ANCAP
Crash testing for safety
AUSTRALASIAN
NEW CAR ASSESSMENT
PROGRAM

NOTES ON THE ASSESSMENT PROTOCOL




VERSION 4.9 ISSUED 13 JULY 2009

Contents

1.1 Introduction

The Australasian New Car Assessment Program (ANCAP) conducts crash tests and associated assessments in accordance with the protocols issued by EuroNCAP www.euroncap.com.

This document sets out clarifications and interpretations determined by the ANCAP Council. Updates are available from www.ancap.com.au

1.2 Star ratings and crash tests

1.2.1 Minimum scores in offset and side impact tests

Version 4.0 of the EuroNCAP Assessment Protocol introduced a minimum score in each of the offset and side impact tests in order to achieve star ratings. This was suggested by ANCAP to address imbalance between offset and side impact results – a vehicle with a good side impact score and poor offset score could reach 3 stars under the previous protocol. Advice from EuroNCAP is that the minimum scores set out in the Protocol have been rounded to the nearest integer. The breakpoints, *before rounding* are set out in the following table:

Table 1. Breakpoints for star ratings

Star Rating	Minimum score in offset test	Minimum in side impact test	Minimum Combined Score (incl. Pole Test & seat belt reminders)
5 *	12.5	12.5	32.5
4	8.5	8.5	24.5
3	4.5	4.5	16.5
2	1.5	1.5	8.5
1	-	-	0.5

* To earn 5 stars a vehicle must meet additional requirements, as described in the section "Five Star Prerequisites".

In cases where the star rating is limited by an individual score, ANCAP will reduce the overall score to the maximum that is available for that star rating. For example, if a vehicle scored 25.30 overall (including seat belt reminders) but 8.15 in the offset test it would be rated at three stars and its overall score would reduce to 24.49 points. Similarly a vehicle that had a combined score of 32.5 or more but did not achieve at least one point in the pole test would be rated at four stars and its overall score would reduce to 32.49 points.

Nov05

1.2.2 Five star prerequisites

In order to be awarded a maximum 5 star rating, in addition to scoring at least 32.5 points overall, vehicles must meet additional requirements:

a) Effective from 1 January 2003, must earn at least one point in the pole impact test

b) Effective from 1 January 2008, must be equipped with an Electronic Stability Control (ESC) system that meets the requirements set out in Appendix B. The vehicle manufacturer must provide statement of compliance for this purpose.

Oct 07

Jul 09

It is stressed that vehicles awarded 5 stars by Euro NCAP might not meet ANCAP's requirements for 5 stars. For example, in the case of vehicles lacking ESC, ANCAP will publish a 4 star rating with an overall score of 32.49. Two ratings (4 and 5 stars) may be published in cases where ESC is optional.

1.2.3 Side impact and pole tests

ANCAP has a departure from the EuroNCAP testing and assessment protocols for side impact protection for occupants of high-seat vehicles (i.e. with a seat reference height 700mm or more).

The Euro NCAP side impact test (i.e. MDB test) is the same as the test prescribed in ADR72 , which is not applicable to high-seated vehicles . Additionally, based on the evaluation of the tests conducted ANCAP identified there was little value to consumers in continuing to conduct MDB tests on high seated vehicles and decided to no longer conduct MDB tests on these vehicles and award all high-seat vehicles a default score of 16 points.

To assist with assessment manufacturers are requested to provide advice about seat reference heights to ANCAP during forward planning of test programs. Where the range of specifications of a variant span the 700mm limit the variant will be regarded as a "low seat".

For all vehicles, including high-seat vehicles, a successful pole test (i.e. score at least one point) is required to achieve 5 stars. From 2008 this optional pole test is only available for vehicles Jul 09 that are within reach of a 5 star rating (that is, an overall score of at least 30.5 prior to the pole test and at least 12.5 scored in offset and side impact tests). The pole test is conducted by ANCAP at the manufacturer's expense. ANCAP will publish the result of the pole test, even if the score is zero.

