Battery Assembly Test for UN Transportation

Manual of Tests & Criteria -Lithium-ion batteries-

JARI

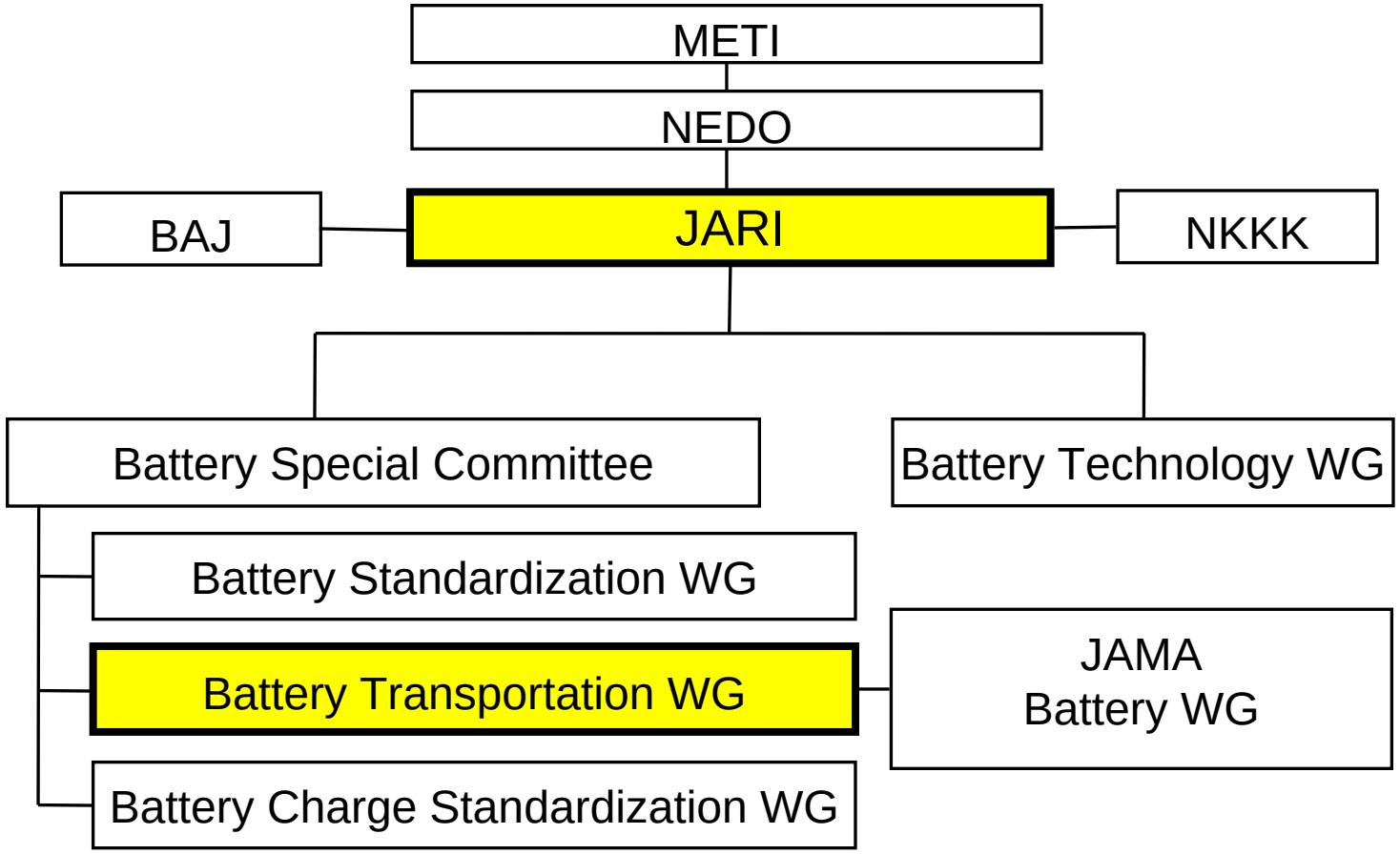
Battery Transportation Working Group

November 12th,2008

Battery Project Structure

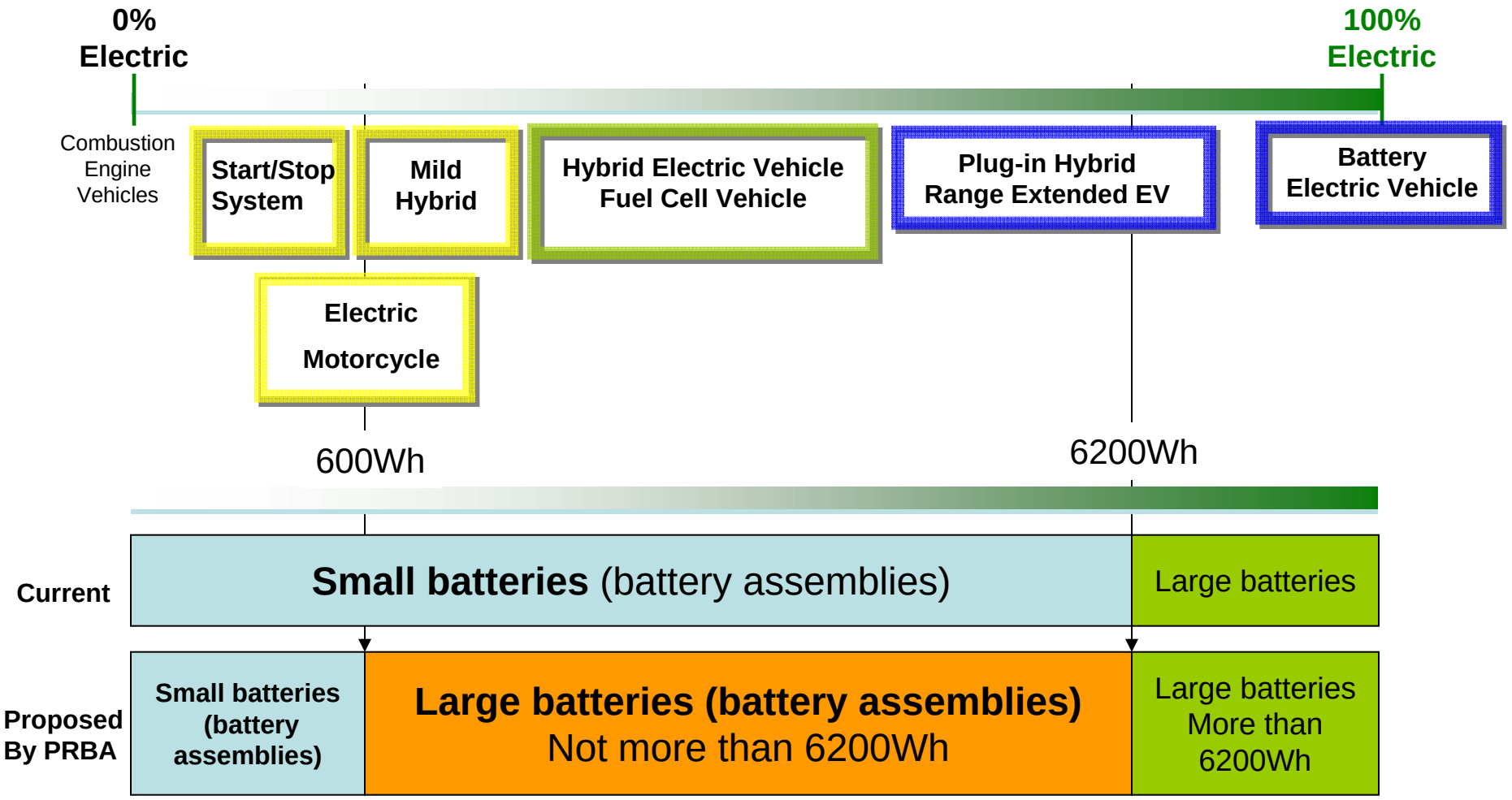
JARI BATTERY COMMITTEE MEMBERS

Automobile Manufacturers
Nissan,Toyota, Honda, Mitsubishi, Subaru, Mazda, Daihatsu, Suzuki, Yamaha
Battery Suppliers
Panasonic, PEVE GS Yuasa, Sanyo, Hitachi VE, AESC
Transport Expert
NKKK
Observers
METI, NEDO, AIST, CRIEPI,BAJ



