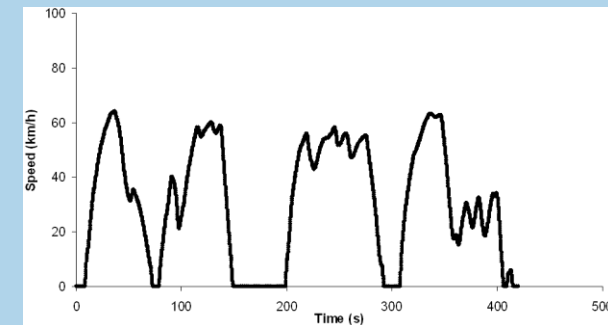
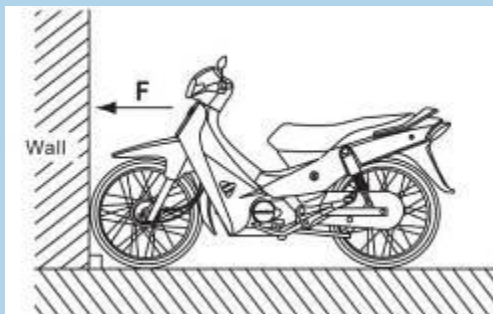


Light Duty Electric Vehicle Standards In Malaysia

Dr. Horizon GITANO
Focus Applied Technologies

Purpose of Standards
Electric Vehicle Standards
Battery Standards
CHALLENGES



Introduction

Focus Applied Technologies develops vehicle and transportation technologies, products and services for the global market

**Dynamometers
Data Loggers
EV Battery Testing**



We are involved in testing and standards development at the global level

www.FocusAppliedTechnologies.com



Range Extended EV 2026

EV Bike Conversion, with an 800W “Range Extender”.
Later put into a helmet box.



Purpose of Standards

Standards need for three main reasons:

Safety

Safety for the product user, and other road users

Product Quality

We want to ensure a *reasonable* level of quality:

- Eliminate “shoddy” products that will disappoint customers
- Ensure that the product meets/exceeds manufacturers claims

Compatibility

Insures interoperability/compatibility with existing infrastructure

There must be a balance between “Quality” and Cost” considerations:
Some low cost products are still very useful to some customers

Performance based Standards

Standards should be based on *performance* not *technology*

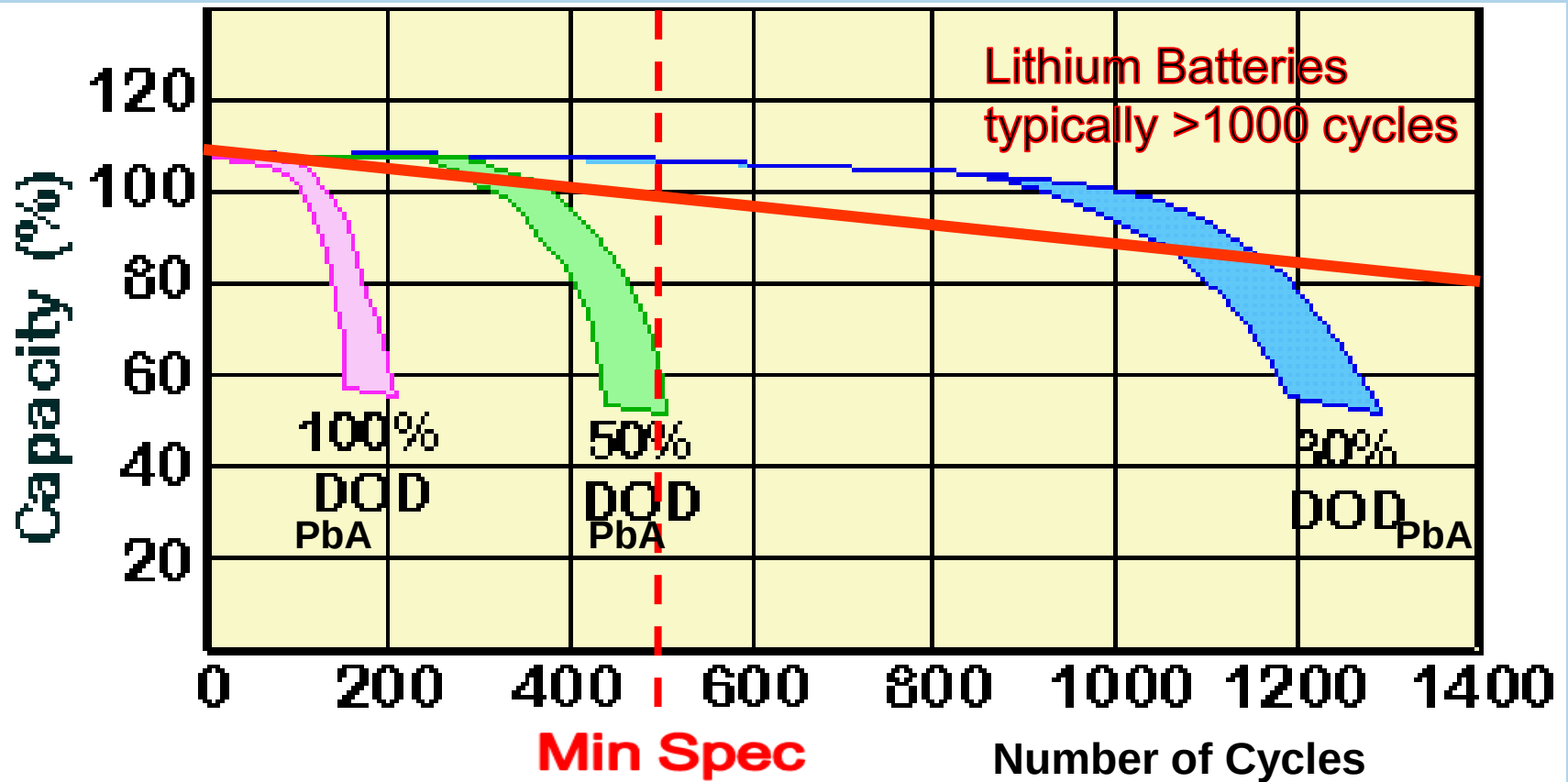
Lead Acid batteries *can* be good EV batteries

