

# Defect Investigation on Panoramic Sunroof in KOREA

May 2014



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# | KATRI, Defect Investigation Agency

KATRI is with you for your happiness.





# I. KATRI, Defect Investigation Agency

Transmitted by the expert from Korea

## History

1980s

**May 1987** Established KATRI (Korea Automobile Testing & Research Institute)  
**Sep. 1987** Appointed as a Vehicle Safety Testing Institute (by MOLIT)

1990s

**Jan. 1994** Extended test items of vehicle safety test (6→38 items)  
**Nov. 1996** Completed construction of 7 Indoor Testing Institute Facilities

2000s

**Dec. 2002** Completed phase 1 of Proving Ground  
**Jan. 2003** Appointed as a Performance Test Institute (MOLIT)

2010s

**May. 2013** Hosted the 23<sup>rd</sup> ESV International Conference  
**Nov. 2013** Construction of 4 advanced test tracks

## Staff

- ❖ Staff of KATRI : 128 persons
- ❖ TS vehicle inspection stations : 57 locations (525 persons)

# I. KATRI, Defect Investigation Agency

## Main Duty

- **Investigation of the manufacturing defects of vehicles and parts.**
  - Compliance Investigation
  - Defects Investigation
  
- **New Car Assessment Program(NCAP)**
  - To provide customers broader selection and induce car manufacturers to produce safer vehicles
  
- **Harmonization of vehicle safety regulations**
  - Active participation in conferences related to the establishment and revision of international standards including UN/ECE/WP29 and APEC, etc.
  
- **Government Outsourcing**
  - Technical review and safety inspection
  - Construction equipment type approval and confirmation inspection



# KATRI, Defect Investigation Agency

Transmitted by the expert from Korea

## Facility Layout

Proving ground

**Total area: 2,146,383m<sup>2</sup>**

- 7 test buildings: 29,464m<sup>2</sup>  
( 108 evaluation equipment )
- Proving ground: 1,650,000m<sup>2</sup>  
( 14 test track )

Driving & rollover test buildings

Noise/EMC test building

Environment test building

Future vehicle test building

General test building

Crash test building

Main building

Impact test building





# Introduction

Your safety is our priority.



## II. Introduction

- **Sharp increase in consumer complaints of panoramic sunroof.**
  - 2011 : 2 cases
  - 2013 : 33 cases (5 cases of imported models)
- **Details of consumer complaints.**
  - **Sudden shattering of panoramic sunroof while driving the car with the driver unaware.**
  - **Driver may suffer abrasions due to shattered glass and encounter risk of secondary accidents.**

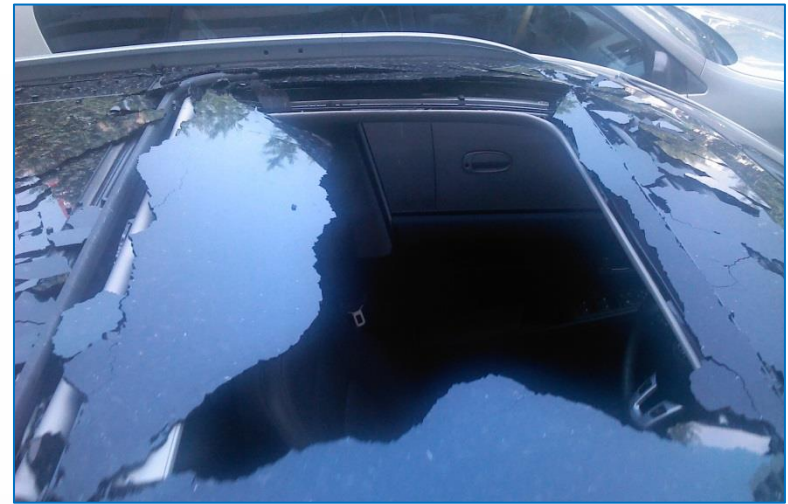




# II. Introduction

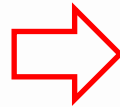
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## Images of panoramic sunroof damages(1)



