used and comply with the latest version of ADR 4/04.

Child Safety Harness belts must not be used – refer to Appendix B for reasons.

Retractable lap/sash seatbelts equipped with emergency locking retractor mechanisms with multiple sensitivity shall be provided for each seating position.

Note: These are described in ADR 4/04 as 'Ar4m-type seatbelts'. Their retractor mechanisms actuate when subjected to rapid changes in vehicle speed (deceleration) or belt length.

6.6 Seatbelt Anchorages

6.6.1 Location of seatbelt anchorages

Locations of seat belt anchorages for Category 1 shall comply with ADR 5/05 requirements or a later edition.

Any one belt anchorage may be used for attaching the ends of two adjacent Seatbelts, provided that the combined strength requirements are satisfied.

Each seat belt anchorage shall be suitable for a 7/16 inch (20 UNF 2B) anchor bolt.

For Category 2 and 3 seats, the upper and lower seat belt anchorages shall be located in the seat structure.

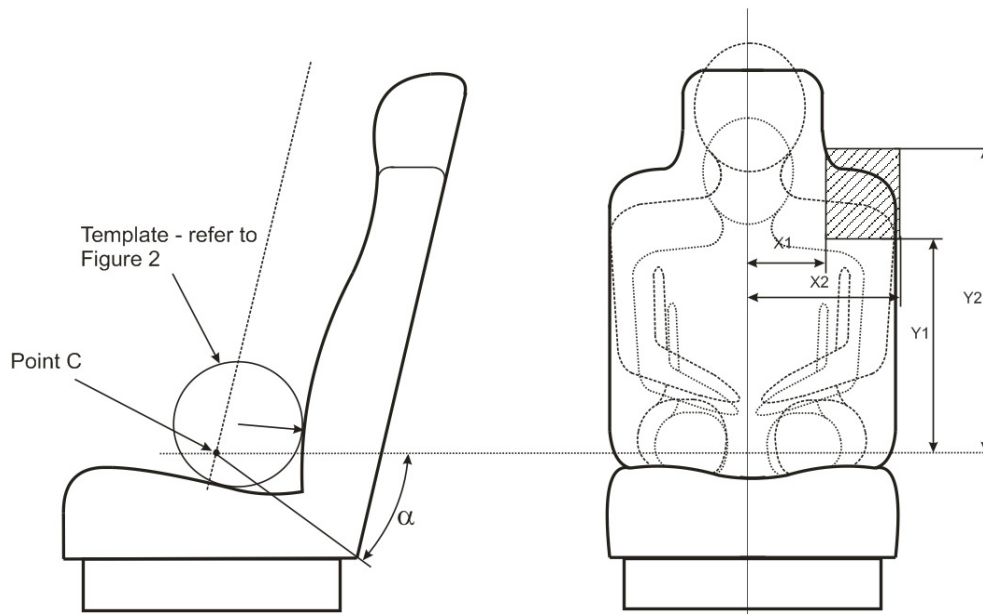


Figure 7. Locations of Upper and Lower Seat Belt Anchorages

The upper anchorage point for Category 2 and 3 seats shall be located within the shaded area shown in Figure 7. The dimensions for the shaded area in Figure 7 are as defined in Table 2.

	X1	X2	Y1	Y2
Category 2	120 mm Min	175 mm	380 mm	550 mm
Category 3	120 mm Min	145 mm	380 mm	450 mm

Table 2. Location of Seat Belt Upper Anchorage

For Category 2 and 3 seats, the angle where lower anchorage point is located (α in Figure 7) shall be within the range of 30 and 80 degrees and shall be at least 320mm apart, symmetrically arranged on either side of the seat's centreline.

6.7 Strength of Seat and Seatbelt Anchorages

The test to examine the strength of the seat anchorages must be conducted using a prototype or facsimile of the original vehicle floor on which the seat is intended to be fitted.

6.7.1 Forward-facing Seats

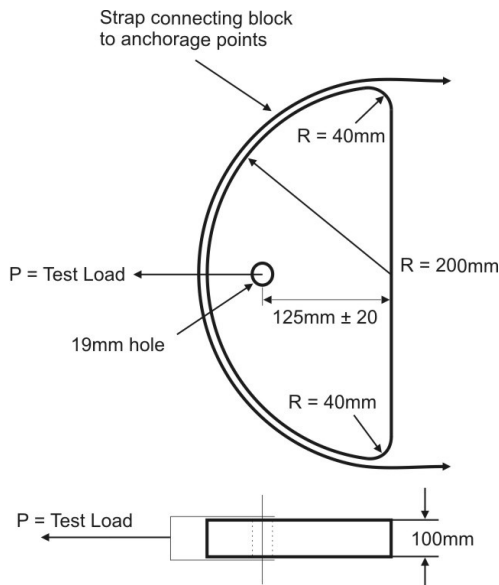
The strength of seat and seat belt anchorages on all forward facing seats must be tested in configuration as shown in Figure 10 to comply with the relevant requirements of ADR 3/03 and ADR 5/05 (or a later version of those ADRs) with the exception that the forces applied to the seat are adjusted according the category of the seats as in Table 3.

