

# Detailed explanation of UN R136

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**JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER**

## Detailed explanation of UN R136

1. Background of UN R136 p4 ~p7

2. Detail of UN R136 p9~p31

## Detailed explanation of UN R136

1. Background of UN R136

2. Detail of UN R136

## Characteristics of e-PTW

(The difference with the conventional gasoline motorcycle)

### Major characteristics of e-PTW

◇ On-board high-energy battery



Their quantity of electricity is 10–20 times as much as batteries of current gasoline vehicles. (Their electric voltage is also 3–10 times as much as batteries of current gasoline vehicles.)

◇ Filling energy from commercial power sources (battery charge)



AC100–230V is connected to vehicles.

◇ Li-ion battery using a flammable electrolyte has a possibility of ignition.



High-voltage leak by flooding



A lithium ion battery of a PC is fired.



Fire accident of "MODEL S" manufactured by TESLA (6/OCT/20

◇ On-board high-energy battery



Their quantity of electricity is 10–20 times as much as batteries of current gasoline vehicles. (Their electric voltage is also 3–10 times as much as batteries of current gasoline vehicles.)

◇ Filling energy from commercial power sources (battery charge)



AC100–230V is connected to vehicles.

◇ Li-ion battery using a flammable electrolyte has a possibility of ignition.

Than these characteristics

## Important things for user's safety at in-use

- **Prevention of electric shock** from the high voltage at in-use ,in-charge.
  - Protection requirements from direct contact / indirect contact  
Insulation requirements including the water resistance of a vehicle and the battery charger
- **Fire, explosion by the battery factor**
  - Requirements of the battery adapting to condition for use the PTW

Satisfaction of the international safety standard/Regulation is important.  
→ Consequently : On the vehicle which can use/sale across a border!

**in peace!**

## e-PTW have requirements that are different from electric passenger vehicle

e-passenger vehicle



Body Shell



Restriction

Air Bag & Seat Belt



Battery Pack



Social  
infrastructure

### Differences between e-PTW and four-wheeled EV



- No passenger cabin  
Rider can be separated from the vehicle when an accident occurs
- Battery and charger are small
- Posture control and parking/stopping methods

Separate



lean



Slant



Fall down

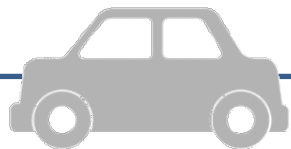


Removable  
Battery



Charge

## UN R100



### §5. Electrical safety

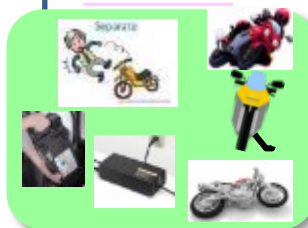
- Protection against direct contact
- Protection against indirect contact
- Insulation resistance
- REESS installation
- Functional safety
- Hydrogen discharge

### §6. REESS safety

- Vibration
- Thermal shock and cycling
- Mechanical impact (in case of collision)
- Fire resistance
- External short circuit protection
- Overcharge protection
- Over-discharge protection
- Over temperature protection

Change

Features of  
L category



Major changes

## UN R136



### §5. Electrical safety

- Protection against direct contact **(strengthened)**
- Protection against indirect contact **(expanded)**
- Insulation resistance
- REESS installation

- Functional safety **(strengthened)**

- Hydrogen discharge

### §6. REESS safety

- Vibration **(strengthened)**
- Thermal shock and cycling
- Mechanical impact **(replaced)**
- Fire resistance **(two-wheelers are excluded)**
- External short circuit protection
- Overcharge protection
- Over-discharge protection
- Over temperature protection

## Detailed explanation of **UN R136**

1. Background of UN R136

2. Detail of UN R136

\*A change part from R100 is indicated by the red character.



## Scope

**This regulation does not cover post-crash safety requirements of road vehicles.**

Part I: Safety requirements with respect to the electric power train of vehicles of category **L** with a maximum design speed **exceeding 6 km/h**, equipped with one or more traction motor(s) operated by electric power and not permanently connected to the grid, as well as their high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train.

Part II: Safety requirements with respect to the Rechargeable Energy Storage System (REESS), of vehicles of category **L** with a maximum design speed **exceeding 6 km/h**, equipped with one or more traction motors operated by electric power and not permanently connected to the grid.

Part II of this Regulation does not apply to REESS(s) whose primary use is to supply power for starting the engine and/or lighting and/or other vehicle auxiliaries systems.

## 1. Scope

	Part I Electrical Safety	Part II REESS Safety
High Voltage	✓	✓
Not High Voltage	No requirement	✓

2.20. "**High Voltage**" means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms).

# Individual examination contents and requirements

## §5 Part I :

Requirements of a vehicle with regard to its electrical safety

# §5.1.1.1.~2. Protection against **direct contact**/ requirements for vehicles without cabin

\*A change part from R100 is indicated by the **red character**.