# II. Introduction

## Images of panoramic sunroof damages(2)





# II. Introduction








## ● Status of panoramic sunroof glass types






Glass type	Manufactures : Model
Toughened glass	<p><b>HYUNDAI(7)</b> : i30, i40, Veloster, Sonata, Grandeur, Tucson, Santafe  <b>KIA(4)</b> : K5, K7, Sorento-R, Sportage-R  <b>RENAULTSANSUNG(3)</b> : SM5, SM7, QM5  <b>BMW(7)</b> : 320d, 520d, GT, X1, X3, S5, Mini cooper  <b>BENZ(4)</b> : M-Class, C-Class, E-Class, S-Class  <b>AUDI(6)</b> : A3 Dynamic, A8L, Q3, Q5, Q7, SQ5,  <b>VOLKSWAGEN(3)</b> : Touareg, The Beetle, Tiguan  <b>JAGUAR LANDLOVER(5)</b> : XJ, Freelander, Discovery 3, Discovery 4, Range Rover  <b>TOYOTA (4)</b>: Lexus ES350, Lexus RS350, Prius, Venza  <b>NISSAN(2)</b> : Murano, JX35(INFINITI)  <b>FORD(5)</b> : Escape, Explorer, MKZ, MKS, MKX  <b>CHRYSLER(2)</b> : Jeep grand cherokee, 300C  <b>PORSCHE(1)</b> : Cayenne</p>
Laminated glass	<p><b>PEUJEOTS</b> : 207, 208, 307SW, 308, 308SW, 3008, 508SW, 5008  <b>VOLVO</b> : V40, XC60  <b>HONDA</b> : CIVIC 5D  <b>MITSUBISHI</b> : RVR 4WD</p>



# II. Introduction

## ● Panoramic sunroof Photo and Ceramic ratio

Vehicle Model	Photo	Ceramic ratio
NISSAN MURANO		59%
TOYOTA E350		73%
FORD MKX		56%
BENZ E-CLASS		53%
JAGUAR All New XJ		45%
HYUNDAI Veloster		70%
KIA K5		59%

Vehicle Mode	Photo	Ceramic ratio
PORSCHE Cayenne		22%
LANDLOVER Discovery4		43%
BMW 320d		37%
AUDI A8		41%
CHRYSLER 300C		31%

## II. Introduction

### Characteristics of panoramic sunroofs

- ◆ The use of panoramic sunroofs has been increasing since 2007.
- ◆ The ceramic print area was small in conventional sunroofs, but, with the introduction of panoramic sunroofs the ceramic print area has increased.
  - Ceramic print area of panoramic sunroofs is **50% on average**, and **90% maximum**.
- ◆ Black enamel, the paint used for ceramic print area of automobile toughened glass, is **produced by 2 companies** and is distributed throughout the world.
  - Components of black enamel thought to be adulterant in toughened glass – impairs sunroof strength.



## Defect Investigations

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# III. Defect Investigations

## Results of 227g ball drop test

- ◆ **Toughened Glass. ( Area without ceramic print )**  
**: No shattering even at drop height of 10 meters.**
- ◆ **Ceramic printed toughened Glass.**  
**: Shattered at average height of 1.4 meters.**
- ◆ **Before toughened Glass. ( prior to toughened )**  
**: Shattered at average drop height of 3 meters.**

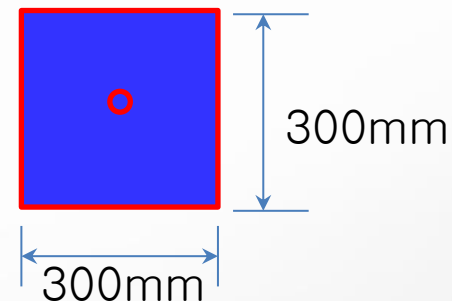
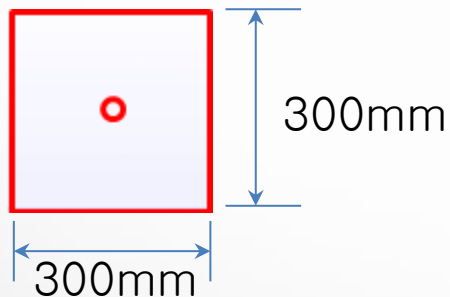
### ❖ **Complaint Manufacturers' Opinion**

- Not require a ball drop test for ceramic print area.
- Point of impact : geometric center(UN R43), support center(GTR 6).

