ANCAP CHILD OCCUPANT PROTECTION ASSESSMENT – PERFORMANCE OF AUSTRALASIAN CHILD RESTRAINTS IN FULL SCALE CRASH TESTS

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ABSTRACT

From the start of 2018 ANCAP's testing and assessment protocols are substantially common with those of Euro NCAP. One key area of difference is assessment and rating of Child Occupant Protection (COP). While alignment of protocols is maintained where possible, differences in products and in vehicle installations require a unique assessment.

The differences arise from a mandatory product standard regulating Child Restraint Systems (CRS) in the Australasian market (AS/NZS 1754). The requirements of the standard mean that all booster seats sold in Australia are high back boosters, while prohibiting of the use of ISOFIX attachments for booster seats. Australian law also mandates use of booster seats by age (up to 7 years).

The 2018 protocols see the first opportunity for assessment of the performance of Australasian booster seats in full scale frontal and side impact crash testing. Typical vehicle accelerations recorded in ANCAP frontal offset tests are above those specified by existing regulatory or consumer CRS testing, and some parties expressed concerns regarding performance of Australasian CRS in comparison with European specification restraints, in particular those CRS recommended by vehicle manufacturers and used in Euro NCAP dynamic COP testing.

The paper provides an overview of early results, considerations for vehicle manufacturers and areas for future consideration in relation to child booster seats in the context of consumer ratings.

INTRODUCTION

From the start of 2018, ANCAP's testing and assessment protocols are substantially common with those of Euro NCAP. However, one key area of difference is assessment and rating of Child Occupant Protection (COP).

The regulatory and usage environment for child occupants in Australia is significantly different to that of Europe, and while alignment of protocols is maintained where possible, differences in products and in vehicle installations are such that a unique assessment is required.

In particular, the differences in product and vehicle installations arise due to unique requirements contained in a mandatory product standard governing the design and performance of child restraints sold on the Australian market (AS/NZS 1754 [1]). Of most relevance are performance requirements within this standard that effectively ensure that all booster seats sold in Australia are high back boosters, while prohibiting of the use of ISOFIX attachments for booster seats. Australian law also mandates use of booster seats by age for occupants of up to 7 years, although best practice guidelines recommend use based on the match between the child's size and rear seat and seat belt geometry.

The 2018 protocols see the first opportunity for assessment of the performance of Australian booster seats in full scale frontal and side impact crash testing. Typical vehicle accelerations recorded in ANCAP frontal offset tests are above those specified by existing regulatory or consumer CRS testing, and some parties expressed concerns regarding performance of Australian CRS in comparison with equivalent testing using European specification restraints.

ANCAP's requirements for Child Occupant Protection from the start of 2018 are contained in two protocols:

- ANCAP ASSESSMENT PROTOCOL - Child Occupant Protection [2]; and
- ANCAP TEST PROTOCOL - Child Occupant Protection [3].

While child restraints and instrumented dummies have been included in ANCAP frontal offset and side impact tests for many years, the 2018 protocols are the first occasion where protection of child occupants forms part of the assessment of the vehicle.

In addition, the 2018 protocols assess children of a different age range to those used in previous ANCAP testing, with 1.5 year old and 3 year old occupants in CRS with integrated harness being replaced with 6 year old and 10 year old occupants in (generally) high-back booster seats.

The 2018 protocols therefore present a new challenge to vehicle manufacturers, particularly for those with vehicle types that have not previously been subject to Euro NCAP assessment. During the lead-up to implementation of the new protocols, ANCAP received representations from a number of vehicle manufacturers suggesting that in-house testing had shown difficulty achieving comparable performance in vehicles fitted with Australian CRS when compared with vehicles of the same specification tested using European specification restraints.

With a range of vehicles of different types having now been tested to the new ANCAP protocols, there is an opportunity to examine performance against the COP dynamic testing and assessment protocols, and to further examine similarities and differences between the performance of the different restraint types.

In this paper, restraints that have been manufactured and certified to the Australian / New Zealand Standard (AS/NZS 1754) and supplied in Australia are referred to as AU. Restraints supplied and used in Europe (meeting UN Regulation 129) are referred to as EU.

BACKGROUND

Child Restraint Requirements in Australia

In Australia, the road rules require vehicle drivers to secure children aged up to 7 years old in an approved child restraint system. For infants up to 6 months of age this must be a rearward-facing CRS with an in-built harness. For children who are 6 months or older, but less than 4 years, this must either be a rearward-facing or a forward-facing CRS with an in-built harness. For children who are 4 years or older, but less than 7 years, this must be a forward-facing CRS with an in-built harness or a booster seat. Children who are 7 years or older, but less than 16 years, must be secured using a child restraint (CRS with in-built harness or booster seat) or by a seatbelt only.

