

# PROGRESS AND FUTURE OF JNCAP

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## Abstract

In 2011, the Japan New Car Assessment Program (JNCAP) started a new test on motor vehicle performance in pedestrian leg protection ahead of the introduction of government legislation. The Agency also started testing the performance of electric vehicles and hybrid electric vehicles in protecting occupants from high voltage electric shocks after collision. Furthermore, the Agency improved its seat belt reminder evaluation from simply publishing whether or not the vehicle has reminders to include a five-point rating of each reminder based on the effect of visual/audio alarms on the use of seat belts.

Thanks to improvements in automotive safety, the number of traffic deaths has been decreasing. In 2008, however, the number of pedestrians killed in traffic accidents exceeded the number of deaths among vehicle occupants for the first time, and has continued to do so. Recognizing that the protection of pedestrians in traffic accidents had become as important as that of vehicle occupants, JNCAP launched in 2011 a new overall safety performance evaluation aimed at protecting not only vehicle occupants but also pedestrians.

On the other hand, merely improving the collision safety performance of motor vehicles is not sufficient to substantially reduce deaths and injuries in traffic accidents. It is vital to promote the spread of motor vehicles with equipment and performance that can avoid accidents in the first place, by conducting evaluations of motor vehicles with preventive safety technologies as part of the new car assessment. In 2012, NASVA drew up a plan setting out milestones for the introduction of evaluations of preventive safety technologies and is now carrying out related research.

## 1. History of JNCAP

1.1 JNCAP started in 1995 with a full-wrap frontal collision test and a braking performance test. With a

side collision test added in 1999 and an offset frontal collision test in 2000, the program published every year the results of an overall evaluation of the

collision safety performance of major models on the market, focusing on the protection of occupants, with six stars given to the highest score.

With the addition of a pedestrian head protection performance test in 2003 and a rear collision neck protection performance test, a rear seatbelt usability evaluation test, and a seatbelt reminder evaluation test in 2009, JNCAP has enhanced the assessment of new cars and thus greatly contributed to the spread of safer motor vehicles and helped consumers select safer vehicles more easily. This has also encouraged automakers to develop safer motor vehicles.

In 2011, in view of pedestrians accounting for a majority of traffic deaths in Japan, a pedestrian leg protection test was added. In addition, in view of the rapid spread of electric and hybrid vehicles, an evaluation test of these vehicles' performance in protection from electric shocks after collision was added. Furthermore, the testing method and evaluation method of the existing seatbelt reminder evaluation test were revised.

On the other hand, the program reviewed the existing overall collision safety performance evaluation, which had focused on the protection of occupants. A new overall safety performance evaluation was introduced, aimed at protecting not only occupants but also pedestrians. The results are published every year, with five stars for the highest score.

In 2012, in the testing method of the existing rear collision neck protection performance evaluation, the test speed was revised from 17.6 km/h to 20.0 km/h.

Meanwhile, a plan was drawn up that set out milestones for the introduction of preventive safety technologies, and research on ESC is now being conducted.

1.2 As part of the new car assessment, JNCAP has evaluated child seats since 2001 by conducting a frontal collision test and a usability evaluation test on sled testers, and has published the results as child seat safety evaluations. Thus, the Agency has contributed to the spread of safer child seats by enabling purchasers to select safer child seats more easily while encouraging manufacturers, etc. to develop safer products.

## 2. Outline of the pedestrian leg protection performance test and evaluation

JNCAP started a pedestrian head protection performance evaluation test in 2003. In view of the increasing number of leg injuries of pedestrians involved in traffic accidents, in 2011 the program started testing and evaluating the performance of motor vehicles in protecting pedestrians' legs using a dummy representing adult male legs (leg impactor) to make the vehicles safer.

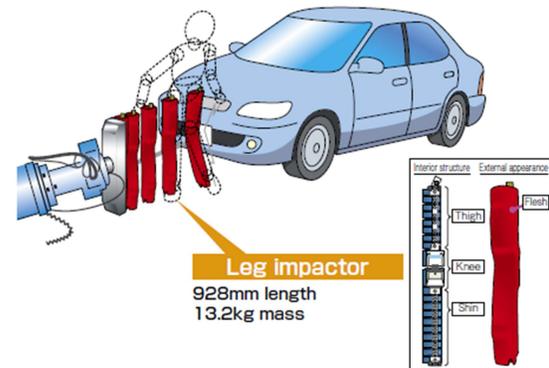
JNCAP is a program sponsored by the Ministry of Land, Infrastructure, Transport, and Tourism, and NASVA. Hence, in line with the national safety standards, the test uses FLEX-PLI as the leg impactor, for which Japan has been a leading developer and which has a higher biofidelity and is better suited for evaluating injuries.