Where ANCAP uses crash test data from Euro NCAP the pole test score will only be included in the overall score where the vehicle is within reach of a 5-star rating. For example, a pole test cannot be used to improve a rating from 3 to 4 stars.

1.2.4 Seat belt reminder

During 2002 EuroNCAP introduced bonus points for seat belt reminders. In essence, one point is earned each for a driver reminder, a front passenger reminder and a status indicator for all rear seats. The requirements for seat belt reminders are set out in EuroNCAP document Seat Belt Reminder Assessment Protocol (copy available from <http://www.euroncap.com>).

Manufacturers should be prepared to describe to ANCAP how the operation of the system can be verified by road test, particularly if there are interim warnings.

Prior to 2008 rear seat systems only needed inform the driver about the status of each rear seat belt.

During 2007 Euro NCAP amended the protocol to require the rear seat belt system to give an Oct 07 audible signal if a seat belt is unbuckled while the vehicle is "in use" (eg travelling at more than 25km/h). ANCAP applied this requirement to rear seat belt reminders assessed from January 2008. Rear seat occupant detection is not required to meet this requirement but is preferred.

If the system does not detect the presence of an occupant then ANCAP *prefers* a positive indicator that shows a green light for each rear seat belt that is being used and that displays no lights for unused seat belts. This means that the driver can easily check that there is a green light illuminated for each rear seating position that has an occupant. If one of these seat belts is unbuckled while the vehicle is in use then it is preferred that the icon flashes or turns red, in addition to the audible alarm.

Where the system detects an occupant (as is necessary for front passenger position) then ANCAP *prefers* a negative indicator that shows a red light for any seating position that has an occupant not wearing a seat belt.

A single light may be used to indicate both driver and front passenger seat belt status. However, a separate light for each seating position is preferred.

1.3 Frontal offset modifiers

1.3.1 Knee impact modifiers

The Upper Leg Score is subject to modifiers resulting from a post-crash assessment of the Oct 07 knee impact zone. These zones are illustrated in the diagram below and depend on the actual points of impact of each of the dummy knees (driver and front passenger). Where there is no clear evidence of a knee contact (paint marks or deformed components) then that particular zone is not subject to a modifier (but comment may still be made about components that might present an undue hazard to the knees).

A *Variable Contact* modifier (up to 1 point deduction from leg score) applies where the component is clearly stiffer than the structure at the actual impact point and is likely to produce a femur compression in excess of 3.8kN and/or knee slider displacements greater than 6mm. Metal brackets are generally considered to be stiffer than plastic components, unless they are clearly designed to collapse during a knee impact (such as diamond shaped hollow extrusions).

Jun 09

In accordance with Version 4.2 of the Euro NCAP protocol, the variable contact modifier will be reduced to 0.5 points where there is no concentrated load modifier for that side and the stiffer structure is confined to either the steering column (defined to be 75mm on either side of the centreline of the steering column) or the remainder of the knee impact zone for that side.