A battery life cycle test with a *reasonable* limit, is better (and more universal) at eliminating bad products than stating “No Lead Acid Batteries”

What happens when Sodium Batteries come along?

Be “Technology” blind, and specify **PERFORMANCE**

Battery Life Cycle Specification Example



If 500 charge-discharge cycles is a reasonable limit, then insist that **ALL** products meet or exceed that limit.

GOOD PbA designs can achieve this limit (40% DOD)
MOST Li-Ion Batteries can achieve this

WHERE TO TEST?

IF you spec a **STANDARD**, you should have the facilities to **TEST** to that standard

If you specify a standard, but can not test... *what is the point of the standard?*

Outsourcing of testing is one way to go:

Bangkok, Malaysia, Vietnam...

All have standards compliance test centers

GOVERNMENT owned vs **PRIVATE** testing facilities

Gov: Less expensive, less convenient, slower

Private: Faster, more \$, more open to “corruption”

What to specify? Problems and Complaints

- #1 Too Slow / Low Range**
Battery Life Expectancy too low
Cost to replace batteries
Chargers breaking

- #2 Poor Breaks**
Expensive Tires (non-standard)

- #3 Warn out front forks**
Warn out head tube
Low Payload Capability
Overall poor quality

Quality Factors of Electric Vehicles

What do customers care about? Just look at adverts:

Cost

Speed

Range

Power

Charging Time

Carrying Capacity

HIGHLIGHTED items included
In vehicle standards

ONTARIO

ELECTRIC

1000W

MAX SPEED 35 KPH

UP TO 60 KILOMETERS RIDING DISTANCE

35Ah

60 Volts

MTR-027-M

FOR ONLY

P333/Day *6 Months/ No Interest

REGULAR PRICE P59,900

CASH / STRAIGHT

CHARGING TIME: 6-8 HOURS

UP TO 300 KILOS LOAD CAPACITY

3 or 6 months

CALIFORNIA

Malaysian Standards Committee

Government Departments:

- Highway Enforcement
- Transportation
- Standards
- Road Safety
- Environment

Also included:

- Academia *(Not too many as they tend to talk a lot!)*
- Industrial Partners (manufacturers and associations)
- Consumers Associations

There is lively debate on the various aspects of the standard with all parties having their say, and in the end a **consensus must be** achieved.

Standards Generation BASICS

We followed a few basic rules of standards generation:

- 1) Base standards on **DATA**, not OPINIONS!
- 2) **SAFETY** of consumers and road users is priority #1
- 3) Protection of the consumer from **poor quality** is #2
- 4) Do **only** what is necessary.
- 5) Do **all** of what is necessary.
- 6) **Whenever possible*** follow EU/Existing standards.
- 7) Adapt, add or drop specs as required for the **local situation**
- 8) If you can't confirm it, don't specify it.

Standards are regularly updated with additions, simplifications, clarifications and corrections

Confirmation Testing

“Trust but verify”

New Model Vehicle Type Approval requires conformation testing before sales or road usage are allowed (except for R&D Vehicles)

The Government **Standards Department** (SIRIM/JSM) is responsible for most of the testing, however the **highway department** or even private companies can be certified to do some of the testing.

Some **foreign standard certification** is accepted in lieu of local testing for the compatible parts of a given standard.