Out of 14 models tested in 2011, 13 scored the highest level of 4, and 6 achieved the full score (4.00).

### 2.1 Outline of the testing method

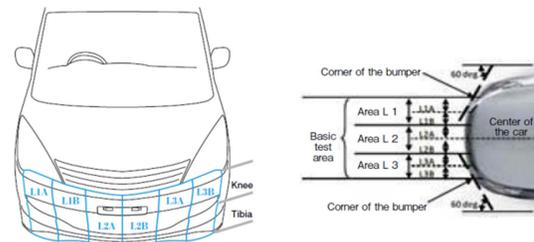
In this test, the leg impactor is launched by the testing machine at a speed of 40 km/h at the bumper of the test car, the lowest part of the bumper being located at 425 mm or less above the ground. When the vehicle collides with a pedestrian, the degree of injuries to the thigh and lower leg areas is measured and evaluated on a four-point scale.

The test area of the bumper evaluated in the leg impactor launch test comprises six segments between both ends of the bumper (excluding the corners), and the points most likely to cause the highest injury values are selected in view of the structure of the vehicle. Thus, the locations at which the leg injury is measured vary depending on the test car. If there are other locations even outside this area that are thought to pose a danger from the effects of structures, a test is conducted for these areas.



### 2.2 Outline of the evaluation method

In the evaluation results, a higher level number means better protection of pedestrians' legs. With injury values of thigh and lower leg areas obtained from the test as representative values, a score is calculated using a sliding scale. These scores are weighted for each of the thigh and lower leg areas, and the score for each area is calculated and then averaged to give a total score as the evaluation of the vehicle.



Injury index	Injury criteria (upper limit value/ lower limit value)	Points (a)	Weight (b)	Overall points (a) × (b)
Shin	Tibia1	0 to 4 points (Only the lowest points for the injury value are used.)	× 0.73	= 2.92 points
	Tibia2			
	Tibia3			
	Tibia4			
Knee	Medial collateral ligament MCL	0 to 4 points (Only the lowest points for the injury value are used.)	× 0.27	= 1.08 points
	Anterior cruciate ligament ACL			
	Posterior cruciate ligament PCL			

Top score is 4 points

### 2.3 Interpretation of evaluation results

Based on measurements from the sensors attached to the leg impactor, the tibia bending moment and the elongation of the knee area medial collateral ligament (MCL), anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) are calculated into scores using a sliding scale.

The overall average score is evaluated on a four level rating. To accurately differentiate between the results of different vehicles, the evaluation classifies scores of less than two (in a four- point rating) as Level 1,

and divides scores above that into three levels of Level 2 to Level 4.

### **3. Outline of the evaluation test on performance of electric vehicles, etc. in protection from electric shocks after collision**

With the rapid spread of electric vehicles and hybrid electric vehicles, consumers have increasing opportunities to purchase these vehicles. When such a vehicle is involved in collisions, occupants should not suffer any electric shocks from high voltage. From 2011, JNCAP evaluates, after conducting tests for full-wrap frontal collisions, offset frontal collisions, and side collisions, the vehicle's performance in protecting occupants from electric shocks in the passenger compartment after collisions.

In 2011, three models were evaluated and all of them satisfied the requirements.

The area of the vehicle evaluated for performance in protection against electric shocks has so far been only "inside the compartment". From 2014, both "inside the compartment" and "outside the compartment" will be evaluated.

#### **3.1 Evaluation items**

After each collision test, the vehicle is evaluated for protection against electric shocks, leakage of high-voltage battery electrolyte, and high-voltage battery attachment status according to respective criteria.

Whether each of the high-voltage parts in the power system meets the requirements for protection against electric shocks is checked by one of the following measuring methods:

- (1) Direct contact protection and indirect contact protection
- (2) Insulation resistance measurement
- (3) Residual voltage measurement
- (4) Residual energy measurement

#### **3.2 Evaluation criteria**

##### **3.2.1 Protection against electric shocks**

###### **3.2.1.1 Direct contact protection and indirect contact protection**

(1) Protection against the live parts of the power system (not including the hybrid coupling system) must meet Protection Class IPXXB.