The strength of upper and lower seat belt anchorages is to be tested using traction devices prescribed in ADR 05/05.

The traction device used to test upper (i.e. sash belt) anchorages shall be as specified in Figure 8. This device shall be used for all seat categories.

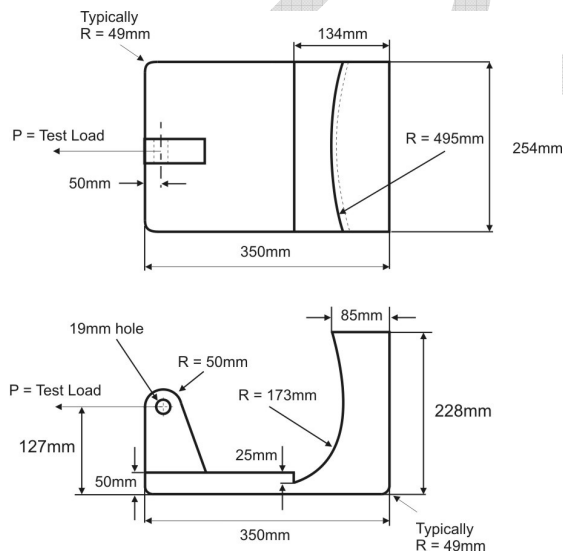
	Lap Belt Anchorage Testing ($F_{lap\ belt}$)	Sash Belt Anchorage Testing ($F_{sash\ belt}$)	Seat Inertial Force
Category 1 Seats	13.5 kN \pm 0.2 kN	13.5 kN \pm 0.2 kN	20 x 9.81 x seat mass
Category 2 Seats	0.5 (13.5 kN \pm 0.2 kN)	0.5 (13.5 kN \pm 0.2 kN)	20 x 9.81 x seat mass
Category 3 Seats	0.35 (13.5 kN \pm 0.2 kN)	0.35 (13.5 kN \pm 0.2 kN)	20 x 9.81 x seat mass

Table 3. Seat and Seat Belt Anchorages Testing Configuration for Forward Facing Seats



NOTE: Block covered by medium density canvas covered foam rubber at least 25mm thick.

Figure 8. Traction Device Testing All Upper Seatbelt Anchorages



NOTE: Block covered by medium density canvas covered foam rubber at least 25mm thick.

Figure 9. Traction Device for Testing Lower Seat Belt Anchorage for Category 2 or 3 seat

The device shown in Figure 9 is to be used for Category 2 and 3 seats. Category 1 seats are to be tested using a traction device with a width of 406 mm that intended for adults.

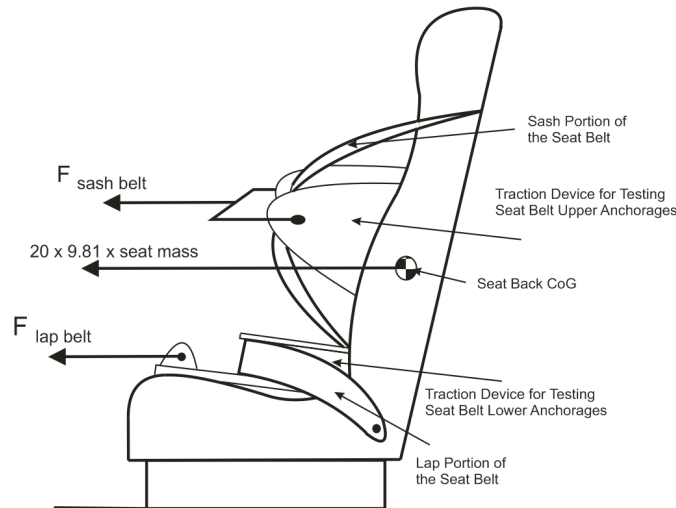


Figure 10. Seat Belt Anchorages Test Configuration

The seat must be able to withstand, without imposing any load on any other seat in the vehicle, a load equivalent to twenty times the weight of the seat and its occupant(s) applied in the rearward direction relative to the vehicle as shown in Figure 11.

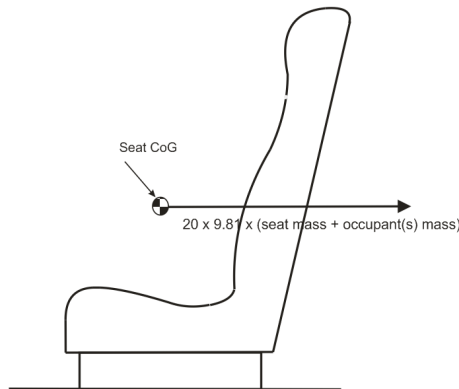


Figure 11. Seat Rearward Test Configuration

6.7.2 Rearward-facing Seats

The strength of seat and seat belt anchorages on all rearward facing seats must be tested in configuration as shown in Figure 10 to comply with the relevant requirements of ADR 3/03 and ADR 5/05 (or a later version of those ADRs) with the exception that the forces applied to the seat are adjusted according the category of the seats as seen in Table 4:

	Lap Belt Anchorage Testing ($F_{lap\ belt}$)	Sash Belt Anchorage Testing ($F_{sash\ belt}$)	Seat Inertial Force
<i>Category 1 Seats</i>	4.5 kN \pm 0.2 kN	4.5 kN \pm 0.2 kN	6.6 x 9.81 x seat mass
<i>Category 2 Seats</i>	0.5 (4.5 kN \pm 0.2 kN)	0.5 (4.5 kN \pm 0.2 kN)	6.6 x 9.81 x seat mass
<i>Category 3 Seats</i>	0.35 (4.5 kN \pm 0.2 kN)	0.35 (4.5 kN \pm 0.2 kN)	6.6 x 9.81 x seat mass

Table 4. Seat and Seat Belt Anchorages Testing Configuration for Rearward Facing Seats

The seat must be able to withstand, without imposing any load on any other seat in the vehicle, a load equivalent to twenty times the weight of the seat and its occupant(s) applied in the forward direction relative to the vehicle as shown in Figure 11.

6.7.3. Seat Anchorage Release Mechanism

Many additional seat installations allow for some seat anchorages to be released, or unlatched, so that the seat may be folded and stowed - usually for access to the spare tyre or to maximise cargo space when the seat is not required. Without proper design these unlatching mechanisms can accidentally release due to their own inertia during a crash. Similarly, it may be possible for vehicle or seat deformation during a crash to disengage any such locking mechanism.

If a seat is designed with an anchorage release mechanism of any description, evidence must be produced that the mechanism can not accidentally release due to inertial crash forces, or due to the vehicle or seat deformations that may be expected during a crash.

6.8 Child Restraint Anchorage Points

Forward-facing seats built in accordance with this Bulletin shall have a child restraint anchorage for each seating position.

Category 1 child restraint anchorages shall comply with the requirements of ADR 34/02 *Child Restraint Anchorages and Child Restraint Anchor Fittings* and ADR3/03 *Seats and Seat Anchorages* or the versions of those ADRs which applies at the time of the installation.

Category 2 and Category 3 child restraint anchorages shall comply with the requirements of ADR 34/02 and ADR 3/03 or the versions of those ADRs which applies at the time of the installation; or with the requirements specified in this Bulletin.

Child restraint anchorages must not be installed to permit restraining devices such as rearward-facing and forward-facing restraints to be used on rear-facing seats.

Where the child restraint anchorages are located in or on the seat back, or in the vehicle body structure more than 100 mm below the top of the seat back longitudinally forward to the child restraint anchorage, 20 times the mass of the entire seat in a forward longitudinal direction simultaneously with a load of 3.4 kN for each child restraint anchorage must be imposed on the seat. The seat and anchorage point must be able to withstand these loads applied for at least one second.

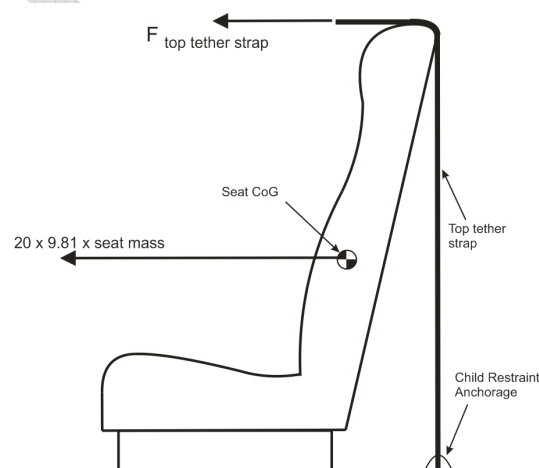


Figure 12. Child Restraint Anchorage Test Configuration

6.9 Head Restraints

All seating positions constructed in accordance with this Bulletin shall be equipped with head restraints to reduce whiplash injuries.

Head restraints shall meet the following requirements:

- head restraints may be provided with vertical and fore-and-aft adjustment;
- head restraints may be removed with or without the use of tools;
- **head restraints shall provide an impact surface meeting the dimensional requirements as shown in Figure 13 with its corresponding Table 5. Minimum Dimensions of Head Restraints**

- Notes:
- 1 ADR 3/03 specifies the height of the head restraints shall not less than 800 mm for front seats and 750 mm for other seats. Erect sitting height of Hybrid III 50th is 883 mm. The head restraint height is 85% of the erect sitting height.
 - 2 Erect sitting height of 50th %tile 12 years old is 763 mm, the minimum head restraint height is 650 mm
 - 3 Erect sitting height of 50th %tile 7 years old is 657 mm, the minimum head restraint height is 560 mm

for the particular of seat;

- head restraints shall be constructed and contoured to decelerate horizontal movements of the occupant's head without concentrations of load on it;
- all solid structural members of the head restraint shall be padded with high density foam of sufficient thickness to prevent injury to the occupant's head. Refer to the padding requirements in 6.10 for the specification of suitable high density foam.