Australian road rules also prohibit children under 4 years old from travelling in the front row of a vehicle with 2 or more rows of seats. Further, children who are 4 years or older but less than 7 years, are prohibited from travelling in the front row of a vehicle with 2 or more rows of seats, unless all seats in the rear rows are occupied by children who are also less than 7 years old. These requirements are to minimise the risks associated with young children travelling in the front seat, including in particular (but not limited to) the risk associated with the installation of a rearward-facing child restraint in a seating position with an active airbag.

Australian /New Zealand Standard AS/NZS 1754 is a mandatory product safety standard and has historically included a number of significant differences in comparison to European product standards. The standard requires that all dedicated child restraint systems, including booster seats, prevent contact between the test dummy's head and a static side door structure in a simulated 90 degree impact. This requirement effectively removes backless booster seats (other than those sold as part of the vehicle i.e. integrated boosters) from the Australian market.

AS/NZS 1754 includes requirements for materials (e.g. webbing, coated metal parts, plastics), general design and construction, dynamic performance, labelling, instructions, marking and packaging.

To meet AS/NZS 1754 a child restraint must satisfy the requirements for at least one designated restraint type. Convertible restraints must meet the requirements set out for the applicable combination of types (e.g. A2/B, A4/B, B/E, B/F etc.). Table 1 summarises each designated restraint type defined by this standard (excluding the Type C harness and the Type H converter). Shoulder height markers are required on all CRS (other than type C and H), providing guidance on when a child should transition to the next designated type, and are prescribed in such a way as to encourage transitions to be as late as possible.

Currently there are two types of booster specified in AS/NZS 1754; Type E boosters which are designated as suitable for use by children approximately 4 years to 8 years, and Type F boosters designated as being suitable for children aged approximately 4 to 10 years. All Type E and F boosters available in Australia are high back boosters.

AS/NSZ 1754 also designates an alternative form of restraint for children aged between 4 and 8 years. This is known as a Type G restraint, which is a forward-facing child seat designed to accommodate a larger child than the traditional Type B forward facing seat. The Type G seat incorporates an integral harness, and is anchored to the vehicle by the three point belt and a top tether strap.

Table 1.
Designated restraint types under AS/NZS 1754

Type Designation	**Description**	**Seated Shoulder Height**	**Approximate Age Range**
A1	Rearward-facing child restraint with in-built harness	Birth up to 290--320 mm	Birth to 6 months
A2	Rearward-facing child restraint with in-built harness	Birth up to 320--350 mm	Birth to 12 months
A3	Side-facing child restraint with in-built harness or other restraint means	Birth up to 290--320 mm	Birth to 6 months
A4	Rearward-facing child restraint with in-built harness	Birth up to 360--390 mm	Birth to 30 months
B	Forward-facing child restraint with in-built harness	From 290 mm up to 405--435 mm	6 months to 4 years
D	Rearward-facing child restraint with in-built harness	From 290 mm up to 405--435 mm	6 months to 4 years
E	Booster seat (child <128cm)	From 385 mm up to at least 475 mm	4 years to 8 years
F	Booster seat (child <138cm)	From 385 mm up to at least 530 mm	4 years to 10 years
G	Forward-facing child restraint with in-built harness	From 290 mm up to 490-510 mm	6 months to 8 years

Generally, AS/NZS 1754 requires child restraints to accommodate specified dummies representative of the smallest child (in summer weight clothing) and the largest child (in winter weight clothing) that the restraint type designation is intended to cover. This is to ensure that the large majority of children will fit properly within restraints of a given designated type, for at least the minimum period required by the road rules.

All restraint types except for booster seats and converters must include provision for attachment to the vehicle using a seatbelt in combination with a top tether. Booster seats greater than 2 kg in mass must also be fitted with a top tether. Rigid ISOFIX connectors or flexible lower anchorage straps/connectors are optional for restraints of Type A, B and D; and are prohibited for all other restraint types. Table 2 summarises the anchoring and attachment system requirements for each designated restraint type.

Finally, while AS/NZS 1754 does include some size requirements, in particular for Type F restraints, it does not include any reference to the European i-Size systems.

Table 2.
AS/NZS CRS Anchoring and Attachment Requirements

Type Designation	Anchoring and Attachment System				
	Anti-rotation Device		Seatbelt Anchorage	ISOfix Connector (Lower)	
	Top Tether	Foot prop (Support Leg)		Rigid	Flexible
A1, A2, A3, A4	✓	✕	✓	✓	✓
B	✓	✕	✓	✓	✓
D	✓	✕	✓	✓	✓
E, F	✓ CRS > 2kg	✕	✓	✕	✕
G	✓	✕	✓	✕	✕

✓ Mandatory ✓ Optional ✕ Prohibited

The dynamic tests required by AS/NZS 1754 include frontal impact, side impact with door, side impact without door, rear impact and inverted tests. For the frontal impact tests, the velocity change must be at least 49 km/h with a negative acceleration of between 24g and 34g for at least 20ms. For the side and rear impact tests, the velocity change must be at least 32 km/h with an acceleration of between 14g and 20g for at least 20ms.