(2) Resistance between the electrical chassis and contactable exposed conductive sections (not including the hybrid coupling system) must be less than  $0.1 \Omega$  when a current of 0.2 A or more is flowing.

##### **3.2.1.2 Insulation resistance measurement**

Insulation resistance measurement must meet the following conditions (not including the hybrid coupling system). This does not apply when the potential of two or more live parts is not protected under Protection Class IPXXB conditions following a collision.

- (1) AC circuits and circuits that include AC circuits must have an operating voltage of  $500 \Omega/V$  or more (operating voltage of  $100 \Omega/V$  or more when Protection Class IPXXB requirements are met or the voltage of AC sections is 30 V or less).
- (2) DC circuits must have an operating voltage of  $100 \Omega/V$  or more.

##### **3.2.1.3 Residual voltage measurement**

Residual voltage at high-voltage parts at 5 to 60 seconds after a collision must be AC 30 V or less or DC 60 V or less.

##### **3.2.1.4 Residual energy measurement**

Energy at high-voltage parts in the power system at 5 to 60 seconds after a collision must be 2.0J or less.

##### **3.2.2 High-voltage battery electrolyte leakage**

- (1) There should be no electrolyte leakage into the passenger compartment.
- (2) In the event of leakage to an area outside the passenger compartment, the total leakage quantity at 30 minutes after a collision must be no more than 7% of the total electrolyte quantity. In the event of an open drive system battery, leakage must be no more than 7% of the electrolyte quantity and no more than 5 liters.

##### **3.2.3 High-voltage battery attachment status**

- (1) A renewable energy storage system (RESS) located in the passenger compartment must be fastened in a prescribed location.
- (2) An RESS located outside the passenger compartment must not intrude into the passenger compartment.

#### 4. Outline of the passenger seat belt reminder performance evaluation test

JNCAP started a rear passenger seat belt usability test in 2009. To further reduce the number of traffic deaths and injuries by increasing the usage of seat belts by passengers, the program started conducting a seat belt reminder evaluation test in 2011.

In 2011, 7 out of 14 models tested were equipped with a seat belt reminder for the front passenger seat and one model also provided a reminder for the rear passenger seats.

#### 4.1 Testing method

The operating conditions of the reminder (timing, duration, type, display location, etc. of the alarm) are checked.

		[Main requirements]
Type of alarm	Visual alarm or auditory alarm	
Start of alarm	Front passenger seat	Within 60 seconds, within 500m, or at a speed of under 25km/h after the car is in motion
	Rear passenger seat	Depending on the specifications of the car manufacturer
Duration of alarm	30 seconds or more	
Length of alarm intervals	Must not be longer than 30 seconds	
Alarm for change of status	Emitting warnings immediately if the car's speed is faster than 25km/h and seatbelts are not buckled	

#### 4.2 Evaluation method

In 2009 and 2010, the evaluation was limited to checking whether the reminder met the requirements prescribed in the testing procedure, and whether or not the vehicle was equipped with a reminder was published.

From 2011, in addition to checking compliance with the prescribed requirements, an evaluation test is added to rate the reminder's performance for each of the passenger seats by evaluating the effects of visual/audio alarms, and a total evaluation is given on a five-point scale.

#### 4.3 Results of evaluation

An evaluation is given on a 100-point scale for whether or not each of the front and rear passenger seats is provided with a reminder as well as an evaluation of the effect of each reminder. In order to clearly differentiate between the evaluations of the effect of the reminder on different vehicles on the use of seat belts, Level 1 is under 45 points; Level 2 is 45 to 59; Level 3 is 60 to 74; Level 4 is 75 to 89; and Level 5 is 90 or more.

For the new overall evaluation of safety performance, the scores are converted from the 100-point scale to an 8-point scale.

