Informal document No. ⑤
(29th GRSP, 7-11 May 2001,
Agenda Item 2.3.)

Japan's Position on TRANS/WP.29/GRSP/2000/12 Proposal for Change in Safety Belt Retraction Force

Transmitted by the Expert from Japan

Background

The above proposal was discussed at the 28th GRSP session, but no conclusion was drawn. By means of this document, the Government of Japan intends to demonstrate the feasibility of this proposal from the standpoint of occupant safety in order to urge the adoption of the proposal.

Also at the 28th GRSP session, the representatives of some regions expressed the concern that the retracting performance of safety belts might deteriorate with the elapse of time. While Japan's proposal pertains to safety belt retraction force, it should be noted that the retraction force when the belt is put on by an occupant and the force of winding the belt into the retractor when the belt is unbuckled reflect two different functions of a safety belt system, and should not be discussed as though one identical function.

The Expert from Japan is convinced that the said proposal will result in an increase in the wearing rate of safety belts and in the enhancement of automotive safety.

Feasibility of Lowering the Retraction Force Limit (28th GRSP Informal Doc. No. 18)

A vehicle crash experiment was conducted to measure the slack amount of the safety belt. Two dummy conditions were applied: normally clothed and thickly clothed. Three cases of belt retraction force were tested: 0.2 daN (current limit), 0.1 daN, and 0.05 daN (proposed limit). Based on the measured data, injury values were compared by the MADYMO crash dummy simulation technique. The results indicated that both the amount of slack and the injury values of occupants did not significantly differ between 0.2 daN to 0.05 daN, under both the normally and thickly clothed conditions (Figures 1 to 3).

In this experiment, the entire amount of slack was assumed to concentrate on the shoulder belt, since the upper body normally records a larger displacement than does the lower body and since a larger injury value is registered in the chest and the head. Consequently it was assumed that the upper body represents the worst conditions against crash safety, although the reality is that the amount of slack is more or less equally divided between the lap belt and the shoulder belt.