## ◆ Objective

*Protection against electrical shock*

*These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies.*

## ◆ General conditions

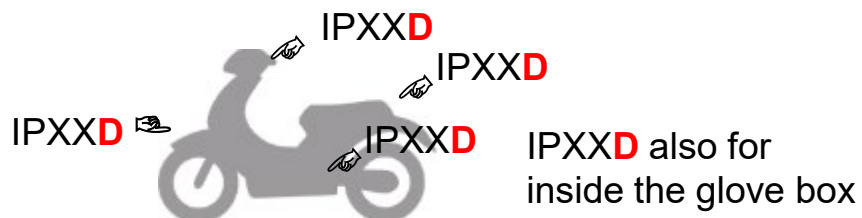
- Environmental temperature: no regulations
- SOC at the start of test: no regulations

## ◆ Typical individual conditions

**Contact protection grade for vehicle without cabin**

\*See the right section for vehicles with cabin  
(the same as four-wheelers)

In case of vehicles without cabin, they need to satisfy protection grade IPXXD in terms of whole vehicle



## ◆ Criteria

5.1.1. These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools.

5.1.1. 1. For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provide

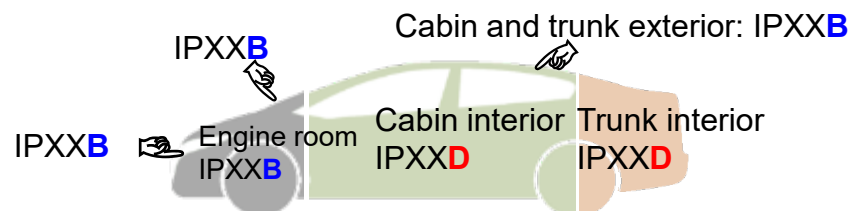
5.1.1.2. Protection of live parts in areas other than the passenger compartment or luggage compartment.

5.1.1.2.1. For vehicles with a passenger compartment, the protection degree IPXXB shall be satisfied.

**5.1.1.2.2. For vehicles without passenger compartment, the protection degree IPXXD shall be satisfied.**

Reference: four-wheelers

- Cabin and trunk have to satisfy protection grade IPXXD
- Parts other than cabin and trunk have to satisfy protection grade IPXXB



\*Cabin denotes the covered space around a passenger.

## ◆ Objective

## -Protection against electrical shock

These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies.

## ◆ General conditions

no regulations

## ◆ Typical individual conditions

## ◆ Criteria

5.1.1.5.1. In the case of a REESS having high voltage capability the symbol shown in Figure 1 shall appear on or near the REESS.

The symbol background shall be yellow, the bordering and the arrow shall be black.

5.1.1.5.2. The symbol shall also be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits.

5.1.1.5.2. But, don't apply to the following cases

a) Where barriers or enclosures cannot be physically accessed, opened, or removed; unless other vehicle components are removed with the use of tools

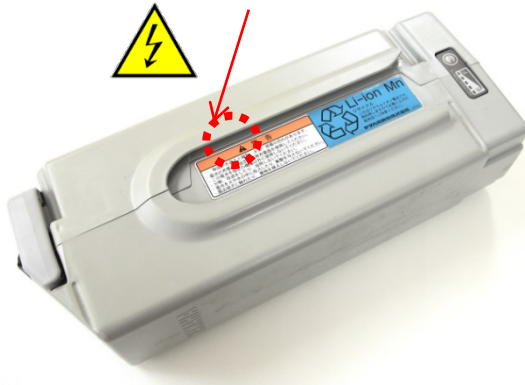
b) Where barriers or enclosures are located underneath the vehicle floor.



fig1.

5.1.1.5.3. Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the color orange.

Mark the decoration of the REESS(@High voltage)



Mark the decoration of the enclosure for expose live parts of high voltage circuits



Distinguish the high voltage line by orange covering



# §5.1.2.4. Protection against indirect contact / vehicle requirements for charging batteries

## ◆ Objective

*Protection against electrical shock*

- Use of a charger without ground connection

## ◆ General conditions

- Environmental temperature: no regulations
- SOC at the start of test: no regulations