The CRS must meet a range of general structural integrity related requirements for each prescribed test, including retention of the dummy in the restraint on the test rig. For the frontal impact tests, there are also maximum head acceleration limits for Type A and D restraints, head excursion limits for Type A, B, D and G restraints and requirements to limit both movement of the sash belt from the shoulder and submarining for Type E and F booster seats. For the side impact tests there are requirements to avoid head contact with the side door, while in the rear impact tests there are head excursion limits for Type A and D restraints.

Child Restraint Requirements in Europe

In Europe, children under 135 cm in height must, when travelling in light vehicles, be restrained in a United Nations (UN) Regulation No. 44 (R44) or a UN Regulation No. 129 (R129) approved child restraint, which is appropriate for their size and weight. Rearward-facing child restraints are permitted to be used in the front passenger seat, provided the airbag is deactivated. There is no restriction on the use of forward-facing child restraints or booster seats in the front seat.

All child restraints sold in Europe must be approved to either UN R44 or UN R129. Child restraints manufactured and approved to UN R44 are classified into five groups, based on child mass, and the child mass group (i.e. mass range) is indicated on the approval label affixed to the restraint. Child restraints manufactured and approved to UN R129 are classified according to the child height range for which the restraint is suitable, which is also indicated on the approval label affixed to the restraint. Further, maximum child mass is also included on the UN R129 approval label for CRS types with an integrated restraint system.

Under UN R129, child restraints are categorised as either i-Size restraints or specific vehicle restraints. i-Size restraints must meet a range of geometrical requirements to ensure they properly fit i-Size seating positions in vehicles. The requirements for i-Size seating positions are set out in UN Regulation No. 14. Specific vehicle restraints are approved for a specific vehicle type (i.e. model).

The dynamic tests required by UN R129 include frontal impact, side impact (with intruding door) and rear impact. For the frontal and rear impact tests, the requirements include general structural integrity related provisions for the CRS, dummy injury assessment criteria limits and head excursion limits.

In the lateral (side) impact tests, there are requirements for general structural integrity (of the CRS), dummy injury assessment criteria and head containment.

Differences between ANCAP and Euro NCAP

While ANCAP's COP testing and assessment protocols are closely aligned with those of Euro NCAP, there are a number of differences that reflect the nature of CRS available in Australasia, and the way in which they are used. The majority of the changes relate to the CRS Installation and Vehicle Based Assessment sections of the protocol and will not be discussed in this paper. The key differences that relate to the performance in the Dynamic Assessment sections are:

	Euro NCAP	ANCAP
CRS Type	Q6 seated in Booster Seat (High back). Q10 seated on Booster Cushion (no back)	Q6 - An "appropriate" forward facing CRS for a 6 year old child. This may be a Type E or Type F booster seat (with back and sides), or a Type G CRS with integrated harness. Q10 – a Type E or Type F forward facing booster seat. (If selected by the OEM).
CRS Selection	CRS as Recommended by OEM. If no recommendation is made, CRS is selected from "Top Pick List"	CRS may be selected by the OEM (no requirement for 'Recommendation') If no selection is made by the OEM, CRS is from ANCAP CRS list for Q6 and Q10 is placed on the vehicle seat (no CRS).
CRS Head Restraint		CRS head restraint is positioned as specified by vehicle manufacturer. Where no specification is made, CRS manufacturer installation directions are followed.
Fitting the CRS	ISOFIX permitted.	Type E and Type F CRS are installed using the adult belt and top tether. AS/NZS 1754 prohibits the use of ISOFIX attachments on booster seats.
Integrated CRS	Integrated CRS will be used even if they are optional equipment.	Where the integrated CRS is optional equipment, ANCAP will determine whether the optional CRS are to be fitted.

Dummy specifications, test set up (including seating locations), and performance criteria are common between the ANCAP and Euro NCAP COP testing and assessment protocols. Where integrated booster cushions are fitted to the test vehicle and suitable for either the Q6 or Q10 dummy the booster seat they are used for these occupants under both ANCAP and Euro NCAP, however the application for optional integrated seats is different between the two programs (to date ANCAP has not tested any vehicle with an integrated booster seat/cushion).