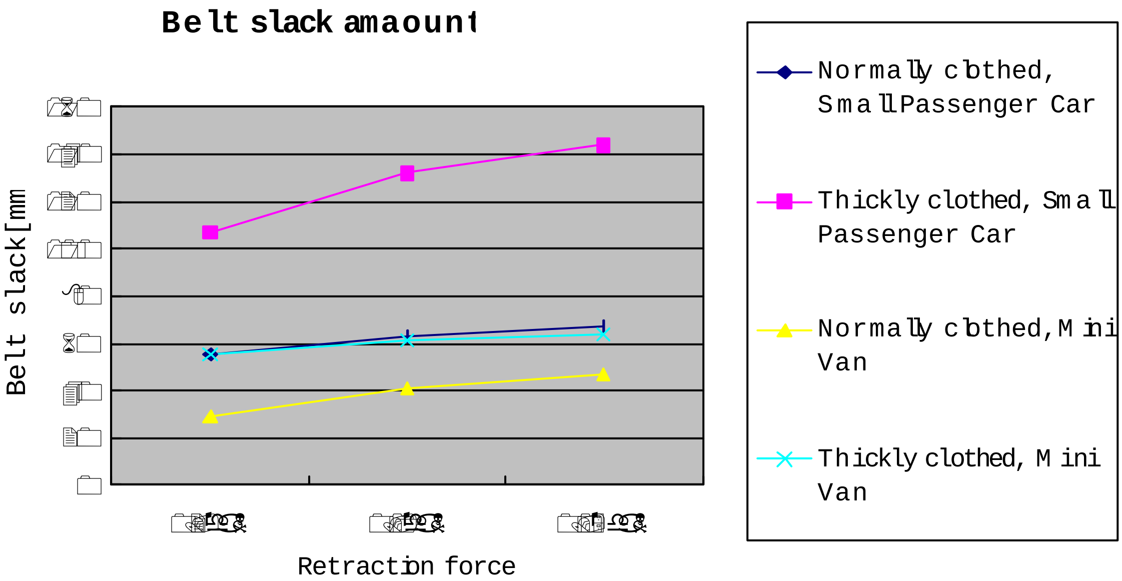

Fig 1 Belt slack amount under various clothing conditions

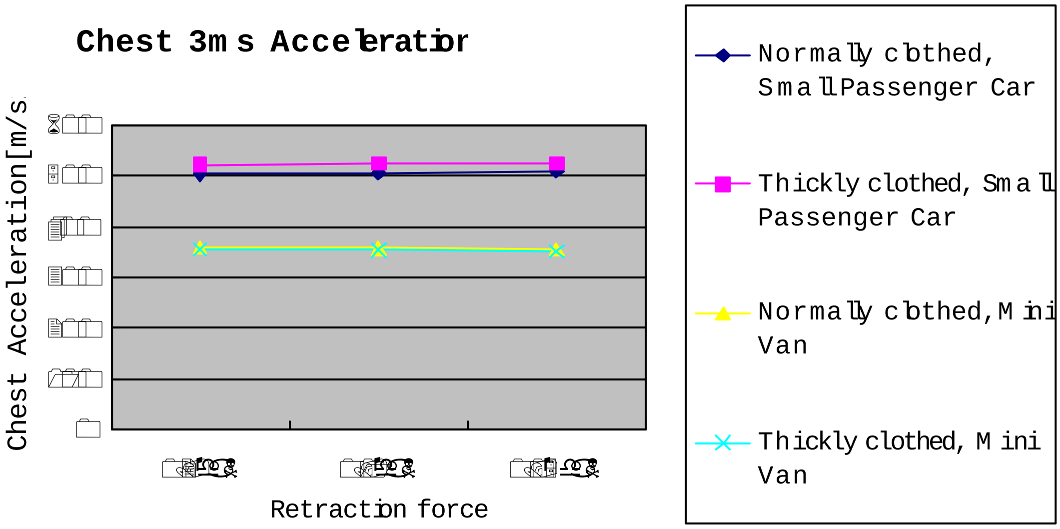

Fig 2 Chest 3ms acceleration calculated by MADYMO

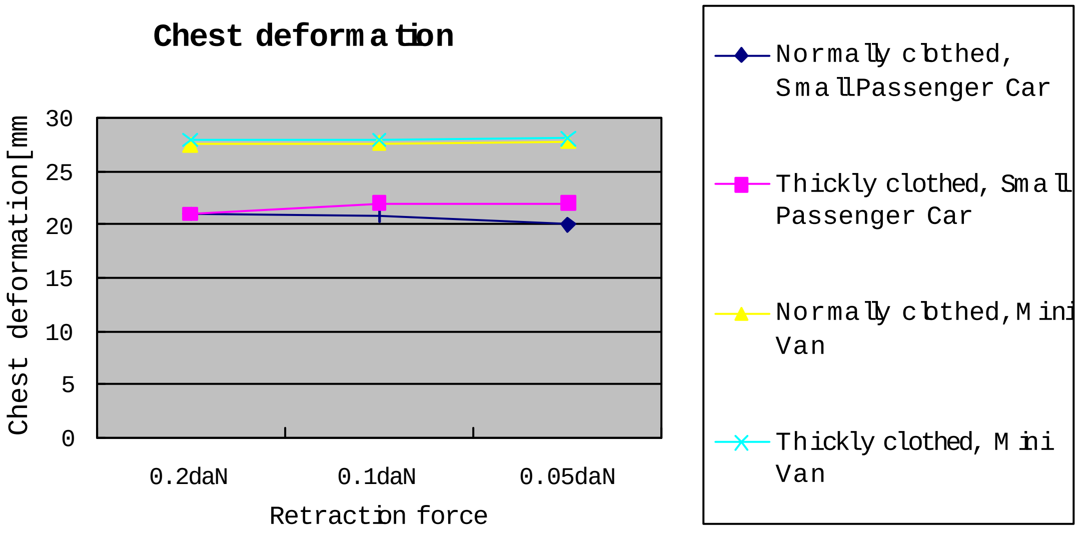

Fig 3 Chest deformation calculated by MADYMO

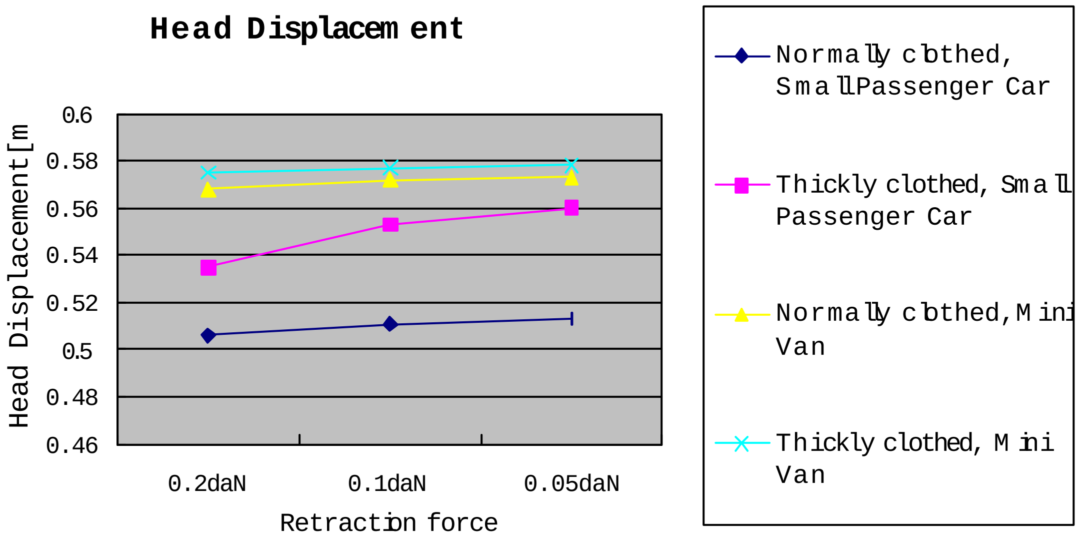

Fig 4 Head displacement calculated by MADYMO

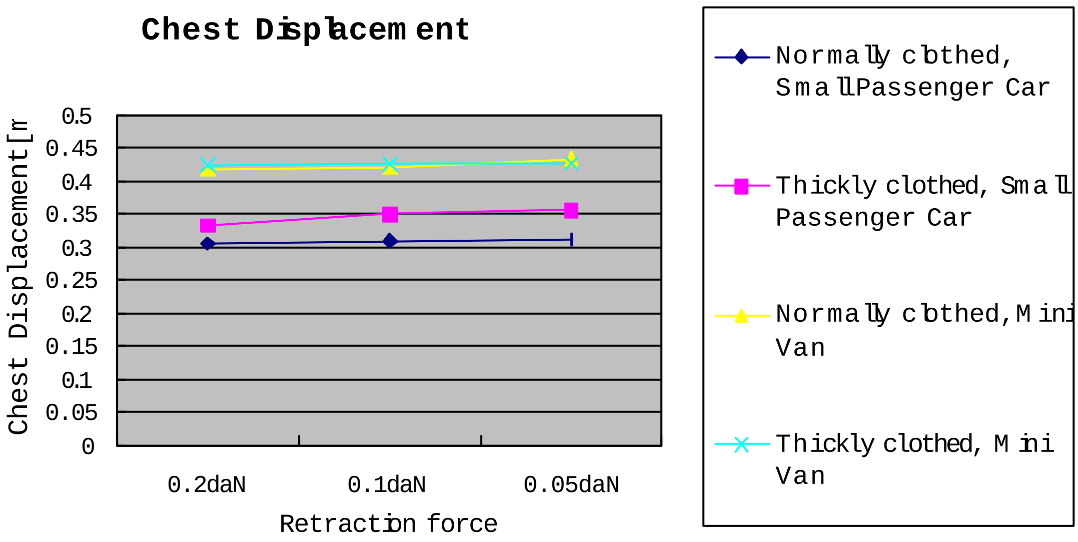

Fig 5 Chest displacement calculated by MADYMO

Difference between Retraction and Belt Winding

According to the ECE Regulation method of measuring safety belt retraction force using a dummy, "retraction force" signifies the force by which the occupant feels a pressure of constriction by the safety belt; it is NOT the force by which the safety belt is wound into the retractor when the belt is unbuckled. Japan's proposal aims at increasing the wearing of a safety belt by reducing the safety belt's constriction pressure on the occupant.

[Supplementary Explanation]