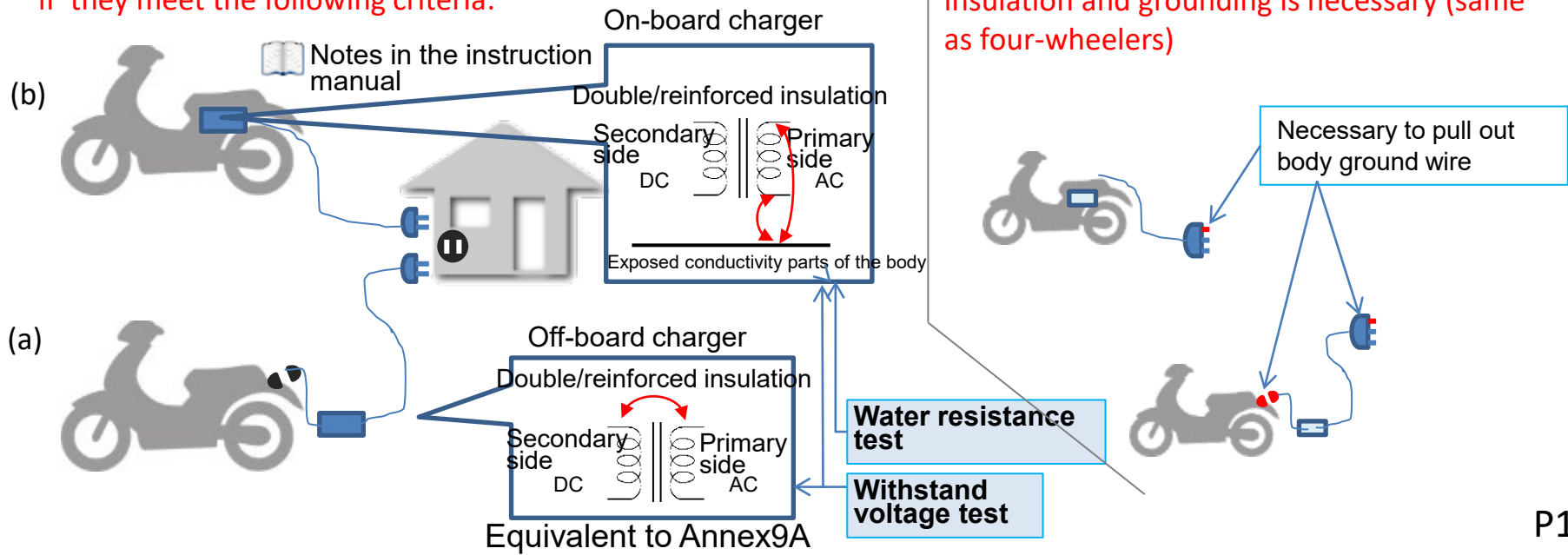
## ◆ Criteria

	5.1.2.4.1 Withstand voltage	5.1.2.4.2 Protection against ingress of water	5.1.2.4.3 Handling Instructions
Apply to 5.1.2.4.(a) Off-board charger	○	—	○
Apply to 5.1.2.4.(b) On-board charger	○	○	○

## ◆ Typical individual conditions

The following requirements are necessary for vehicles using on-board chargers without ground connection or off-board chargers.

Chargers without ground connection are exempted from 5.1.2.3. if they meet the following criteria:



## ◆ Objective

*Protection against electrical shock*

- Use of a on-board charger without ground connection

## ◆ General conditions

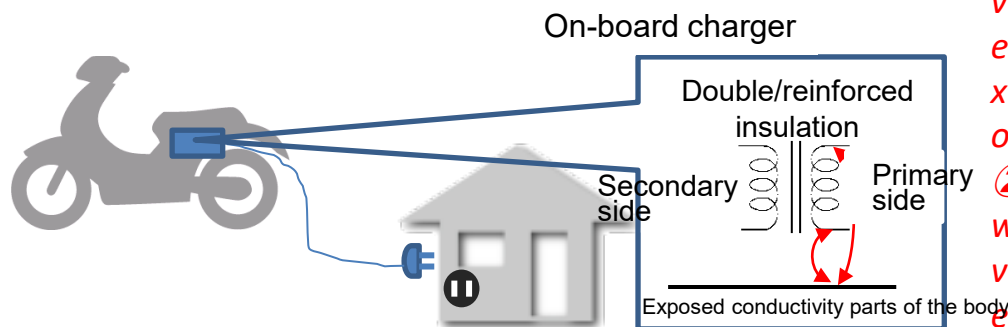
- The test shall be performed on the complete vehicle
- All the electrical devices shall be connected.

## ◆ Criteria

## 5.1.2.4.1.2.

*The insulation resistance shall be equal to or greater than 7 MΩ when applying 500 V DC between all the inputs connected together and the vehicle's exposed conductive parts/electrical chassis.*

## ◆ Typical individual conditions



- ① Between all the inputs of the charger (plug) and the vehicle's exposed conductive parts including the electrical chassis if present, apply a AC test voltage of  $2 \times (U_n + 1200)$  V rms at a frequency of 50 Hz or 60 Hz for one minute, where  $U_n$  is the AC input voltage (rms).
- ② After the test, measure the insulation resistance when applying 500V D.C. between all the inputs and the vehicle's exposed conductive parts including the electrical chassis if present.

⇒ The insulation resistance shall be equal to or greater than 7 MΩ

## ◆ Objective

*Protection against electrical shock*

- for vehicle with on-board charger without ground connection

## ◆ General conditions

- Vehicle Test
- SOC at the start of test: no regulations

## ◆ Criteria

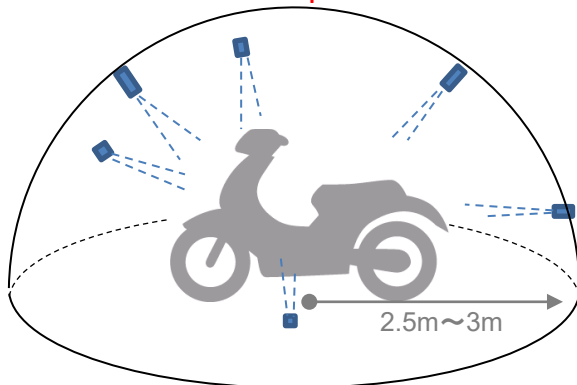
5.1.2.4.2.2. After the TEST ,

*The insulation resistance shall be equal to or greater than 7 MΩ, when applying 500 V DC.*

## ◆ Typical individual conditions

In accordance with the test procedure to evaluate IPX5 protection against ingress of water.

Spraying with a stream of fresh water  
the enclosure from all practicable directions .



## Test condition

- \*Internal diameter of the nozzle: 6.3 mm;
- \*Delivery rate: 12.5 l/min  $\pm$  5 per cent;
- \*Water pressure: to be adjusted to achieve the specified delivery rate;
- \*Core of the substantial stream: circle of approximately 40 mm diameter at 2.5 m distance from nozzle;
- \*Test duration per square metre of enclosure surface area likely to be sprayed: 1 min;
- \*Minimum test duration: 3 min;
- \*Distance from nozzle to enclosure surface: between 2.5 m and 3 m.