ANCAP CRS Selection List

As with Euro NCAP, ANCAP's COP protocols include an assessment of installation of a range of child restraints in each vehicle that is rated. However, a key difference is that ANCAP's "CRS Selection List" is intended as a selection of typical, readily available child restraints covering each of the applicable CRS types in the Australian / New Zealand standard, with no relative assessment of the performance of each CRS against other available products (and therefore is not a 'Top Pick' list). The CRSs were chosen, where applicable, to include ISOFIX attachments in addition to the mandatory belt installation, allowing assessment of installation in both modes.

There is no requirement that the CRS selected by vehicle manufacturers for the dynamic tests be chosen from the CRS Selection List, and manufacturers can and do select from the full range of CRSs of the specified types.

COP scoring matrix and considerations

The scoring distribution under COP for ANCAP is the same as the Euro NCAP COP protocol, though ANCAP awards default points for a subset of the static CRS installations. ANCAP also rewards the provision of ISOFIX seating positions, rather than i-Size, which is not applicable under the Australian / New Zealand standard for CRS.

Table 3.
COP Scoring for ANCAP and Euro NCAP

	Euro NCAP (49)	ANCAP (49)
Dynamic Assessment	(24)	(24)
Frontal Impact	16	16
Side Impact	8	8
Vehicle Based Assessments	(13)	(13)
Gabarit Installation on all Passenger Seats	2	2
i-Size and TopTether Marking	3	-
ISOFix Availability	-	3
Two or more ISO/R3 Positions	1	1
Passenger Airbag Warning Marking and Disabling	4	4 (Default 2)
Integrated CRS	3	3
Installation of Child Restraints	(12)	(12)
Universal seats	4	4
Belted with top tether seats		
ISOFIX seats	2	2
i-Size seats	4	Default 4
Recommended seats	2	Default 2

As is the case with Euro NCAP, most vehicles score 8 or fewer points out of 13 for the Vehicle Based Assessment. As a result, the Dynamic Assessment becomes critical for the COP score and ultimate star rating for a vehicle. The minimum score for a 5 star rating in 2018 is 39.2 points, and therefore a vehicle with a Dynamic score lower than approximately 20 is unlikely to be eligible for the highest star rating.

Chest Injury Metrics

At the start of 2018 a change to the chest injury metric for the Q6 dummy has been applied. Under Euro NCAP protocols up to the end of 2017 the chest injury score was calculated from chest (thoracic spine) acceleration, with the higher performance threshold being set at 41g. From 2018 (version 7.2 of the protocol) and for all ANCAP COP assessments, the chest score is calculated from chest deflection, with a higher performance threshold of 30mm. In order to enable comparison of 2017 and 2018 results, both metrics are recorded and presented in this paper. Chest deflection is also presented for the Q10 dummy, which is fitted with upper and lower deflection sensors (IR-TRACCs) – no performance criterion has been specified for the Q10. For normalisation an arbitrary value of 30mm has been applied in this analysis.

Table 4.
Frontal impact criteria, limits and available points per body region for Q6, Q10

	CRITERION	Performance limits			Available points
		Higher	**Lower**	**Capping**	
Head Score	HIC15 (with hard contact)	500	700	800	4 points
	Resultant 3ms acceleration	60g	80g	80g	
	Head excursion modifier Q6 Q10	 450mm	 550mm 550mm	 NA NA	
Upper Neck	Tension Fz	1.7kN	2.62kN	NA (monitoring)	2 points
	Extension My (with head to interior contact) Q6 Q10	 NA NA	 36Nm 49Nm	 NA NA	
Chest (T4)	Resultant 3ms acceleration* Q6 Q10	 41g** 41g	 55g** 55g	 NA 55g	 NA 2 points
	Deflection Q6 Q10	 30mm (monitoring)	 42mm (monitoring)	 NA NA	 2 points NA
TOTAL					**8 points/dummy**

** 2017 limit values

METHODS

The analysis draws on three separate sets of data from full scale crash tests. All results are from frontal crash tests into an Offset Deformable Barrier at 64 km/h in accordance with the "ANCAP Test Protocol – Frontal Impact Offset Deformable Barrier" (v7.1.2) [4]. The test requirements of this protocol are the same as in the Euro NCAP "Offset Deformable Barrier Frontal Impact Test Protocol" (v7.1.2).

AU/EU Comparison Tests

Data were available for two vehicle models that were tested separately by Euro NCAP and ANCAP, allowing comparisons of the COP performance between AU and EU CRS. In some cases, the ANCAP tests formed part of the laboratory commissioning process for the 2018 protocols and were not part of official rating programs. Data were available for two vehicle models, one a small SUV and one a medium SUV. The performance of both models for adult occupant protection is good, and both models carried 5 star ratings under ANCAP and Euro NCAP. It is worth noting, however, that vehicles tested in Australia were right-hand-drive, while the vehicles tested by Euro NCAP were left-hand-drive. This has some effect on the vehicle crash pulse measured at the B-Pillar.