# III. Defect Investigations

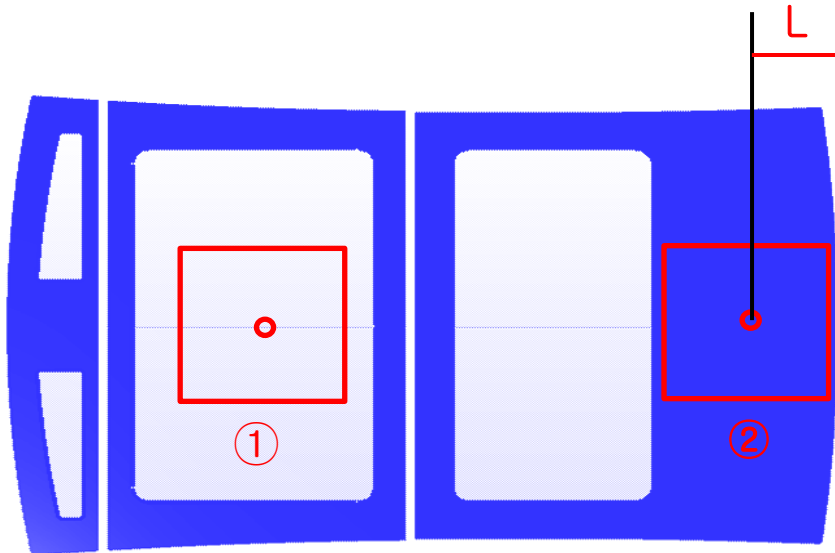
## ➤ Sample Limit Test (227g steel ball drop test)

Original glass manufacturers	K (Korea)	S (France)	G (USA)	Average Height
Black enamel manufacturers	J (UK)	F (USA)	F (USA)	
Toughened glass manufacturers	K (Korea)	H (Korea)	S (Korea)	
Before toughened glass	2.6 m	3.2 m	3.2 m	3.0 m
Toughened glass	10.0 m	10.0 m	10.0 m	10.0 m
Ceramic printed toughened glass	1.4 m	1.2 m	1.8 m	1.4 m



# III. Defect Investigations

## ➤ Finished Product Test (227g steel ball drop test at 2 m)



- ◆ Panoramic sunroof,  $L > 150\text{mm}$ ,
  - ① Geometric center : No shattered
  - ② Support center : Shattered

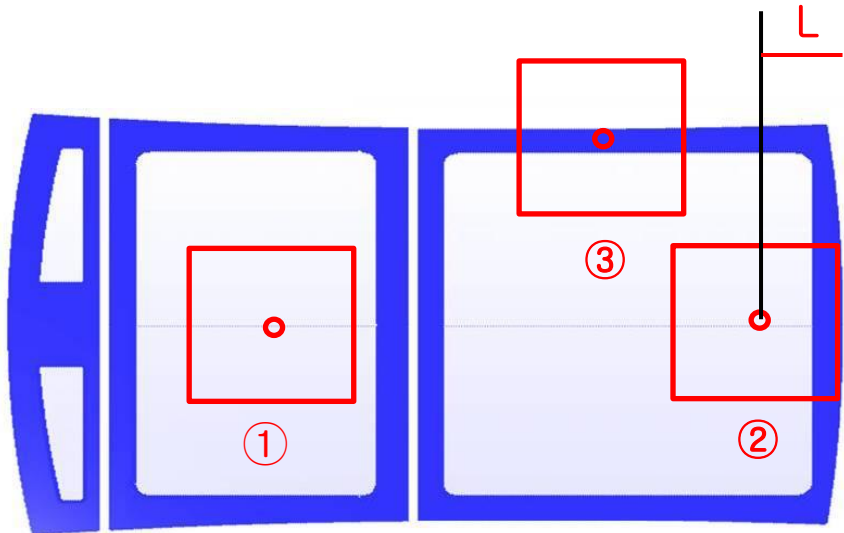
### ➤ Automobiles with panoramic sunroof defect in Korea

- Domestic : 14 models from 3 manufacturers
- Imported : 22 models from 5 manufacturers



# III. Defect Investigations

## ➤ Finished Product Test (227g steel ball drop test at 2 m)



- ◆ Panoramic sunroof,  $L < 150\text{mm}$ ,
  - ① Geometric center : No shattered
  - ② Support center : No shattered
  - ③ Ceramic Area : Shattered

