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Promotion Strategy of Electric Scooters in Taiwan

Bing-Ming Lin[1], Shiow-Huey Suen[1], and Jason Shian-Ching Jang[2]
[1] *Material and Chemical Research Laboratories, Industrial Technology Research Institute, Hsinchu, Taiwan, ROC, e-mail: bmlin@itri.org.tw*
[2] *Department of Materials Science and Engineering, I-Shou University, Kaohsiung, Taiwan, ROC*

Abstract

Owing to the GHG emission and fossil fuel consumption made by the vast amount of motorcycles, Taiwan Government raised the strategy to promote a hundred thousand electric scooters on road in four years. Electric scooter nowadays becomes much acceptable and marketable than ever by adopting detachable lithium-ion battery pack which makes the vehicle lighter to handle, and not necessarily rely on charging infrastructure. However, due to the safety issue of lithium-ion battery, the IDB (Industrial Development Bureau) of MOEA in Taiwan draws up a subsidization program that the detachable lithium-ion battery pack is mandatory required and need to pass safety test of TES-0B-01-01 (Lithium-ion battery pack test method of Taiwan Electric Scooter, based on BATSO-01) which includes electrical, mechanical and environmental tests. In parallel, the performance shall also meet target value set for different categories of vehicle.

Keywords: promotion, lithium battery, electric scooter, vehicle performance, safety, subsidy

1 Introduction

The registered quantity of motorcycles in Taiwan now already exceeds 14 million and accompanies the high petroleum price, the large amount of regular commuters take motorcycles instead of cars for transportation. Therefore, this situation certainly increases the environmental loading to the cities. Although Taiwan has adopted the fifth phase emission regulation which is equivalent to EU4 since July 2007, the green house gas emitted and fossil fuel consumed by the huge amount of motorcycles is still a long-term issue needs to be solved by Taiwan government. Based on 40 years development and manufacturing experience in motorcycle industry, Taiwan has strong R & D resources, manufacturing infrastructure, service and maintenance system with long time scooter driving culture. Thus, one of the effective ways to solve the envrionment problem is suggested applying the electric scooter to substitute the ICE (internal combustion engine) motorcycle.

Recently, the technology of lithium-ion battery has been successfully developed and applied on many fields, such as 3C products, power tools, and electric bicycles etc. The high energy density lithium-ion battery not only makes the vehicle lighter to handle but also can be designed into an easy-carried detachable battery pack, and not necessarily rely on charging infrastructure. Considering all of above factors, Taiwan Government once again raises the strategy to promote a hundred thousand electric scooters on road in four years starting from 2009 [Ref.1]. At the same time, this promotion can not only convert traditional motorcycle manufacturers to fabricate low pollution products but also drive local lithium-ion battery industry into power battery business segment.

2 Promotion strategy

By learning from the unsuccessful experience of promotion on electric scooter during last decade, IDB of Taiwan draws up a thoughtful subsidization program to reach the goal of one hundred thousand electric scooters on road in four years including the subsidy for consumers, the reward for manufacturers, and the subsidy for constructing charging facilities. To ensure the high quality products which can satisfy the requirement of consumers, the detail key points, conditions and quality consistency of subsidization policy for the electric scooter are set up and listed as followings [Ref.2-4]:

Conditions:

- Vehicle type approved by MOTC (Ministry of Transportation and Communications)
- Adopt detachable lithium-ion battery pack
- Nominal voltage of the battery pack is 48V.
- Information of BMS (battery management system) including temperature, voltage, residual capacity, abnormal signal, recharging cycles, and battery identification should be recorded and can be read out.
- Meet the criteria of performance and safety
- Issue business operation plan being approved:
  - Projected sale quantity
  - Detailed vehicle performance
  - Detailed battery specification (including nominal voltage and BMS information)
  - Warranty conditions
  - Promoting plan and sales channel
  - After service

Quality compliance：

- Regularly scheduled inspection
- Irregularly scheduled inspection
  - Customer complains
  - Certain incident issues etc.