ANCAP Ratings

Complete COP data are available for five vehicle models that have been tested and rated by ANCAP in 2018. These represent a cross section of vehicle types including small and medium family cars, medium and large SUVs. None of the rated vehicle models had been previously tested by ANCAP or Euro NCAP. The CRS used in each case were selected by the vehicle manufacturer. The CRS selections included Type E and Type F booster seats, with both types being applied for Q6 and Q10 occupants.

The Q6 and Q10 dummies were fitted with all instrumentation specified in the ANCAP (and Euro NCAP) COP test protocols.

Comparison Test with Q10 on Adult Seat

An ODB test was conducted on one further vehicle model as part of a separate ANCAP program. The opportunity was taken to place a Q10 dummy on the (passenger side) rear seat, in order to assess performance with no booster seat (or booster cushion). A Euro NCAP test result was available for a variant of the same model for comparison, with the Q10 in the EU vehicle being installed on a booster cushion and restrained by the adult belt. In this case there were some differences in the drivetrain between the EU and AU vehicle, which in combination with a change from left-hand-drive to right-hand-drive resulted in a more severe crash pulse for the AU vehicle on the struck side, however the B-Pillar acceleration on the non-struck side (more relevant for the Q10) was not recorded in the Euro NCAP test and therefore is not presented in this study.

RESULTS

General

There was no hard contact observed between the child dummies and the CRS or vehicle interior in any of the tests. HIC_{15} and Neck Extension Moment are therefore not considered for point-score or rating, but are presented for information. With the changes in chest injury criteria, both deflection and acceleration values are reported. The metrics that are not applicable under 2018 protocols are shaded in charts below for clarity.

Injury metrics presented are normalised against the "Higher Performance" threshold of ANCAP and Euro NCAP protocols. As previously noted, an arbitrary value of 30mm is applied for normalisation of Q10 chest deflections. For the Q10, the values displayed are from the Upper IR-TRACC, which in all cases recorded greater deflection than the lower sensor.

Comparison of results – Australian vs European CRS

Comparison of accelerations at the driver's side B-Pillar shows comparable load cases for the EU and AU CRS, though there is some variation in the peak recorded acceleration. As an additional indicator, the *Occupant Load Criterion* (OLC) [5][6] was calculated using the driver's side B-pillar acceleration for each vehicle. Calculated OLC values are listed in Table 5. For the medium SUV the calculated OLCs were very close. For the small SUV, the EU vehicle showed a slightly higher OLC.

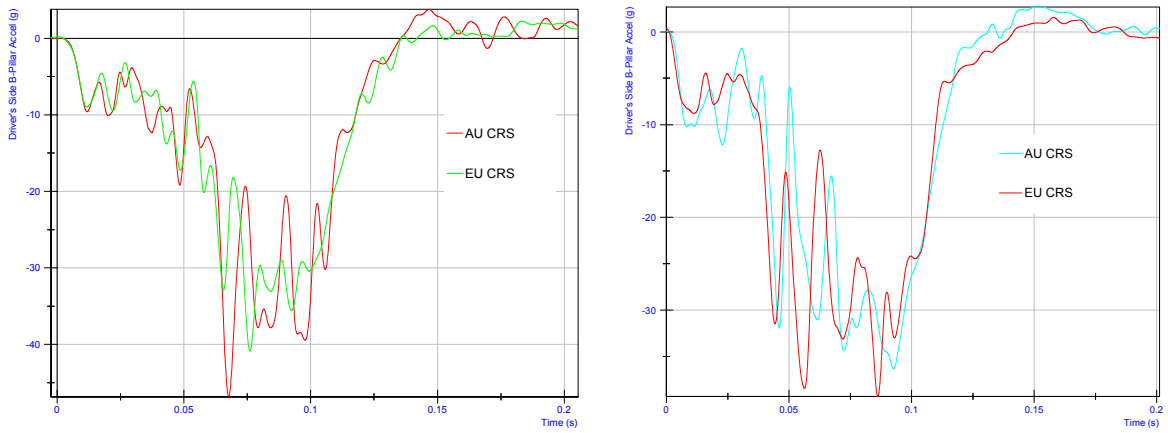

Figure 1 - B-Pillar Acceleration Comparison - Medium SUV (left) and Small SUV (right).

Table 5.
Occupant Load Criterion Comparison - AU and EU CRS

Occupant Load Criterion	Medium SUV	Small SUV
AU (ANCAP)	25.83	26.33
EU (Euro NCAP)	25.38	28.88

Figure 2 shows the injury metrics from the comparison tests. In both cases there is good correlation between the injury metrics of the ANCAP and Euro NCAP test vehicles.