## ➤ Automobiles with panoramic sunroof defect in Korea

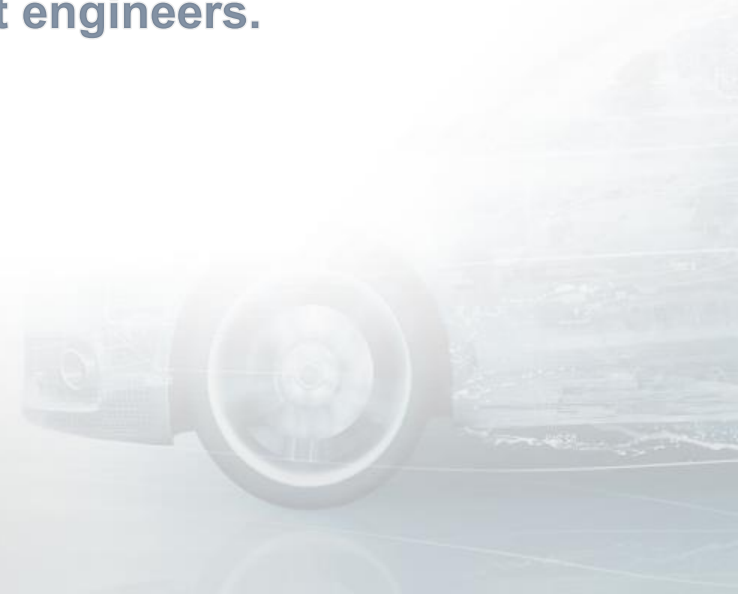
- Imported : 19 models from 4 manufacturers



# IV

## Comparison of Regulations

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as well as the best engineers.**



# IV. Comparison of Regulations

## ➤ Definition

Definition	GTR No.6	UN R 43	FMVSS 205 (ANSI/SAE Z 26.1-1996)
Toughened glass	3.3.7. <u>Uniformly toughened – glass</u> : means glazing consisting of a single layer of glass which has been subjected to special treatment <u>to increase its mechanical strength</u> and to condition its fragmentation after shattering.	2.1. " <i>Toughened-glass</i> " means glazing consisting of a single layer of glass which has been subjected to special treatment <u>to increase its mechanical strength</u> and to condition its fragmentation after shattering.	1.21 Tempered Glass “tempered glass” means a single piece of specially treated sheet, plate, or float glass possessing <u>mechanical strength substantially higher than annealed glass</u> . When broken at any point, the entire piece breaks into small pieces that have relatively dull edges as compared to those of broken pieces of annealed glass.

※ In Korea, the meaning of “Uniformly toughened glass” is interpreted to mean that toughened glass should be uniform in terms of mechanical strength and fragmentation conditions.




# IV. Comparison of Regulations

## ➤ Impact Point

Definition	GTR No.6	UN R 43	FMVSS 205 (ANSI/SAE Z 26.1-1996)
Impact Point	6.3.2.3. The point of impact shall be within 25 mm of <b><u>the centre of the supported area</u></b> for a drop height less than or equal to 6 m, and within 50 mm of the centre of the supported area for a drop height greater than 6 m.	2.1.4. Procédure ~ The point of impact shall be within 25mm of <b><u>the geometric center of the test piece</u></b> for a drop height less than or equal to 6m, ~	5.6.2 <b><u>striking the specimen within 25 mm (1 in) of its center.</u></b>

※ GTR No.6 → the center of the **supported area**

※ UN R 43 → **geometric** center of the test piece

 results of investigation, never been implemented for finished products.

