AUSAP

Australian Safety Assessment Program

Test & Assessment Protocol

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The Australian Safety Assessment Program (AuSAP) Test and Assessment Protocol has been developed by Mobility and Accessibility for Children in Australia Ltd (MACA). MACA is a registered charity dedicated to advancing the rights of children with disabilities and medical conditions to safe and equitable transport. For more information, visit macahub.org

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Test and Assessment Protocol for AuSAP

This document is a protocol for the testing and assessment of special purpose child restraint systems (SPCRS).

These assessments are intended for internal (non-public) use only with the outcomes used to achieve Mobility and Accessibility for Children in Australia Ltd.'s (MACA) Australian Safety Assessment Program (AuSAP) aims.

The main purpose of the assessments is to inform the development of MACA's information resources and advice to support best practice prescribing, supply and use of SPCRS in Australia.

1. Introduction

AS/NZS 1754 *Child Restraint Systems for Use in Motor Vehicles* is one of the most demanding child restraint standards in use. It requires the child restraint to undergo a series of sled tests with different sized dummies and configurations. The sled tests include a frontal impact test with a speed of 49km/h and a side impact test at 32km/h that includes a structure representing a door and side window. It is only recently that standards/regulations in other parts of the world have included a side impact test. Many child restraints that are claimed to conform with older overseas requirements have not been subjected to a side impact test.

AS/NZS 1754 Clause 3.13 states that child restraints designed for children with disabilities should comply with the intent of AS/NZS 1754. AuSAP is not intended to determine whether the SPCRS is likely to pass (or fail) this standard; however, it will provide valuable information relating to the safety and performance of SPCRS.

AuSAP generally uses two sled tests based on AS/NZS 1754 to assess the protection provided to a typical occupant in these types of severe crashes. The purpose is to give an indication of the ability of the SPCRS to protect the occupant when subjected to similar tests to a child restraint that is certified to AS/NZS 1754. Safety-related assessments of design are also conducted as a supplement to the sled tests.

The following protocol describes how the tests are to be conducted and what information is to be recorded.

Assessment criteria are set out in the Appendix.

2. Types of child restraint systems

The Type of Child Restraint System (CRS) refers to definitions in AS/NZS1754. They can be summarised as:

- Type A - rearward facing with a crash harness (similar to ECE R44/ECE R129 Groups 0, 0+ and 1)
- Type B - forward facing with a crash harness (similar to ECE 44/ECE R129 Group 1)
- Type D - rearward facing with a crash harness (up to 4yo, similar to ECE R44/ECE R129 Group 1)

- Type G - forward facing with a crash harness (similar to ECE 44/ECE R129 Groups 2 and 3)
- Types E & F – forward facing booster seat that relies on the adult seatbelt for occupant restraint (similar to ECE 44/ECE R129 Groups 2 and 3)
- Medical Car Booster Seat with occupant mass limit above 36 kg (from USA/Canada)
- Harnesses Type C1 (used with CRS)
- Harnesses Type C2 (used without CRS)

The above categories also cover the range of CRS specified in USA and Canadian regulations (FMVSS 213 & CMVSS 213)

The following are not covered by AS/NZS 1754 but may be encountered in SPCRS assessments:

- Special Purpose Harnesses (not included in Types C1 and C2).
- Medical Car Seat with inbuilt harness with occupant mass limit above 36 kg (from USA/Canada)

Note: "Crash harness" refers to providing primary occupant restraint in a crash. This does not include a harness that is only intended for postural support or to prevent self-extrication (escape) - these must be used in conjunction with a seatbelt that provides primary occupant restraint in a crash. These harnesses are sometimes referred to as a "postural harness" or "positioning harness" and are intended to assist the occupant maintain their sitting posture but not to provide primary occupant restraint in a crash.

3. Multiple tests with the same SPCRS

In view of the limited availability of some models of SPCRS, consideration will be given to conducting up to three sled tests with the same SPCRS. This is at the sole discretion of MACA. Where a SPCRS is to be subjected to subsequent dynamic tests the following conditions apply:

a) the tests are conducted in order of severity, with the most demanding test first

b) a thorough visual inspection of the SPCRS after the previous test reveals no visual evidence of damage to the restraint that could adversely affect the next test

c) harness components, seatbelt clamps and top tether adjusters operate correctly

d) the subsequent test does not result in a structural failure or a failure in occupant retention components (e.g., crash harness components). For example, the failure would result in a "marginal" result for an assessment parameter (see Appendix)

In effect this provision only applies where the SPCRS performs well in all dynamic test scenarios. Any failures in a subsequent dynamic test (i.e., any tests after the initial dynamic test) mean that the outcomes of the subsequent test where a "marginal" failure occurred (in accordance with the Appendix) are not used and a new test with an untested SPCRS needs to be arranged to complete the suite of dynamic tests.

4. Anthropomorphic Test Devices (ATD or crash test dummies)

The preferred test dummy (ATD), the particular model of SPCRS and installation configuration will be nominated in the request for testing. Normally the tests include an

ATD that is equivalent to the largest child nominated for the SPCRS in that configuration. Dummies can be TNO P-series, Humanetics Q-Series or Hybrid III child dummies.

Head injury data is required for the side impact test. It is preferred that instrumented ATDs be used for a frontal impact test so that injury data (e.g., head acceleration and chest acceleration) is available for analysis but injury criteria are not applied to the assessments. Slings specified in AS3629.1:2013 7(h) are not required. Where ATDs will not be instrumented (or where injury data will not be recorded) for the frontal impact test the lab must contact MACA and confirm these arrangements.