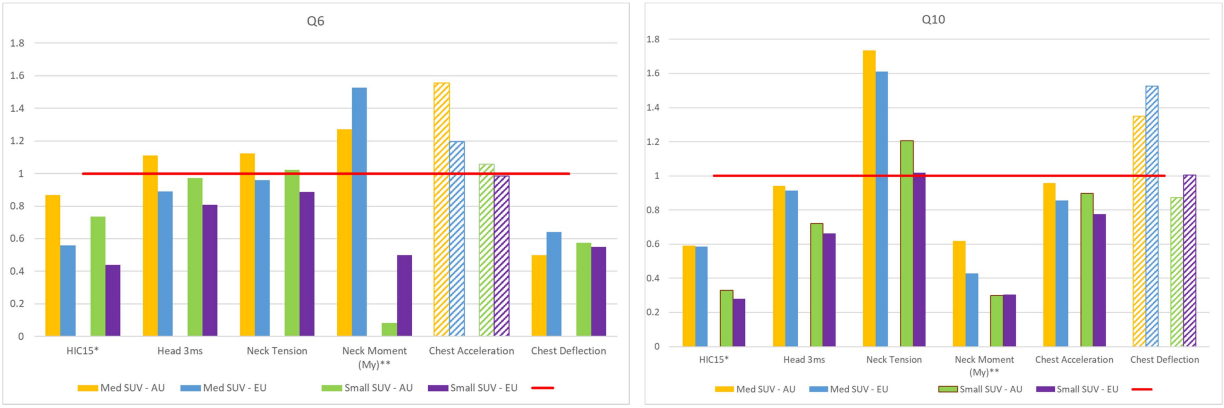

Figure 2 - Comparison of Injury Metrics for Q6 and Q10 with EU and AU CRS.

Results from 2018 ANCAP Ratings Testing

In tests conducted to date, there have been consistently good overall results shown in ANCAP testing for dynamic child occupant protection. While in some cases there were injury metrics that exceeded the higher performance thresholds, there was only one result exceeding the lower performance threshold. The results are shown in Figure 3.

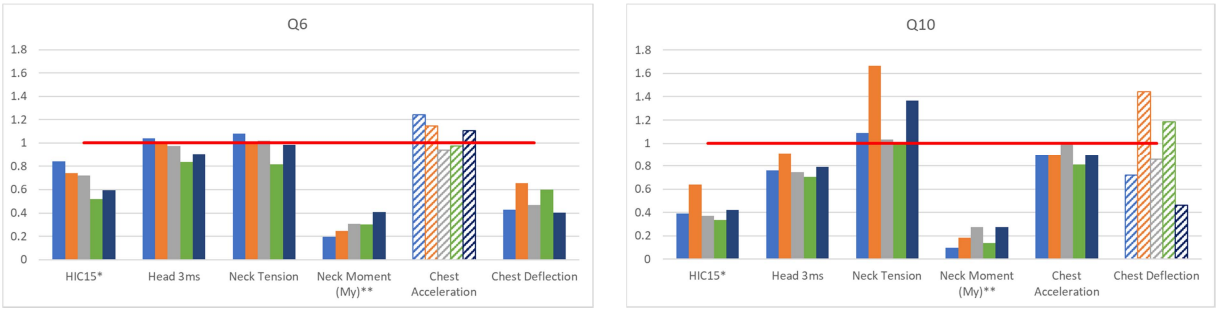

Figure 3 - Normalised results from ANCAP ratings

All vehicles rated during 2018 achieved the COP points score threshold necessary for a 5 star rating. The COP point scores for the five vehicles are shown in Figure 4, identifying the contributions of each of the areas of assessment.

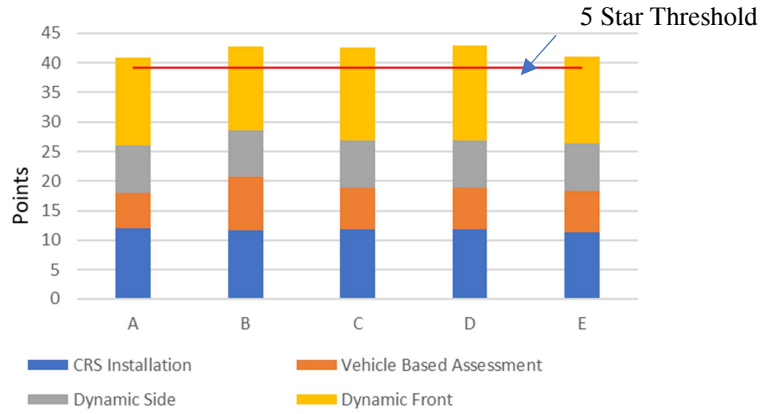

Figure 4 - Comparison of COP point scores for 2018 ANCAP ratings

Results from Comparison Test with Q10 on Adult Seat

Injury metrics for the Q10 were very similar between the two tests (Figure 5) however, where the Q10 was seated on the adult seat without any booster cushion, submarining of the dummy was observed, with the lap belt slipping upwards off the dummy's pelvis and into the abdomen (Figure 6). Submarining was not observed in the test with the Q10 on the booster cushion. Under the ANCAP assessment protocol, a capping modifier is applied to the score where submarining occurs and zero points are scored for that occupant.