In some cases individual vehicles require related testing (eg. Commercial vehicles breaks, emissions, etc. every 6 months) which are performed at various “**Puspakom**” centers around the country.

Points to Consider when Developing Standards

1) MANPOWER

To properly implement vehicle standards, you must have sufficient manpower to perform the required testing and verification

2) BUDGET

A working budget must be provided to the standards development and confirmation teams.

3) TOOLS

Testing and Verification may require some special tools

4) KNOWLEDGE

Standards workers will require continuous training on the latest technologies.

5) SPACE

Vehicle testing requires a fair amount of space for storage and testing.

STANDARDS Challenges

Additional Challenges:

Poor Statistics on fleet size and usage if they are not currently registered

Accident Stats not tracked police don't have accident investigation training/recording

CHARGING Standards:

Manual Emergency Shutoff

Automatic Fault Detection and Shutoff:

- Thermal

- Over Current

- Short Circuit

- Current Leak

Proper Grounding

Ground Fault Protection

Ingress Protection (IP54 to IP65)

Wire Insulation/Robustness

Impact Resistance

STANDARDS: Local or International?

STANDARDS are sometimes used as a “trade barrier”, so beware!

EUROPEAN MOTORCYCLE BRAKING STANDARD: **6.5m/s²**

BUT: In Pakistan 80% of the 2-wheelers are the CD70, with small front Drum brake:
~**5m/s²**

**IF we accept the European standard,
80% of our local manufacturers will FAIL!**

The manufacturers will need time to integrate
Better brakes.

SOLUTION:

We publish a schedule of “upcoming standards”:

This Year: 4.5m/s²

Next Year: 5.5m/s²

2 years: 6.5m/s²

*Make sure current ones are good
Better shoes, larger hub, etc.
Disk Brakes*



ICE – EV DIFFERENCES

ELECTRIC VEHICLES

Charging: Slower

Batteries

Motor Controller

Motor: Good Power

Range: Low to Med

Regen Braking

Weight: 1,900kg Car

ICE VEHICLES

Fueling: Fast

Tank

Engine Controller

Engine: Good Power

Range: High

Emissions

Weight: 1,300kg Car

EV SPECIFIC STANDARDS

Electrical Safety

Water Ingress/Protection

Battery Integrity (vibrations and crash)

Over/Under Charging, Charger safety

BEWARE OF FEAR OF THE UNKNOWN:

People routinely report fear of EV fires, but

ICE's are 20 x more likely to burn than EVs

ELECTRIC VEHICLE STANDARDS

VEHICLE PERFORMANCE

Speed, Range, Hill Climb

Braking, Lighting

Crash Safety, Shock/Vibration

ELECTRICAL SAFETY

Labeling

High Voltage / Low Voltage Isolation (even in a crash)

Hi Pot / Insulation

BATTERY SPECIFIC

Short Circuit, Over Charge, Venting/Spillage

LIFE SPAN

COMPATIBILITY – ENVIRONMENTAL

EMI / EMC

Charging Infrastructure

Rain, Flood Fording, IP (Ingress Protection)

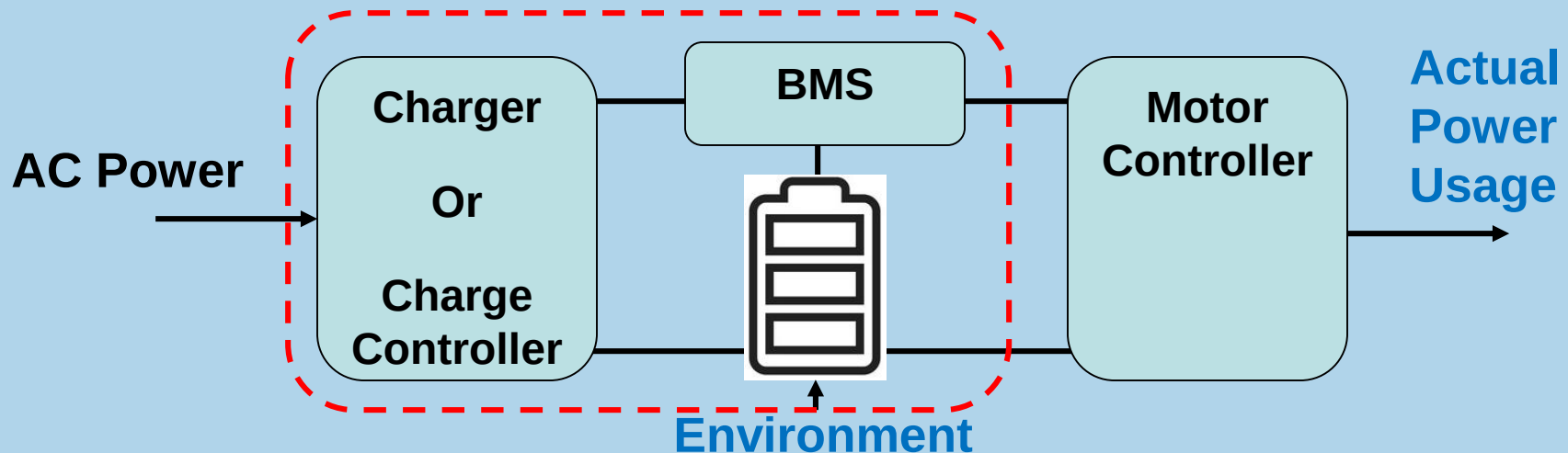
Acoustic Warning System (in some countries)

