***29th Asia Expert Meeting***
***on Protection of Occupants (Vehicle Crash) of***
***UN/ECE R94 (Protection of occupants against frontal collision), and***
***UN/ECE R95 (Protection of occupants against lateral collision)***

Date: October 6(Thu) 9:30 - 16:30, 2011
Place: JPJ Academy, Malacca
Address:

Akademi Pengangkutan Jalan Malaysia
KM 15, Jalan Tiang Dua,
75460 Air Molek, Melaka

**9:00 - 9:30 Registration**

**9:30 - 9:40 Opening address:** from JPJ

**9:40 - 9:50 Message:** from JASIC Nanbu

**9:50 - 11:20 R94 & R95 General Information & Technical Requirements**
**:** from JASIC Mr. Tani

**11:20 - 12:00 Q & A & Discussion**

**12:00 - 13:00 Lunch (60 minutes)**

**13:00 - 14:30 R94 & R95 Test Method:** from JASIC Mr. Sato

**14:30 - 15:00 Q & A & Discussion**

**15:00 - 15:20 Coffee Break (20 minutes)**

**15:20 - 16:20 Malaysia Vehicle Assessment Programme (MyVAP) : MIROS**

**16:20 - 16:30 Closing address:** from JPJ

***Technical Tour on Motorcycle Crash Test using Motorcycle Anthropomorphic Testing Dummy (MATD)***

Date: October 7(Fri), 2011
Place: JPJ Academy, Malacca
Address:

Akademi Pengangkutan Jalan Malaysia
KM 15, Jalan Tiang Dua,
75460 Air Molek, Melaka

a. Motorcycle Crash Test 1

MATD using normal jacket however the motorcycle will be equipped with airbags.

b. Motorcycle Crash Test 2

MATD will be equipped with airbag jacket however the motorcycle as normal.

Both injuries of MATD will be compared to evaluate the effectiveness of each product.

# Introduction of UN / ECE R94

# Requirement for Frontal Crash regulation

*6th OCT 2011*

*T. Tani*
*JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER*

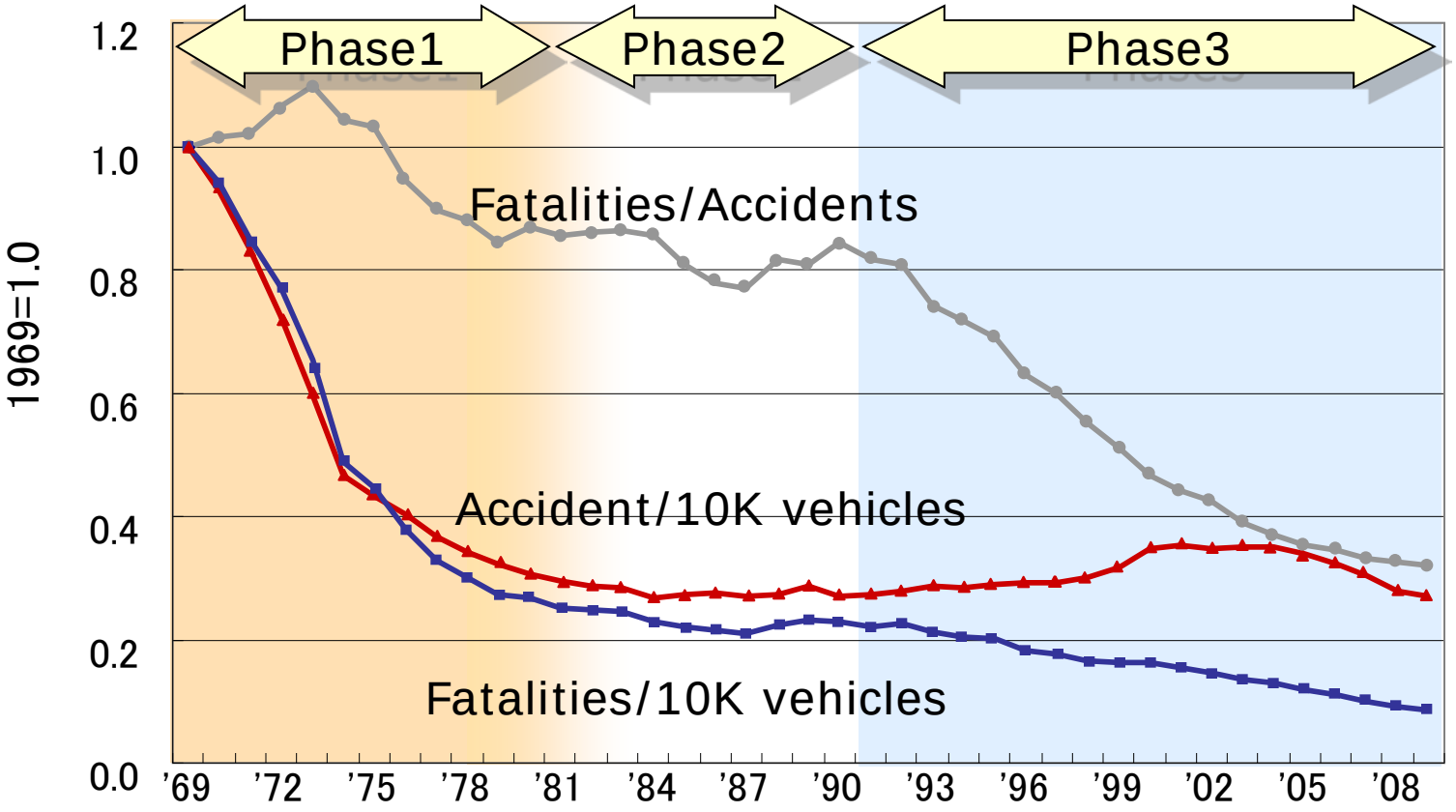
# Contents

# 1. Accident statistics in Japan

# 1. Accident statistics in Japan (1)

■ Safety enhancement of vehicles by regulation is one of the most important points to reduce fatalities in accident.

- Phase1: Accident ratio and fatalities ratio were reduced.
- Phase2: Almost consistent
- Phase3: Fatalities/Accidents were significantly reduced.

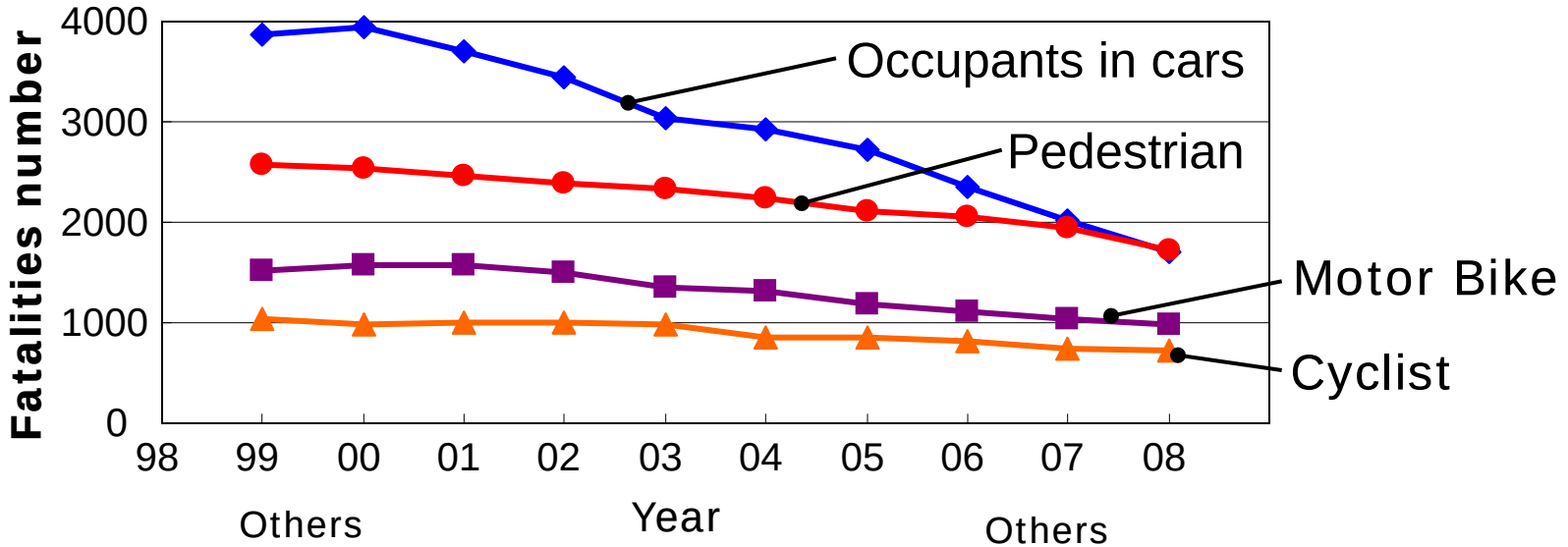


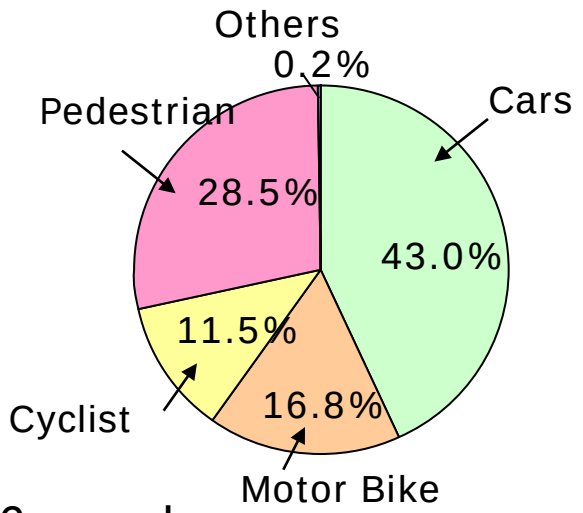

Accident statistics in Japan (1969-2008)

Source: Traffic statistics 2009

# 1. Accident statistics in Japan (2)

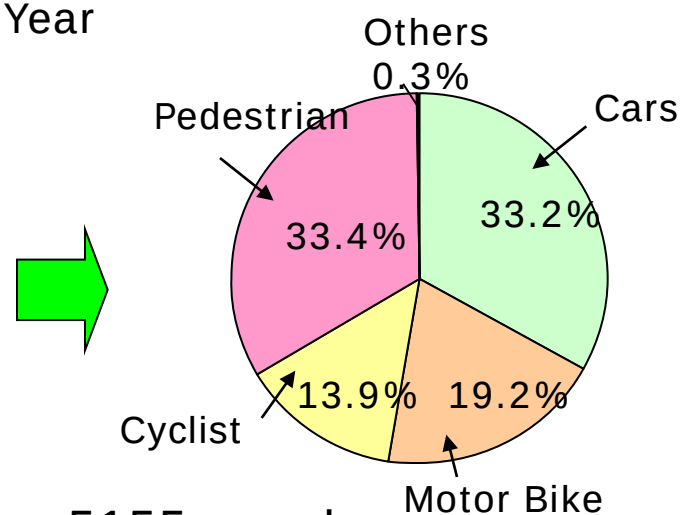
- Fatalities number in cars have been reduced almost 50%.




9006 people

**Situation in1999:**



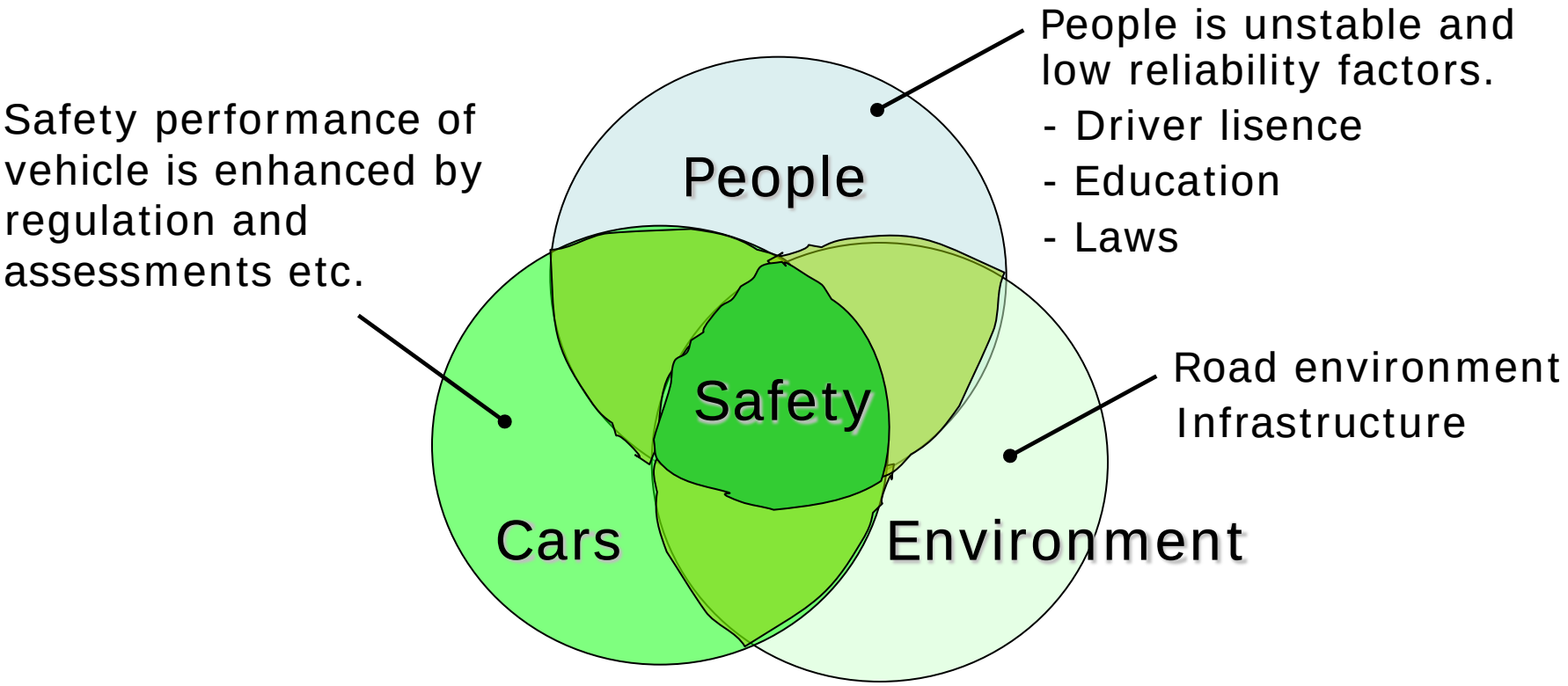

5155 people

**Situation in 2008**

Source: Police/ITARDA

# 1. Accident statistics in Japan (3)

■ Safety perfromance of car itself is one of most important factors to enhance the safety.




3 main factors for safety

# 2. Requirement in R94 Frontal crash test

# 2-1. Introduction of Frontal Crash Test (1)

- ECE R94 Frontal crash test has been developed by EEVC (European Enhanced Vehicle-safety Committee) as basis for legislation.
- Frontal impact at 56kph, car to deformable barrier 40% overlap offset.
- This test represents “Car to Car crash” in real world. Deformable barrier was developed as a representative of real cars.

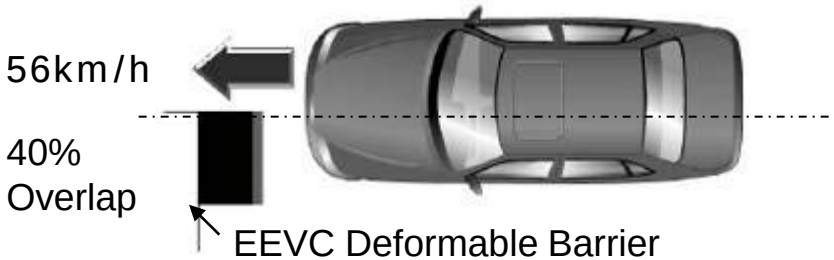
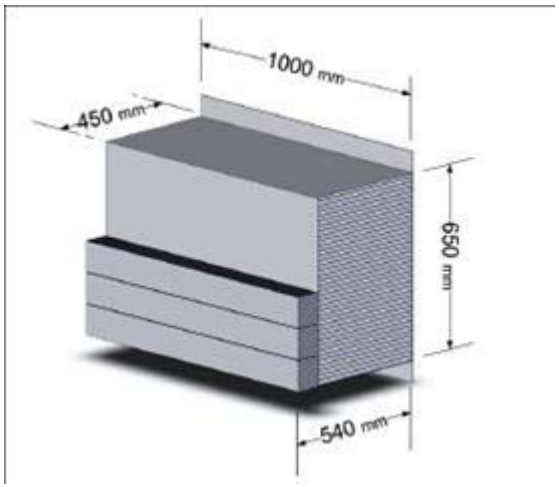



Fig.1 Plan View of test condition




Aluminum honeycomb barrier

Fig.2 40% offset deformable barrier

# 2-1. Introduction of Frontal Crash Test (2)

- Injury level during the crash is evaluated by Dummies called Hybrid3 (HYB-3).

