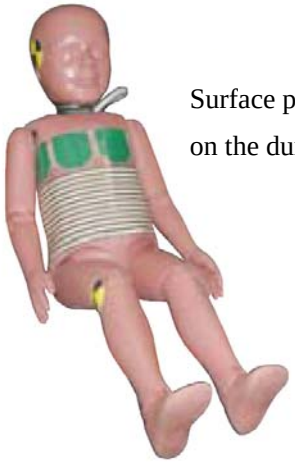
Transmitted by the expert from Japan

Informal document No. **GRSP-43-15/Rev.1**
(43rd GRSP, 19-23 May 2008
agenda item 12(a))

Impact-Shield Type CRS in JNCAP

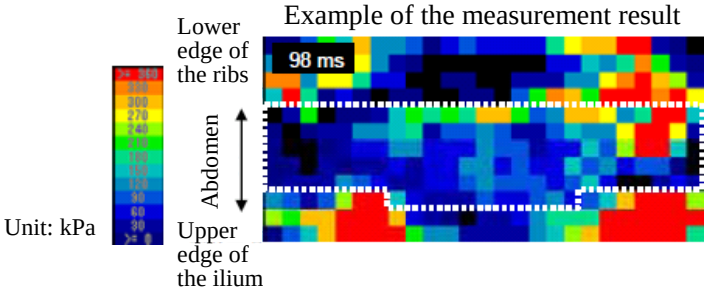
1. Background

In the Japan New Car Assessment Program (JNCAP), child restraint system (CRS) assessment has been conducted since 2001 by frontal impact safety performance test and usability evaluation test. In the frontal impact safety performance test, a cut body (Toyota Estima) in the condition similar to the real-world usage is used as a trolley and impact waveforms (55 km/h) are measured. The evaluation items in the test include whether or not the harness, buckle, or impact shield gives excessive pressure to weak body areas such as the abdomen. In order to quantitatively measure the degree of pressure, a surface pressure gauge is installed on the abdomen of the dummy (Hybrid III 3YO).



Surface pressure gauge installed on the dummy's abdomen

Example of the measurement result

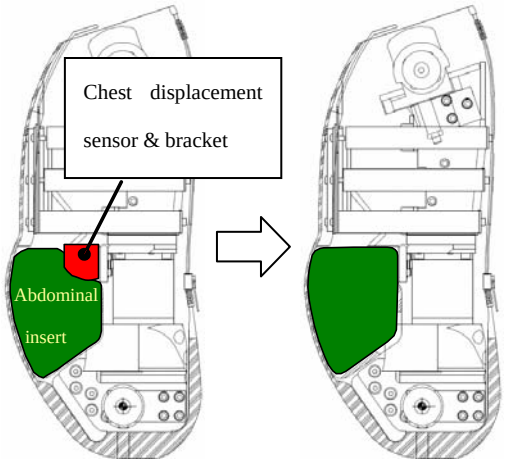


In the past measurements on seven impact-shield type CRSs using the surface pressure gauge, large chest deflections and bottoming-out of the ribs on the thoracic spine were observed in all the tested CRSs and large abdominal loads in some of these CRSs.

The following describes the history of abdominal load measurements on impact-shield type CRSs in the JNCAP:

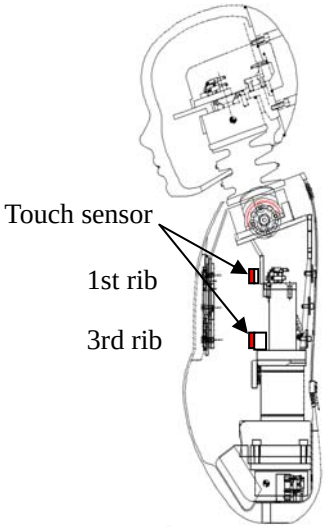
(1) In 2003, measurement using a surface pressure gauge was introduced in the JNCAP to

quantitatively evaluate the abdominal pressure generated by vest-type CRSs. The results of tests in 2005 using the surface pressure gauge found that the abdominal pressure becomes larger in impact-shield type CRSs than harness-type CRSs, and thus we investigated the cause. As a result, it was clarified that, in the impact-shield type CRSs, large abdominal deformations were generated and the abdominal load distribution was affected by the mounting bracket for the chest displacement sensor. Therefore, we made an improvement by eliminating the chest displacement sensor and installing touch sensors between sternum and thoracic spine so as to monitor the chest deformation.



Standard dummy

Improved dummy



In 2007, tests were conducted on four impact-shield type CRSs using the improved dummy, and the dummy's chest bottomed out on the touch sensors in all the tested CRSs. Assuming that a displacement as large as that causing the bottoming-out on the touch sensors (about 40 mm) will be generated in the actual child chest, there may be risks of injuries to the heart and/or lung. However, due to the unavailability of actual accident data, we were unable to evaluate how this phenomenon in the dummy would affect the injury risk of actual children. Furthermore, the measurements using the surface pressure gauge also presented higher numerical values for impact-shield type CRSs than harness-type CRSs, but since a question was raised as to whether it is appropriate to apply the existing harness threshold to the abdominal load evaluation, we decided to exclude the impact-shield type CRS from the evaluation for now.

(2) With regard to CRS safety regulations, neither FMVSS 213 nor ECE R44 specifies any provisions on the chest deflection. FMVSS 213 removed the Hybrid III chest deflection

provision from the requirements for the reason that children's chest injuries are infrequent. As for ECE R44, since the P dummy is used, it is impossible to measure the chest deflection. At present, the dummy's chest deflection in CRSs is measured in the JNCAP only.

2. Our request to supply information on impact-shield type CRSs

We would like to obtain answers to the following questions:

(1) Do you have any data on accidents involving impact-shield type CRSs or information on the chest displacement or abdominal pressure caused by impact-shield type CRSs?

(2) If a displacement of about 40 mm is generated on the chest of a dummy (Hybrid III 3YO), does it mean that the same injury would occur in a human body as well? In the case of children, the rib fracture is unlikely because their ribs are flexible. If injuries to internal organs are possible, what kind of injuries are they?

(3) Are there any differences in the injury mechanism between abdominal pressure given by wide surfaces such as impact shields and that given by strips such as harnesses? In addition, as an abdominal injury threshold, is it acceptable to apply the same threshold to the harness load and the impact-shield load?

(4) According to the German accident data (from "A Study on Children's Injury Risks by CRS Type," published by the Institute for Vehicle Safety of the German Insurance Association [GDV]), the injury probability is lower for impact-shield type CRSs than 5-point-harness-type CRSs. This result differs from the JNCAP result that the dummy injury value is lower in 5-point-harness-type CRSs. What is the cause of this difference?

From the JNCAP test results, which show that chest displacement and abdominal loads in crashes are larger in impact-shield type CRSs than harness-type CRSs, we can judge that the safety performance of impact-shield type CRSs is lower. However, since the results of some other studies indicate that the injury probability in actual accidents is lower for impact-shield type CRSs, Japan finds it difficult to decide how we should evaluate this type of CRSs in the future.