NEDO: New Energy and Industrial Technology Development Organization
METI: Ministry of Economy, Trade and Industry
JAMA: Japan Automobile Manufacturers Association
BAJ: Battery Association of Japan
NKKK: Nippon Kaiji Kentei Kyokai

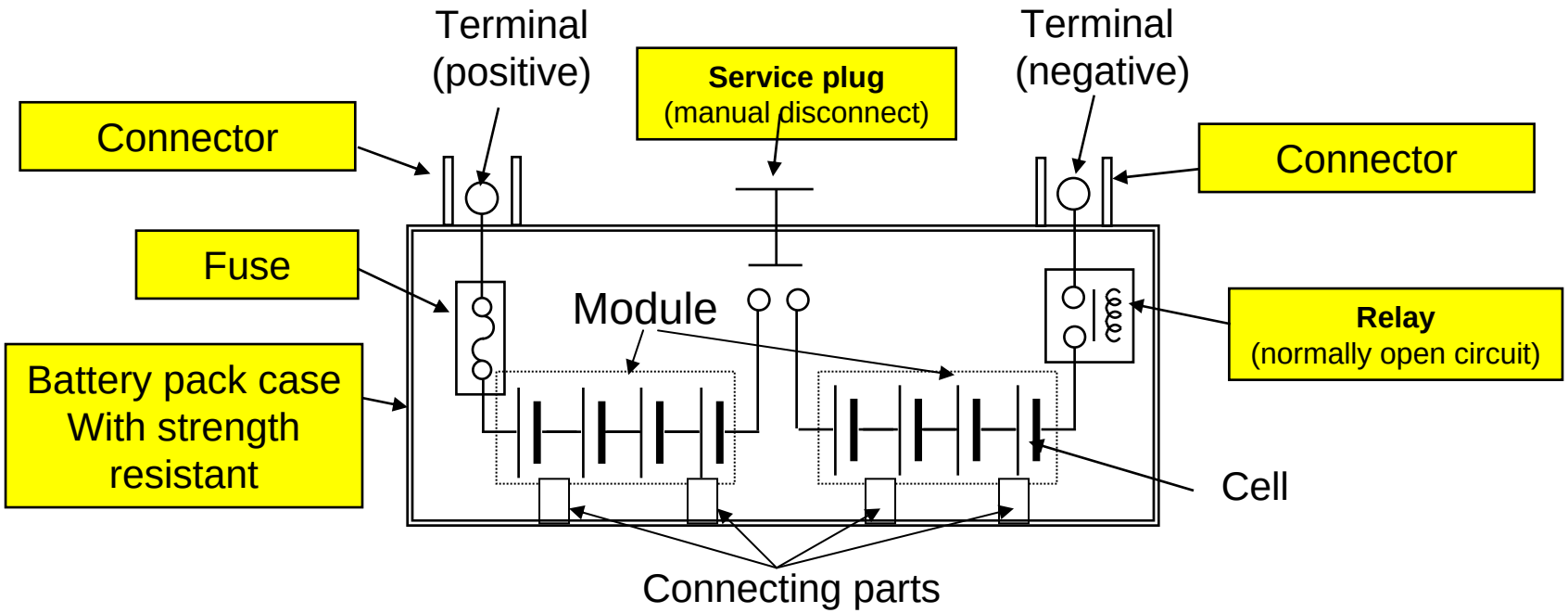
Energy Capacity Level of Battery Assemblies for current and near future automobiles