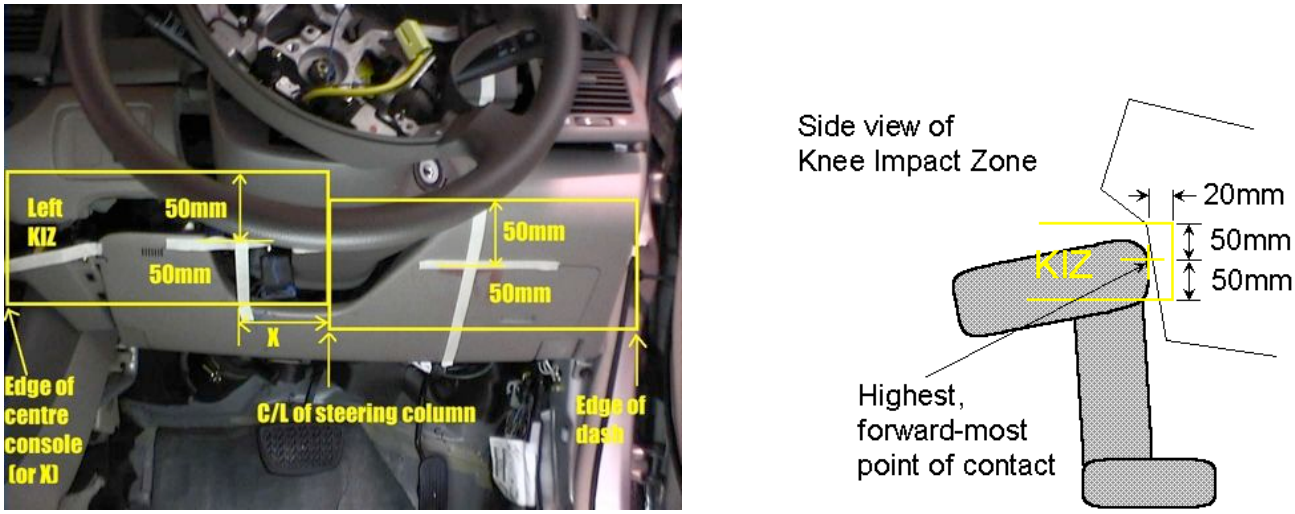

Illustration of Knee Impact Zone (a rectangular prism based on actual points of impact)

Manufacturers may provide test data to show that the injury criteria (femur force and knee displacement) are unlikely to exceed the prescribed limits, if the component of concern is struck by the knee.

An object is regarded as a "*concentrated load*" if it presents an unyielding impact surface with any linear dimension less than 20mm or otherwise *exposes the knee to a risk of a penetrating knee injury.*

Usually the Concentrated Loading modifier (1 point deduction each knee) applies where the component is also found to be a 'Variable Contact' and the double deduction is applied. However, cases have occurred where the point of impact was found to be the stiffest structure and high injury measurements were obtained but the component was also found to be a concentrated loading. In this case only the concentrated loading modifier is applied.

Some manufacturers have treated steering column covers and fascia covers with a sandwich of energy absorbing foam and metal sheets which protect the knees from concentrated loads. In the absence of objective performance criteria from Euro NCAP these have generally been accepted by ANCAP, provided that they protect the knees from hazardous protrusions within the steering column. Results of manufacturer's impact tests that show load distribution and energy absorption would assist in such assessments.

Since the knee assessment depends on the actual points struck by the dummy knees it is possible for the knee impact zone to vary between tests. Several cases have been observed

where a component of concern was just outside the knee impact zone but slightly different crash circumstances could have led to a different outcome. Manufacturers should consider such variations when designing steering and fascia components.

1.3.2 Knee airbags

Where knee airbags are fitted ANCAP has decided that no modifiers will apply if the following requirements are met:

1. The airbag deploys correctly in the offset crash test and the deployed bag would prevent the knees from coming into contact with fascia or steering column components in this type of crash
2. There is no evidence of the airbag bottoming out (eg from femur load trace)

If these requirements are not met then the fascia and steering column will be assessed in the usual way, with an approximation made of the knee contact points from the paint marks on the knee airbag, if there are no signs of contact on these components. In these circumstances the knee airbag housing is likely to be within the knee impact zone.

Republication of Euro NCAP results - lack of knee airbag in Australia.

Oct 07

Increasingly vehicles tested in Europe have a driver knee airbag. This usually eliminates knee modifiers (see above). There have been several cases were the Australasian version does not have a knee airbag and so ANCAP has either not been able to republish the Euro NCAP result or has needed to conduct an offset crash test of the local model without a knee airbag.

The main purpose of the knee modifiers is to take account of situations when the crash conditions are slightly different (such as a different size of occupant). Therefore ANCAP has decided to apply full knee modifiers (ie 2 point deduction from upper leg injury score) to the Euro NCAP results were a knee airbag was present in the European test but is not available on the Australasian model.

Manufacturers have the option of funding an ANCAP offset test, or providing other evidence acceptable to ANCAP, if they think that the local model will score better than when a 2 point knee modifier is applied to the Euro NCAP result.