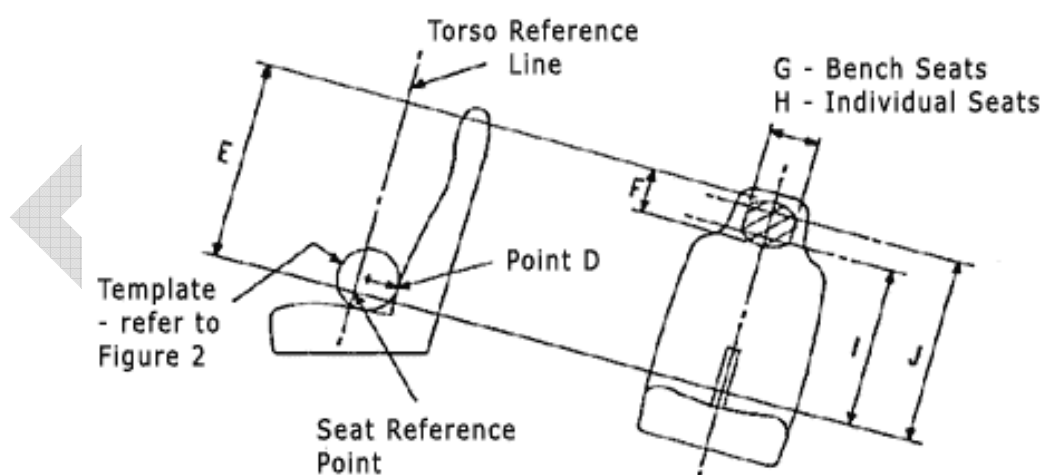


Figure 13. Dimensions of Head Restraints

DIMENSION	CATEGORY OF SEAT		
	1*	2	3
E	750 ¹ mm	650 ² mm	560 ³ mm

F	115 mm	115 mm	115 mm
G	250 mm	250 mm	250 mm
H	170 mm	170 mm	170 mm
I	635 mm	585 mm	445 mm
J	685 mm	585 mm	495 mm

*Also applies to rearward-facing seats

Table 5. Minimum Dimensions of Head Restraints

- Notes:
- 1 ADR 3/03 specifies the height of the head restraints shall not less than 800 mm for front seats and 750 mm for other seats. Erect sitting height of Hybrid III 50th is 883 mm. The head restraint height is 85% of the erect sitting height.
 - 2 Erect sitting height of 50th %tile 12 years old is 763 mm, the minimum head restraint height is 650 mm
 - 3 Erect sitting height of 50th %tile 7 years old is 657 mm, the minimum head restraint height is 560 mm

The strength of the head restraints on all seats must be tested and shown in Figure 14 to comply with the relevant requirements of ADR 3/03 (or a later version of that ADR) with the exception that the applied 890 N force about point C specified for testing each seating position can be reduced for Category 2 and Category 3 seats to:

$$\begin{aligned} \text{Category 2 Seats} & \quad (0.5 \times 890 =) \quad 445 \text{ N;} \\ \text{Category 3 Seats} & \quad (0.35 \times 890 =) \quad 312 \text{ N.} \end{aligned}$$

A representative *Head Form* 165mm in diameter shall be used to assess the head restraint.

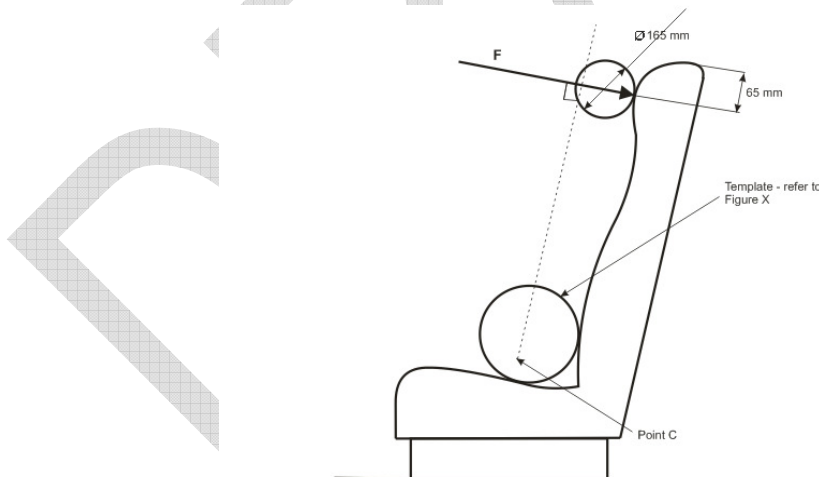


Figure 14. Head Restraint Test Configuration

A load corresponding to the seat category shall be applied to the head form at a point 65mm below the top of the head restraint.

With the specified load applied, the displacement of the rearmost point of the head form perpendicularly rearward of the displaced Torso Reference Line shall not exceed 102mm.

6.10 Padding

6.10.1 Seat Padding Requirements

Seat padding and upholstery must be securely attached to the seat frame to prevent movement during impact.

Additional front-facing must be covered with at least a 25 mm thickness of padding material within the 'Head Contact Area'.

Seat padding and upholstery must be securely attached to the seat frame to prevent movement during impact.

Loose cushions must not be used.

6.10.2 Padding Material

If padding is required by this Bulletin, then the following padding materials, or their equivalent, shall be used:

- semi-rigid moulded polyurethane with a density of approximately 300 kg/m³
- self-skinning rigid moulded polyurethane with a density of approximately 300 kg/m³
- closed-cell polyethylene foam with a density of approximately 300 kg/m³
- closed-cell EVA foam with a density of approximately 300 kg/m³

Foams typically used for upholstery work shall not be used for occupant protection padding unless they meet these requirements.