EV Battery Life

Battery Life is one of the **LEAST accessible** parameters, but one of the **MOST IMPORTANT**.

Battery Life is a function of:

- Cell Quality
- Battery Management System (Vmin, Vmax...)
- Charger (Current)
- Use (Discharge Current)
- Environment (Temperatures, Vibrations)



We recommend verification test of the vehicle **pack/charger/BMS** as a unit based on **actual usage** and environment.

INTERNATIONAL Vehicle Performance

NO	ORGANIZATION	STANDARD
1	ISO	8714 , 8715, 21782, 18246, 23280, 19466
2	SAE	J3007, J2982, J227, J1666, J1634
3	UNECE	Regulation No. 138

Electromagnetic Compatibility / Interference (EMC/EMI)

NO	ORGANIZATION	STANDARD
1	ISO	12405, 7637, 11452, 10605
2	SAE	J2929, J2464, J1113/1, J1772
3	IEC	61851, 62196, 62133
4	UNECE	Regulation No. 10

Battery Performance

NO	ORGANIZATION	STANDARD
1	ISO	12405, 18243, 19453, 13064, 18300, 18243
2	SAE	J2380, J1798, J2288, J2758, J1798/1, J2929, J2464
3	IEC	61982, 62660, 62840, 63193, 60254

Electrical Safety

NO	ORGANIZATION	STANDARD	
1	ISO	26262, 16750, 6469, 13063	
2	SAE	J1766	
3	UNECE	Regulation No. 100, 136, 94, 95, 12, 153	
4	Others	US	FMVSS 305
		Japan	Attachment 110 and 111
		Canada	CMVSS 305
		Korea	Motor Vehicle Safety Standard, Article 18-2 and 91-4

Charging and Compatibility

NO	ORGANIZATION	STANDARD
1	ISO	17409, 15118, 19363, 5474, 17409, 21498, 12906,
2	SAE	J2953/4, J1772
3	IEC	61980, 61851, 61439-7, 62196, 62893, 62933-2-200, 62955, 63110, 63119, 63454, 63472, 60364-7-722

MALAYSIAN EV Standards

We have 3 categories of vehicles based on op speed:

Low Speed

0-25kph

“Bicycle”

Medium Speed

25-50 kph

“Scooter”

Normal Speed

>50kph

“Motorcycle”

ALL of these categories apply to 2, 3 and 4-wheeler vehicles



“Bicycles”



“Motorcycles”



“Bicycles”: Low Speed ($\leq 25\text{kph}$)

Originally written as an “Electric Power Assist Bicycle” it has been expanded to ALL $< 25\text{kph}$ EVs.

Popular for older people, women with children and children with children.



EPAB



E-“Moped” 25-50kph class

This is by far the **most popular** class of E2W and used in urban centers, and rural areas.

Typical Performance:

35kph, 30-40km range, Lead Acid batteries, 500\$ cost

Popular with “contractors” and foreigners who lack licenses (unregulated)



E-Motos: >50kph

Higher speed, greater range, much more expensive (1000-3000\$) preferred by the government and local manufacturers.

The idea is that the Chinese have already dominated the “low end” so Malaysia should focus on the “high-end” next-generation vehicles.

Chain Drive



Hub Motor



E-Motos: 2- 3- and 4-Wheelers

These standards were originally laid out for 2-wheelers, but have subsequently been expanded into 3- and 4-wheelers as well. All of these standards include Hybrids by default.



Electric 2-Wheeler Regulations

Many different regulations apply to the various classes.
This is a review of the road legality regulations.

Class	Speed (kph)	Roads	EV Label	Registration/Tax	Helmet
Bicycle	<25	Bicycle	YES	Local Authority	Users Choice
“Moped”	25-50	TBD ¹	YES	TBD ²	Required (TBD)
Motorcycle	>50	All	YES	Yes: 1kW = 20.1 cc	Required

NOTES:

- 1: Mopeds will likely be restricted from using federal highways, and expressways unless there is a sequestered motorcycle lane
- 2: Mopeds will likely have to be registered and pay a nominal fee for road usage, and identified with a special plate number/color

E2W Performance Spec'

Electromagnetic Compatibility and Interference tests are similar. There are some differences in the mechanical shock and vibrations and breaking tests.