- HYB-3 50th Percentile Male Dummy is the most widely used crash test dummy for the evaluation of automotive safety performance.

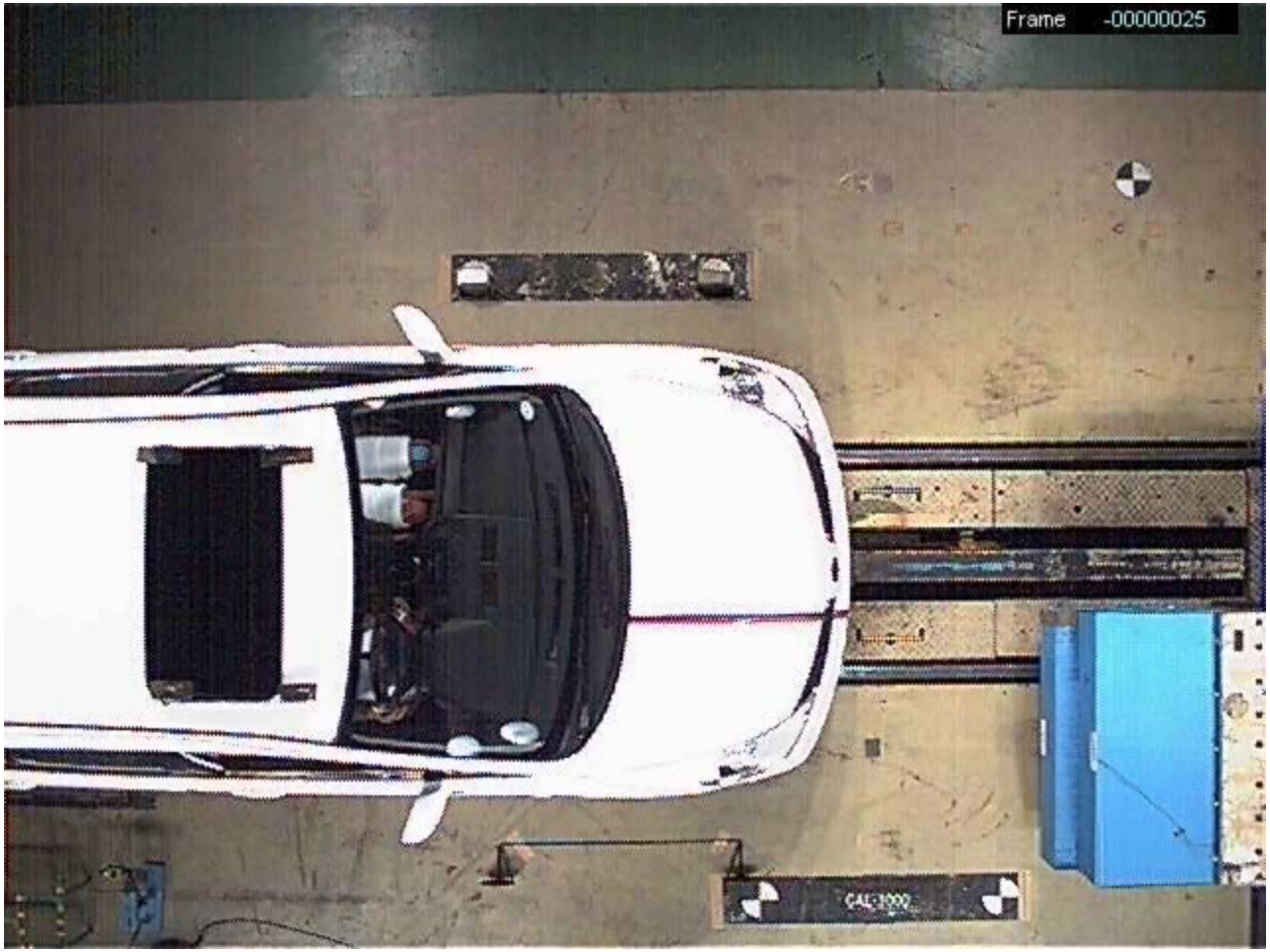
- HYB-3 is a regulated test device all over the world.
  (US, ECE, Japan, China, ADR)

- Also used in NCAP assessment in the world.

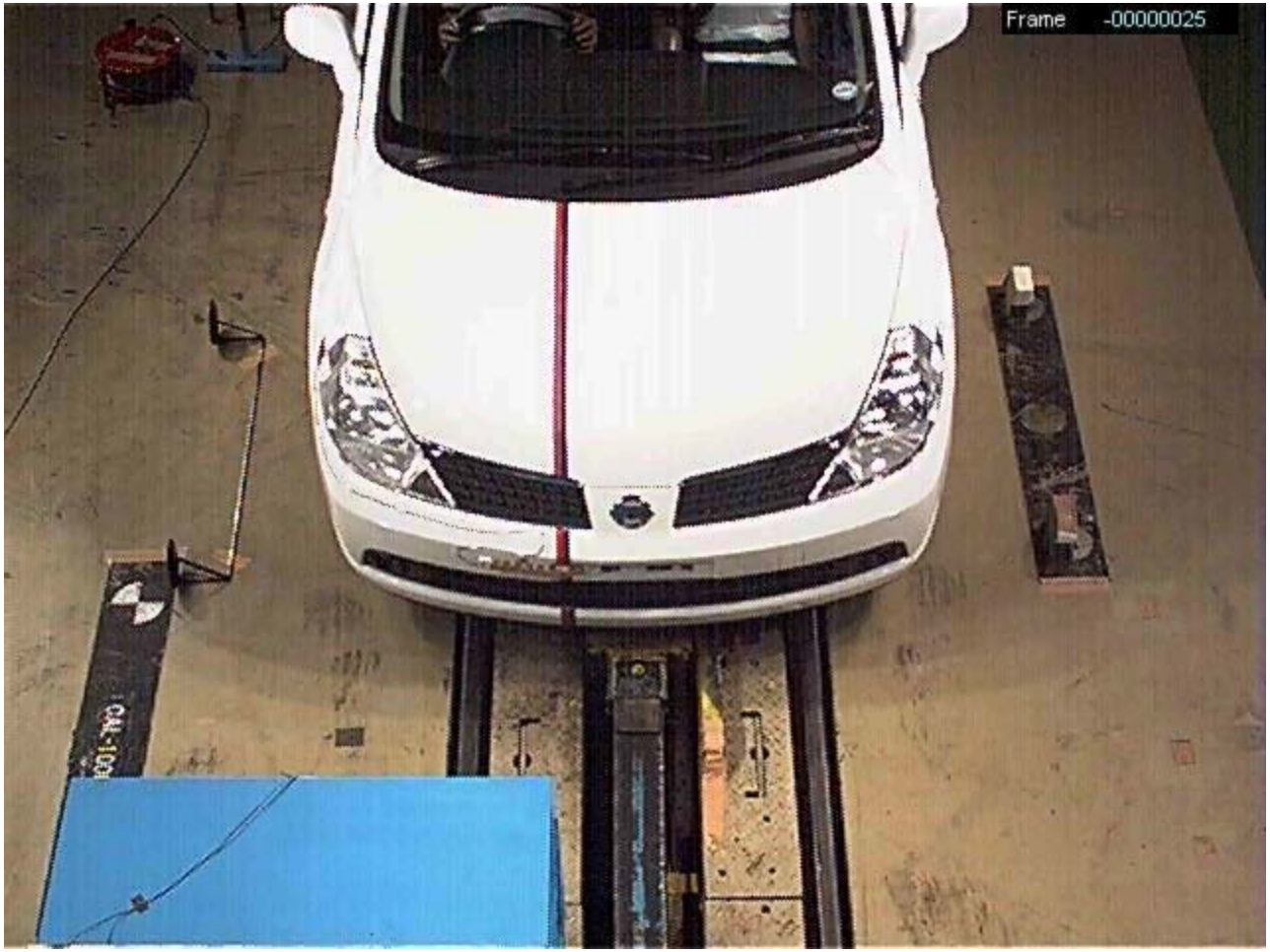
**Fig.1 HYB-3 AM50**

# R94 Offset crash (Side view)

# R94 Offset crash (Plan view)



# R94 Offset crash (Front view)



# 2-2. Requirement

Requirements in ECE R94.

- Injury criteria
- Steering wheel displacement
- Door Open/Lock
- Occupant rescue
- Fuel leakage

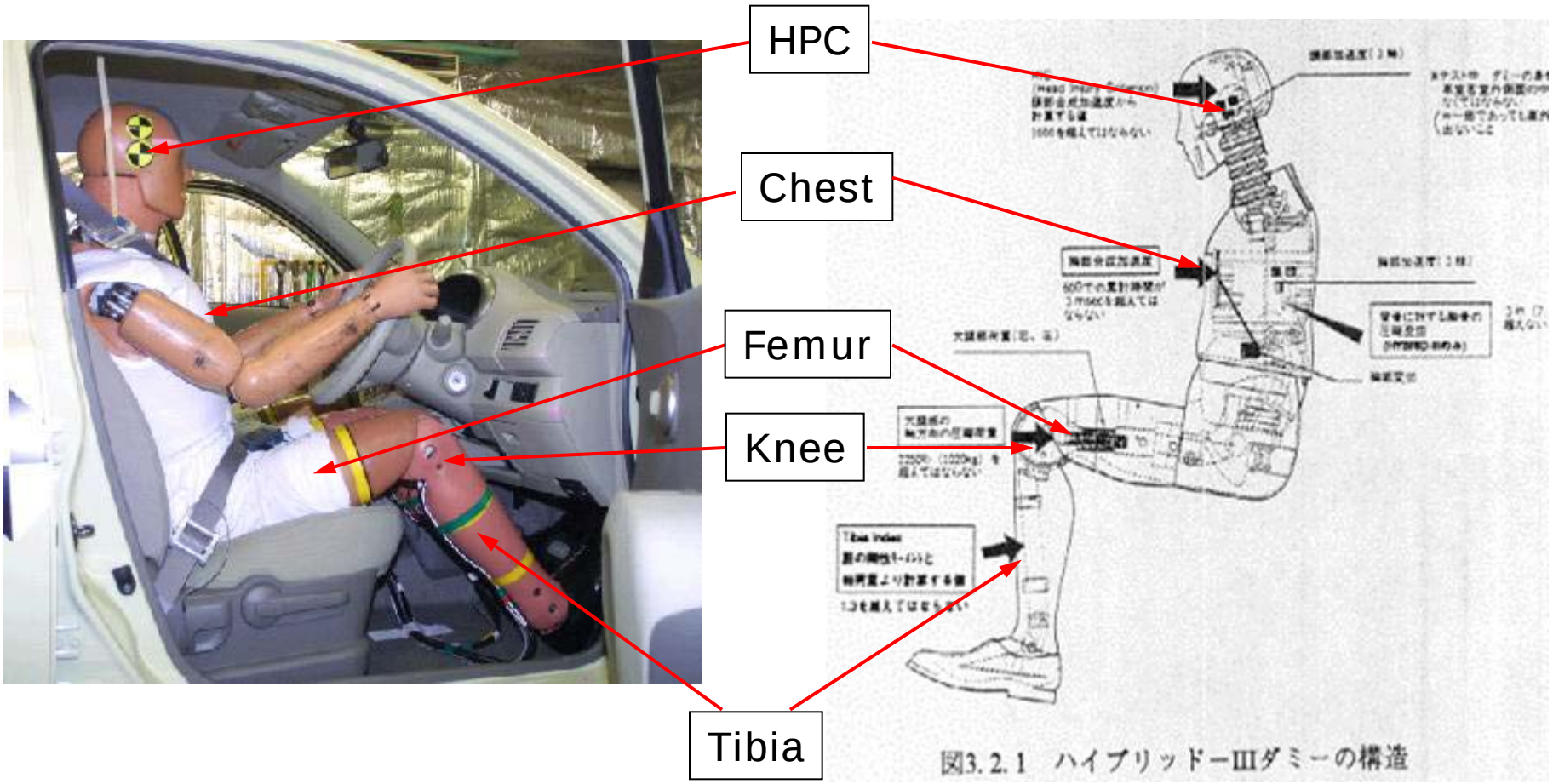
# 2-2. Summary of Injury Criteria

Japan Automobile Standards Internationalization Center

- Following Injury levels are measured and evaluated.

| Injury Criteria | | Limit of maximum value |
|---|---|---|
| Head | HPC | ≦1000 |
| | G-3msec | ≦80G-3ms |
| Neck | Neck tension criterion | ≦3.3kN(0ms), 2.9kN(35ms), 1.1kN(60ms) shall not exceed the force-time performance |
| | Neck Shear criterion | ≦3.1kN(0ms), 1.5kN(25-35ms), 1.1kN(45ms) shall not exceed the force-time performance |
| | Neck Bending Moment | ≦57Nm |
| Chest | Thorax compression criterion (ThCC) | ≦50mm |
| | Viscous criterion (V*C) | ≦1.0m/s |
| Femur | Femur Force criterion | ≦9.07kN(Oms), 7.56kN(10ms) shall not exceed the force-time performance |
| Knee | Knee Slider | ≦15mm |
| Tibia | Tibia compression force | ≦8KN |
| | Tibia Index | ≦1.3 |

# 2-2. Summary of Injury Criteria

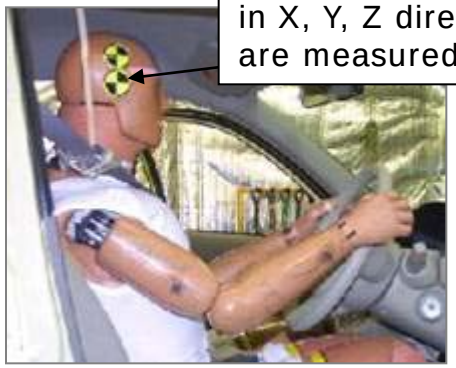


# 2-2-1. Head Injury

## HPC (Head Performance Criteria)

- HPC is considered to be satisfied, if no contact between the head and any vehicle component.

- If there is contact between the head and vehicle component, calculation of HPC is made by resultant of head acceleration in XYZ.




Resultant of head acceleration:

$$a = \sqrt{X^2 + Y^2 + Z^2}$$

$$HPC = (t_2 - t_1)\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2} a\,dt\right]^{2.5}$$

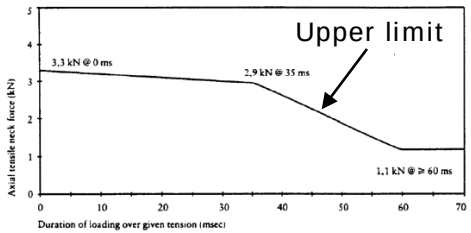
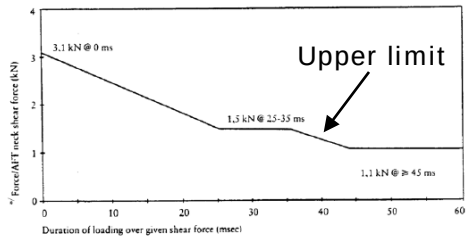

## Head G-3msec

- The resultant head G during forward impact which is exceeded for 3 ms cumulatively is calculated from the resultant head acceleration measured.