7 LABELLING AND MARKING OF SEATS

7.1 Manufacturer's Labels and Installer's Labels

Each replacement or additional seat manufactured in accordance with this Bulletin shall have a permanent manufacturer's plate or label, showing the make(s) and model(s) of vehicle that the seat was designed for and the date that the seat was manufactured.

The manufacturer's plate or label shall be affixed in a conspicuous place on the seat.

An installers' plate or label shall also be affixed in a conspicuous place on or near the seat.

If the seat's manufacturer is also its installer, a single plate or label may be used. If a single plate or label is used, it shall state:

This seat was manufactured by *(insert manufacturer's name)* **on** *(insert build date)* **for** *(insert vehicle make and model)* **and installed on** *(insert installation date)* **in accordance with VSB 05***(insert version number and year)*

If the seat manufacturer is not the installer, the plate or label shall state:

This seat was manufactured by *(insert manufacturer's name)* **on** *(insert build date)* **for** *(insert vehicle make and model)* **in accordance with VSB 05** *(insert version number and year)*.

This seat was installed by *(insert installer's name)* **on** *(insert installation date)* **in accordance with VSB 05** *(insert version number and year)*

These plates or labels shall:

- a) be made of a durable material which is not easily removed or defaced in normal use; and
- b) display the required statements, clearly legible in characters at least 5mm high on a contrasting background.

7.2 Usage Labels for Category 2 and 3 Seats

Category 2 and 3 seats must display the following warning label:



7.3 Shoulder Height Marking

Upper and lower shoulder height markers shall be placed on Category 2 and 3 seats and shall meet the following requirements.

- The marking shall be permanently fixed to the front of the seat back or otherwise permanently marked onto that surface;
- The size of the label text box on the upper and lower shoulder marking shall be as defined in Figure 15 and 15 respectively.
- The marking shall be positioned in close proximity to the expected occupant shoulder height or as shown in Figure 17;
- The marking shall be made from a durable material;

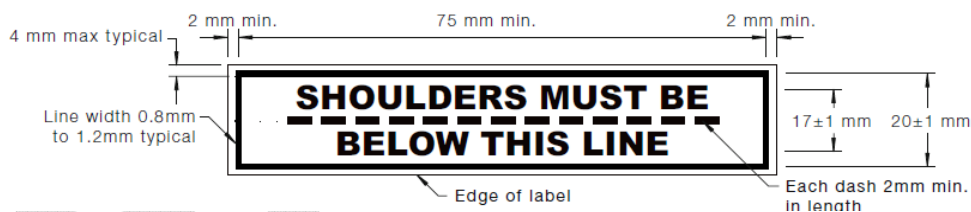


Figure 15. Upper Shoulder Marker

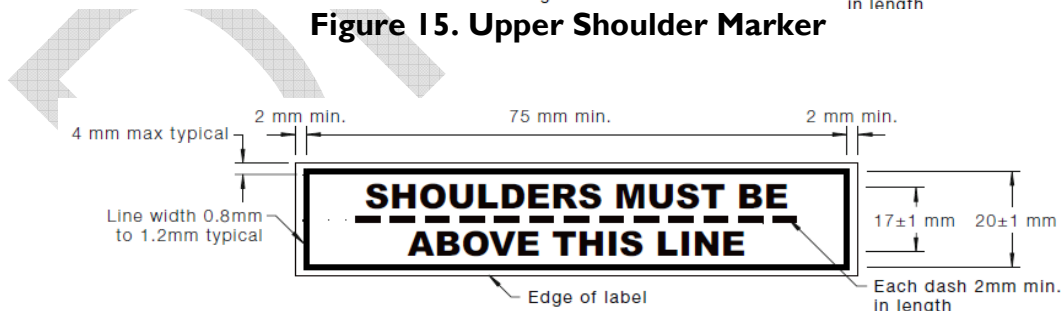


Figure 16. Lower Shoulder Marker

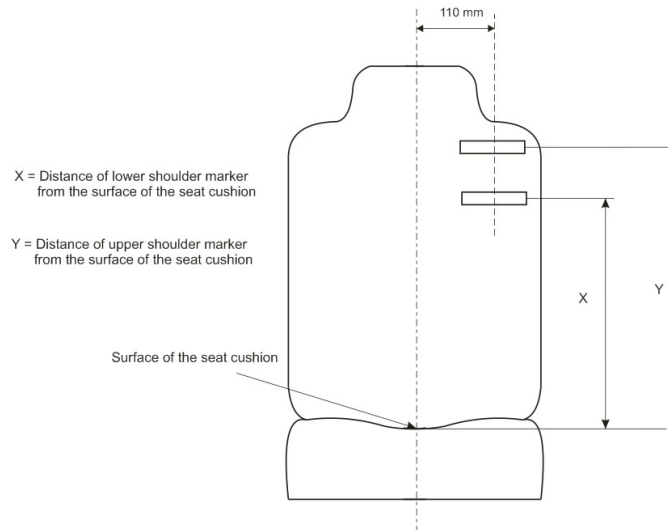


Figure 17. Locations of Shoulder Markers

Locations of Lower Shoulder Height Marker

For Category 2 and 3 Seats, the horizontal centreline of the label shall be at 350¹mm above the surface of the seat cushion, measured on the centreline of the seating position, dimension X in Figure 16.