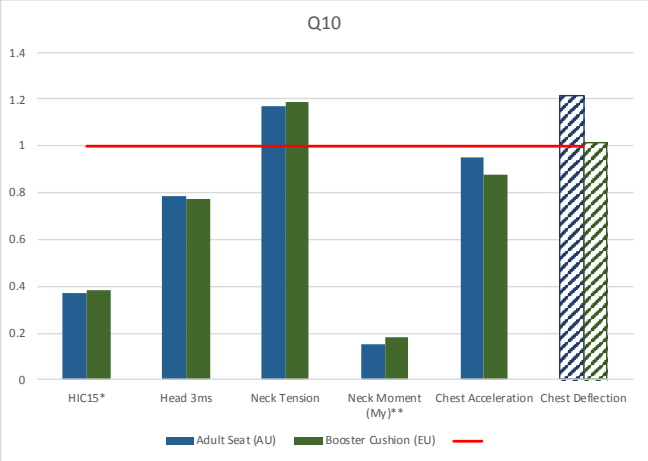

Figure 5 - Comparison of Q10 Injury Metrics on Adult Seat with Booster Cushion.

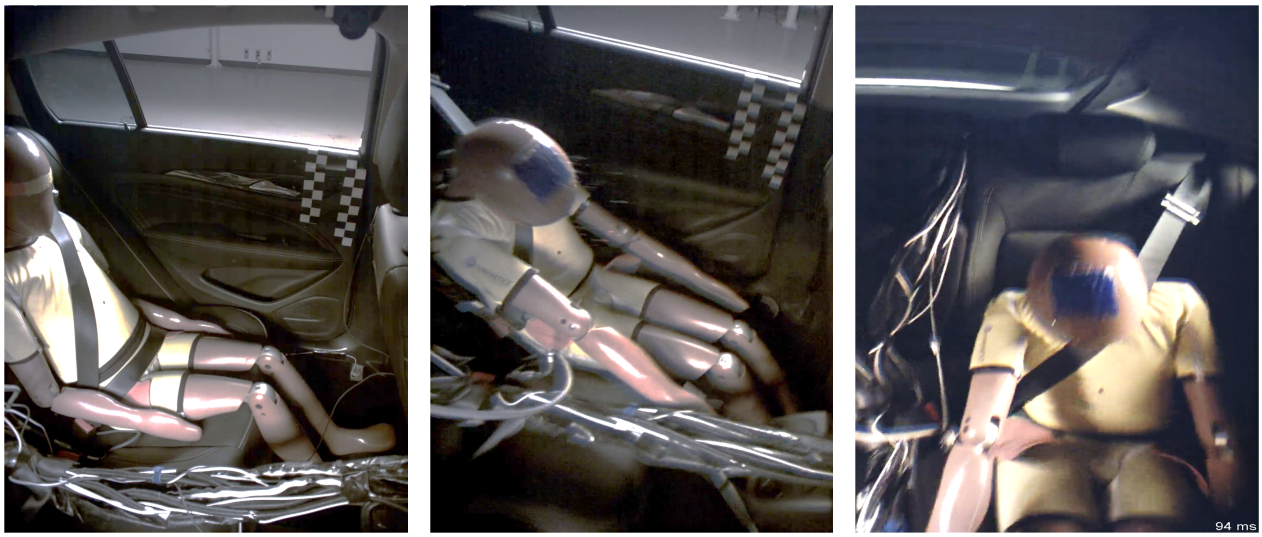

Figure 6 - Submarining of the Q10 on the Adult Seat - Pre-impact (Left) and During the impact.

DISCUSSION

Seat-belt Path

One factor that may result in variations in test performance of AU child restraints appears to be the path of the seatbelt through the CRS belt guide. All of the booster seats have a belt guide that sets the position of the belt over the dummy's shoulder, but that can also introduce friction to the belt. This seems to be most significant where there is a large deviation in belt path due to the belt guide, resulting in a 'z-shaped' belt path (see examples in Figure 7). It appears possible, though not investigated in depth at this time, that friction from the belt guide may inhibit effectiveness of the pre-tensioner, and result in sub-optimal injury metrics. Location of the belt guide also affects the position of the belt across the dummy chest, which may influence chest deflection results.