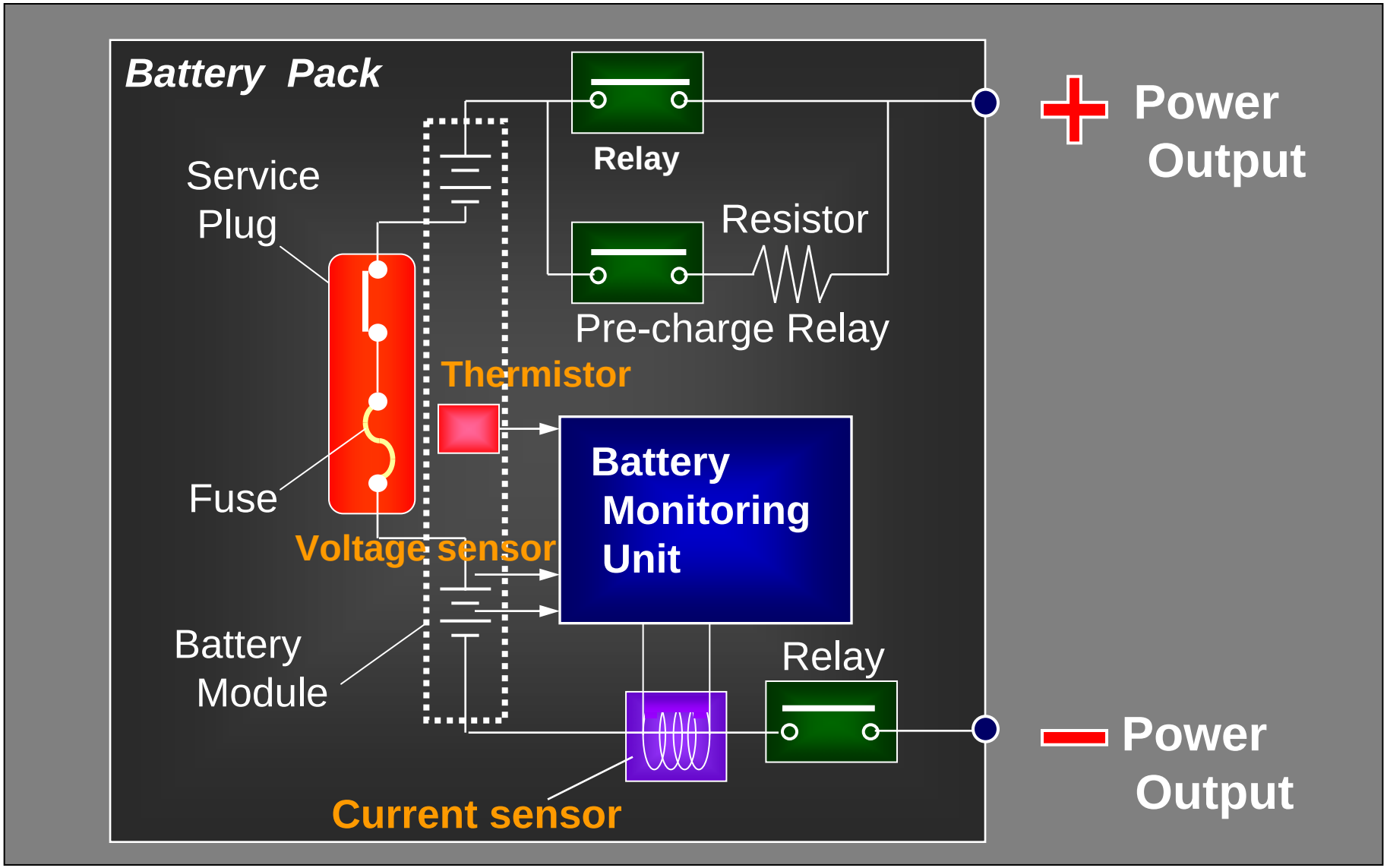
Standard battery pack configuration for EV,PHEV,HEV

Standard automobile battery pack for these automobiles (EV,PHEV,HEV);

- does not vary with any kinds of electrode materials, such as lead-acid, nickel metal hydride, and lithium ion batteries.
- Are equipped and designed with mechanical and electrical protective functions as parts of automobiles.
- Are controlled by vehicle control systems to maintain the battery condition and safety during the vehicles operation.