Locations of Upper Shoulder Height Marker

For Category 2 Seats, the horizontal centreline of the label shall be at 490²mm above the surface of the seat cushion, measured on the centreline of the seating position, dimension Y in Figure 16.

For Category 3 Seats, the horizontal centreline of the label shall be at 410³mm above the surface of the seat cushion, measured on the centreline of the seating position, dimension Y in Figure 16.

- Notes:
- 1 Sitting mid shoulder height of 50thtile 4-year-old.
 - 2 Sitting mid shoulder height of 50thtile 12-year-old.
 - 3 Sitting mid shoulder height of 50thtile 7-year-old.

APPENDIX A – DEFINITIONS

The following terms are used in this Bulletin.

Anti-Submarine Device something used to prevent submarining, and includes the design of the seat pan or a crotch strap incorporating a clip that fixes to lap part of a seatbelt to help stop the person's pelvis sliding forward

Australian Design Rules (ADRs) are mandatory vehicles safety, performance and environmental standards that apply to new vehicles supplied to the Australian market for use in road transport.

Child Restraint is a device to restrain a child passenger of a motor vehicle in the event of a vehicle impact and thus minimise the risk of bodily injury.

Head Contact Area is the area forward of the *Seating Reference Point* contained within an arc of *Radius R* from the *Seating Reference Point*, a vertical longitudinal plane at each end of the seat cushion and a horizontal plane through the *Seating Reference Point*.; and where *Radius R* is 835 mm for Category 1 seats, 715 mm for Category 2 seats and 625 mm for Category 3 seats.

Hybrid III dummy is a dummy developed by General Motors for use in frontal crash testing.

May indicates an option that is permissible and which does not affect compliance with a test whether or not it is used.

Must indicates that something is an essential part of, or essential to, the test.

P-series dummies is a series of crash test dummies that represent children aged six weeks (P0), 9 months (P3/4), three years (P3), six years (P6) and 10 years (P10).

Seating Reference Point (SRP) is the vehicle manufacturer's design reference point representing the position of the pivot centre of human torso and thigh for the rearmost normal design driving or riding position for each designated seating position in a vehicle.

Shall indicates something that is a mandatory to ensure compliance with this Bulletin.

Should indicates something that is recommended, but is not necessary to ensure compliance with this Bulletin.

Shoulder Height the vertical distance between a flat surface on which the person is seated and the top of the person's mid shoulder.

Station Wagon means a motor vehicle: body style variant of a sedan/saloon with its roof extended rearward over a shared passenger/cargo volume with access at the back via a third or fifth door and usually has one or more rows of folding or removable seats behind the driver to increase its load carrying capacity. Many MC Category vehicles are designated as station wagons.

Submarining is a phenomenon where the pelvis of the seat occupant slips forward under the lap belt in a frontal crash causing the lap belt to penetrate the soft abdomen of the occupant.

Torso Reference Line (TRL) is a line parallel to the seat back and passing through the *Seating Reference Point*. For seats with fully adjustable seat backs, it is a line inclined no more than 30 degrees to the vertical.

APPENDIX B – EXPLANATORY

A study was undertaken to compare the protection level offered to children seated directly on the Category 2 additional seat to those secured in an Approved Forward Facing Child Restraint (AFFCR) or a booster seat fitted on an additional seat.

A typical station wagon, fitted with a Category 2 additional seat, underwent a frontal crash-barrier test to investigate the interaction between the seat's occupants and the vehicle's interior and to assess the strength of the seat's anchorages. Testing was conducted at Crashlab using two P3 dummies in the following configurations:

- One dummy was positioned directly on the additional seat on the driver's side of the vehicle and restrained by the lap-only belt and a child safety harness (CSH) that came standard with the seat. The dummy was positioned in a 'natural' posture, with the heels resting on the vehicle floor. In order to allow the feet to rest on the floor the dummy had to be positioned in a slouching posture (see Fig B1).
- The other dummy was restrained in an AFFCR which was fitted on the passenger's side of the vehicle (see Fig B1).



Figure B1. Test configuration for the frontal barrier test

The crash-barrier test results indicated that excessive submarining occurred on the dummy seated directly on the additional seat, while the legs of the dummy restrained by the AFFCR heavily impacted the second-row seat back (see Figure B2). Comparing the results, the risk of injury for the child sitting directly on the seat was greater than when secured in the AFFCR. While the seat anchorage performance was found acceptable, the seat latching-mechanism on the additional seat failed during the test.



Figure B2. The point of maximum head forward excursion for P3 dummies seated directly on a category 2 seat (left) and on an AFFCR (right).

This study found that current additional seats that meet the minimum requirements of VSB 05 provide less crash-protection compared to those when used with an AFFCR or a booster seat.

Child Anthropometry

Anthropometry data was taken from the studies conducted at the University of Michigan in the 1970s (Snyder et al. 1977; Snyder et al. 1975), since more recent anthropometry data for the US or Australian population was not available. Buttock to popliteal data was taken from study conducted by NeuRA (Bilston and Sagar 2007). Data from those studies are summarised in Table I. Additional data were taken from geometries of Hybrid III dummies.