## ◆ Objective

*Protection against electrical shock*

- Use of a on-board charger without ground connection

## ◆ General conditions

- **Instruction Manual**

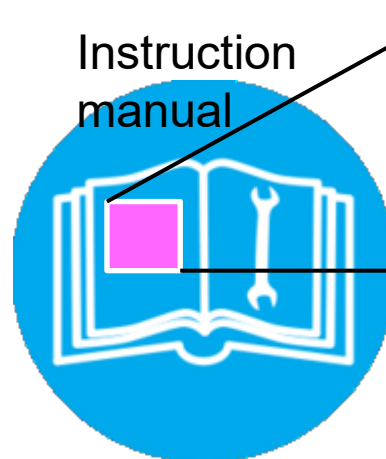
## ◆ Criteria

*Appropriate instructions for charging shall be provided and included in the manual.*

*Example of the content in the manual :*

*"If during charging, your vehicle or charger becomes submerged in water you should not touch either the vehicle nor the charger because of danger of electric shock. Also, do not use the battery nor the vehicle and ask your dealer to take (appropriate) measures."*

## ◆ Typical individual conditions



*"If during charging, your vehicle or charger becomes submerged in water you should not touch either the vehicle nor the charger because of danger of electric shock. Also, do not use the battery nor the vehicle and ask your dealer to take (appropriate) measures."*

## ◆ Objective

*Safety requirement for equipped REESS  
for open type traction batteries that may produce  
hydrogen gas*

## ◆ General conditions

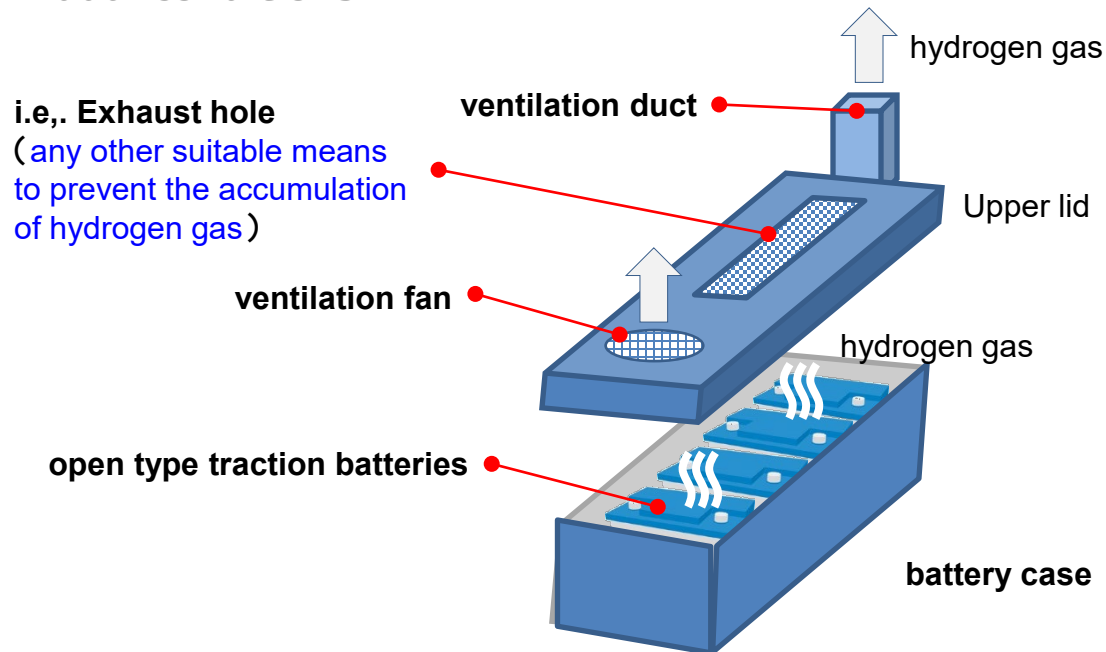
no regulations

## ◆ Criteria

5.2.2.

*Spaces for open type traction batteries that may produce  
hydrogen gas shall be equipped with a ventilation fan, a  
ventilation duct **or any other suitable means** to prevent  
the accumulation of hydrogen gas.*

## ◆ Typical individual conditions



### ◆ Objective

*Safety requirement for equipped REESS*

Prevent injury to driver/passenger/people around from electrolyte leakage in normal use conditions.

### ◆ General conditions

In ordinary use or when operating a function

### ◆ Criteria

*5.2.3. Vehicles shall foresee that no spilled electrolyte from the REESS and its components shall reach the driver, rider or passenger nor any person around the vehicle during normal condition of use and/or functional operation.*

*When the REESS is in the upside-down position, no electrolyte shall spill.*

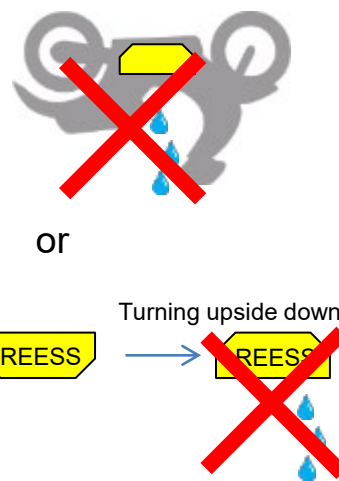
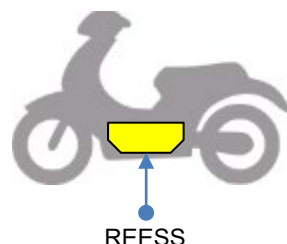
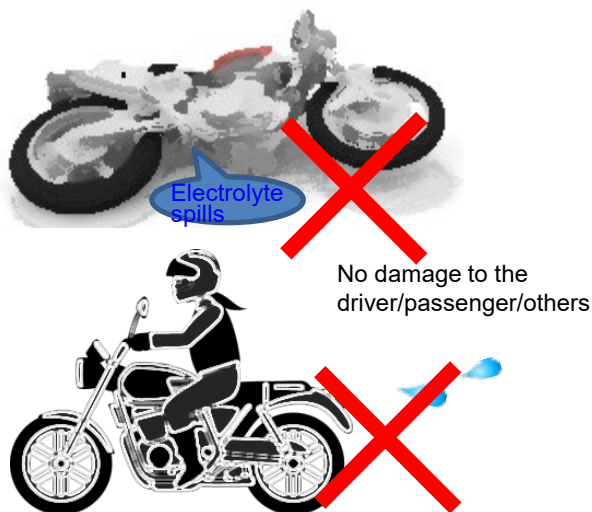
### ◆ Typical individual conditions