※ FMVSS 205 → **specimen** center

# IV. Comparison of Regulations

## ➤ Test Pieces

Definition	GTR No.6	UN R 43	FMVSS 205 (ANSI/SAE Z 26.1-1996)
Test Pieces	<p>6.3.4.1. The test pieces shall be flat samples measuring 300 x 300 mm, <b><u>specially made or cut</u></b> from the flat test part of a windscreen or pane.</p> <p>6.3.4.2. Test pieces <b><u>can alternatively be finished products</u></b> that may be supported over the apparatus described in paragraph 6.3.1.</p> <p>6.3.4.3. If the test pieces are curved, care should be taken to ensure adequate contact with the support.</p>	<p>2.1.3. Test piece                      The test piece shall be a flat square of side <b><u>300 + 10/-0 mm or shall be cut from the flattest part</u></b> of a windscreen or other curved pane.                      Alternatively a curved pane may be tested. In this case care shall be taken to ensure adequate contact between the safety glazing and the support.</p>	<p>5.6.2 Procedure.                      Twelve 305 mm x 305 mm (12 in x 12 in) substantially flat specimens, submitted, shall be tested.</p>

- ※ Test pieces should represent finished products.
- ※ The weakest part, i.e., the flattest part of finished products, should be used as test samples.

# IV. Comparison of Regulations

## ➤ Secondary Characteristics

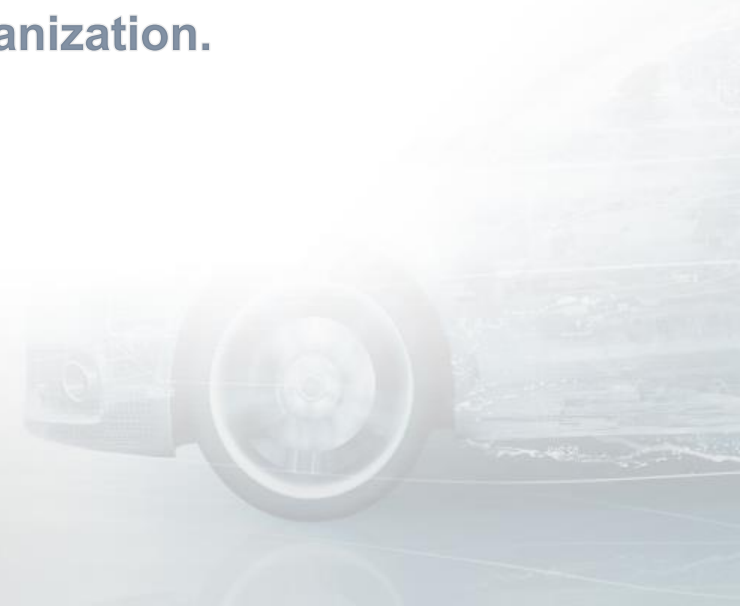
Definition	GTR No.6	UN R 43	FMVSS 205 (ANSI/SAE Z 26.1-1996)																
Definition of type	-	1. Definition of type Uniformly-toughened glass panes <b><u>shall be deemed to belong to different types</u></b> if they differ in at least one of the following <b><u>principal or secondary characteristics.</u></b>	-																
Secondary Characteristics	-	3.1. 227g ball test 3.1.1. Indices of difficulty of the secondary characteristics. <table border="1" data-bbox="680 882 1379 1076"> <thead> <tr> <th>Material</th> <th>Index of difficulty</th> <th>Colouring</th> <th>Index of difficulty</th> </tr> </thead> <tbody> <tr> <td>Polished glass</td> <td>2</td> <td>colourless</td> <td>1</td> </tr> <tr> <td>Float glass</td> <td>1</td> <td>tinted</td> <td>2</td> </tr> <tr> <td>Sheet glass</td> <td>1</td> <td></td> <td></td> </tr> </tbody> </table> <p>The other secondary characteristic <b><u>(namely, incorporation or otherwise of conductors) is not involved.</u></b></p>	Material	Index of difficulty	Colouring	Index of difficulty	Polished glass	2	colourless	1	Float glass	1	tinted	2	Sheet glass	1			-
Material	Index of difficulty	Colouring	Index of difficulty																
Polished glass	2	colourless	1																
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# V