# 2-2-2. Neck Injury

## NECK INJURY CRITERIA (NIC)

- The compressive axial force, the axial tensile force and the fore/aft shear forces at the head/neck interface, expressed in kN and measured and by the duration of these forces expressed in ms.
- The neck bending moment criterion is determined by the bending moment, expressed in Nm, about a lateral axis at the head/neck interface and measured.

| | | |
|---|---|---|
| **Neck tension criterion** | **≦3.3kN(0ms), 2.9kN(35ms), 1.1kN(60ms)** shall not exceed the force-time performance | Figure 1: Neck tension criterion   |
| **Neck Shear criterion** | **≦3.1kN(0ms), 1.5kN(25-35ms), 1.1kN(45ms)** shall not exceed the force-time performance | Figure 2: Neck shear criterion   |
| **Neck Bending Moment** | **≦57Nm** | |

# 2-2-3. Chest Injury

| | | |
|---|---|---|
| **Chest** | **Thorax compression criterion (ThCC)** | **≦50mm** |
| | **Viscous criterion (V*C)** | **≦1.0m/s** |

- Thorax compression criterion is determined by the absolute value of the thorax deformation, expressed in mm.

- Viscous criterion (V*C) is calculated as the instantaneous product of the compression and the rate of deflection of the sternum. Both are derived from the measurement of sternum deflection.

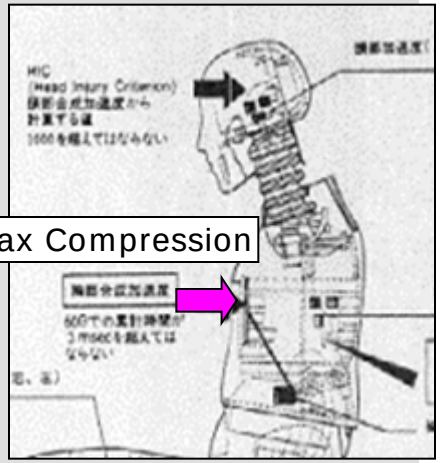
The sternum deflection response is filtered once at CFC 180. The compression at time t is calculated from this filtered signal as:

$$C_{(t)} = \frac{D_{(t)}}{0.229}$$

The sternum deflection velocity at time t is calculated from the filtered deflection as:

$$V_{(t)} = \frac{8\left(D_{(t+1)} - D_{(t-1)}\right) - \left(D_{(t+2)} - D_{(t-2)}\right)}{12\partial t}$$

where D(t) is the deflection at time t in meters and partial t is the time interval in seconds between the measurements of deflection. The maximum value of partial t shall be 1.25x 10-4 seconds.



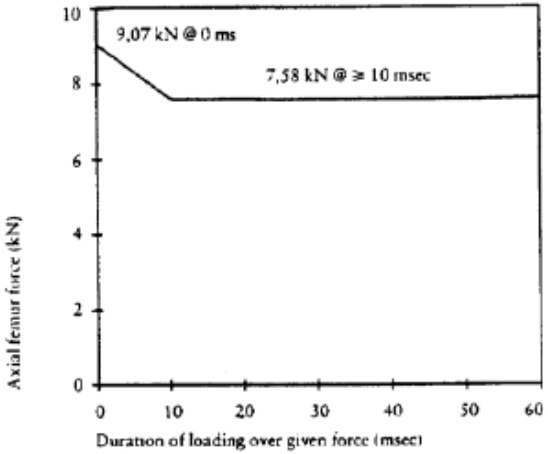
# 2-2-4. Femur Force Injury

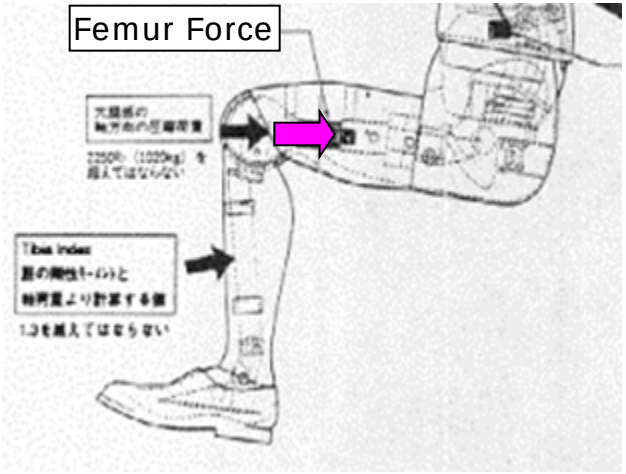
## FEMUR FORCE CRITERION (FFC)

- This criterion is determined by the compression load expressed in kN, transmitted axially on each femur of the dummy and measured.

| Injury Criteria | | Limit of maximum value |
|---|---|---|
| **Femur** | **Femur Force criterion** | **≦9.07kN(0ms), 7.56kN(10ms)** shall not exceed the force-time performance |

**Figure 3: Femur force criterion**



# 2-2-5. Tibia Injury

FEMUR FORCE CRITERION (FFC)

- The tibia compressive force criterion is determined by the compressive load (Fz) expressed in kN, transmitted axially on each tibia of the dummy

- The tibia index is calculated on the basis of the bending moments (Mx and My)

$$TI = |M_R/(M_C)_R| + |F_Z/(F_C)_Z|$$

$$M_R = \sqrt{(M_X)^2 + (M_Y)^2}$$

Mx = bending moment about the x axis
My = bending moment about the y axis
(Mc)R = critical bending moment and shall be taken to be 225 Nm
FZ = compressive axial force in the z direction
(Fc)Z = critical compressive force in the z direction
and shall be taken to be 35.9 kN

$$TI = \left| \frac{\sqrt{(M_X)^2 + (M_Y)^2}}{225} \right| + \left| \frac{Fz}{35.9} \right|$$

Tibia Index is calculated for Upper/Lower of tibia; The value obtained is used for the top and bottom TI.
Moments Mx and My are both measured separately at both locations.

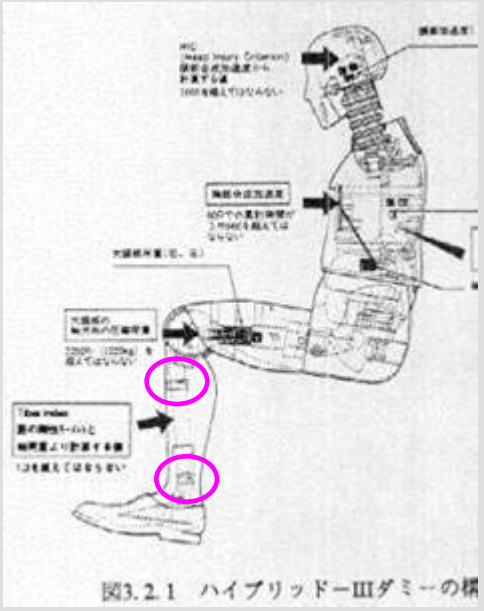


図3.2.1 ハイブリッドIIIダミーの

# 2-3. Others

- There are injury, Steering displacement, Door Latch requirements.

| | |
|---|---|
| **Steering displacement** | **≦80 mm in the upwards vertical direction**<br>**≦100 mm in the rearward horizontal direction** |
| **Door** | During the test **no door shall open**. |
| | During the test **no locking of the locking systems** |
| **Occupant** | After the impact, it shall be possible, **without the use of tools**, |
| | To **open at least one door per row seats** |
| | To release the dummies from their restraint system which, if locked, shall be **capable of being released by a maximum force of 60 N** on the centre of the release control |
| | To **remove the dummies from the vehicle without adjustment of the seats.** |
| **Fuel leakage** | **Fuel Leakage ≦ 30 g/min** if continuous leakage after collision<br><br>Various liquids cannot easily be separated and identified, all the liquids collected shall be taken into account in evaluating the continuous leakage. |

1.Driver Airbag
Consist of the inscription "AIRBAG" located in steering wheel.
(Durably affixed and easily visible)

2. Warning label for Passenger Airbag
- Hazard for the use of rearward-facing child restraints on seats
- Label with a pictogram and text warning
- One of the languages of the Contracting Party where the application for approval is submitted.


- Warning is provided at least in one of the languages of the country in which the vehicle is to be sold.
- Durably affixed to each face of the passenger front sunvisor
  (at least one warning on the sun visor is visible at all times)
-Owner's manual; following text in the official languages of the country where the vehicle is to be registered,
"Do not use a rearward facing child restraint on a seat protected by an airbag in front of it"

# Example of Warning label for Passenger Airbag


# Appendix

# ECE R94 Contents

R94 Contents

1. Scope
2. Definitions
3. Application for approval
4. Approval
5. Specifications
6. Instructions for users of vehicles equipped with airbags
7. Modification and extension of approval of the vehicle type
8. Conformity of production
9. Penalties for non-conformity of production
10. Production definitely discontinued
11. Transitional provisions
12. Names and addresses of Technical Services responsible for conducting approval tests, and of Administrative Departments

# ECE R94 Contents

R94 ANNEXES

Annex 1 - Communication concerning the approval or extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type with regard to the protection of the occupants in the event of a frontal collision, pursuant to Regulation No. 94

Annex 2 - Arrangements of the approval mark

Annex 3 - Test procedure

Annex 4 - Determination of performance criteria

Annex 5 - Arrangement and installation of dummies and adjustment of restraint systems

Annex 6 - Procedure for determining the "H" point and the actual torso angle for seating positions in motor vehicles

Appendix 1 - Description of the three-dimensional "H" point machine

Appendix 2 - Three-dimensional reference system

Appendix 3 - Reference data concerning seating positions

Annex 7 - Test procedure with trolley

Appendix - Equivalence curve - Tolerance band for curve deltaV = f(t)

Annex 8 - Technique of measurement in measurement tests: instrumentation

Annex 9 - Definition of the deformable barrier

Annex 10 - Certification procedure for the dummy lower leg and foot

# Introduction of UN / ECE R95

# Requirement for Side Impact regulation

*6th OCT 2011*

*Takao Tani*

*JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER*

# Contents

# History of Side Impact

- Side Impact test is to evaluate the occupant safety in case of Side Impact in real world.

- The ratio of fatal/serious injuries by Frontal crash and Side impact is high, therefore test method was developed in Europe and US in 80's.

- FMVSS 214 Side Impact regulation was started from 1993.
- ECER95 Side Impact was started from 1998.

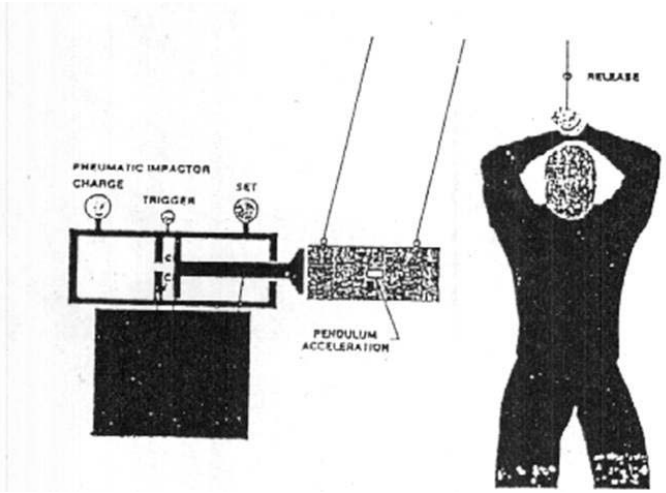



Fig.1 Example of cadaver test

# 1-1. Scope

- ECE R95 Side Impact test was applied for brand new vehicles from 1998 and all vehicles from 2003 in Europe.

- Category

M1: Passenger vehicles with seating positions are not more than 8 except for a driver

N1: Goods transporting vehicles with gross weight no more than 3.5 tons

- R point* ≦700mm from ground level
  (with reference mass of 100kg dummy and instrumentation)

*R point:
The Lowest and most rearward normal driving position
3D coordinates determined in relation to the vehicle structure

# What is Side Impact?


Movie

# 1-2. Introduction of Side Impact test

- Mobile Deformable Barrier (MDB) impacts the driver's door at 50 km/h.
- The injury protection is assessed by a crash test dummy in the driver's seat.

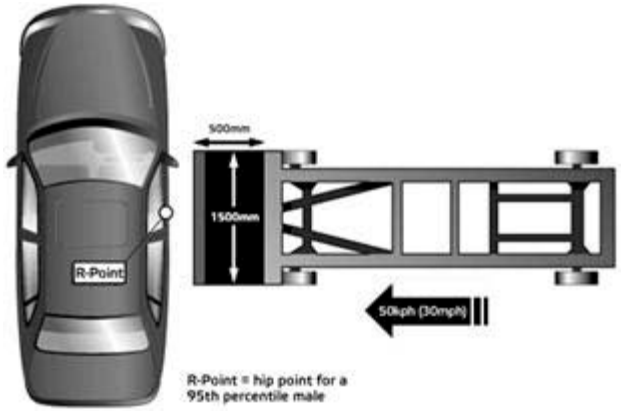



Fig.1 Plan View of test condition

Fig.2 deformable barrier

# 1-3. Introduction of Dummies

- Side Impact dummy called EuroSID2 (ES-2) is used to evaluate the injury levels.

- ES-2 side impact dummy was applied from 2007 as next generation of the EuroSID1 from 1998.

Fig.1 ES-2 (AM50)

Fig.2 ES-2 (Post-test)

# 2. Requirements

Following requirements are in R95.

2-1. Injury criteria measured by ES2 dummy.

2-2. Others

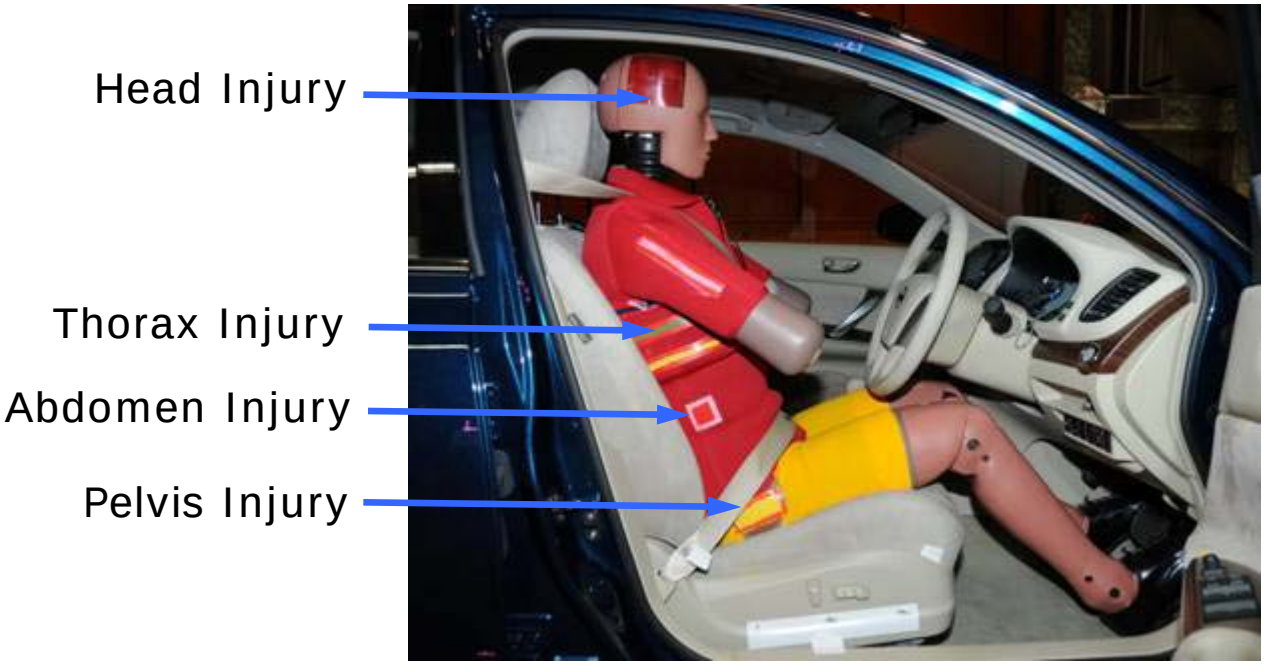
- Door Open/ Door Lock
- Occupant rescue performance
- Fuel leakage

# 2-1. Summary of Injury Criteria

Japan Automobile Standards Internationalization Center

- Following Injury levels are measured and evaluated.

| Performance Criteria | | Limit of maximum value |
|---|---|---|
| Head | HPC | ≦1000 |
| Thorax (Chest) | Rib Deflection Criterion (RDC) | ≦42mm |
| | Viscous criterion (V*C) | ≦1.0m/s |
| Abdomen | Abdomen Peak Force (APF) | ≦2.5KN |
| Pelvis | Pubic Symphysis Peak Force (PSPF) | ≦6KN |



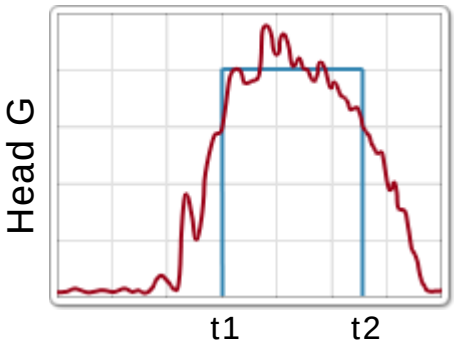
# 2-1-1. Head Injury

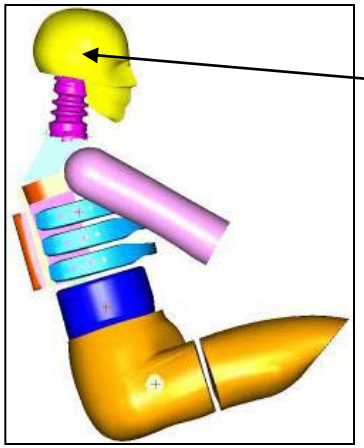
HPC (Head Performance Criteria) ≦1000

- When head contact takes place, HPC is calculated for the total duration between the initial contact and the last instant of the final contact.
- HPC is the maximum value of the expression:

$$HPC = (t_2 - t_1)\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2} a\,dt\right]^{2.5}$$

where “a” is the resultant acceleration at the centre of gravity of the head in m per second per second divided by 9.81 recorded versus time; t1 and t2 are between the initial contact and the last instant of the final contact.