Objective

- Leakage when it falls
- No leakage onto surroundings while driving →

Confirmation method

Confirm using alternative confirmation method (turning upside down)



### ◆ Objective

#### *Safety requirement for equipped REESS*

Prevent injury to driver/passenger/people around from accidental or unintentional detachment of REESS and its parts

### ◆ General conditions

In ordinary use or when operating a function

### ◆ Criteria

#### *5.2.4.*

*The REESS and its components shall be installed in the vehicle in such a way so as to preclude the possibility of inadvertent or unintentional detachment of the REESS.*

*The REESS in the vehicle shall not be ejected when the vehicle is tilted.*

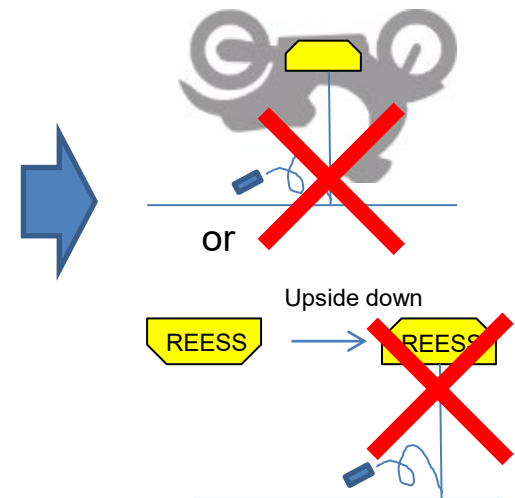
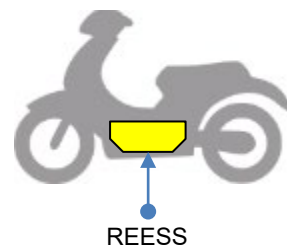
*The REESS components shall not be ejected when the REESS is put upside-down.*

### ◆ Typical individual conditions

Due to the shock from a fall or the load from inclination

→ REESS and related parts do not drop out or the parts do not scatter

→ Confirm using alternative confirmation method (Turning upside down)



### ◆ Objective

Peculiar functional safety requirement for an electric vehicle

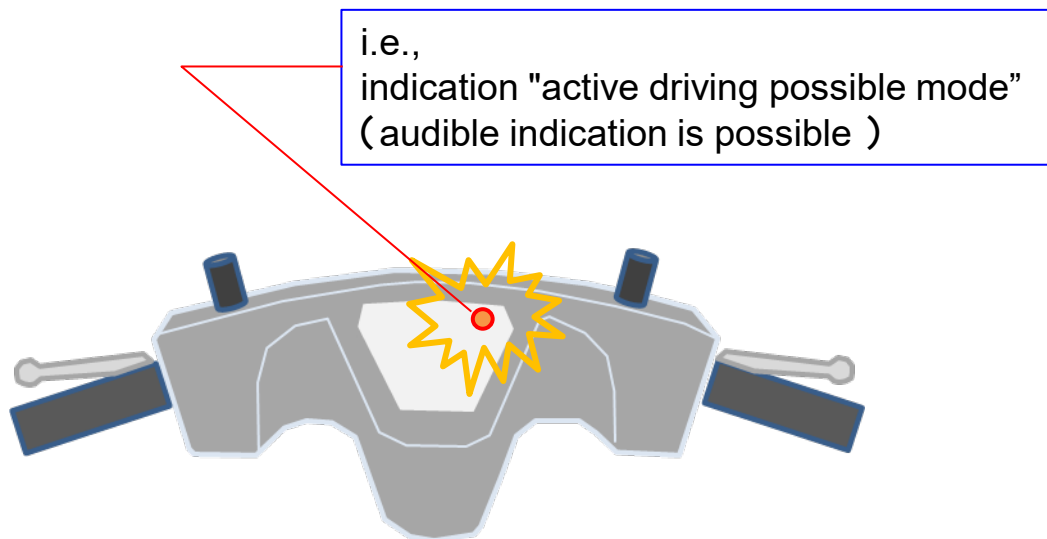
### ◆ General conditions

no regulations

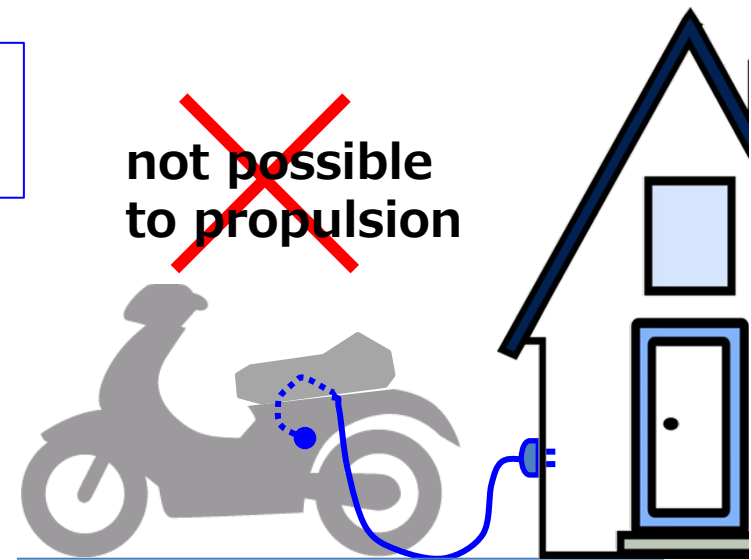
### ◆ Criteria

- A momentary indication shall, as minimum, be given to the driver when the vehicle is in "active driving possible mode".
- When leaving the vehicle, the driver shall be informed by a signal (e.g. optical or audible signal) if the vehicle is still in the active driving possible mode.
- If the onboard REESS can be externally charged by the user, movement caused by the vehicle's propulsion system shall not be possible while the external electric power supply is physically connected to the vehicle inlet.