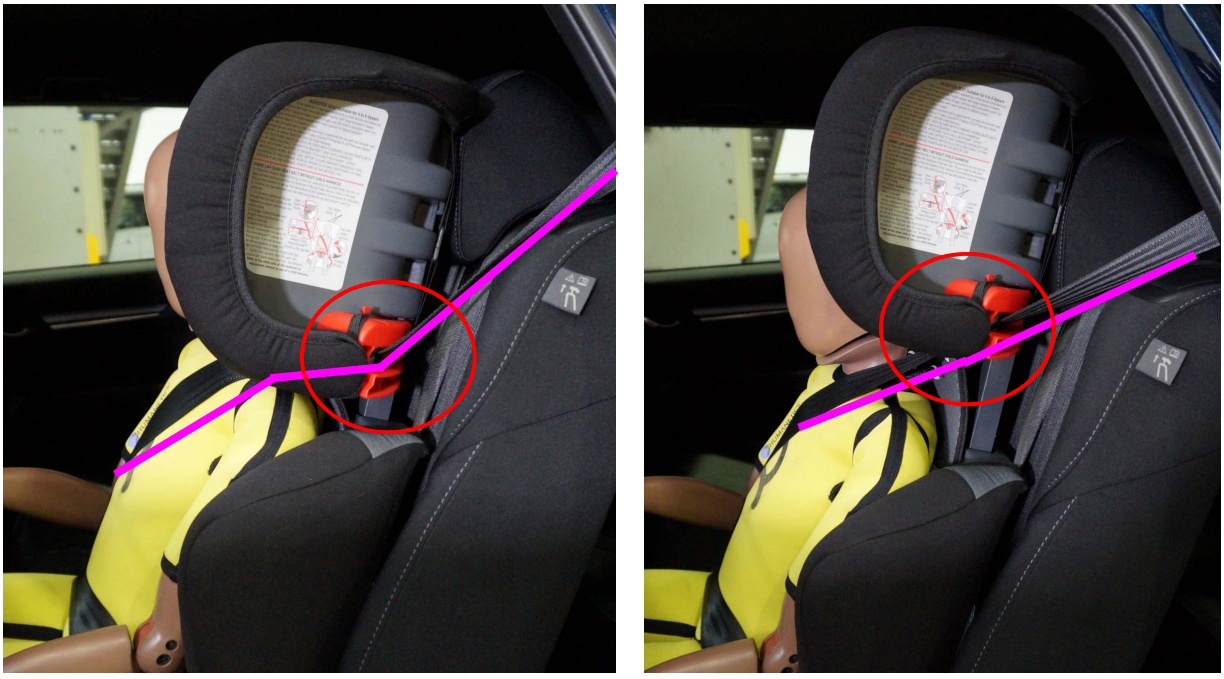

Figure 7 - Examples of Seat Belt Path with CRS in lowest (left) and upper-mid (right) positions

The ANCAP COP testing protocol allows the vehicle manufacturer to specify the position of the head restraint of the selected CRS, which in most cases will result in a CRS head restraint that is higher than the position specified by the CRS manufacturer (which is generally the lowest position for which the shoulder height marker is above the shoulder) and results in a straighter belt path through the CRS belt guide.

The general behaviour of belt guides in high severity crash tests of vehicles with advanced seat belts is an area that warrants some further research.

Chest deflection of Q10 – Type F CRS

For both the Q6 and Q10 child dummies, the ANCAP protocol allows the manufacturer to select either Type E or Type F booster seats – and both types have been applied for both occupant sizes in the tests that have been conducted.

As noted in a study by Adalian and Bendjellal [7], a lower chest deflection was recorded with an AU booster than the EU booster for the same selection of vehicles. It is noted that the AU Type F booster seat, as used in that analysis, has no armrest or belt guide at the buckle. This is a consequence of width requirements for the Type F booster that are included in the Australian / New Zealand Standard.

In ANCAP tests with AU restraints the same trend was noted, with generally lower chest deflections recorded in Type F CRS than in tests using European specification booster seats or using AU Type E seats (noting that the sample size is small at this point).

With no lower belt guide, the belt takes a more rearward position at the hip, allowing the upper part of the belt to sit higher on the dummy thorax, which may influence the deflection measurement.

CONCLUSIONS

From the testing conducted to date the following conclusions have been drawn:

- Good dynamic performance can be achieved in the 64 km/h Offset Deformable Barrier crash test when using Australian / New Zealand Standard child restraints.
- It is realistic for current vehicles to consistently meet 5 star performance requirements under the COP Pillar of current ANCAP protocols.
- Child Occupant Protection performance can be expected to be similar when comparing tests of the same vehicle model using AU and EU child restraints.
- Neck tension was the most common exceedance of the ANCAP higher performance limits.
- Consideration of the CRS selected for dynamic testing, and specifying the applicable CRS head restraint position are likely to contribute to higher overall scores.

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