Japan's proposal seeks a decrease in the constriction pressure on the occupant, but does not affect the safety belt system's ability to wind the belt into the retractor. This is made possible, for example, by a tension reducer which reduces the safety belt's constriction pressure on the occupant while ensuring a strong belt winding performance during the non-use of the belt. Tension reducers are already being used in the Japanese and North American markets, where the proposed lower retraction force standard has been in effect.

An example of the tension reducer mechanism

As above-mentioned, there is a mechanism widely used in Japan called tension reducer, which is each fitted as part of the safety belt system to switch between two retraction springs. The tension reducer switches to the weak spring under the buckled condition to moderate the occupant’s feeling of being tied down and to the normal (strong) spring when the safety belt is in an unbuckled condition. Thus the tension reducers can tempt more occupants to wear the safety belts and at the same time ensure a high level of belt winding performance comparable with the performance under the current retraction force limit.

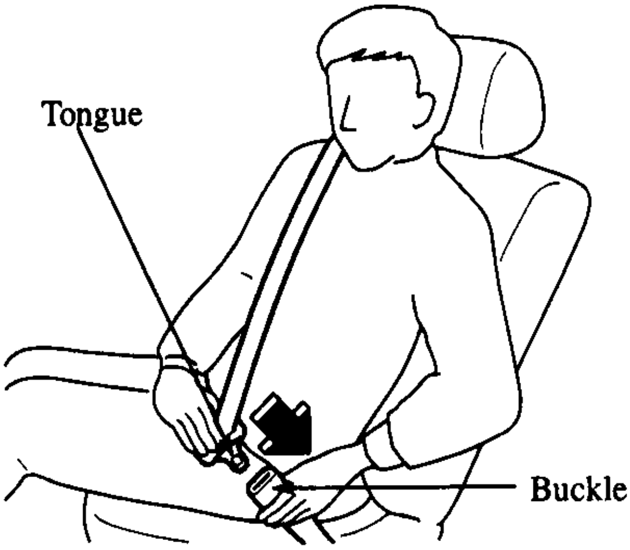

Fig 6 Tension reducer switches retracting spring when tongue latched completely.

Tension reducers typically have the following mechanism:

* Strong retraction force is maintained until the tongue is completely latched in the buckle as illustrated in Figure 6. Accordingly, as long as the safety belt remains unbuckled, the tension reducer ensures the safety belt to be fully retracted and the belt slack to be minimized to the level equivalent to the current standard.

* When the tongue is completely latched in the buckle, information is usually converted into electric signals and is transmitted to the retractor.

* In response to this information, the retractor switches from the strong spring to the weak spring for reducing the restraining force of the safety belt on the occupant.

* Inversely, when the tongue is released from the buckle, the retractor switches from the weak spring to the strong spring to make sure the safety belt is fully retracted.

Since this mechanism has the effect of prolonging the strong restraining performance of safety belts throughout their service life, the use of tension reducers should eliminate apprehensions about the possible deterioration of retraction performance with time.