### ◆ Typical individual conditions



\* This provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle's propulsion power.



Connecting to the power source for charging

### ◆ Objective

Safety requirement at the charging.

\* The case that requirement is not apply.

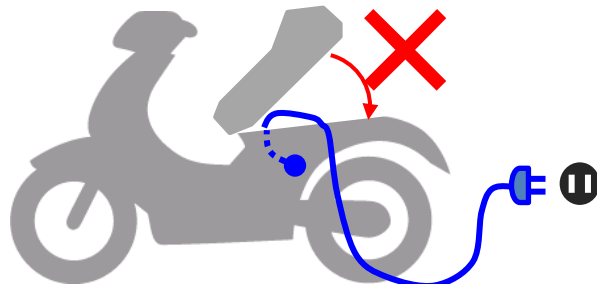
### ◆ General conditions

no regulations

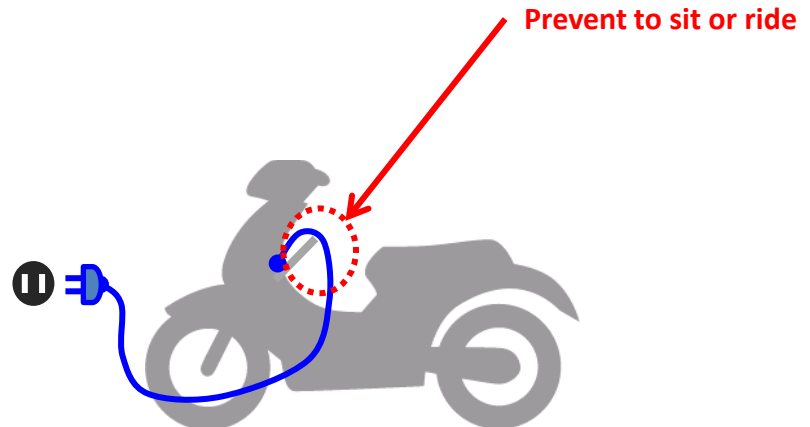
### ◆ Typical individual conditions

The following cases are not applied to this requirement.

- seat cannot be closed
- the cable position does not allow the rider to sit in or step into the vehicle



A seat cannot be closed  
A seat loosens



## ◆ Objective

Safety requirement .  
Prevention of the unexpected departure.

## ◆ General conditions

no regulations

## ◆ Criteria

## 5.3.1.1.

*At least two deliberate and distinctive actions shall be performed by the driver at the start-up to select the active driving possible mode.*

## 5.3.1.2.

*Only a single action shall be required to deactivate the active driving possible mode.*

## ◆ Typical individual conditions

There is no idling by electric vehicle and as for the vehicle driver is difficult to grasp the vehicle conditions.  
 →There is a possibility that vehicle start by unexpected throttle operation.  
 →To prevent above , Intentional operation by driver is needed to activate to drive.  
 →At least two actions shall be performed by the driver to shift the active driving possible mode.

First action

→ Second action

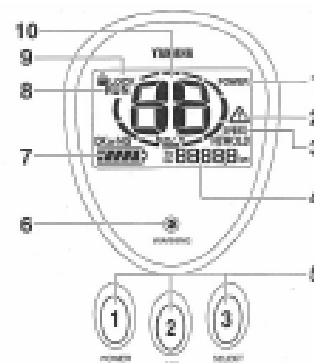
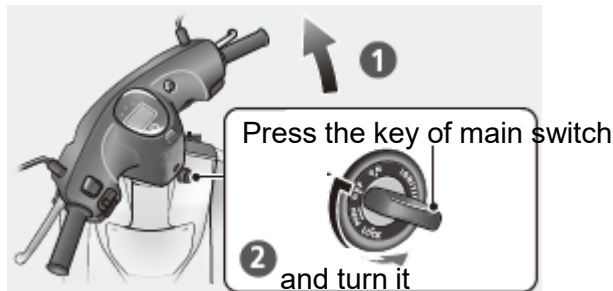
Power SW( Main SW )

Start button(Activate)

or

Other intentional operations  
i.e., gear shift operation

Multi-Function Meter



## ◆ Objective

Peculiar functional safety requirement  
for an electric vehicle

\* Ensure driving safety during power down aimed at  
protecting vehicle functions

## ◆ General conditions

Indication of temporary power down not caused by  
failure or temporary power down due to SOC of REESS

## ◆ Criteria

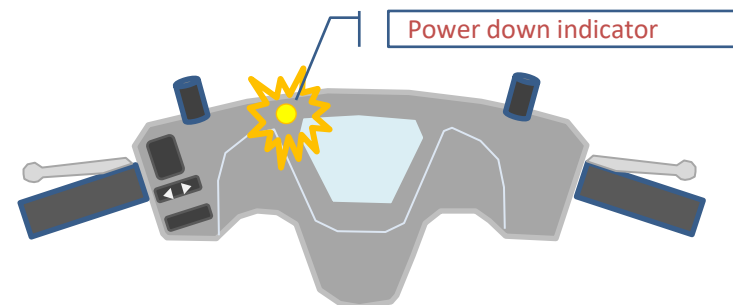
*5.3.1.3.1.*

*The vehicle shall have a function/device that indicates to  
the driver/rider if the power is automatically reduced below  
a certain level, (e.g. due to activation of the output  
controller to protect the REESS or the propulsion system) or  
due to a low SOC.*

## ◆ Typical individual conditions

- Driving force is prominently involved in the banking movement in cornering of a two-wheeler.
- Unintentional reduction of this driving force affects the posture of the two-wheeler and the course.
- The driver has to ride the two-wheeler upon grasping the driving force of own vehicle.