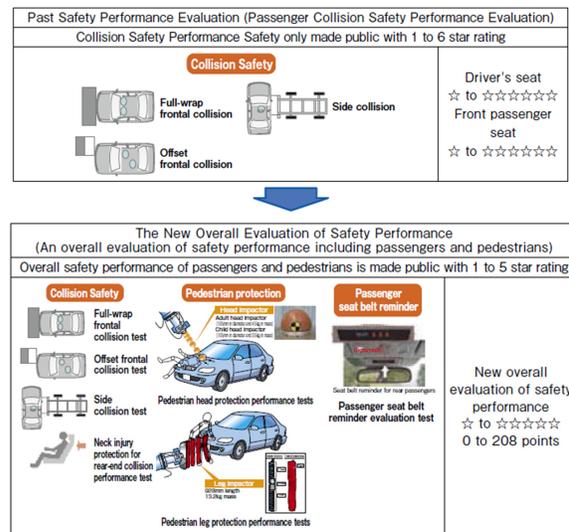
#### 5. New overall safety performance evaluation

As seen in 1 above, JNCAP started in 1995 with a full-wrap frontal collision test and a braking performance test. Later, it expanded the scope by adding a side collision test and an offset frontal collision test, and annually published the results as an overall collision safety performance evaluation, with the highest score gaining six stars.

Enhancements have continued, with a pedestrian head protection performance test and a rear collision neck protection performance test.

In 2011, reflecting the situation of traffic accidents, the program added a pedestrian leg protection performance test. At the same time, the program, which had been limited to evaluating collision safety performance focusing on the protection of occupants, underwent a major review. The new program is a comprehensive evaluation of motor vehicle safety performance aimed at not only the protection of occupants but also that of pedestrians, with the highest score being five stars.

Among the 14 models tested in 2011, 4 models were given three stars, 7 models four stars, and 3 models five stars.



#### 5.1 Overall points

The maximum total of points for the new overall evaluation of safety performance is 208 points, consisting of occupant protection performance evaluation (maximum 100 points), pedestrian protection performance evaluation (maximum 100 points), and seat belt reminder evaluation (maximum

8 points). Since one of the objectives is to reduce the number of traffic deaths and injuries, JNCAP does not prioritize between occupants and pedestrians in reflecting the results of evaluating occupant protection and pedestrian protection to the distribution of scores.



## 5.2 Results of evaluation

Based on the scores given in 5.1 above, each vehicle is evaluated on a five-point scale (expressed in number of stars).



※ If an evaluation is given that is two levels or more lower than the highest evaluation in any of the safety performance comparison tests (passenger protection performance evaluation tests and pedestrian protection performance evaluation tests), then a five-star rating cannot be obtained.

## 6. Future tasks

### 6.1 Introduction of preventive safety technologies

In Japan, JNCAP has conducted safety performance evaluations based on the results of various collision tests to reduce the number of traffic deaths, serious injuries, etc. On the other hand, merely improving the collision safety performance of motor vehicles is not sufficient to substantially reduce injuries in case of traffic accidents. In 1991, Japan launched an Advanced Safety Vehicle (ASV) Project and started studying the commercialization and spread of preventive safety technologies for motor vehicles. With the advancement of electronic control technologies in recent years, various preventive safety technologies have entered practical use, some of which are used in motor vehicles on the market. JNCAP has drawn up a plan setting out milestones for introducing performance evaluations of preventive safety technologies, in order to help protect occupants and pedestrians.

6.2 Regarding electronic stability control (ESC) systems, JNCAP is currently conducting research before determining the testing method and evaluation method. Based on the results, we will start testing in 2013 or thereafter.

6.3 For automatic emergency braking (AEB) systems, we will examine potential problems in introducing an evaluation of AEB in collision with other vehicles based on studies on testing method, etc. in other countries, determine the testing method and evaluation method in 2013 and start testing in 2014.

We will also consider introducing a test on vehicle-to-pedestrian collisions in the future.

6.4 With regard to lane keeping assist (LKA) systems, their effects on reducing accidents are low, but since lane departure warning (LDW) systems, which use the same method of detection, are effective in reducing accidents, we intend to evaluate the two devices together. The target date for starting such evaluation tests is 2016.

6.5 Other devices are not dealt with in the current plan, but we intend to study them if we consider they are effective in reducing accidents and in view of future technological developments and diffusion of these devices.

## 7. Summary

This document summarized the activities of JNCAP. This year, the program marks the 19<sup>th</sup> year since its creation. During this time, collision safety performance has significantly improved and contributed to the diffusion of safer motor vehicles.

In the future, JNCAP will continue to enhance its assessments for evaluating not only the collision safety performance of motor vehicles in accidents, but will also introduce the evaluation of preventive safety technologies that are expected to be effective in avoiding accidents themselves. It will thus help consumers select safer vehicles more easily, while encouraging automakers to develop safer motor vehicles.

JNCAP remains committed to fulfilling its mission of promoting the spread of safer motor vehicles.