Class	Range (km)	Batt Life (cycles)	Hill Climb	Flood Fording (10cm deep)	Rain
Bicycle	>20	>300*	None	140m	25cm/h, 4h
"Moped"	>40	>300	20%	200m	25cm/h, 8h
Motorcycle	>60(tbd)	>300*	20%	200m	25cm/h, 8h

NOTES:

* Battery Life Cycles will be amended into the existing regulations in the next revision. This will require them to achieve the manufacturers stated # of cycles, or total vehicle range (before 20% battery degradation) but not be less than 300 cycles.

Additional Standards: E-Bikes

VIN, Motor serial number, Motor Power Rating

State Of Charge Indicator

E-Bicycle: *Operator must be 12 years old and above*

Lights, Reflectors, Horn/Bell

Modes: On (but not run, ie. Accessories mode), Off, Run

HiPot: 250 (wet) – 4000 ohm

Dry Breaking: < 5m from 20kph

Wet Breaking: <10m from 20kph

Drop Test: 75kg, 0.5m 5x

Removable Battery Drop Test: 1.0m 6x

Shock/Vibe: Varies 8G to 3G at 10 to 200Hz

EMI/EMC: CISPR 12 or ISO 11451-2

Most Difficult to Pass

UNR136: Many Battery Level Tests



Standards Generation

A good deal of the specifications are “common sense” based.

If the **maximum gradient** (slope) on gazette roads is **20%** then the vehicle should be able to take-off from a stand still on a 20% gradient slope without tipping over, or rolling back.



Standards Generation

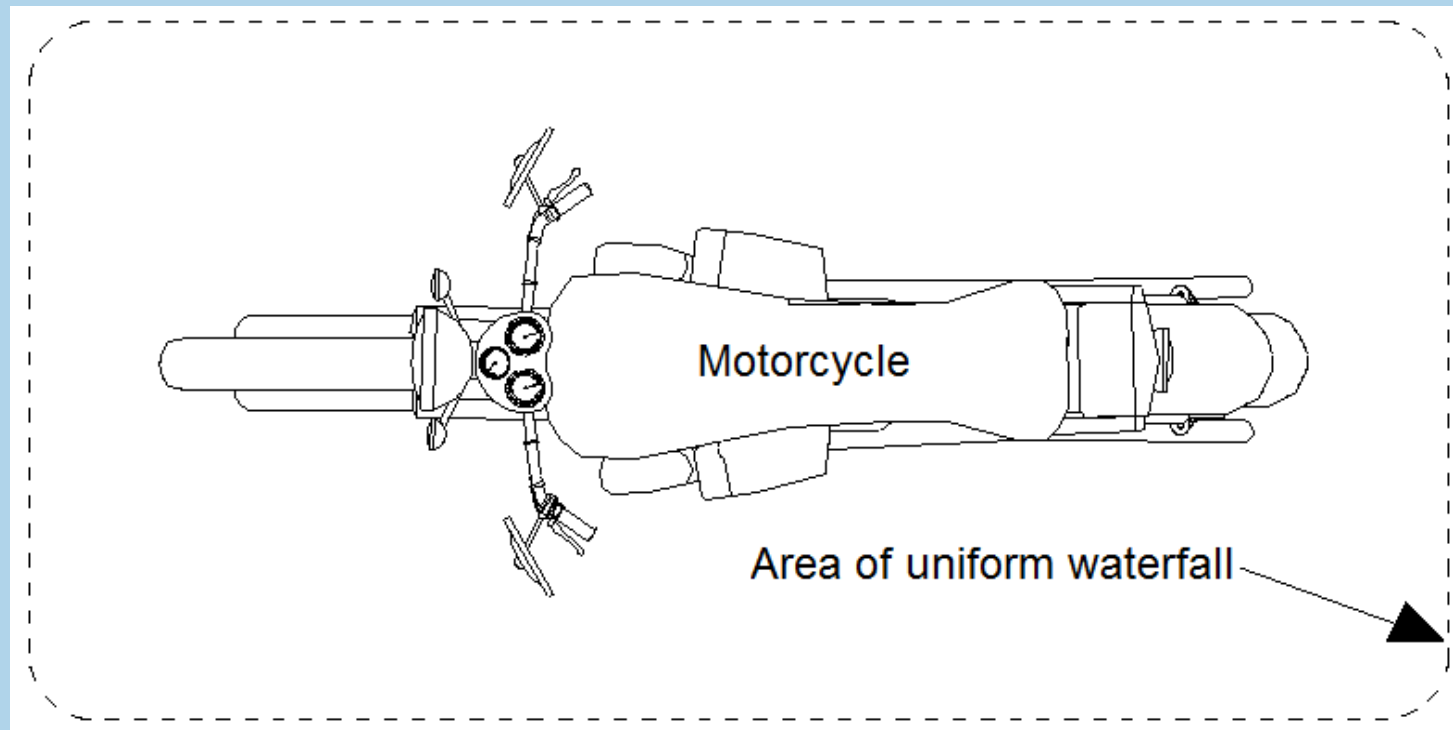
Asia is tropical and it rains. ***A lot.*** Your vehicle will eventually be driven through a flood and sit in a tropical rainstorm. We've got "**Tropical Rain**" and **Flood Fording** tests.