Temporary power down of electrically powered two-wheelers has to be conveyed to the driver promptly.





### ◆ Objective

Safety requirement at the backward driving.

### ◆ Criteria

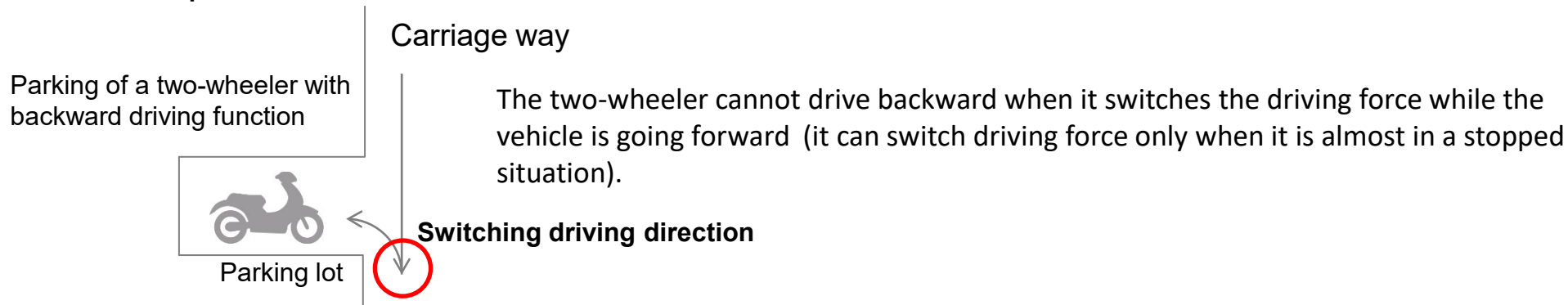
*It shall not be possible to activate the vehicle reverse control function whilst the vehicle is in forward motion.*

### ◆ General conditions

**-No prescribed conditions**

### ◆ Typical individual conditions

#### Example



# Individual examination contents and requirements

## §6 Part II :

Requirements of a **REESS** with regard to its safety

REESS: Rechargeable Electrical Energy Storage System

### ◆ Objective

*The purpose of this test is to verify the safety performance of the REESS under a vibration environment which the REESS will likely experience during the normal operation of the vehicle.*

### ◆ General conditions

- Implement with complete REESS or REESS subsystem
- Environmental temperature:  $20 \pm 10^{\circ}\text{C}$
- SOC at the start of test: 50% or higher

### ◆ Criteria

- No electrolyte leakage (to be verified by visual inspection without disassembling)
- No rupture (applicable only to high-voltage REESS)
- No fire
- No explosion

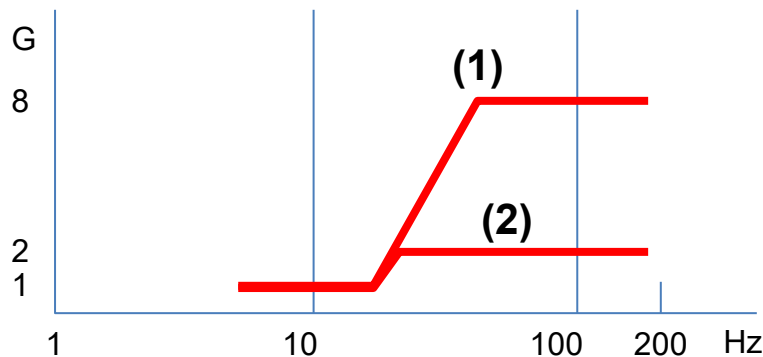
*For a high voltage REESS, the isolation resistance measured after the test in accordance with Annex 4B to this Regulation shall not be less than 100  $\Omega$ /Volt.*

### ◆ Typical individual conditions

Vibration profile

(1) Weight of test body <12kg

(2) Weight of test body  $\geq 12\text{kg}$



*•The test shall end with an observation period of 1h at the ambient temperature conditions of the test environment.*

## §6.3. Removable battery drop test

### ◆ Objective

*Simulates a mechanical impact load which may occur at an unintended drop after REESS removal.*

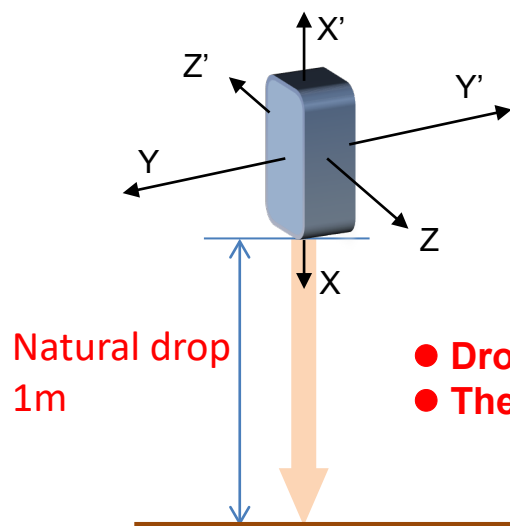
### ◆ General conditions    Parts test

- *Environmental temperature:  $20 \pm 10^\circ\text{C}$*
- *SOC at the start of test: Part 90% or higher of the rated capacity described in Annex 6*
- *1m/6 directions/each time*