Where the modifier is applied in this way the ANCAP result sheet will note:

> "The vehicle tested by Euro NCAP had a driver knee airbag but the Australasian model does not have this safety feature. ANCAP has applied a 2 point modifier to the driver leg score to take account of the extra risk of injury without the knee airbag".

1.3.3 Measurement of intrusion

In tests of utility-style vehicles during 2001 and 2002 it became evident that measurement of intrusion (steering column and pedals) from a reference point on the rear of the vehicle was not appropriate. For the utilities, where there was often substantial crush in the load space, intrusion was assessed relative to the rear wall of the cabin. ANCAP has reviewed the method of assessing intrusion for all vehicles and has decided to utilise a method used by the US Insurance Institute for Highway Safety (IIHS) - assessing intrusion relative to the average of the four mounting bolts of the driver's seat. This method is applied to steering column displacement and pedal displacement (in all three dimensions).

In the case of A-pillar displacement, the approach is similar to that used by IIHS (which assesses door opening width reduction) except that displacement is assessed relative to the C-

pillar. This gives an indication of the integrity of the whole passenger compartment but excludes any crush to the rear of the compartment. For two-door vehicles the A-pillar displacement is assessed relative to the B-pillar and so is the same as IIHS.

In all cases assessed by ANCAP to date these requirements result in longitudinal (X) displacements that are less than those assessed according to the EuroNCAP protocol (i.e. in the manufacturer's favour). It is possible that vertical (Z) displacements (eg upward movement of steering column) may be greater under the ANCAP system if the driver's seat drops, relative to the original frame of reference. It is considered that this gives a more realistic indication of the hazard from upward movement of the steering column (or brake pedal).

1.3.4 Breakaway brake pedal

Manufacturers should advise prior to the offset test if the brake pedal (and clutch pedal, if applicable) is designed to breakaway in the crash. Successful breakaway avoids a reduced foot score due to rearward displacement of the brake pedal.

1.3.5 Breakaway steering column

Manufacturers should advise prior to the offset test if the steering column is designed to breakaway under load. This will affect the assessment of steering column movement (the modifier is not applied if the post-crash residual displacement cannot be reliably measured AND there is no evidence of excessive steering column movement affecting airbag performance in the crash videos).

1.3.6 Blocked pedal modifier

In 2004 Euro NCAP introduced a blocked pedal modifier for the offset crash test.

After the crash the displacement of each pedal is measured with no load and with a forward horizontal load of 200N applied. The second measurement is referred to as a “blocked pedal displacement”. The *unblocked* pedal displacement, compared with the pre-crash pedal position, is used to calculate a foot score, as in the previous assessment protocol (but ANCAP measures both relative to the driver’s seat, as described above (“Measurement of Intrusion”). The second measurement is used to derive a modifier for the foot score. A "blocked pedal" is one that moves forward less than 25mm when the load of 200N is applied. If the *blocked* pedal displacement, compared with the pre-crash position, is less than 50mm then no modifier is applied. If the displacement is more than 175mm then one point is deducted from the foot score. A sliding scale applies between 50mm and 175mm. This is illustrated below.

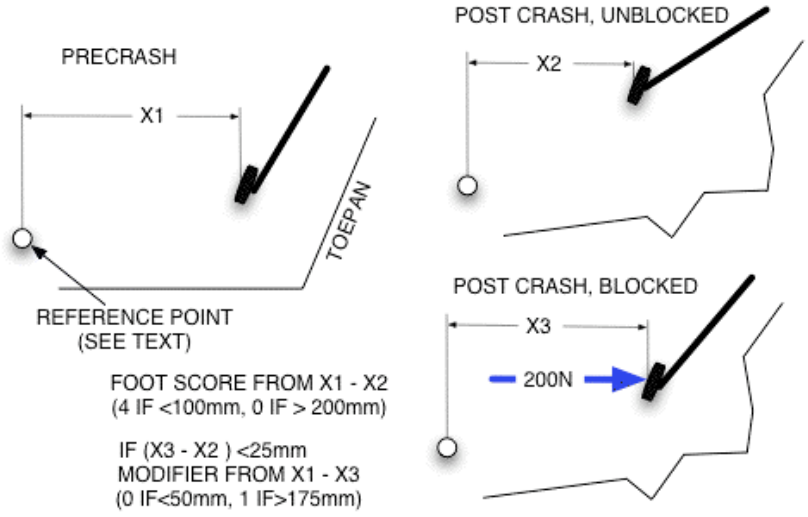

Illustration of blocked pedal modifier

This modifier also applies where the pedal mounts are designed to breakaway during the crash but the pedal still offers some resistance to blocking (successful breakaway earns a pre-modified foot score of 4 points).