Monitoring and Controlling System



Differences of Batteries Configuration Between Automobiles and Consumer Applications

Automobile batteries have a high energy capacity (Wh), volume, and mass compared to batteries for mobile devices.

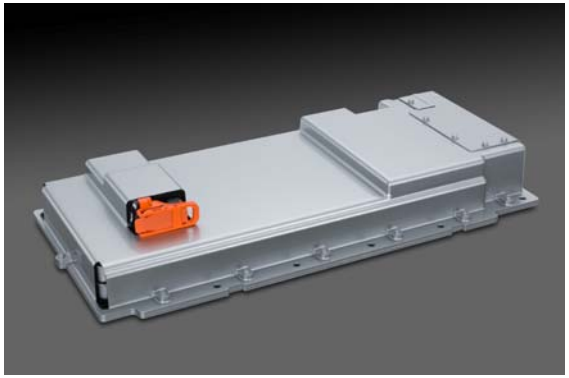
The traction battery systems include monitoring and control systems in a battery made of electrically interconnected modules or battery cells, which monitor and control the battery conditions and state of charge. The batteries are managed in conjunction with the vehicle control system under vehicle usage.

A shut-off mechanism is also included for safety. Although the energy capacity, external shape and mass differ depending on the design conditions, the basic constructions of traction batteries are the same.

Case Design of Automobile Battery Assembly

The casing of battery assembly is designed to have enough strength and to meet the severe endurance reliability required during manufacturing, transportation and installation into a vehicle.

Start/stop system



Hybrid electric Vehicle

Electric Vehicle

Number of Batteries Required for Testing

PRBA's amendment proposal on battery to UN tests and criteria is convincing.

It can reduce both automobile and battery manufacturer's development cost without sacrificing real production qualities.

Test #	Current	PRBA Proposal	
	Small battery Not more than 6200Wh	**Large battery 600Wh< and <6200Wh**	**Large battery More than 6200Wh**
T-1 altitude simulation	**16 batteries**	**4 batteries** in the case of a lithium ion Battery is assembled from cells or batteries that have passed all applicable tests, **one battery assembly** in a fully charged state **shall be tested under Tests 3, 4, and 5, and, in addition, Test 7** in the case of a rechargeable battery assembly.	**4 batteries** **battery assembly that is consisted with batteries that have passed all applicable tests does not need to be tested if it is equipped with a system capable of monitoring the battery assembly and preventing short circuits, or over discharge between the batteries in the assembly and any overheat or overcharge of the battery assembly.**
T-2 thermal			
T-3 vibration			
T-4 shock (150 Gn for small batteries, 50 Gn for large batteries)			
T-5 external short circuit			
T-7 overcharge	**8 batteries**	**4 batteries**	
Required number	**24 battery assemblies**	**At least 1 battery assembly**	**4 battery assemblies, but not required when above satisfied, for example, EVs.**