Tropical Rain Test (Simplified)

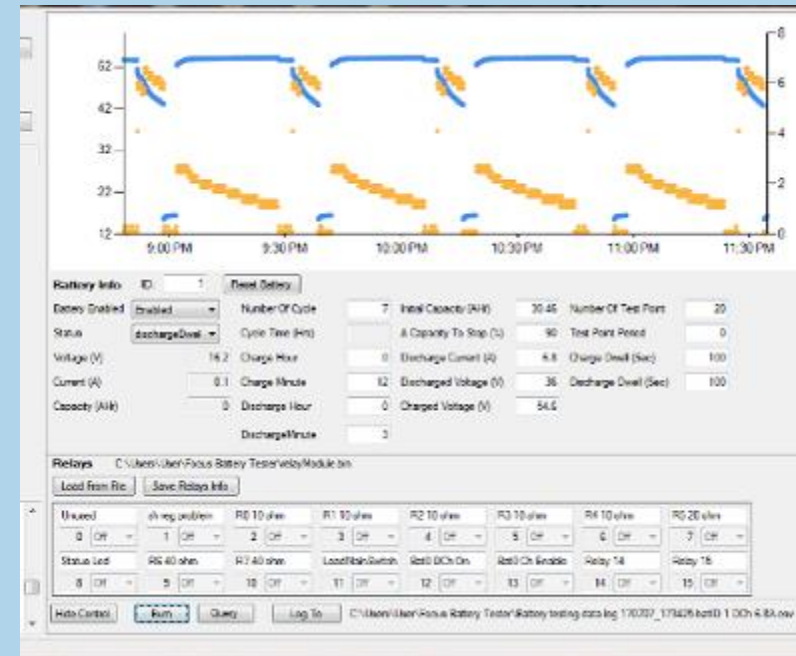
Requirement for water resistant test shall be as follows:

- a) place test vehicle in upright position, inside the test chamber with proper mounting on the machine base
- b) the water shall be sprayed uniformly at a flowrate of at least 25 cm/h as measured by standard rainfall measurement method;
- c) water temperature shall be within 20°C to 35°C; and
- d) test shall be carried out for 8h.