ANCAP applied this requirement to tests conducted from June 2004.

1.4 Side impact modifiers

1.4.1 Backplate loads

Backplate loads are measured in ANCAP side impact tests. In July 2003 ANCAP began testing to Version 4 of the EuroNCAP test Protocol (including the EuroSID II dummy) and the modifier has been applied to tests conducted from July 2003.

1.4.2 T12 Modifier

Where the T12 loads Fy and Mx exceed 2.0kN or 200Nm respectively, a two point penalty is applied to the driver's chest assessment. Between 1.5kN – 2.0kN or 150Nm – 200Nm the penalty is calculated using a sliding scale from 0 to 2 points. The assessment is based upon the worst performing parameter. This was introduced in Version 4.1 of the Euro NCAP Assessment Protocol (issued March 2004) and ANCAP started to apply the modifier to tests conducted from September 2004.

Scoring with T12 modifier

Jul06

Euro NCAP has advised that the backplate and T12 modifiers apply to the chest score but are *limited to a maximum deduction of 2 points.* ANCAP has applied the modifiers to tests conducted from December 2003 but no published ratings are affected by the two point limit.

1.4.3 Republication of Euro NCAP results - lack of side airbags/curtains

Jul 09

Many tested in Europe have side airbags and side curtains. There have been several cases where an Australasian variant does not have these airbags and so ANCAP has either not been able to republish the Euro NCAP result for that variant or has needed to conduct a side impact crash test of the local model without the airbags.

ANCAP has decided to apply a 2 point deduction to the head score where a head-protecting side airbag was present in the European side impact test but is not fitted to the base Australasian variant. Similarly a 2 point deduction is applied to the chest score where a thorax-protecting side airbag was present in the European test but is not fitted to the Australasian variant. The maximum modifier applied to any body region is 2 points.

Manufacturers have the option of funding an ANCAP side impact test, or providing other test evidence acceptable to ANCAP (such as certified ADR72 test results) , if they think that the local model will score better than when these modifiers are applied to the Euro NCAP result.

Where the modifier is applied in this way the ANCAP result sheet will note:

"The vehicle tested by Euro NCAP had side airbags/curtains but the Australasian model does not have these safety features. ANCAP has applied a 2 point modifier to the head and chest scores to take account of the extra risk of injury without these airbags."

This principle may be applied to other cases, such as the lack of a passenger airbag in the frontal offset test.

1.5 General modifiers

1.5.1 Door open modifiers

Mar 07

In accordance with the Euro NCAP Assessment Protocol, one point is deducted for each door that opens during the crash test. This applies to the frontal offset, MDB side impact and pole crash tests. The definition of an "open" door is as described in the Euro NCAP protocol.

1.5.2 Airbag deployment modifiers

Oct 07

An airbag deployment modifier has always applied to the pole impact test. From 1 January 2008 ANCAP will also apply this modifier to the frontal offset and side impact crash tests. These will work in the same way as the pole test modifier, where an incorrect deployment results in a one point deduction. The deduction will apply to the head score in the case of the offset test, to the chest score in the case of a thorax side airbag and to the head score in the case of a head-protecting side airbag.

An airbag is regarded as incorrectly deployed if it does not fully inflate to its design position prior to the occupant loading the airbag. Currently ANCAP only applies this modifier where the incorrect deployment occurs during a relevant test. For example the incorrect deployment of a side curtain would not be considered if it only occurred during the frontal offset test.