Head acceleration in X, Y, Z direction are measured.

# 2-1-2. Thorax Injury

| | | |
|---|---|---|
| **Thorax** | **Rib Deflection Criterion(RDC)** | **≦42mm** |
| | **Viscous criterion (V*C)** | **≦1.0m/s** |

- Peak chest deflection is the maximum value of deflection on 3 ribs as determined by the thorax displacement transducers.

- Viscous criterion (V*C) is calculated as the instantaneous product of the compression and the rate of deflection of the rib. Both are derived from the measurement of rib deflection.

The rib deflection response is filtered once at CFC 180. The compression at time t is calculated from this filtered signal as:

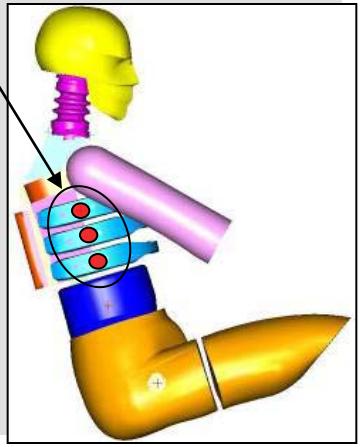
$$C(t) = \frac{D_{(t)}}{0.14}$$

The sternum deflection velocity at time t is calculated from the filtered deflection as:

$$V_{(t)} = \frac{8\left(D_{(t+1)} - D_{(t-1)}\right) - \left(D_{(t+2)} - D_{(t-2)}\right)}{12\partial t}$$

where D(t) is the deflection at time t in meters and partial t is the time interval in seconds between the measurements of deflection. The maximum value of partial t shall be 1.25x 10-4 seconds.

3 Ribs (Upper/Mid/Lower) are measured



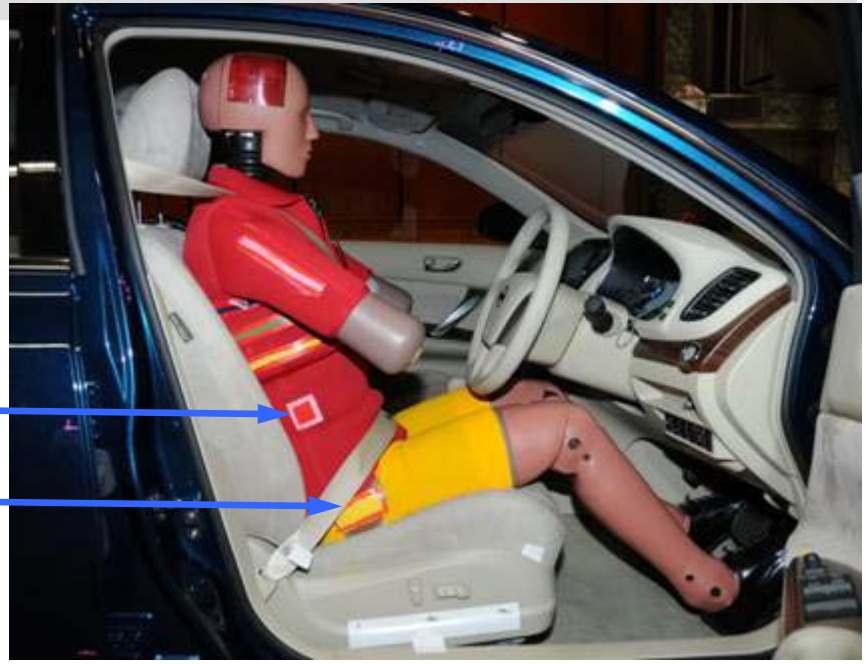
# 2-1-3. Abdomen and Pelvis injury

- Abdomen Peak Force (APF) ≦2.5KN

The peak abdominal force is the maximum value of the sum of the three forces.

- Pubic Symphysis Peak Force (PSPF)

The pelvis injury is measured by a load cell at the pubic symphysis of the pelvis.



# 2-2. Others

- No door open during the test
- Without the use of tools to:
  - open a sufficient number of doors
  - release the dummy from the protective system (Seatbelt etc)
  - remove the dummy from the vehicle

# 2-2. Others

- No sharp edge

No interior device or component detached, not to increase the risk of injury from sharp projections or jagged edges.

# 2-2. Others

- Fuel leakage

Rate of leakage: Not exceed 30g/min.

If fuel liquid cannot be saparated and identified, all liquids are evaluated.

Japan Automobile Standards Internationalization Center

# Thank you for your attention

# Test Procedure for Occupant Protection in the event of Frontal Collision

October 6, 2011

Automobile Type Approval Test Department

Collision Safety Group

# Outline

1. Overview of collision test
2. Test equipments
3. Test procedure
4. Analysis of test result
5. Additional requirements for EV, HEV and FCV
6. Summary

# - Occupant Protection Test in Frontal Collision -

**Test summary:** Dummy is mounted on test vehicle.
Front offset collision is performed against vertical barrier.
Vehicle performance is evaluated by measuring impact to the dummy's head, chest and leg.

**Test dummy:** - Hybrid III (incorporated into Code of Federal Regulations) with ankle joints having an angle of 45°
- represents a $50^{th}$ percentile adult male

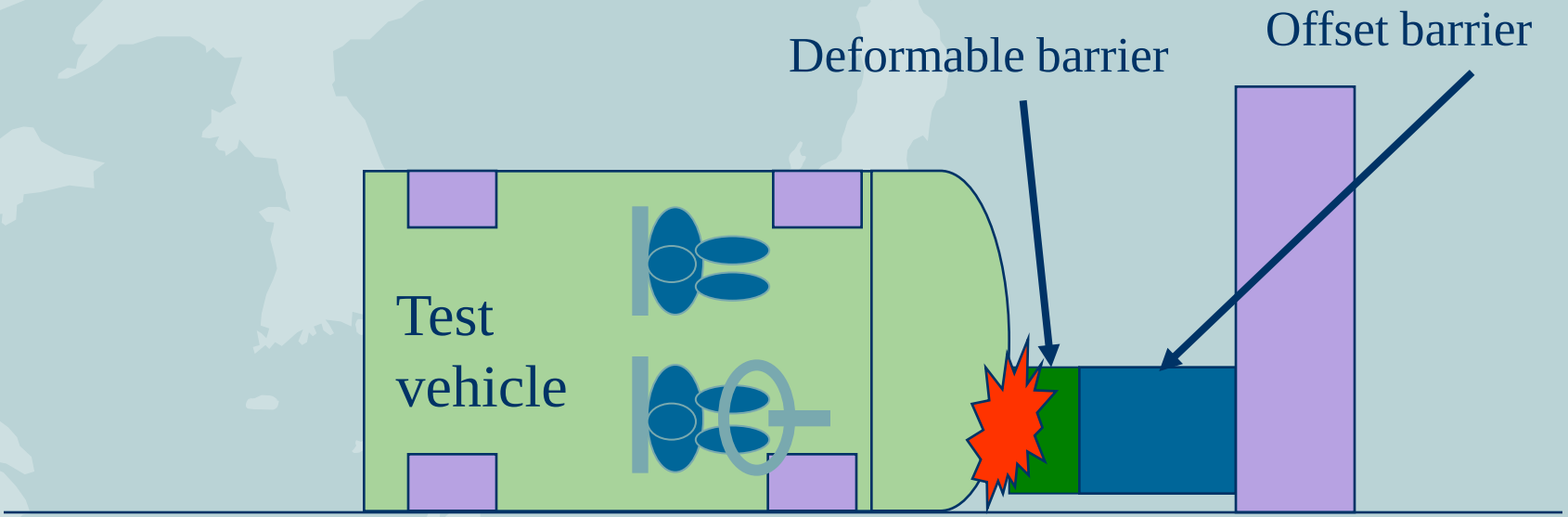
**Dummy position:** driver's seat and passenger seat

**Impact position:** 40%±20mm of vehicle width; steering column side

**Impact velocity:** $56^{+1}_{-0}$ km/h

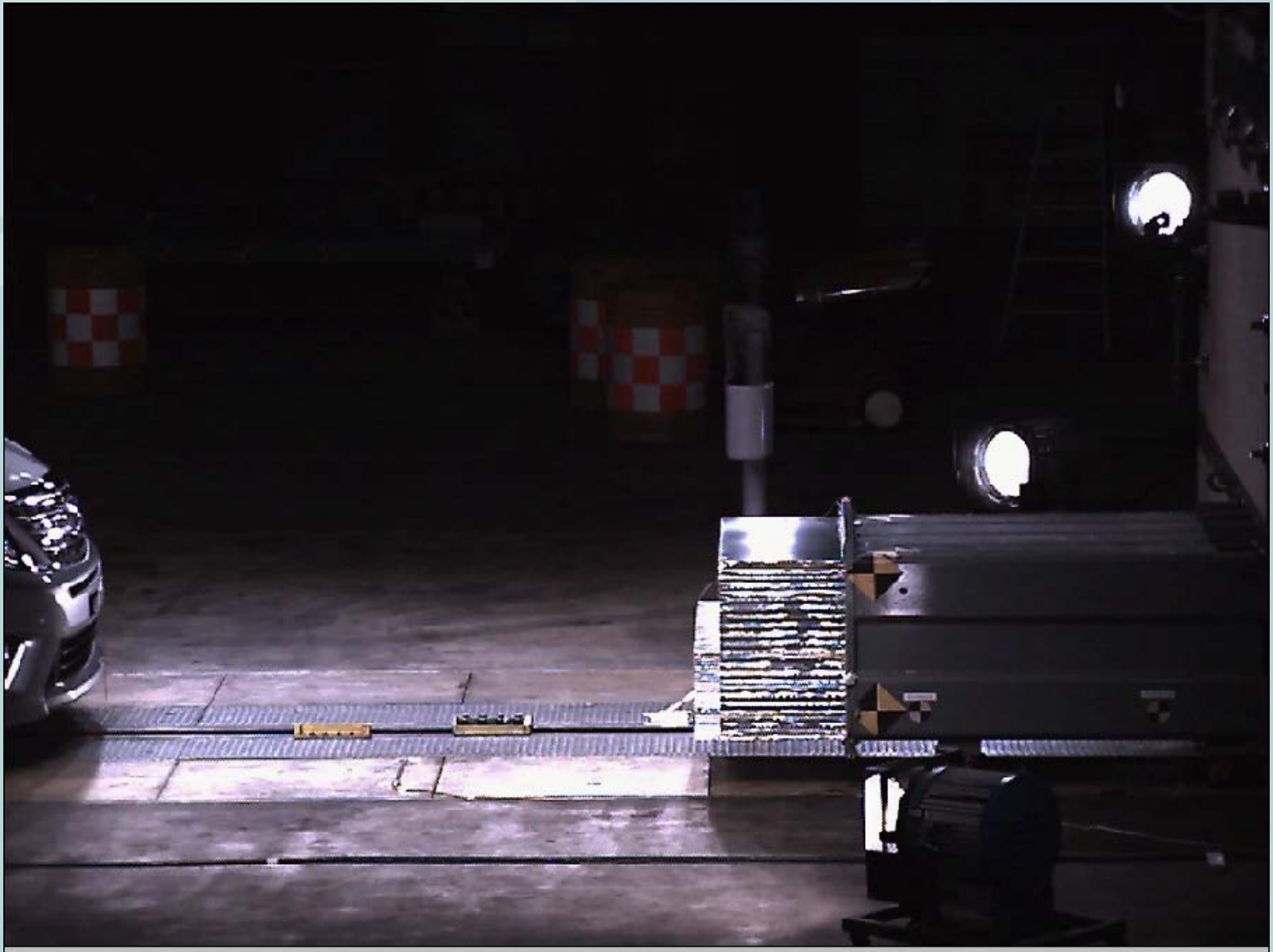
**H point:** measurement using three-dimensional manikin

# Occupant Protection Test in Frontal Collision




$56 \pm {}^{1}_{0}$km/h

# Movie of Frontal Collision Test



ALPHARD_Rside.avi

# - Major Differences of Collision Tests -

| | Lateral collision | Frontal collision |
|---|---|---|
| Test summary | Trolley is collided into test vehicle | Test vehicle is collided into vertical barrier |
| Test dummy | EUROSID II | HYBRID III |
| Dummy installation position | Driver's seat or passenger's seat | Driver's seat and passenger's seat |
| Impact position | Vehicle lateral side with disadvantageous performance; barrier surface of trolley | 40%±20mm of vehicle width Steering column side |
| Impact velocity | 50±1km/h | $56^{+1}_{-0}$km/h |
| H point measurement | Three-dimensional manikin | Three-dimensional manikin |

# Outline

1. Overview of collision test
2. Test facilities and equipments
3. Test procedure
4. Analysis of test result
5. Additional requirements for EV, HEV and FCV
6. Summary

# - Collision Safety Test Building -

Kumagaya Proving Ground: Collision Test Bldg.


Barrier bldg.

Test track

Launch bldg. (soak room)

# - Instrumentation-

Test dummy

- Set accelerometer and displacement sensor inside test dummy

Head – accelerometers to measure each direction of the 3 axles (XYZ)

Neck: 6 axle load meter (moment gauge)

Thorax: displacement sensor to measure rib displacement

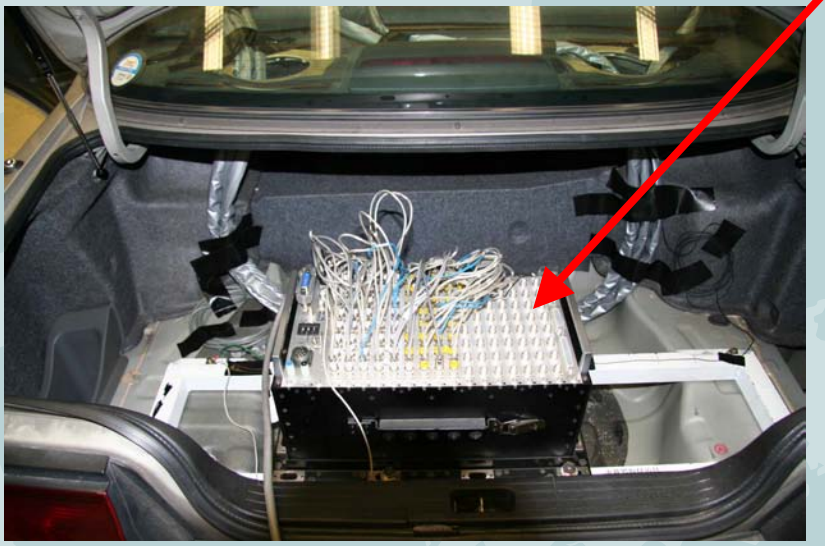
Femur: load meter to measure influence from vehicle body

Tibia: load meter to measure influence from vehicle body

Knee: string-type displacement sensor to measure slide movement

# - Instrumentation -

## On-board data acquisition device



Device is controlled by a computer.