For the side impact test the ATD head should be appropriately painted in order to show any contacts with components.

5. Test records

The Appendix indicates the measurements and other information to be recorded by the lab. In addition the sled velocity and deceleration are to be recorded. As above, where ATDs will not be instrumented (or where injury data will not be recorded) the test lab must contact MACA and confirm these arrangements.

Photographs are required of the test set-up, including the dummy before and after the test. Any issues such as CRS component breakages are also to be photographed and reported.

Video of a frontal test must include a side view that shows potential head and knee excursion and covers the period from T0 to the end of the crash with a minimum of 1000 frames a second. If feasible, an overhead view should also be recorded. A diagram showing a plan view of the test set-up with dimensions (at T0) between the camera and the side of the seat and spacing between reference marks on the side of the seat is required to enable dummy excursion to be independently estimated from the video.

Video of a side test must include a side view (front-on to the seat) that shows potential head contact with the door and that covers the period from T0 to the end of the crash with a minimum of 1000 frames a second.

6. Frontal Sled Test

Method: A frontal sled test is conducted in accordance with AS/NZS 1754:2013 and AS 3629.1:2013, subject to the items described below. An ATD is installed in the CRS, which is attached to a rig representing the rear seat of a vehicle. For all SPCRS it is preferred that a spacer, as specified in AS 3629.1 10(f) is used to create a set amount of slack in the harness. The spacer is removed prior to the test. The limits on head excursion and knee excursion assessments take into account use of the spacer to introduce slack in the restraint (AS/NZS 1754 requires separate tests without a spacer). In effect, where a spacer is not used the requirements are less stringent but no adjustment is made for this situation.

Head excursion at the peak of the crash is measured in accordance with AS/NZS 1754:2013 (CR point to centre of gravity of dummy head). Knee excursion is based on the relative forward displacement of the knee (e.g. a bolt head or decal) at T0 and the point of maximum excursion. The lab may use any accurate, repeatable method for measuring excursion.

Either a rebound or a deceleration sled is acceptable for this test. A deceleration sled is subject to a T0 (entry) velocity of 49km/h (+/-2 km/h) and a deceleration envelope in the range 27g to 29g*. Where required in the request for test the top tether is to be attached to the appropriate anchorage (s) on the test rig (note that some SPCRS might

not have a top tether, some may have two top tethers^ or the top tether may be optional).

Notes for frontal test

* AS/NZS1754 sets a range of 24g to 34g but a narrower range is preferred to improve consistency between tests.

In effect AS/NZS1754 requires a rebound sled for type testing or certification testing. If a rebound sled is used then a delta V of 49km/h (+/-2 km/h) is used.

^ Some SPCRS sourced from the USA and intended for small adults may require the use dual top-tether anchorages. These are to be used, where requested, in accordance with the manufacturer's instructions.

7. Side Sled Test

Method: A side impact sled test is conducted in accordance with AS/NZS 1754:2013 and AS 3629.1:2013, subject to the items described below. Only the test with a simulated door is to be conducted. An ATD is installed in the CRS, which is attached to the test seat nominated in AS/NZS 3629.1 or an equivalent test rig. A deceleration sled is subject to a T0 (entry) velocity of 32km/h (+/-2km/h) and a deceleration envelope in the range 18g to 20g. Where required in the request for test, the top tether is to be attached to the appropriate anchorage(s) on the test rig (note that some SPCRS may not have a top tether, some may have two top tethers^ or the top tether may be optional).

It is preferred that a 10mm thick polystyrene foam panel[@] be fixed to the door to detect a close head contact. Head contact with the foam will then indicate that the gap is 10mm or less (as specified in the standard) and so video analysis will not be necessary.

There must be a means to ensure that the CRS is in the correct position at T0 and has not moved out of place due to the sled acceleration. Foam blocks positioned on the non-struck side are acceptable for this purpose.

Notes for side test

* AS/NZS 1754 sets a minimum value of 14g but a higher value is preferred to improve consistency between tests.

In effect AS/NZS 1754 requires a rebound sled for type testing or certification testing. If a rebound sled is used then a delta V of 32km/h (+/-2 km/h) is used.

@ The foam panel should be an equilateral triangle approximately 250mm on each side and positioned so that it does not impede the CRS but is likely to be contacted by the dummy's head, if there is excessive head excursion. Conformance with clause 2.1 below can then be determined by paint transfer rather than measurement (as specified in AS/NZS 3629.1). The foam panel can be affixed with suitable self-adhesive tape.

^ Some SPCRS sourced from the USA and intended for small adults may require the use dual top-tether anchorages. These are to be used, where requested, in accordance with the manufacturers instructions.

8. Assessment of design

Assessment of design is carried out by AuSAP representatives. These parameters are assessed through observation and operation of various components. In particular the design assessments are intended to identify potential sources of misuse that could lead to extra risk of serious injury.

Although not part of the formal assessment process, lab staff are encouraged to report any observations about good or bad design features they encounter, breakage or unusual performance while conducting dynamic sled tests.

APPENDIX - ASSESSMENT PARAMETERS

This Appendix sets out the parameters to be assessed, including the method of assessment and the AuSAP criteria for assigning a result of "good', "acceptable", "marginal" or "not acceptable".

Some parameters are listed as "on hold". These are included for information only and do not form part of the safety assessment at this time.