3 Criteria of vehicle performance and safety

Table 1 show the detail criteria of performance and safety for light and small light electric scooter respectively in the subsidization program which includes the vehicle, battery module, and charger system. The test for each item in Table 1 should follow the test method as listed in Table 2. In addition, the test procedure and test organizations have also been established and approved by IDB as shown in Figure 1. Since the lithium-ion battery has safety issue, especially for the large power battery pack, that the detachable battery pack has to pass the safety test of TES-0B-01-01 (based on BATSO-01) [Ref.5,6] which includes electrical, mechanical and environmental tests as described in Table 3. Additionally, the safety test procedure and sequence of battery packs is also shown as Figure 2. All of these tests aim at a high standard of vehicle performance and safety for electric scooter which is to ensure the commercial product to meet consumers' requirement.

Table 1: Criteria of performance and safety for light electric scooter in the subsidization program

Items		Light （Small light）grade standard
Vehicle	Safety	Comply with TES-0A-08-01 "Safety guide rules of detachable battery module"
		Comply with TES-0A-10-01 "Specific safety requirement for electric motorcycles"
	Climbing ability	Over 10km/h at 18％（12％）gradient
	Max. speed	Over 50（30）km/h
	Acceleration	From 0 to 100m, within 12sec（from 0 to 50m, within 9sec）
	Driving range	Over 40（30）km under city driving pattern
	Durability	After accelerated deteriorate driving test for 5,000 (3000) km without major failure, driving range shall retain 85% of initial test result
	Battery capacity indication	At least additional 2km driving range before and after durability test when low level warning of residual capacity occurs
	EMC	Comply with TES-0A-07-01 EMC test methods for electric motorcycle
Battery module	Safety	Comply withTES-0B-01-01 "Methods of secondary lithium-ion battery safety test "
	Weight	Under 10kg for a single module
Charge system		Comply with TES-0A-09-01 "Safety guide rules of charge system"

Table 2: TES test methods

Modified from CNS existing test methods		
Test code	Name of method	Referred testing standard
TES-0A-01-01	Method of climbing ability test for electric motorcycles	CNS14386
TES-0A-02-01	Method of maximum speed test for electric motorcycles	CNS14386
TES-0A-03-01	Method of acceleration test for electric motorcycles	CNS14386
TES-0A-04-01	Measurement of driving range and energy consumption for electric motorcycles	CNS14386
TES-0A-07-01	Method of EMC test for electric motorcycles	CNS14434
TES-0A-10-01	Specific safety requirement and test methods for electric motorcycles	CNS14386
New developed test methods		
TES-0A-05-01	Accelerated deteriorated durability test method for electric motorcycles	
TES-0A-06-01	Residual capacity indication principle and test method for electric motorcycles	
TES-0A-08-01	Safety guide rules of detachable battery module for electric motorcycles	
Quote and modified from other test methods		
TES-0B-01-01	Methods of secondary lithium-ion battery safety test	BATSO-01
TES-0A-09-01	Safety guide rules of charge system for electric motorcycle-general requirement	IEC61851-1
TES-0A-09-02	Safety guide rules of charge system for electric motorcycle-connection	IEC61851-1

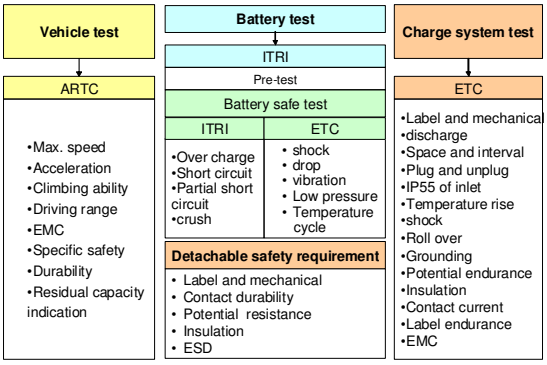

Figure 1: Test procedure and test organizations

Table 3: Test items of TES-0B-01-01

Test items
◆ ***Electrical tests:***
-Overcharge
-External Short Circuit
-Vibration endurance
-Partial short circuit
◆ ***Mechanical tests:***
-Crush
-Shock
-Drop
◆ ***Environmental tests:***
-Low-pressure
-Thermal