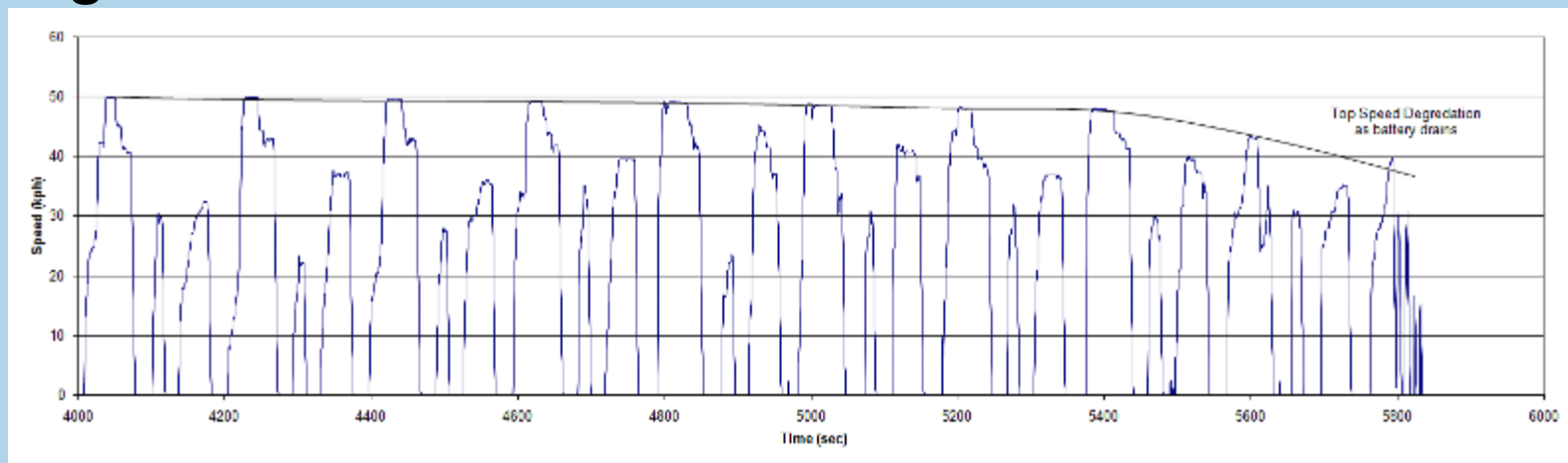


EV Standards Testing

Battery Life Test: 80% capacity for ≥ 300 cycles



Range Test: Automated as vehicles run >130 km on ECER40

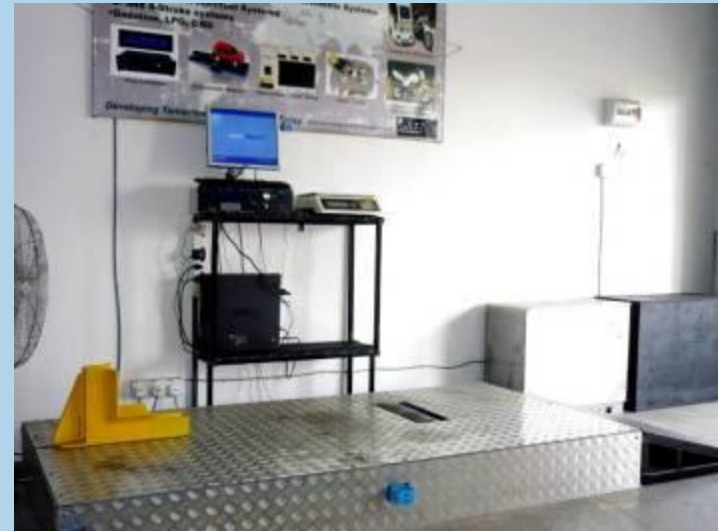


Automated Drive Cycle

Chassis dynamometers are capable of running automated drive cycle testing.



**Motored Chassis
Motorcycle Dyno**



Low Profile Motorcycle Chassis Dyno



Inertia Matching Roller

Conformity Testing: EMC

In EMC Testing the device is subject to RF noise and observed during various phases of operation



Electromagnetic Compatibility Standards

Emissions

Frequency range (MHz)	Broadband dB (μ V)	Narrow band dB (μ V)	Test method
30 to 75	32	22	CISPR 12
75 to 400	32 to 43	22 to 33	CISPR 12
400 to 1 000	43	33	CISPR 12
NOTE. The limits increase linearly with logarithm of the frequency in the range of 75 MHz to 400 MHz.			

Frequency range (MHz)	Broadband dB (μ V)	Narrow band dB (μ V)	Test method
30 to 75	42	32	CISPR 12
75 to 400	42 to 53	32 to 43	CISPR 12
400 to 1 000	53	43	CISPR 12
NOTE. The limits increase linearly with logarithm of the frequency in the range of 75 MHz to 400 MHz.			

Electromagnetic Compatibility Standards

AC Mains Emissions (During Charging)

No	Environmental phenomenon	Test specification	Basic standard
1.	Emission of harmonics generated on AC power lines	Class A	MS IEC 61000-3-2
2.	Emission of voltage changes, voltage fluctuations and flicker on AC power lines	Class A	MS IEC 61000-3-3
3.	Emission of radio frequency conducted disturbances on AC or DC power lines	Class B	MS CISPR 22
4.	Emission of radio frequency conducted disturbances on network and telecommunication access from vehicles	Class B	MS CISPR 22

Electromagnetic Compatibility Standards

Immunity Testing (Motor Running)

Environmental phenomenon	Typical test specification (for the latest specification refer to basic standard in this table)	Basic standard
Radiated electromagnetic immunity test Vehicle mode during test: a) engine-running mode (50 km/h with no load); and b) key-on, engine off with brake-on.	30 V/m 80 MHz to 800 MHz AM 80 % 1 kHz	ISO 11451-2
	30 V/m 800 MHz to 2 000 MHz PM; t on 577 μ s, period 4 600 μ s	ISO 11451-2

Electromagnetic Compatibility Standards

Immunity Testing (Charging)

Environmental phenomenon	Typical test specification (for the latest specification refer to basic standard in this table)	Basic standard
Immunity of vehicles to electrical fast transient / burst disturbances along AC or DC power lines	± 2 kV 5 kHz 1 min duration	MS IEC 61000-4-4
Immunity of vehicles to surge conducted along AC or DC power lines	1.2/50 μ s (8/20 μ s) AC = ± 2 kV, ± 1 kV DC = ± 0.5 kV	MS IEC 61000-4-5
Immunity of vehicles to RF conducted immunity test along AC or DC power lines	3 V _{rms} 150 kHz to 80 MHz 1 kHz 80 % AM	MS IEC 61000-4-6
Immunity of vehicles to electrostatic discharge test	± 4 kV contact discharge ± 8 kV air discharge	MS IEC 61000-4-2
Radiated electromagnetic immunity test. Vehicle at charging mode during test	30 V/m 80 % AM 1 kHz 80 MHz to 2 000 MHz	ISO 11451-2
	30 V/m 800 MHz to 2 000 MHz PM; t on 577 μ s, period 4 600 μ s	ISO 11451-2

Conformity Testing: Labeling

Vehicle and batteries must have clear markings indicating that it is an EV, Battery Chemistry, and requirements for recycling batteries and “high voltage” if $>60V$ DC.