## Data acquisition device

Records measurement signals from accelerometer, etc. set inside dummy

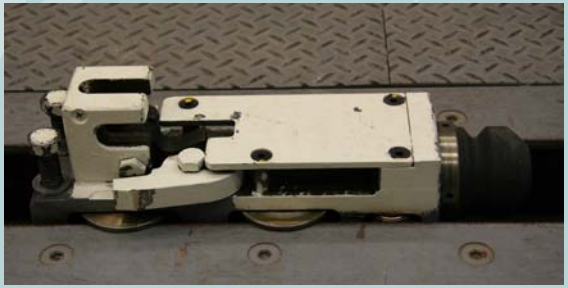
# - Towing Device -

## 1. Retracting-type wire rope


The wire is buried underground

## 2. Towing dolly

Wire connecting side

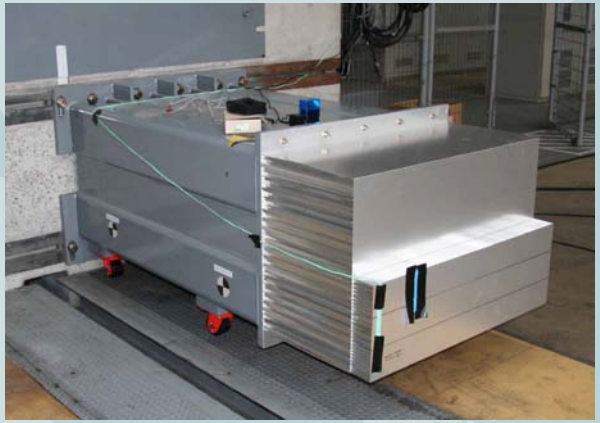


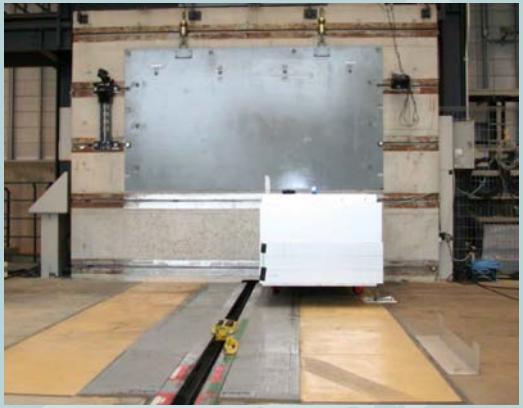
Side connected to test vehicle

Connected state

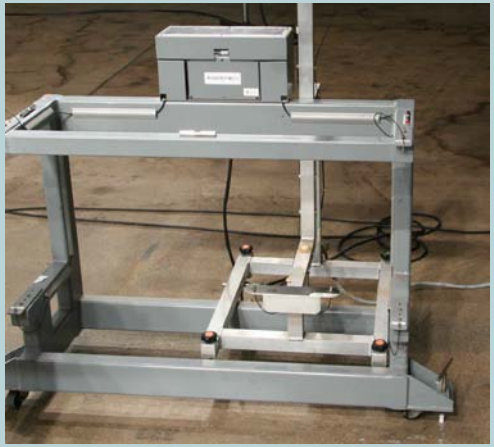
# - Devices of Barrier Building -

## Impact barrier and aluminum honeycomb





## Speed meter



## Striker (removes dolly)

## High-speed video camera

## Illumination equipment

# - Measuring Equipment -

## Three-dimensional measuring device

**This device:**
**- simultaneously measures length, depth and height of the object**

**- displays any position the tip of probe shows at a coordinate**

**- measures H point of three-dimensional manikins and dummies**

## Thermometer

**- records temperature of test dummy and measurement system**

# Outline

1. Overview of collision test
2. Test equipments
3. Test procedure
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6. Summary

# 1. Confirmation of Test Vehicle

## ① Confirmation of selected test vehicle

→ Seat specifications, power train system, presence of airbag, etc.

## ② Vehicle state

→ Effects on test results caused by normally fitted devices / removed devices

## ③ Weight measurement

→ Check vehicle mass does not differ from unladen kerb mass

## ④ Position of steering wheel

→ Measure displacement of the steering wheel center after the test

# Vehicle Mass

## Unladen kerb mass

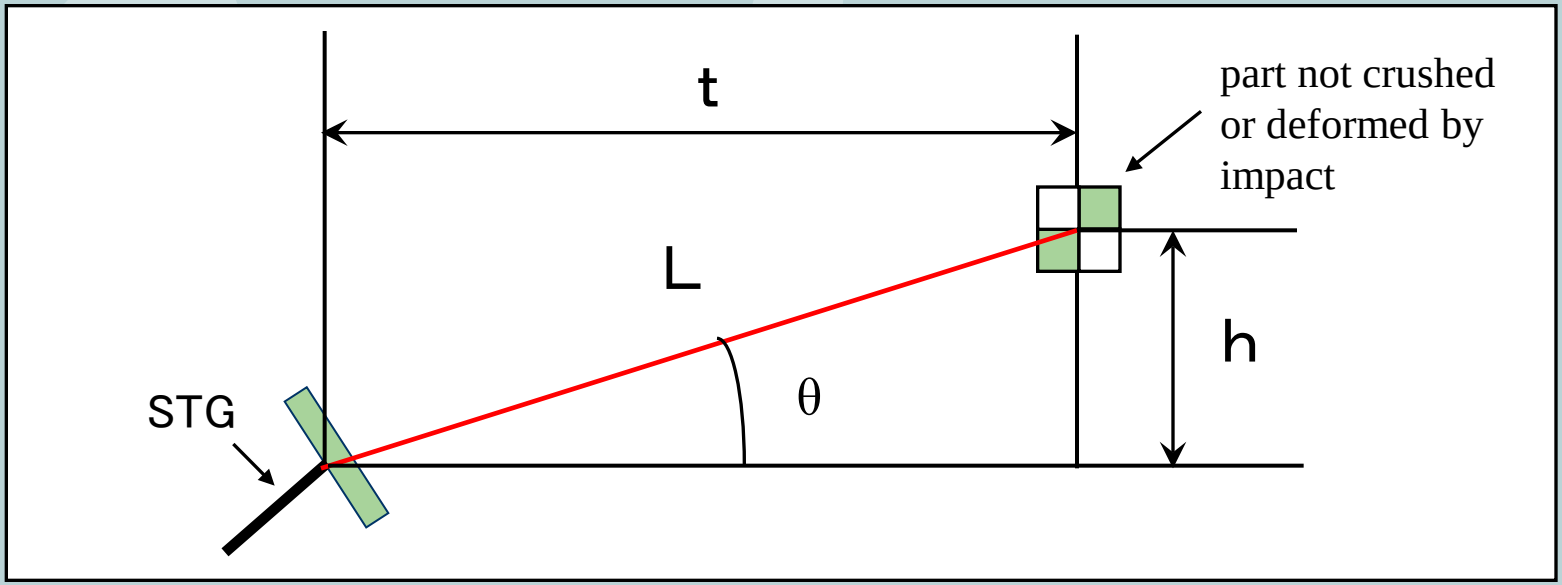
**The mass of the vehicle in running order, unoccupied and unladen but complete with fuel, coolant, lubricant, tools and a spare wheel (if these are provided as standard equipment by the vehicle manufacturer).**

### Other requirements

- **Fuel tank: fill with water or mass equal to 90±1% of the mass**
- **Remove oils and accessories = offset with equivalent mass**
- **Instrumentation: if the mass exceeds 25kg, compensate by reduction which has no effect on results**
- **Measuring device: the mass shall not exceed each axle reference load by more than 5%, each variation not exceeding 20kg**

# Position of Steering Wheel

1. Co-ordinate method
   (three-dimensional instrumentation)
2. Simplified method




$t = L\cos\theta$

$h = L\sin\theta$

# 2. Determination of H Point and Actual Torso Angle

① Judgment of H point, actual torso angle & R point, and design torso angle

H point : within a square of 50mm side length with horizontal and vertical sides whose diagonals intersect at the R point

Actual torso angle: within 5 degrees of design torso angle

② State of seat

Fore/aft position: rearmost normal driving or riding position

③ Installation of three-dimensional manikin

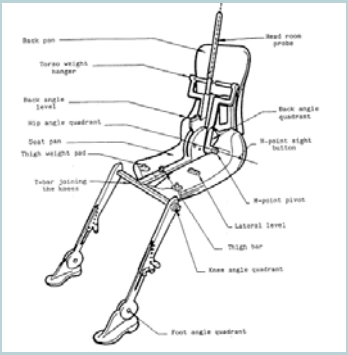
Room temperature: 20±10℃

④ Measurement

H point: three-dimensional measuring device

Actual torso angle: back angle quadrant

Three-dimensional manikin



# 3. Installation of Impact Dummy

## ① Dummy clothing and shoes

Garments with short sleeves: mid-calf length trousers
(specified in US Federal Motor Vehicle Safety Standard)

Shoes: weight 0.57±0.1kg (US military standard)

## ② Adjustment of passenger compartment

Fore/aft position of seat: mid-position of travel or nearest position

Height: position specified by vehicle manufacturer

Seatback: angle specified by vehicle manufacturer or inclination of 25°

Headrest: highest position

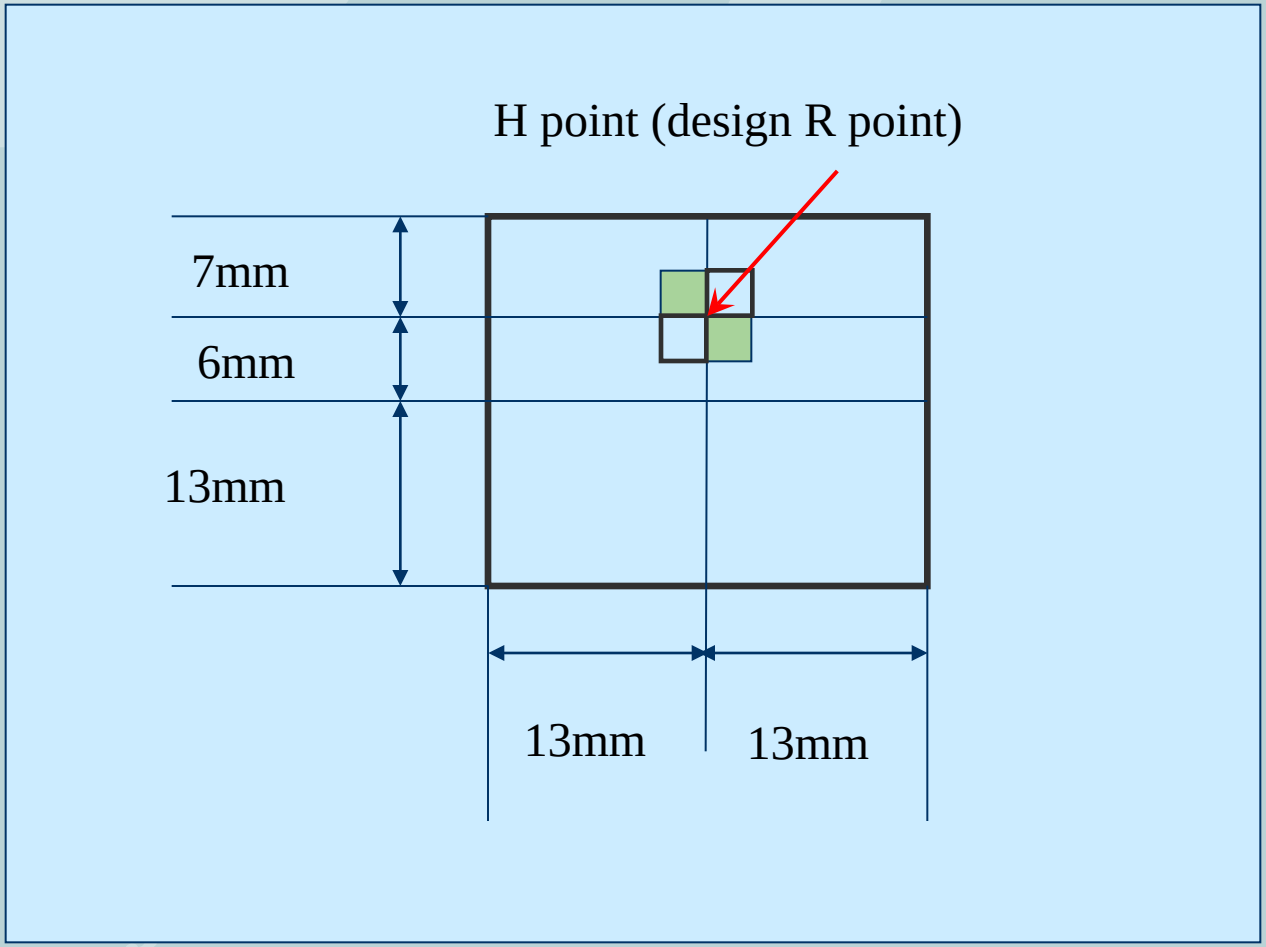
Steering wheel: normal position or middle position specified by vehicle manufacturer

# ③ Arrangement and Installation of Dummy

Head: Head angle shall be within ±2.5° of the horizontal

Pelvic angle: The angle determined by inserting the pelvic angle gauge into the H point gauging hole shall be 22.5±2.5° from the horizontal

# ④ H Point



# 4. Instrumentation System File

## ① Creation of system file

**Enter the performance of the mounted dummy's information, for example the calibration value, into analysis software**

# 5. Soak (stabilize vehicle to a fixed state)

## ① Temperature of test dummy and measurement system

→ Stabilized temperature: 19℃ - 22℃

Soak time: over 4 hours (Technical Standard for Occupant Protection in Frontal Collision)

## ② Confirmation of soak

→ Check temperature and elapsed time with thermometer

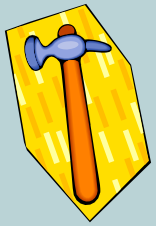
# 6. Setting of Instrumentation

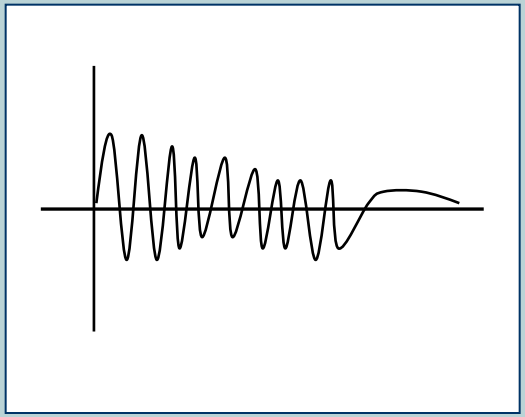
## ① Connection of instrumentation

Connect each sensor of the dummy to On-board data acquisition device.

## ② Hammering

Confirm wire breakage and abnormal waveforms, after impacting each part of dummy.

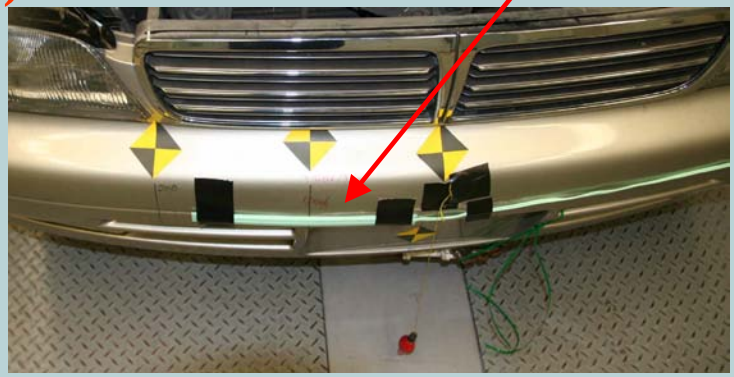




# ③ Confirmation of Trigger

(detect starting point of impact)

tape switch



Check normal input of trigger signal into On-board data acquisition device

# ④ Calibration

Determine reference point (zero point)
(response point differs according to instrumentation)

# 7. Setting of Test Vehicle

## ① Attachment of towing cable

→ Attach cables to test vehicle's front and rear

## ② Attachment of dolly

→ Connect underground wire and test vehicle

## ③ Deviation

→ Make markings to measure deviation between test vehicle and barrier

## ④ Apply greasepaint

→ Apply greasepaint to head, tibia, etc. of dummy to confirm secondary impact

# 8. Final Check in Launch Room

## ① Confirmation of passenger compartment

Position of seat and head restraints
Position of inside rear view mirror
Position of sun-visor
State of window glass
Door is closed (not locked)
Starting system etc.