Jul 09

The Hazardous airbag deployment modifier, introduced in Version 4.2 of the Euro NCAP protocol, is not currently applied by ANCAP.

1.6 Calculation of scores

Measured parameters are rounded to a certain number of decimal places prior to calculation of scores. The number of decimal places used for each parameter are included in the ANCAP assessment report (score sheet). In general injury measurements are rounded to two decimal places but, in the side impact test, abdomen force and pubic symphysis force are rounded to three decimal places (the sliding scale is very sensitive for these injury parameters). Deformation measurements are taken to the nearest millimetre.

Resulting scores are calculated to three decimal places. These are added together to give a test score to three decimal places. The individual test scores are added together to give a combined score and this is rounded to two decimal places.

Bonus points (currently only available for seat belt reminders) are added to the combined score, if applicable.

Star ratings are assigned according to Table 1 and, if necessary, the overall score is adjusted to match the highest score available for the derived star rating.

If the *premodified* injury score for the head, chest, abdomen or pelvis is zero then a warning note (eg "High risk of life threatening chest injury in side impact") is added to the published overall rating. Euro NCAP uses a "struck through star" to indicate this situation and ANCAP assessment reports also use a struck star for reference purposes, but this is *not included in the final ANCAP publication.*

Jan06

1.7 Child restraint assessment

Manufacturers are encouraged to nominate models of child restraint that have been found to suit the vehicle being tested - and are preferably available from dealers. Otherwise a default model of child restraint will be used by the test organisation.

Child dummies are instrumented and parameters are recorded but they are not currently assessed by ANCAP. The Euro NCAP protocol for assessing child restraints is not appropriate for the designs of child restraint systems (CRS) used in Australia. For background see the research report "Effectiveness Of Child Restraints, The Australian Experience" available from http://tinyurl.com/yrorg9.

Recommendations for assessing the compatibility between child restraints and vehicle are set out in the appendix to the research report. ANCAP has no plans to implement these recommendations in the short term but manufacturers should consider the issue of CRS to vehicle compatibility when designing new vehicles.

1.8 Enquiries

Enquiries about test and assessment protocols should be addressed to:

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Appendix A - Summary of protocol changes

This appendix provides a brief historical summary of changes to test and assessment protocols used by ANCAP.

Guide to ANCAP Protocol Changes

BROC. DATE	*OS VER*	OS MAX SC	*SI VER*	SI MAX SC.	*POLE VER.*	POLE MAX SC	SEAT BELT REMINDER	O'ALL MAX SC.	*PED. VER.*	PED. MAX.	COMMENT
Nov-99	*2.0*	16	*2.0*	16				**32**			Euro NCAP protocols. 50km/h SI test introduced. Full frontal dropped.
Nov-00	*2.0*	16	*2.0*	16	*2.0*	2		**34**	*2.0*	36	Pole & ped tests introduced
Nov-01	*3.0*	16	*3.0*	16	*3.0*	2		**34**	*3.0*	36	Intrusion relative to seat mounts. Breakaway steering column provision (ANCAP only)
Dec-02	*3.1*	16	*3.1*	16	*3.1*	2		**34**	*3.1*	36	Revised Ped test
Feb-03	*3.1*	16	*3.1*	16	*3.1*	2	3	**37**	*3.1*	36	Seat belt reminders
Dec-03	*4.0*	16	*3.1*	16	*4.0*	2	3	**37**	*4.0*	36	Points balance for overall score
Jul-04	*4.0*	16	*4.0*	16	*4.0*	2	3	**37**	*4.0*	36	ES2 dummy in side impact, backplate modifier
Jan-05	*4.1*	16	*4.1*	16	*4.1*	2	3	**37**	*4.1*	36	OS pedal blocking. SI T12 Modifier & barrier revision.
Dec-05	*4.1*	16	*4.1*	16	*4.1*	2	3	**37**	*4.1*	36	Points balance limits overall score (clarification)
Jul-06	*4.1*	16	*4.1*	16	*4.1*	2	3	**37**	*4.1*	36	Chest modifiers in SI score limited to 2 pt deduction
Oct-07	*4.1*	16	*4.1*	16	*4.1*	2	3	**37**	*4.1*	36	ESC for 5 stars, knee modifier clarification, knee airbags, airbag deployment. rear seat belt reminder
Jul-09	*4.1*	16	*4.1*	16	*4.1*	2	3	**37**	*4.1*	36	Pole test eligibility clarification. 0.5 deduction for knee modifier. Lack of curtains. ESC minimum speed 20km/h