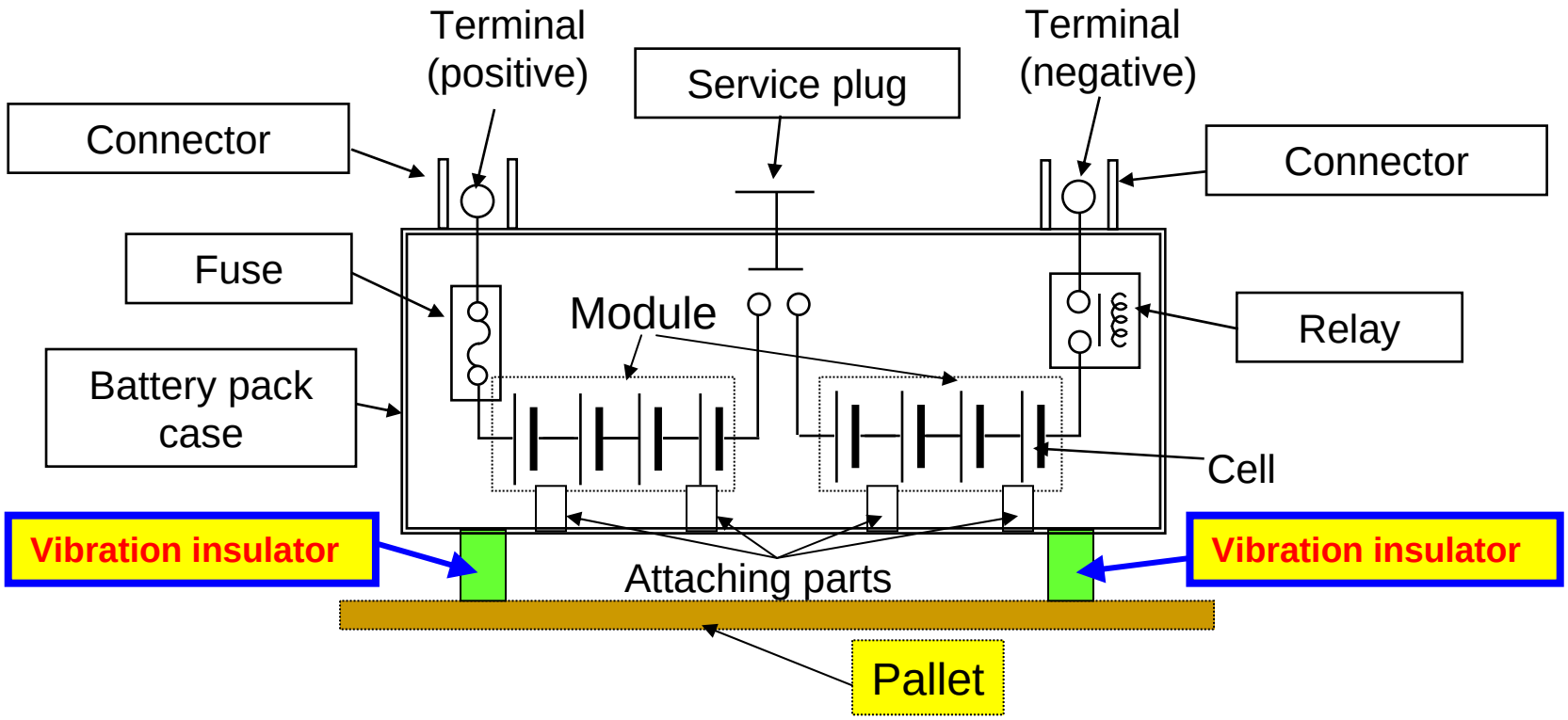
Note: T-6(impact) and T-8(forced discharge) are required for cells.

Mechanical Design Challenge to Pass the Vibration Test

1. For large battery of capacity no more than 6200Wh, strict mechanical design requirement is the same for such battery and for battery assemblies of capacity more than 6200Wh.
2. In order to pass the strict vibration condition of transportation requirement, the mechanical design of battery pack should increase its weight, lose the compactness and spend both development cost and time of examination.
3. Both to assure transportation safety and to reduce above burden in development, vibration absorption device (like rubber insulators or rubber mountings) can be one of effective countermeasures. These insulators attached to outer casing of battery pack shall be designed by manufacturer. The battery pack shall be equipped with these insulators by shipper under manufacturer's instruction.

Battery Pack Equipped with Vibration Insulator

- A battery pack to which vibration insulators are attached can be put through any applicable tests as it is, as long as the battery pack is shipped with the insulators. The insulators can be considered to be parts of the battery pack (battery assembly).



Summary

- High volume of international transportation of lithium-ion batteries for automotive applications is expected due to a popularization of hybrid electric vehicle and near future penetration of electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles. With these developments, we hope UN will revise its recommendation so it is also suitable to the transportation of automotive lithium-ion batteries.

- In view of the above background, JARI Battery Transportation WG generally supports the PRBA's proposal for the UN Manual of Test and Criteria, Chapter 38.3.

- However, there is still battery pack design challenge remain to pass the vibration and shock tests. Economic efficiency and environmental effect might have to be sacrificed due to a new sturdy design to pass the current regulation.

- Countermeasures is strongly required to satisfy both transportation safety and advancement in design technologies for battery pack.