(also checked immediately before test)

## ② Dolly

connected condition, handles for removal, etc.

## ③ Greasepaint

for test dummy, etc.

# 9. Setting of Impact Site

## ① High-speed video camera

Left (behavior of passenger's seat dummy), right (behavior of driver's seat dummy, entire vehicle), upper part (entire vehicle, opening of doors)

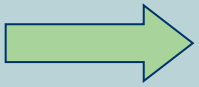
## ② Illumination

For high-speed video camera recording

## ③ Speed meter

Immediately before impact, near rear edge of vehicle

## ④ Confirmation of deviation



Application of greasepaint to mark impact point on aluminum barrier

## ⑤ Confirmation of fuel leakage

Preparation of fuel leakage pan

# 10. Test

## ① Setting of towing device and operating device

→ Enter specifications of test vehicle in operating device

## ② Lighting up of illumination

→ Light up illumination 10 minutes before starting test

## ③ High-speed video camera

→ Prepare each video camera in a state awaiting trigger

## ④ Tension of wire rope

→ Apply tension to wire before traction
→ Prevent slackness in retention

# Outline

1. Overview of collision test
2. Test fixture
3. Test procedure
4. Analysis of test result
5. Additional requirements for EV, HEV and FCV
6. Summary

## ① Impact velocity

→ Within range of $56^{+1}_{-0}$km/h

## ② Fuel leakage

→ Measurement of leakage: 30g/min., at intervals of 1 minute and 5 minutes

## ③ Deviation from impact point

→ Within ±20mm from impact point

## ④ Restraint requirements

→ No door shall open during the test

No locking of the locking systems of the front doors shall occur during the test

## ⑤ Removal of dummy

**It shall be possible to:**

- **open at least one door per row of seats**
- **release dummy from restraint system by a maximum force of 60N on the center of the release control**
- **remove dummies from vehicle without adjusting seats**

## ⑥ Steering wheel

- **Upwards vertical direction: does not exceed 80mm**
- **Rearwards horizontal direction: does not exceed 100mm**

## ⑦ Confirmation of vehicle underside

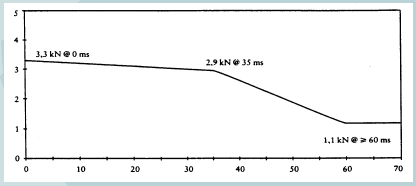
- **Check for fuel leakage, damage of test vehicle, etc.**

# ⑥ Performance criteria

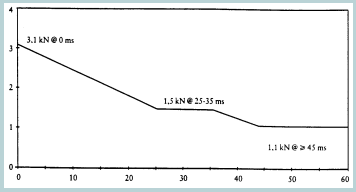
- HPC: 1,000 or less

-Resultant head acceleration : not to exceed 80 g for more than 3 ms.

- Neck injury criteria: shall not exceed the values shown in the figures below

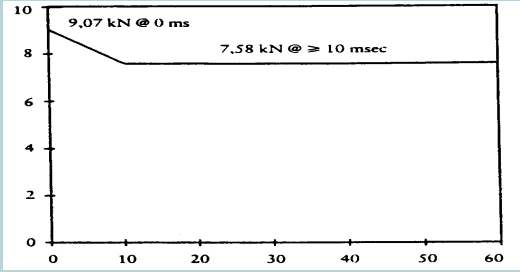



neck tension criterion




neck shear criterion

- Neck bending moment (around Y axis): not to exceed 57Nm
- Thorax compression criterion: not to exceed 50mm
- Thorax viscous criterion: not to exceed 1.0m/s
- Femur force criterion: not to exceed performance criterion shown in figure on right
- Tibia compression force: not to exceed 8kN




- Tibia index: top and bottom of each tibia not to exceed 1.3
- Sliding knee movement: not to exceed 15mm

# Outline

1. Overview of collision test
2. Test fixture
3. Test procedure
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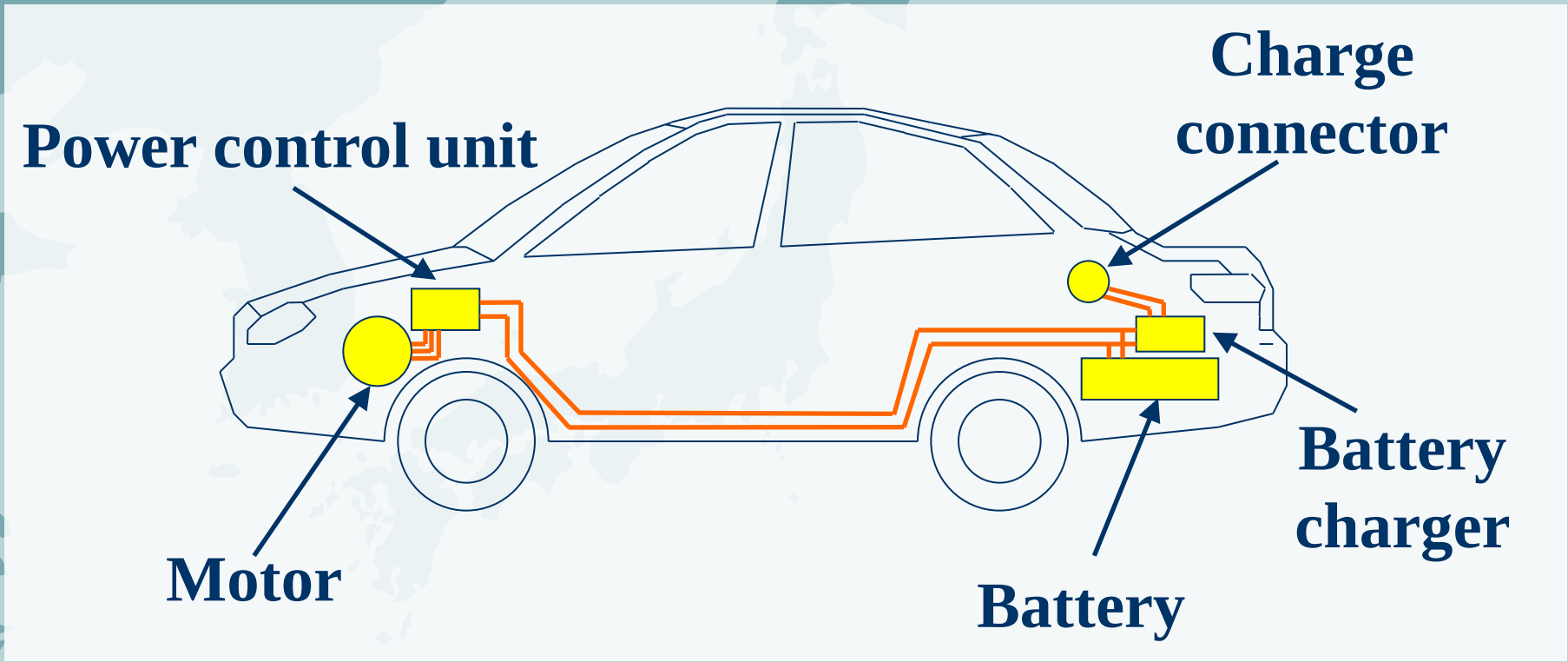
# Requirement for EV, HEV and FCV

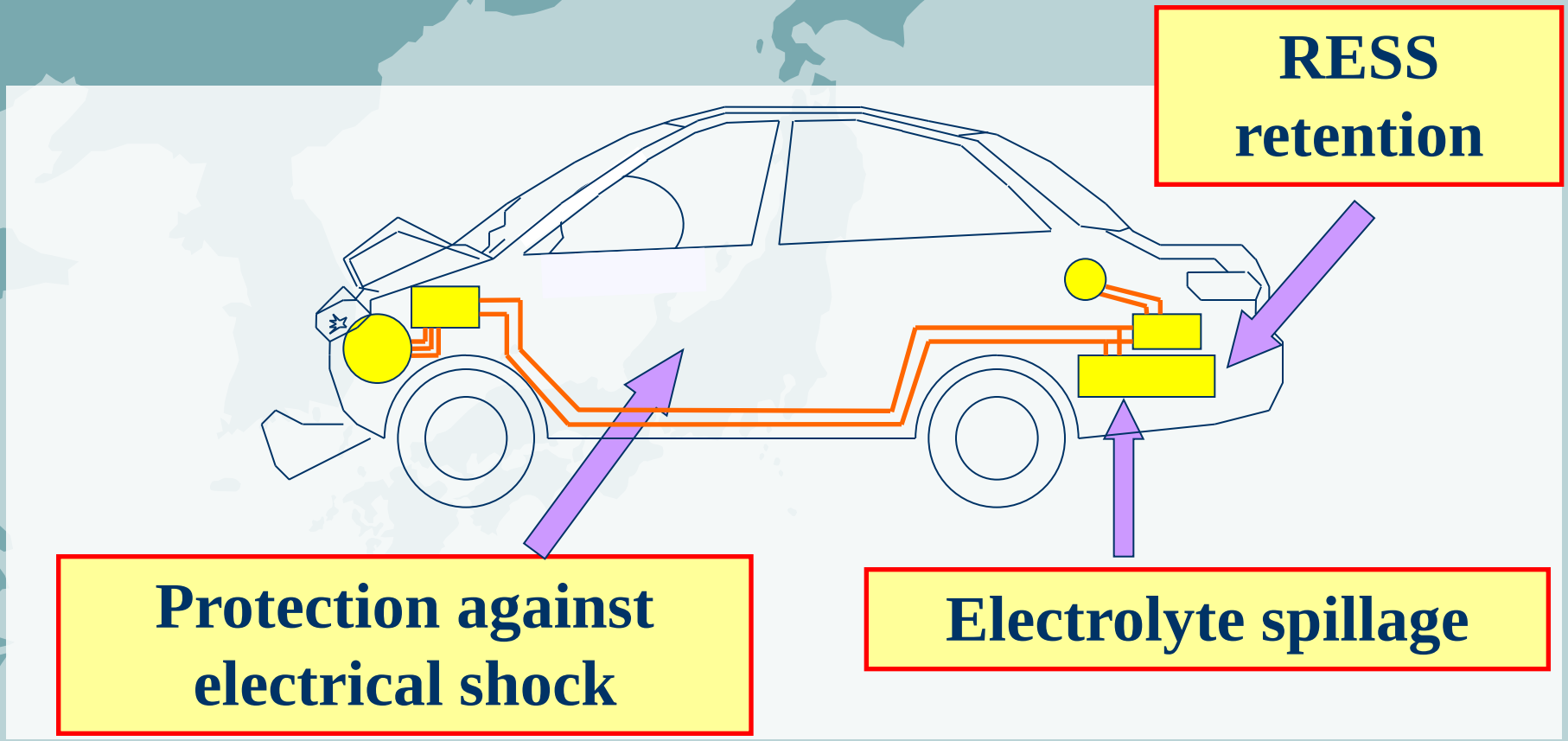
## Example of the high voltage parts




High Voltage Bus

Exposed Conductive Part

# Requirement for EV, HEV and FCV




**RESS : *Rechargeable energy storage system***

# Requirement for EV, HEV and FCV

## Protection against electrical shock

Absence of high voltage

Low electrical energy

Physical protection

Isolation resistance

## Electrolyte spillage

In the period from the impact until 30 minutes after no electrolyte from the RESS shall spill into the passenger compartment.

No more than 7 per cent of electrolyte shall spill from the RESS outside the passenger compartment.

## RESS retention

RESS located inside the passenger compartment shall remain in the location

# Outline

1. Overview of collision test
2. Test fixture
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# - Summary -

**Create test report for Occupant Protection in Frontal Collision**

**official test**

**(1) Are the test results in conformity with the Regulations?**

**(2) Are the test procedures carried out according to the standard?**

**(3) Are the test facilities set correctly? etc.**


Thank you

# Test Procedure for Occupant Protection in the event of Lateral Collision

October 6, 2011

Automobile Type Approval Test Department

Collision Safety Group

# Outline

1. Overview of collision test
2. Test equipments
3. Test procedure
4. Analysis of test result
5. Additional requirements for EV, HEV and FCV
6. Summary

# - Occupant Protection Test in Lateral Collision -

**Test summary:** Dummy is mounted on the test vehicle. A trolley is collided into the lateral side of a test vehicle, on the side the dummy is mounted. Vehicle performance is evaluated by measuring impact to the dummy's head, thorax, pelvis, and abdomen.

**Test dummy:** EUROSID II dummy representing a 50th percentile adult male; without lower arms

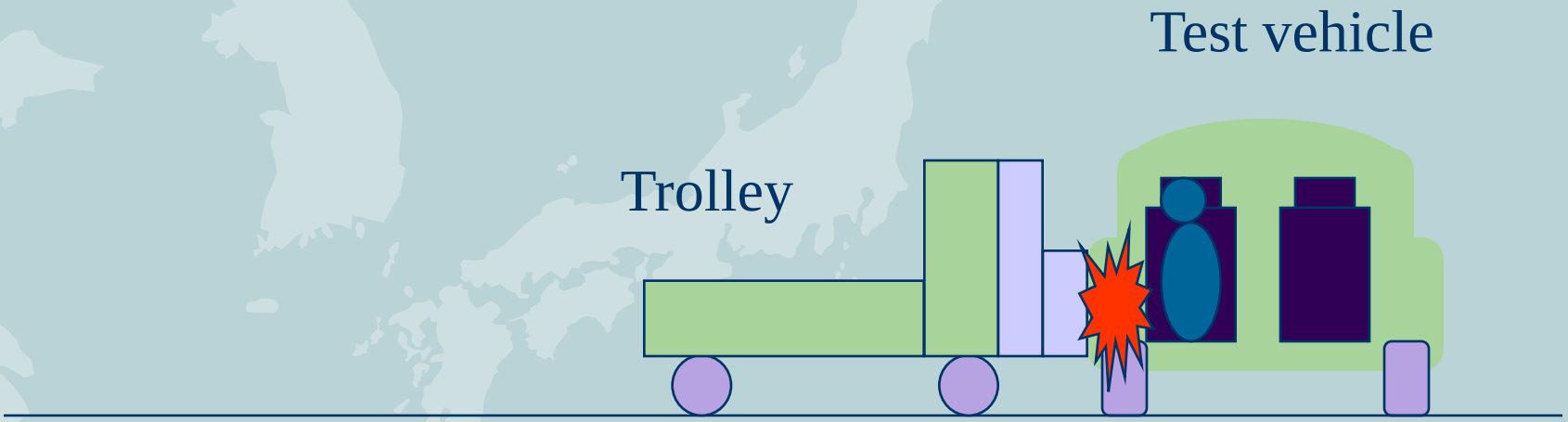
**Dummy position:** driver's seat or passenger's seat

**Impact position:** vehicle lateral side with disadvantageous performance; barrier surface of trolley

**Impact velocity:** 50±1 km/h

**H point:** measurement using three-dimensional manikin

# Test for Occupant Protection Device in Lateral Collision




50±1km/h

# Movie of Frontal Collision Test

Lexus_Lateral.avi

# - Major Differences of Collision Tests -

| | Lateral collision | Frontal collision |
|---|---|---|
| Test summary | Trolley is collided into test vehicle | Frontal collision is performed with test vehicle against vertical barrier |
| Test dummy | EUROSID II | HYBRID III |
| Dummy installation position | Driver's seat or passenger's seat | Driver's seat and passenger's seat |
| Impact position | Vehicle lateral side on with disadvantageous performance; barrier surface of trolley | 40%±20mm of vehicle width Steering column side |
| Impact velocity | 50±1km/h | $56^{+1}_{-0}$km/h |
| H point measurement | Three-dimensional manikin | Three-dimensional manikin |

# Outline

1. Overview of collision test
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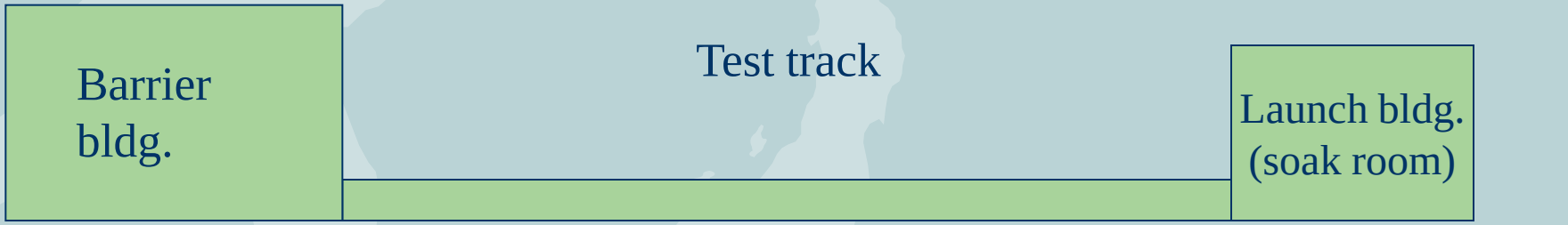
# - Collision Safety Test Building -

Kumagaya Proving Ground: Collision Test Bldg.