## Conclusion

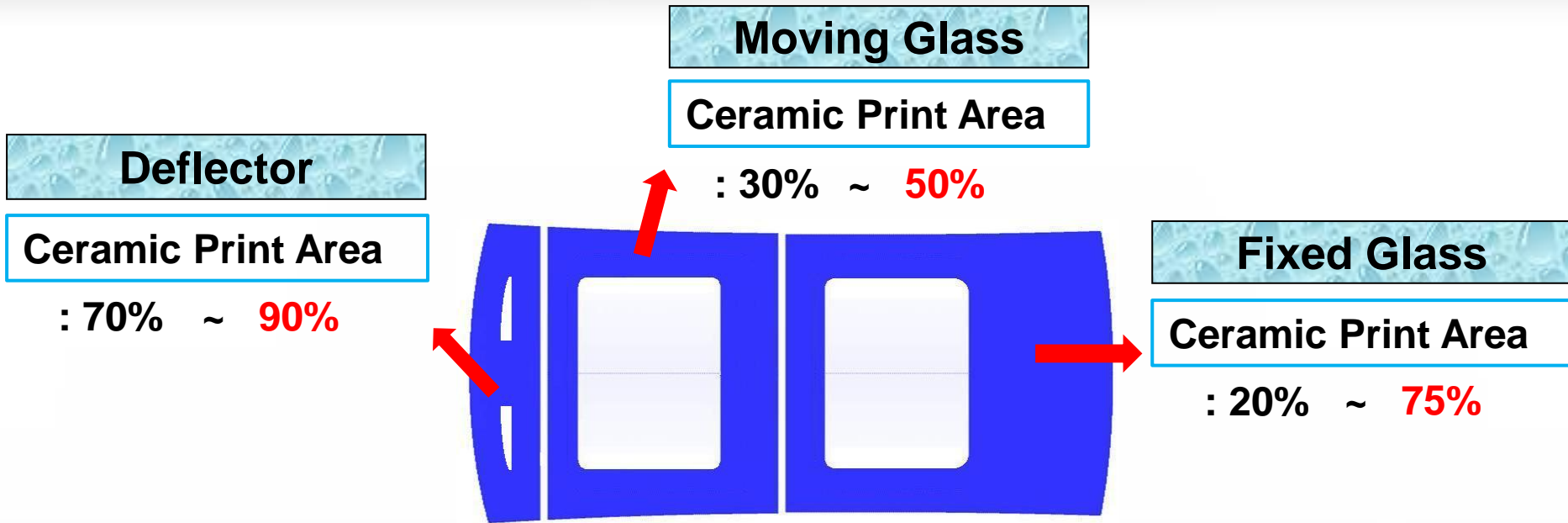
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vehicle safety organization.**





# V. Conclusion

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Ceramic printed toughened glass cannot be considered toughened glass as its strength is poorer than to before toughened glass.

- Ceramic printed toughened glass : approx. 1.4 m
- Original glass prior to toughened : approx. 3.0 m

# V. Conclusion

## ➤ GTR Amendment (Definition)

Current (GTR No.6)	Draft (GTR No. 6)
<p>3.3.7. Uniformly toughened-glass : means glazing consisting of a single layer of glass which has been subjected to special treatment to increase its mechanical strength and to condition its fragmentation after shattering.</p>	<p>3.3.7. Uniformly toughened-glass : means glazing consisting of a single layer of glass which has been subjected to special treatment to increase its mechanical strength <b><u>before toughened glass</u></b> and to condition its fragmentation after shattering.</p>

※To clarify the terms defined in 3.3.7. of GTR 6, it is necessary to add the following phrase: **“before toughened glass”**

# V. Conclusion

## ➤ GTR Amendment (Test Pieces)

Current (GTR No.6)	Draft (GTR No.6)
<p>6.3.4. Test pieces</p> <p>6.3.4.1. The test pieces shall be flat samples measuring 300 x 300 mm, specially made or cut from the <b>flattest</b> part of a windscreen or pane.</p>	<p>6.3.4. Test pieces</p> <p>6.3.4.1. The test pieces shall be flat samples measuring 300 x 300 mm, specially made or cut from the <b><u>weakest</u></b> part of a windscreen or pane.</p>

※ 'flattest'  'weakest'

- There is a need to test the weakest part of glass so that we can determine the minimum strength of toughened glass in the test under the regulation.



# V. Conclusion

## ➤ GTR Amendment (Exclude test item)

Current (GTR No.6)	Draft (GTR No.6)
-	<u>6.3.4.4. It is possible to exclude from the list of test items the conductor installed to secure the driver's field vision.</u>

### ※ Exclude test item

- If conductors are inserted into toughened glass, it is impossible to meet the requirement of the “ball drop test” but this is essential technology for safe driving including securing the driver’s field vision : hence the need to exclude the conductor from the list of test items.

# Thank you very much!!



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