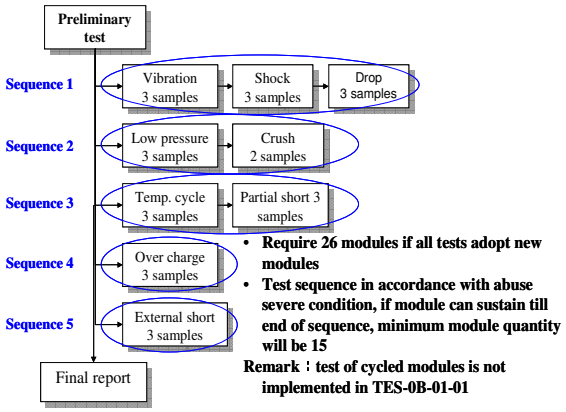

Figure 2: Safety test procedure and sequence of battery pack.

4 Future work

Besides the basic performance and safety of the electric scooter, the recharging infrastructure for extending the driving distance need to be considered as another major issue in the future. Therefore, a program to promote common battery pack is underway which needs the standard interface and communication protocol, even the size is also required to be unified. For approaching the standard interface and communication protocol, a non-profit EnergyBus organization (EnergyBus e.V.), a platform for institutions and industry representatives to work together on the development and market introduction of EnergyBus, is based in Germany and was founded on March 19, 2007 in Taiwan [Ref.7]. EnergyBus consists of a standardized set of connectors, which safely connects electric components of light electric vehicles, such as batteries, chargers, motors, sensors, human interface etc. These components communicate with each other on a CAN (computer area network)-based protocol. The regulated exchange of information enables each component to provide optimum performance. In overall, the idea is simply let drivers exchange their empty battery into a full one at battery swap station to extend the driving range easily. The government intends to extend subsidiary policy tool to make such dream come true.

5 Conclusions

After many times thoughtful discussion and policy modification by the cooperation of IDB, ITRI (Industrial Technology Research Institute), ARTC (Automotive Research and Testing Center), ETC (Electronic Testing Center) and representatives of electric scooter industries in Taiwan, the draft subsidization policy for electric scooter has been proposed by IDB on April of 2009. At the same time, the TES test methods also has been published on March 26, 2009. These TES test methods are believed to consist of the most well-defined specifications for electric scooter in the world so far. This subsidization program for electric scooter encourages the traditional motorcycle leading companies, such as Sanyang Motor Co. (SYM), and Kwang Yang Motor Co. (KYMCO) and electric scooter manufacturers all put into the development of electric scooters since 2007. In addition, some prototype electric scooters with lithium-ion battery pack have been announced in 2008 as shown in Figure 3. Accordingly, Taiwan Government optimistically prospect the future

development can be expanded the target amount of electric scooter from one hundred thousand to one hundred and sixty thousand. Hopefully, the development of electric scooter would benefit Taiwan industries as well as to help on decreasing the air pollution of the world.

(a) E-Mio, SYM

(b) E-Mo, E-Ton

Figure 3: Two prototype electric scooters with lithium-ion battery pack

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References

[1] Chinatimes 2008-09-20
[2] Chinese Conference on the Taiwan E-Scooter Program (March 18, 2009, Taipei, Taiwan)
[3] Light Electric Vehicles Conference 2009 (March 16-24, 2009, Taipei and Hsinchu, Taiwan)
[4] http://www.levconference.org/
[5] BATSO-01 (Battery Safety Organization. Manual for Evaluation of Energy System for Electric Vehicle (LEV)-Secondary Lithium Batteries, 1st edition)
[6] http://www.batso.org/
[7] http://www.energybus.info/Basics/What-is-EnergyBus

Author

Bing-Ming Lin:
Research manager, Material and Chemical Research laboratories, Industrial Technology Research Institute, Chutung, Hsinchu, Taiwan, 31040, ROC.
Major work: Power lithium-ion battery development and application.

Shiow-Huey Suen:
Administrator, Material and Chemical Research laboratories, Industrial Technology Research Institute, Chutung, Hsinchu, Taiwan, 31040, ROC.
Major work: Power lithium-ion battery and light electric vehicle promotion

Jason Shian-Ching Jang:
Professor and Chairman, Department of Materials Science and Engineering, I-Shou University, Kaohsiung, Taiwan, 84008, ROC.
Major work: Metallic glass materials and metallic biomaterials research