Barrier bldg.

Test track

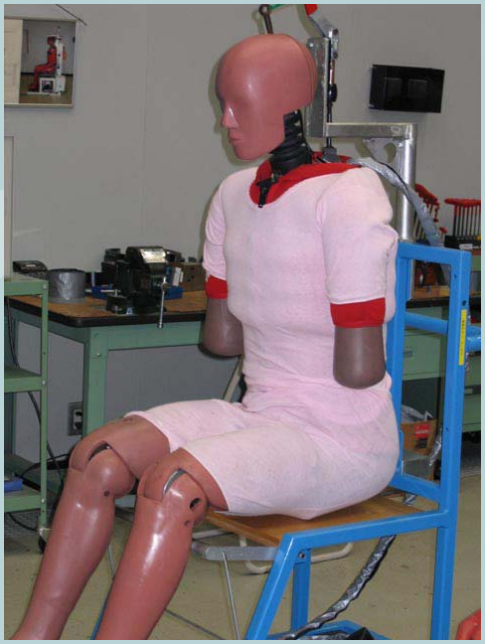
Launch bldg. (soak room)

# - Instrumentation -

## Lateral collision dummy

- Measurement of injury criteria at the moment of collision

→ Set accelerometer and displacement sensor inside test dummy



Head – accelerometers to measure each direction of the 3 axles
(head performance criterion) HPC

Thorax – displacement sensor to measure displacement of rib
(rib deflection criterion) RDC

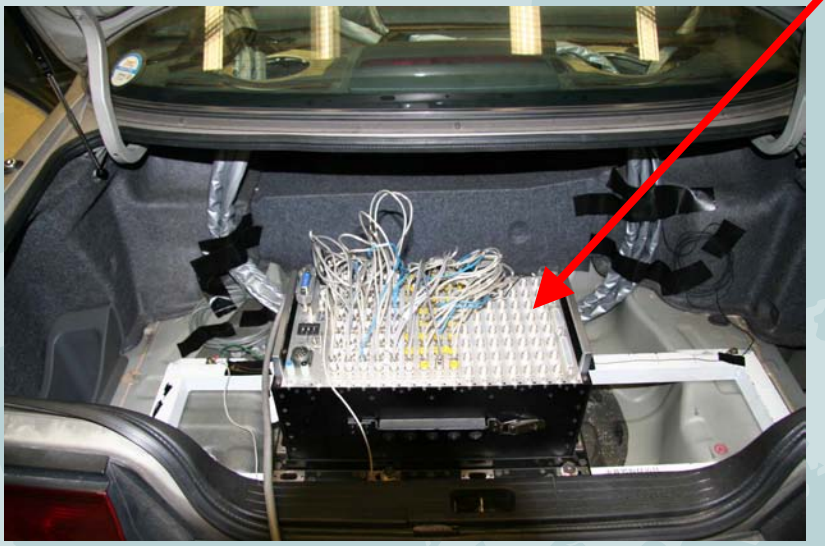
Thorax – load meter to measure amount of compression of thorax
(soft tissue criterion) VC

Hip – load meter to measure pubic symphysis of pelvis
(pubic symphysis peak force) PSPF

Abdomen – load meter to measure abdominal peak force
(abdominal peak force) APF

# - Instrumentation -

## On-board data acquisition system



Device is controlled by a computer.

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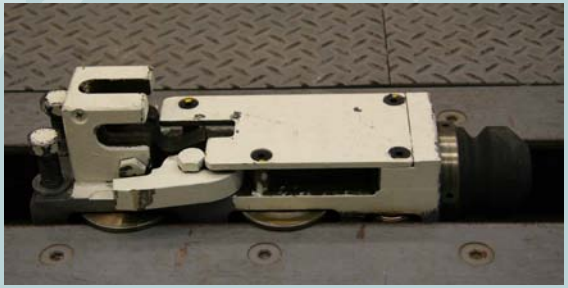
The wire is buried underground

## 2. Towing dolly

Wire connecting side



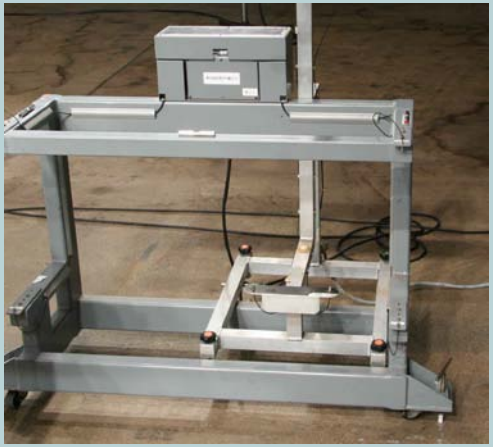
Side connected to test vehicle

Connected state

# - Devices of Barrier Building -

## Test trolley

## Speed meter



## Striker

## (removes dolly)

## High-speed video camera

## Illumination equipment

# - Measuring Equipment -

## Three-dimensional measuring device

**This device:**
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**- displays any position the tip of the probe shows at a coordinate**

**- measures H point of three-dimensional manikins and dummies**

## Thermometer

**- records temperature of test dummy and measurement system**

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# 1. Confirmation of Test Vehicle

## ① Confirmation of selected test vehicle

→ Seat specifications, power train system, presence of airbag, etc.

## ② Vehicle state

→ Effects on test results caused by normally fitted devices / removed devices

## ③ Weight measurement

→ Mass refers to reference mass

# Vehicle Mass

- **Reference Mass**

  **- unladen mass of vehicle increased by a mass of 100kg (= mass of side impact dummy and its instrumentation)**

  **- Adjusted to ±1% of reference mass**

- **Unladen Mass**

  **The mass of the vehicle in running order without driver, passengers or load, but with the fuel tank filled to 90% of its capacity and the usual set of tools and spare wheel on board, where applicable.**

**Other conditions**

**Fuel tank: fill with water or mass equal to 90±1% of the mass**

**Remove oils and accessories = offset with equivalent mass**

**Instrumentation: if the mass exceeds 25kg, compensate by reduction which has no effect on results**

**Measuring device: the mass shall not exceed each axle reference load by more than 5%, each variation not exceeding 20kg**

# 2. Determination of H Point and Actual Torso Angle

## ① Judgment of H point, actual torso angle & R point, and design torso angle

H point : within a square of 50mm side length with horizontal and vertical sides whose diagonals intersect at the R point.

Actual torso angle: within 5 degrees of design torso angle

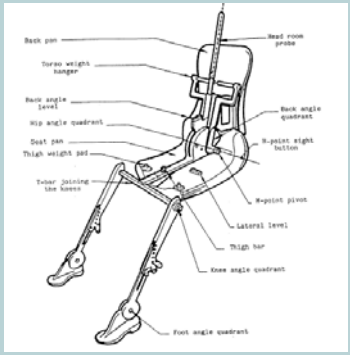
## ② State of seat

Fore/aft position: rearmost normal driving or riding position

## ③ Installation of three-dimensional manikin

Room temperature: 20±10℃

Three-dimensional manikin



## ④ Measurement

H point: three-dimensional measuring device

Actual torso angle: back angle quadrant

# 3. Installation of test Dummy

## ① Position and installation of dummy

Position: outboard front seat

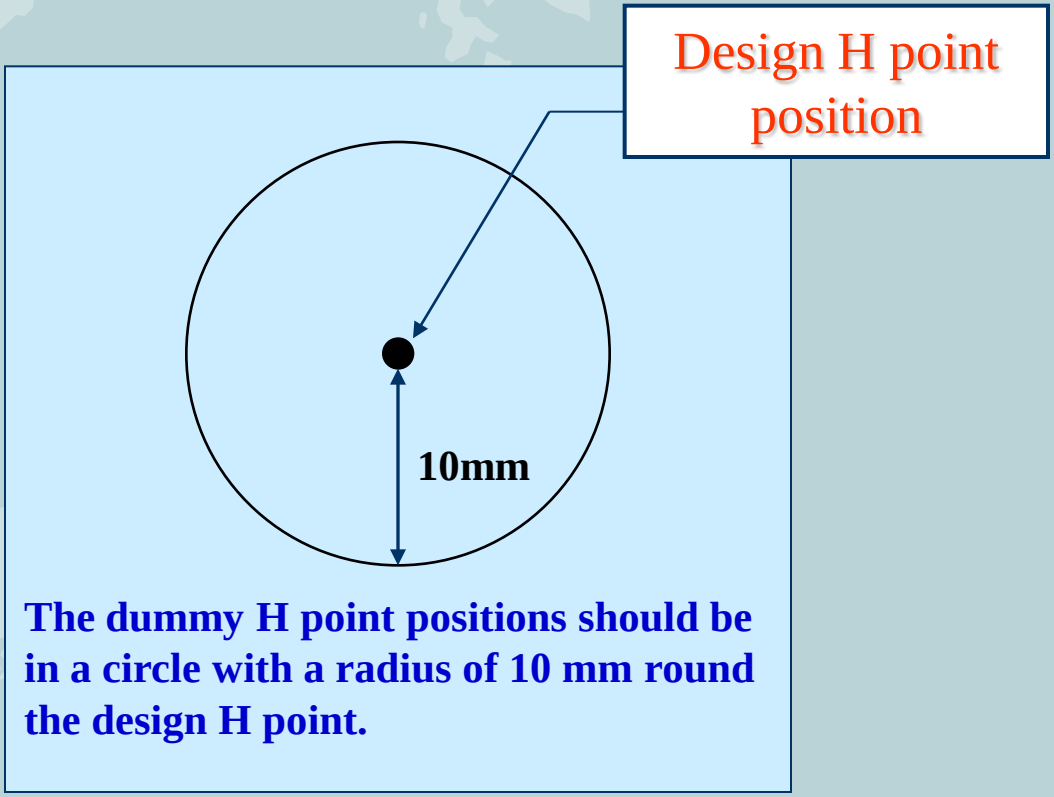
Installation: coincident with vertical meridian line

Lateral line passing through H point:
perpendicular to longitudinal center plane;
horizontal with a maximum inclination of ±2°

Upper arm angle: 40° ±5°

Knees: outside surfaces are 150±10mm from symmetry plane of the dummy… etc.

# ② H point




**The dummy H point positions should be in a circle with a radius of 10 mm round the design H point.**

**ES-II dummy**

# 4. Instrumentation System File

## ① Creation of system file

**Enter the performance of the mounted dummy's instrumentation into analysis software**

# 5. Soak (stabilize vehicle to a fixed state)

## ① Temperature of test dummy and measurement system

→ Stabilized temperature: 22±4℃

Soak time: over 4 hours (Technical Standard for Occupant Protection in Frontal Collision)

## ② Confirmation of soak

→ Check temperature and elapsed time with thermometer

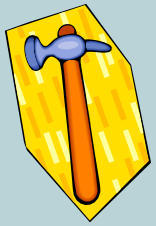
# 6. Setting of Instrumentation

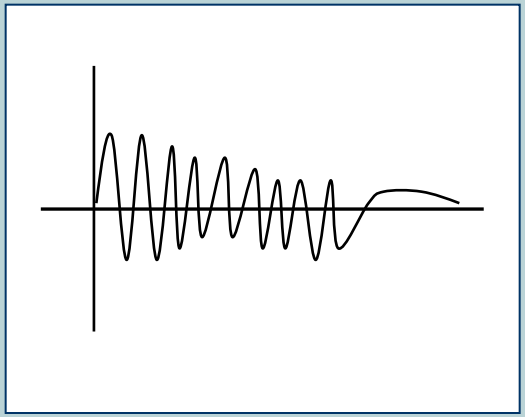
## ① Connection of instrumentation

Connect each sensor of the dummy to On-board data acquisition device.

## ② Hammering

Confirm wire breakage and abnormal waveforms, after impacting each part of dummy.





# ③ Confirmation of Trigger

(detect starting point of impact)

tape switch

Check normal input trigger signal into On-board data acquisition device

# ④ Calibration

Determine reference point (zero point)
(response point differs according to instrumentation)

# ⑤ Apply greasepaint

Apply greasepaint to head, tibia, etc. of dummy to confirm secondary impact

# 7. Preparation of Impact Trolley

## ① Connection of towing device

Connect impact trolley to underground wire rope using a dolly

## ② Deviation position

Apply greasepaint to the measured impact point to measure deviation between test vehicle and impact barrier

## ③ Brakes of impact trolley

Connect a tape switch to operate brakes of impact trolley

# 8. Final Check in Launch Room

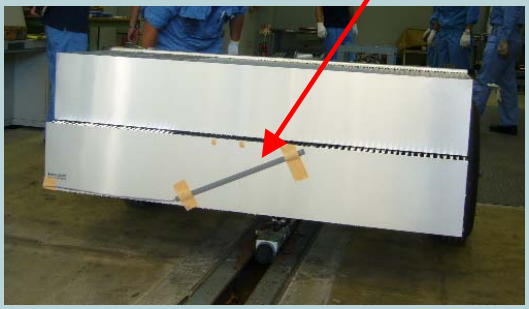
## ① Attachment of dolly

Connected condition, handles for removal, etc.

## ② Trolley brakes

Confirm whether trolley brakes without fail

tape switch



## ③ Deviation

Check markings to confirm deviation

# 9. Setting of Impact Site

## ① High-speed video camera

Front (behavior of dummy), rear (behavior of vehicle), upper part (entire vehicle, opening of doors)

## ② Illumination

For high-speed video camera recording

## ③ Speed meter

Immediately before impact, near rear edge of vehicle

## ④ Confirmation of fuel leakage

Preparation of fuel leakage pan

# 10. Test

## ① Setting of towing device and operating device

→ Enter specifications of test vehicle in operating device

## ② Lighting up of illumination

→ Light up illumination 10 minutes before starting test

## ③ High-speed video camera

→ Prepare each video camera in a state awaiting trigger

## ④ Tension of wire rope

→ Apply tension to wire before traction
→ Prevent slackness in retention

# Outline

1. Overview of collision test
2. Test fixture
3. Test procedure
4. Analysis of test result
5. Additional requirements for EV, HEV and FCV
6. Summary

## ① Impact velocity

→ Within range of 50±1km/h

## ② Fuel leakage

→ Measurement of leakage: 30g/min., at intervals of 1 minute and 5 minutes

## ③ Deviation from impact point

→ - within±25mm of fore and after direction, ±25mm of above and below direction

## ④ Particular requirements

→ No door shall open during the test

# ⑤ Removal of dummy

It shall be possible to:

- open a sufficient number of doors provided for normal entry of passengers, and if necessary tilt the seatbacks or seats to allow evacuation of all occupants
- release dummy from protective system
- remove dummy from vehicle

# ⑥ Passenger compartment

- No interior device or component shall become detached in such a way as to noticeably increase the risk of injury from sharp projections or jagged edges.

# ⑦ Confirmation of vehicle underside

- Check for fuel leakage, damage of test vehicle, etc.