### ◆ Criteria

- *No electrolyte leakage (to be verified by visual inspection without disassembling)*
  - *No rupture (applicable only to high-voltage REESS)*
  - *No fire*
  - *No explosion*
- For a high voltage REESS, the isolation resistance measured after the test in accordance with Annex 4B to this Regulation shall not be less than  $100 \Omega/\text{Volt}$ .*

### ◆ Typical individual conditions



- **Dropped in six directions (to be decided with the testing institution)**
- **The manufacturer may use different units for each test**

**A smooth and level concrete surface or a floor with equivalent hardness.**

### ◆ Objective

*The purpose of this test is to verify the safety performance of the REESS under mechanical shock which may occur during fall on the side from stationary or parked situation.*

### ◆ General conditions Parts test

- Applicable for vehicles with centerstand/sidestand
- Implement with complete REESS or REESS subsystem
- Environmental temperature:  $20 \pm 10^{\circ}\text{C}$
- SOC at the start of test: 50% or higher

### ◆ Criteria

- No electrolyte leakage (to be verified by visual inspection without disassembling)
- No rupture (applicable only to high-voltage REESS)
- No fire
- No explosion

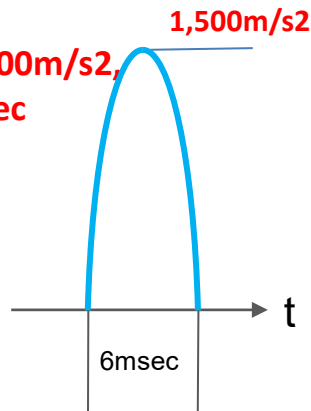
*For a high voltage REESS, the isolation resistance measured after the test in accordance with Annex 4B to this Regulation shall not be less than 100  $\Omega$ /Volt.*

### ◆ Typical individual conditions

#### -Impact profile

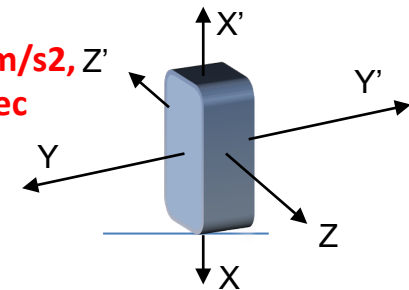
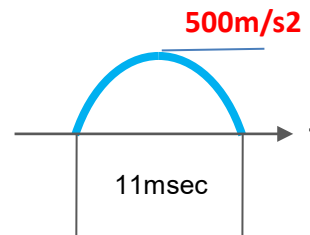
#### (1) Weight of test body <12kg

Sine half wave shock  
at peak acceleration of  $1,500\text{m/s}^2$ ,  
and pulse duration of 6msec



#### (2) Weight of test body $\geq 12\text{kg}$

Sine half wave shock  
at peak acceleration of  $500\text{m/s}^2$ ,  
and pulse duration of 11msec



Give shock test a total of 18 times for three axes of x, y and z; up/down - 3 times each, front/back 3 times each, sides - 3 times each

### ◆ Objective

*The purpose of this test is to verify the resistance of the REESS, against exposure to fire from outside of the vehicle due to e.g. a fuel spill from a vehicle (either the vehicle itself or a nearby vehicle).*

### ◆ General conditions

*This test applies for vehicles with a passenger compartment only.  
This test is required for REESS containing flammable electrolyte.  
The test shall be carried out on one test sample.*

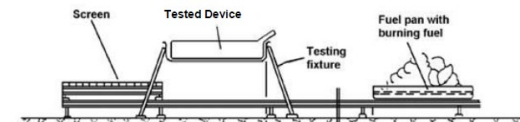
- Environmental temperature:  $>0^{\circ}\text{C}$
- SOC at the start of test: 50% or higher

### ◆ Criteria

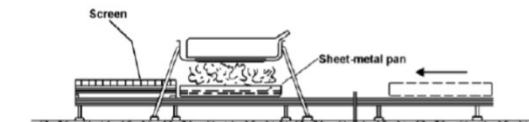
- No explosion

### ◆ Typical individual conditions

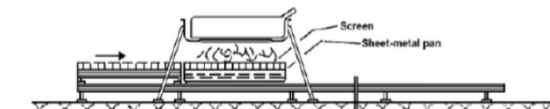
Phase A: Pre-heating



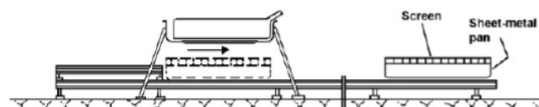
Phase B: Direct exposure to flame



Phase C: Indirect exposure to flame



Phase D: End of test



Phase A: Pre-heating(60sec)



Phase B: Direct exposure to flame(70sec)



Phase C: Indirect exposure to flame (60sec)



Phase D: End of test

*After removal of the pan the tested-device shall be observed until such time as the surface temperature of the tested-device has decreased to ambient temperature or has been decreasing for a minimum of 3 hours.*

- Appropriate EV regulations are necessary for the people's safety.
- The international regulations for Category L EV's electricity and REESS safety have gone into effect in January 2016. Japan also have adopted them and revised relevant laws and regulations at the time of enactment.
- To protect the people's safety and develop the EV industry in a sound manner, JASIC recommends also to establish electricity and REESS safety regulations for Category L EV harmonized with UN R136.

Thank you!