Appendix B - Electronic Stability Control

Effective from 1 January 2008, to be eligible for a 5 star rating vehicles must be equipped with an Electronic Stability Control (ESC) system that complies with the following requirements:

a) FMVSS 126 Clauses:

S4. Definitions.

Electronic Stability Control System or ESC System means a system that has all of the following attributes:

(1) That augments vehicle directional stability by applying and adjusting the vehicle brake torques individually to a vehicle;

(2) That is computer controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer;

(3) That has a means to determine the vehicle's yaw rate and to estimate its side slip or side slip derivative with respect to time;

(4) That has a means to monitor driver steering inputs;

(5) That has an algorithm to determine the need, and a means to modify engine torque, as necessary, to assist the driver in maintaining control of the vehicle, and

Jun 09 | (6) That is operational over the full speed range of the vehicle (except at vehicle speeds less than 20 km/h or when being driven in reverse).

S5.1 Required Equipment.

Vehicles to which this standard applies must be equipped with an electronic stability control system that:

S5.1.1 Is capable of applying brake torques individually to all four wheels and has a control algorithm that utilizes this capability.

Jun 09 | S5.1.2 Is operational during all phases of driving including acceleration, coasting, and deceleration (including braking), except when the driver has disabled ESC, the vehicle speed is below 20 km/h , or the vehicle is being driven in reverse.

S5.1.3 Remains capable of activation even if the antilock brake system or traction control system is also activated.

b) ESC systems that can be switched off are permitted provided that:

(a) a visual indicator is provided which activates whenever the ESC system is switched off and

(b) the ESC system is activated automatically each time the ignition is switched on.

c) Alternative symbols and words to those specified in FMVSS 126 are acceptable for instrumentation displays, provided they are clearly explained in the owner manual.

Notes about ESC requirements

ANCAP's preferred position is that ESC systems meet a recognised international standard. The above requirements are based on FMVSS 126.

A copy of the FMVSS 126 Final Rule can be obtained by going to http://dms.dot.gov and searching under docket number 27662.

The recent Global Technical Regulation No. 8 is an acceptable alternative to FMVSS 126. Global Technical Regulation 8 can be downloaded from:

http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29registry/gtr8.html

The reference to 20km/h in the above text is based on the GTR.

GTR8 Definition & Functional Requirements

"Electronic Stability Control System" or "ESC System" means a system that has all of the following attributes:

(a) That improves vehicle directional stability by at least having the ability to automatically control individually the braking torques of the left and right wheels on each axle or an axle of each axle group 1/ to induce a correcting yaw moment based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver;

(b) That is computer-controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver;

(c) That has a means to determine directly the value of vehicle's yaw rate and to estimate its side slip or side slip derivative with respect to time;

(d) That has a means to monitor driver steering inputs; and

(e) That has an algorithm to determine the need, and a means to modify propulsion torque, as necessary, to assist the driver in maintaining control of the vehicle.

Functional requirements. An electronic stability control system shall be one that:

(a) Is capable of applying braking torques individually to all four wheels 2/ and has a control algorithm that utilizes this capability;

(b) Is operational over the full speed range of the vehicle, during all phases of driving including acceleration, coasting, and deceleration (including braking), except:

(i) When the driver has disabled ESC,

(ii) When the vehicle speed is below 20 km/h,

(iii) While the initial start-up self test and plausibility checks are completed, not to exceed 2 minutes when driven under the conditions of [paragraph 7.10.2 ESC Malfunction Detection]

(iv) When the vehicle is being driven in reverse;

(c) Remains capable of activation even if the antilock brake system or traction control system is also activated.