A series of fitting tests was conducted to assess the current requirements for head and leg spacing matching the anthropometry of children allowed using these seats. TNO P3, P6 and P10 series dummies were used to represent average three-, six- and ten-year-old children. The P3 dummy was chosen because there is no available dummy that represents an average four year old child. In addition to that some shorter four year old children have the same statures as an average three year old child. A fifth percentile female Hybrid III dummy was used to represent a 12 year old child. This dummy has similar stature of a 12 year old child (see Table B1). These dummies were placed one by one on a category 2 seat fitted into a Ford Falcon Station Wagon and the results are presented in the tables below.



Figure B3. TNO P3 (a) and P6 (b) series dummies fitted to a VSB 05 Category 2 seat



Figure B4. TNO P10 and 5th percentile female Hybrid III dummies

	%tile	Age (year)			5 th HIII Dummy	50 th HIII Dummy
		3.5 - 4.5	6.5 - 7.5	11.5 - 12.5		
Buttock to Popliteal (BTP)	5 th	232	289	369		
	50 th	254	316	408	426	465
	95 th	285	353	452		
Shoulder Breadth (35)	5 th	230	265	312		
	50 th	256	291	351	358	429
	95 th	282	331	399		
Erect Sitting Height (9)	5 th	537	607	712		
	50 th	575	657	763	787	884
	95 th	615	709	832		
Seated Hip Breadth (11)	5 th	178	186	239		
	50 th	198	205	280	307	363
	95 th	219	230	332		
Sitting Mid-Shoulder Height	5 th	313	372	446		
	50 th	348	407	493	~485	~520
	95 th	379	447	543		
Chest Depth	5 th	108	121	141		
	50 th	123	137	161	183	221
	95 th	138	156	195		

Table B1 Child Anthropometry (Snyder 1977, Sagar 2010, Hybrid III 5th Female User Manual) See Figure B5 for key.

	HIII 3 yo	HIII 6 yo	HIII 10yo	HIII 5%	HIII 50%
Total Sitting Height (A)	546.1	635	716.3	787.4	883.9
H-Point Height (C)	39.4	68.6	84.1	88.8	86.4
Seated Height from Hip Pivot (A-C)	506	566	632	703	797.5
Buttock to Knee Length (K)	292.4	381	473.7	533.4	591.8
H-Point from Seat Back (D)	62.0	94	138.2	147.3	137.2
H-Point to Knee Length (K-D)	230	287	336	386	456

Table B2 Set up of dummies for testing. See Figure B6 for key.