# ⑥ Performance criteria

- Head performance criterion (HPC): less than or equal to 1000

- Thorax performance criteria

  Rib Deflection Criterion (RDC): less than or equal to 42mm

  Viscous Criterion (VC): less than or equal to 1.0m/sec

- Pelvis performance criterion

  Pubic Symphysis Peak Force (PSPF): less than or equal to 6kN

- Abdomen performance criterion

  Abdominal Peak Force (APF): less than or equal to 2.5kN
  internal force

# Outline

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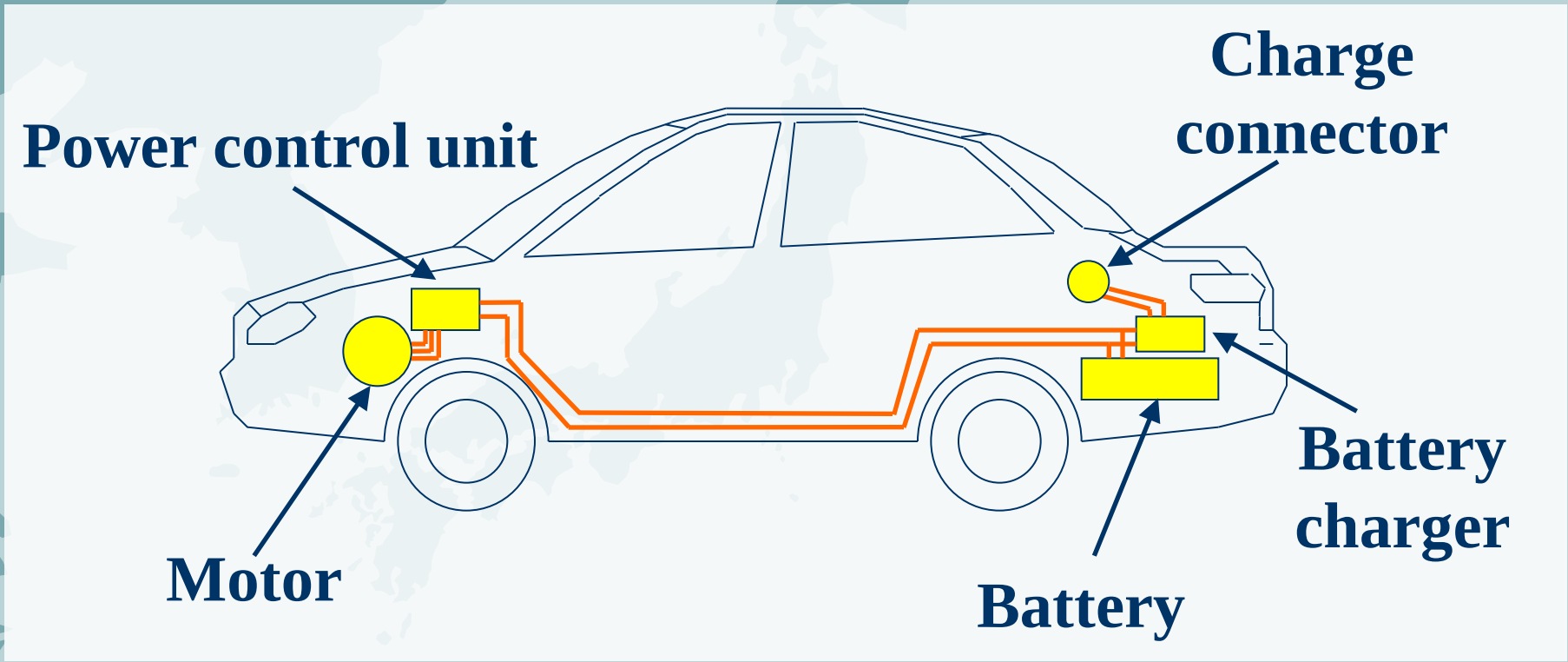
# Requirement for EV, HEV and FCV

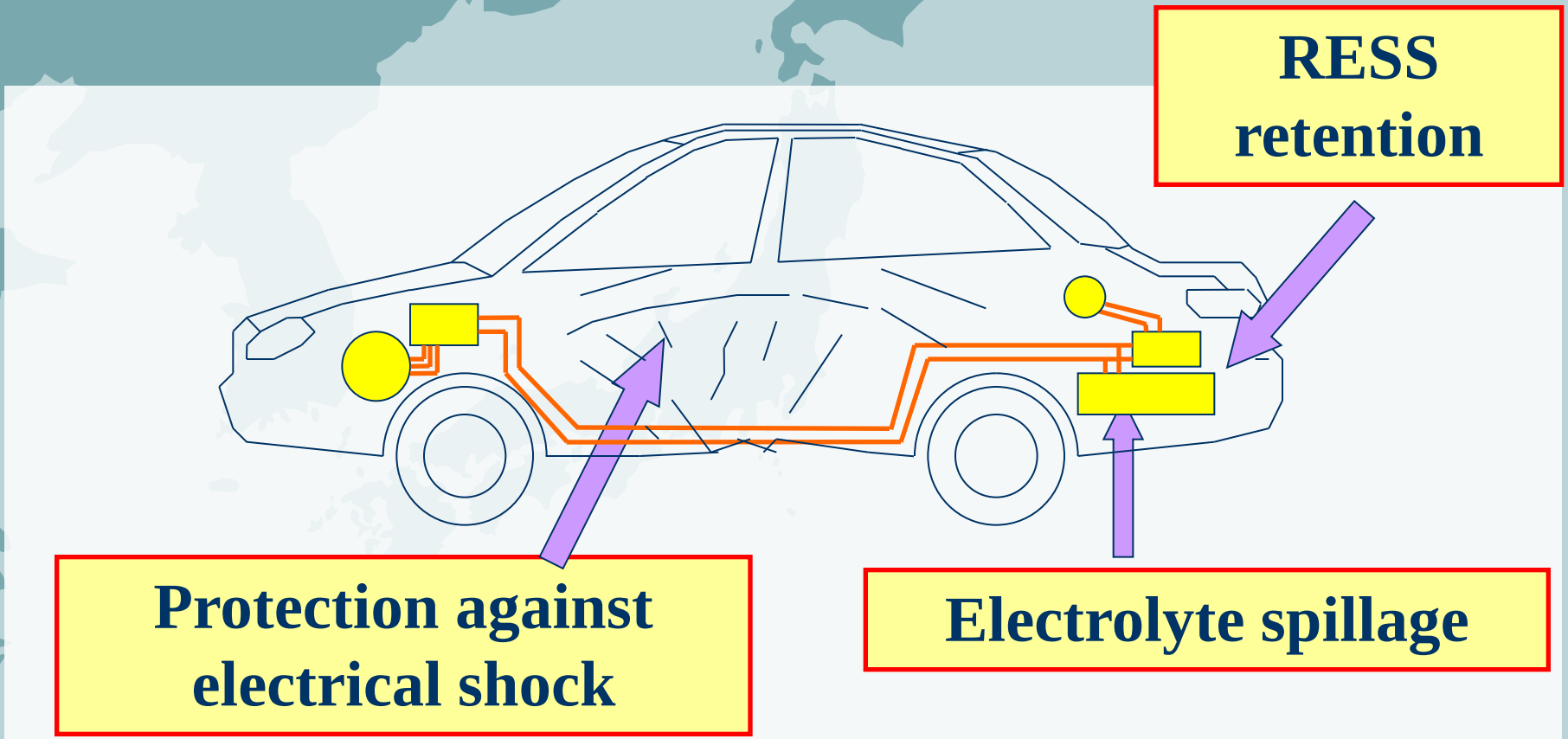
## Example of the high voltage parts




High Voltage Bus

Exposed Conductive Part

# Requirement for EV, HEV and FCV




**RESS : *Rechargeable energy storage system***

# Requirement for EV, HEV and FCV

## Protection against electrical shock

Absence of high voltage

Low electrical energy

Physical protection

Isolation resistance

## Electrolyte spillage

In the period from the impact until 30 minutes after no electrolyte from the RESS shall spill into the passenger compartment.

No more than 7 per cent of electrolyte shall spill from the RESS outside the passenger compartment.

## RESS retention

RESS located inside the passenger compartment shall remain in the location

# Outline

1. Overview of collision test
2. Test fixture
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# - Summary -

**Create test report for Occupant Protection in lateral Collision**

**official test**

**(1) Are the test results in conformity with the Regulations?**

**(2) Are the test procedures carried out according to the standard?**

**(3) Are the test facilities set correctly? etc.**


Thank you

# Minutes of Meeting
## 29th JASIC Asia Expert Meeting in Malaysia

1. Date: Thursday October 6, 2011, 9:00-16:30 (Lectures)
Friday October 7, 2011, 9:30-12:30 (Public test on a frontal collision of a motorsycle)

2. Place: JPJ Academy, Malacca

3. Organizers: Road Transport Department (JPJ)
Attendees: 69 representatives or so in total from automobile-related agencies and companies such as JPJ, Malaysian Institute of Road Safety Research (MIROS), Standards and Industrial Research Institute of Malaysia (SIRIM), Malaysian Automotive Association (MAA), Mercedes-Benz, Proton, Ford, Astra Honda, Honda Malaysia, UMW Toyota, and Perodua.

4. Attendees from Japan:
Three members comprised of Mr. Takao Tani from Nissan Motors, who presented the legal requirements of R94 (frontal collision) and R95 (lateral collision); Mr. Amane Sato from NTSEL, who explained the testing methods, and Mr. Yoshiaki Nanbu from JASIC Secretariat.

5. Outline of the meeting
Representing the organizer, Mr. IR Mohamad Bin Dalib, Director General, JPJ, gave an opening address. Presentations were given by Mr. Tani on the legal requirements of R94 (frontal collision) and R95 (lateral collision), COP, etc., by Mr. Sato on the testing methods on R94 (frontal collision) and R95 (lateral collision), and by Mr. Khairil from MIROS on the assessment and testing plans in Malaysia, followed by an overall Q&A session. Through discussion held in an animated and friendly atmosphere, the meeting deepened the understanding of the attendees from Malaysia and successfully ended.

### 1. Day One (Lectures)

Presentations by JASIC

R94 and R95 - General Information and Technical Requirements: Presentation by Mr. Tani from Nissan Motors

After presenting the outline of the regulation, Mr. Tani explained the details of the statistics on accidents in Japan, technical requirements, scope of application upon model change, and COP, in this order. The audience deepened their understanding on the details of certification regarding frontal collision and lateral collision under the regulations to be reflected in future. The presentation was followed by an overall Q&A session and lively exchange of views.

● Major Questions and Answers

Q1: What's the difference between HPC and HIC?
A1: The method of calculation is the same. The only difference is that, while you get an OK for HPC as far as there's no head interference, HIC is judged based on calculated values, whether there's head interference or not.

Q2: When you start running in the collision test, how's door lock?
A2: It's off.

Q3: Is there any specification on the colors of caution labels?
A3: Yes, there is.

Q4: What do you do for COP test? Is it the same as the certification test?
A4: Yes, it's the same if you're required to do that.

Q5: How do you get your driving license in Japan?
A5: Usually you go to a driving school and take about 20 day of lessons learning traffic rules and driving on the driving course and get a temporary license. Then, you hit the street, practice driving in town for about ten lessons and get your license at the final exam. But this isn't mandatory; you can also practice by yourself and take an exam at a licensing center. Both ways, driving license is under the jurisdiction of the National Police Agency. As to safety regulations of motor vehicles, they are handled by the MLIT.

Q6: How old must you be to get a driving license in Japan?
A6: 18 years and over.

Q7: How come in Japan the rate of motorcyclists among traffic fatalities has been going up?
A7: Actually, the number of motorcycle fatalities itself has been declining, but the total number of persons killed on motor vehicles has been declining more rapidly, which is making the rate of motorcycle fatalities relatively increase.

Q8: How much time do you take to get certification?
A8: It'll take about a week to prepare and conduct the collision test and about 2 days to process the test results thereafter. It'll take three to six months at least to prepare certification test, including time for getting the test vehicle. It'll take one year or two at least to develop a model that satisfies the regulations.

Q9: What's the definition of "sharp edge"?
A9: They don't give any definition specifically, so it's rather a subjective assessment. For instance, if, after the collision, a trim part is broken and shows sharp edges or an inside metal part's showing, the certification officer will assess it. In new model development, manufacturers should make best efforts to minimize these risks.

Q10: Isn't the degree of neck injury upon a lateral collision a subject of assessment?
A10: The regulation says nothing about it. The EuroSID2 dummy currently used can't assess neck injury, either. For future dummies, however, that's under discussion.

Q11: Are side and curtain-airbags necessary to satisfy the regulation on lateral collision?
A11: You can satisfy the regulation without those airbags. However, Euro NCAP tests in Europe for instance have introduced pole lateral collision tests that simulate collision into a tree or telephone pole. Side and curtain airbags are effective for that kind of collisions.

R94 and R95 - Test Methods: Presentation by Mr. Sato from NTSEL

Mr. Sato gave specific presentation on the requirements for the test methods. The audience deepened their understanding on the details of test methods of frontal collision and lateral collision under the regulations to be reflected in future. The presentation was followed by an overall Q&A session and lively exchange of views.

● Major Questions and Answers

Q1: How long do you keep the test vehicle?
A1: In a certification test, the manufacturer can take it back right after the test's done. For assessment, the vehicle will be kept for a certain period of time.

Q2: Should the vehicle used in the test be a production vehicle?
A2: In principle, it should, but we know it's hard to get it at a right time, so a shop prototype will do if it's the same spec as the production vehicle.

Q3: There's a limit to the test speed. Do we fail if it exceeded the limit?
A3: No, it's acceptable.

Q4: Then what about when the test speed limit is 57 km/h and we do it at 64 km/h with a child dummy added?
A4: The speed is OK, but there's no precedent of a child dummy added. As to child seats, there's ECE R44 and it's that that you should comply with.

Q5: What does the phrase "reference load" on page 16, last line, of R95 mean? Could you tell me more specifically?
A5: The same meaning as "reference mass" on page 16, first line, which means the sum of the empty vehicle weight and 100 kg. The 100 kg is supposed to be as the total weight of the dummy and the measuring instruments. Axles must not each exceed 5 % of the reference mass and altogether 20 kg.

Q6: We've never done these tests for R94 and R95. How should we proceed?
A6: There's no shortcut. Probably you'll face various problems doing those tests, but all you can do is to clear them one by one.

Q7: The setting ambient temperature is prescribed 19 to 22 C in R94, but 22±4 C in R95. Why the difference?
A7: It's just as it's said, I don’t know why. Among possible reasons is difference in test methods or dummies.

Q8: What’s the test speed in the Japanese regulation?

A8: 50 km/h for the full-wrap frontal collision test. There's provisions on rear-end collision, but the purpose is prevention of fuel leakage. With offset frontal collision, lateral collision, you have to pass four tests in total.

Q9: As for airbag labels, is it mandatory to mention them in the owner's manual, regardless of the vehicle having airbags or not?
A9: It's not necessary if the vehicle hasn't air bags.

1. Day Two (Public Test)

The Indonesian MOT is now building a collision test facility at JPJ Academy, will start testing under R94 from this December, and, after a transition period, will have completed the move to R94 by July 2012. The facility, owned by JPJ, will be used as a technical service, but used also by the research study institute MIROS for its tests. On the occasion, an open-air demonstration of motorcycle frontal collision test was given by MIROS as follows:

[Conditions of collision]
- A four-wheel vehicle to be used as power is equipped with a fixture for a motorcycle.
- A motorcycle with a dummy on it is set to the fixture.
- As the object of collision, a four-wheel vehicle is set at the point of collision.
- The driving car runs up to a point immediately before the point of collision giving the motorcycle the target speed (50 km/h in this test), stops there, let the motorcycle go off and collide with the other car.

[Test Specifications]
- Test 1 = Motorcycle with an airbag + Dummy in suit with an airbag.
- Test 2 = Motorcycle without an airbag + Dummy in suit without an airbag.

The results were not published, but video will be published later (to be added to this report as soon as available).

As the number of motorsycle in use increase in Malaysia and other South East Asian countries, the number of motorsycle fatalities has been rapidly going up. To mitigate this increase, Malaysia is studying collision tests as part of vehicle safety along with two other elements of traffic safety: environmental and human safety.