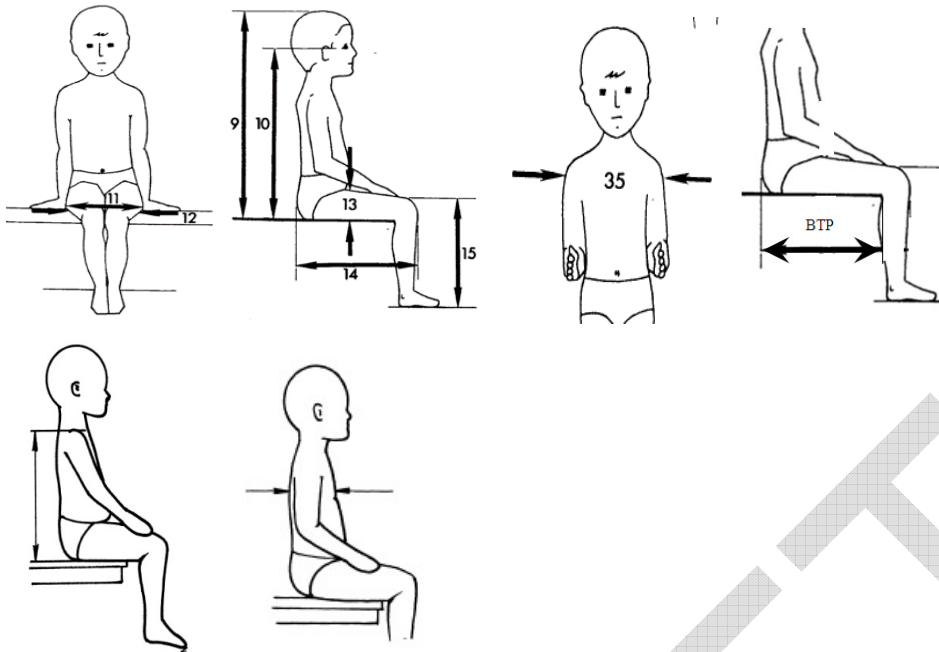


Figure B5 Key to Table B1

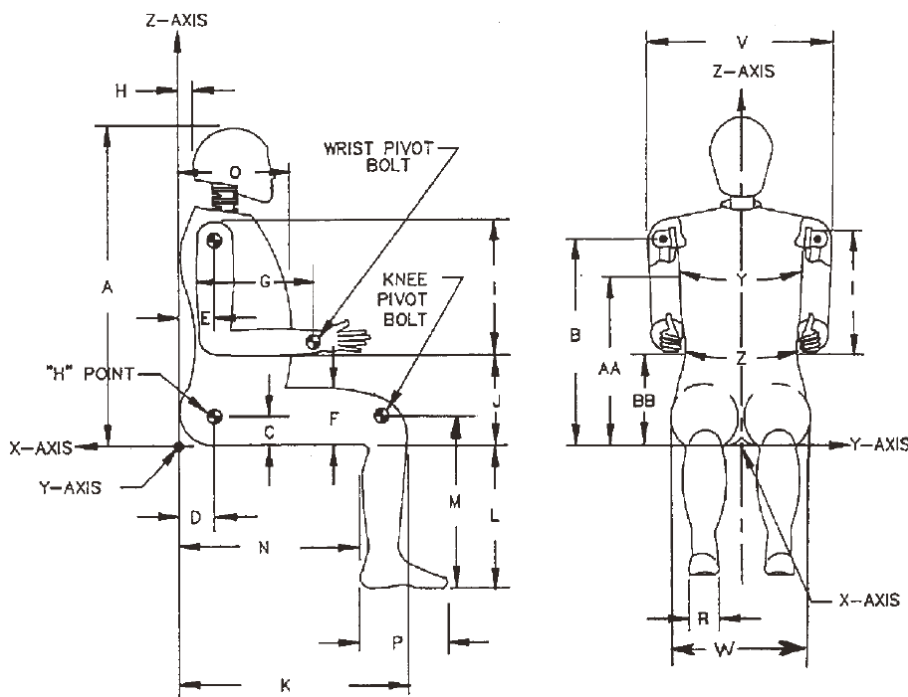
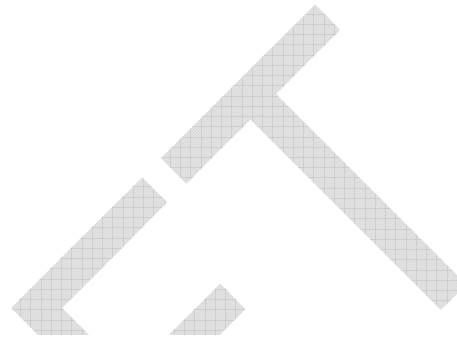


Figure B6. Key to Table B2

Leg Space

With reference to Figures B3 and B4, the current leg space requirement accommodates smaller dummies (P3 and P6), but would be too narrow for P10 and the 5th female dummies. In fact the knees of the 5th dummy were abutted against the top of the back of the seat in front. As a result of the short leg space and compounded with the shallow foot well, the thighs of the dummies need to be raised up higher which consequently pushes up the lap belt onto the soft abdomen area, hence, the dummy would submarine in frontal crash.

A series of sled tests were conducted to investigate the adequacy of the current leg spacing requirement with regard to the risk of head and knee injuries as a result of the head and knee of the

seat occupant striking the seat in front. The results show that the heads of both P6 and P10 series dummies strike the back of the seat in front.



Figure B7. Typical crash test done under previous version of VSB 05. Note the dummies' head striking the seat in front of them.

Considering the above facts, the current leg space requirements have an increased risk of injury to the seat occupant. For each category of seats is determined by the knee length measured from the hip point or C point plus an allowance of approximately 100 mm for the stretching of the seat belt during a crash. In those regards the Radius B of each seat category is given in Table B3 below.

	CATEGORY OF SEAT		
	1	2	3
Radius B	560 mm Min	490 mm Min	400 mm Min

Table B3

Head Space

The previous version of VSB 05 allows Category 2 seat for use by children up to the age of 12 years. As seen in Table 1 the erect seated height of 50th percentile of 11.5 – 12.5 year old child is 763 mm. Current VSB 05 requires the maximum head space (Radius A) is 710mm which is measured from point C on the template to the back of the seat in front. If the measurement is taken from the seat cushion surface, this would give the maximum erect seated height of the occupant as approximately 755mm (the distance from point C to seat cushion surface is ~45mm). In this regard, an average 12-year-old child would be too high for Category 2 seat.

A similar approach is taken for Category 1 and 3 seats. Therefore, the head space requirement (Radius A) has been changed to accommodate the largest occupant allowed to use the seat as shown in Table B4 below.

DIMENSION	CATEGORY OF SEAT		
	1	2	3
Radius A	898 mm Min	803 mm Min	700 mm Min

Table B4

Submarining

Children are particularly prone to submarining as their pelvic bone has not fully developed.

A series of tests were conducted at Crashlab to investigate an option to fit an anti submarining clip (a crotch strap) to prevent submarining. An example of anti submarining clip

is shown in Figure 5. Three types of dummies were used in this study, P3, P6 and P10 representing an average 3, 6 and 10 years old child, respectively. The results demonstrate that anti submarining clip prevents the dummy from submarining.



Figure B7. Seat fitted with anti submarining clip; these can be seen at the front and middle of the seat pan.

Changing weight to age

Anderson and Hutchinson (2006) found that using mass classification would mean that five percent of all children under the age of six would be using a restraint not suited to their mass classification. They suggested that changing mass to age classification could reduce the level of misclassification to less than one percent.