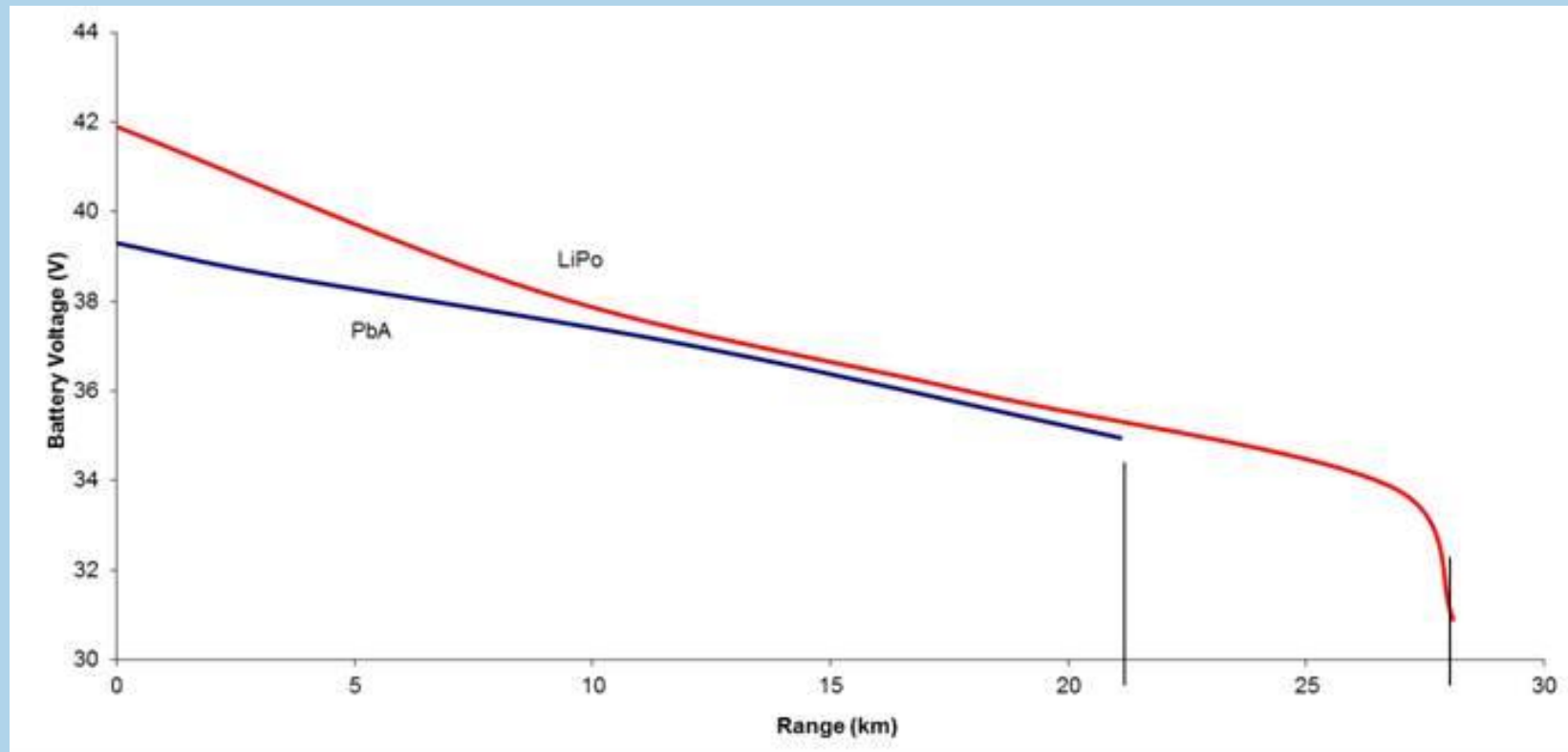
Conformity Testing:

Every motor is required to have a unique serial number conforming to the international numbering scheme.



Conformity Testing:

Li Batteries are smaller, lighter, and give better range, but cost many times the PbA batteries



Electrical Safety Standards: Battery & Vehicle

Insulation Resistance (Wet and Dry)

Hi-pot Test

Overload Protection (Overload cutoff)

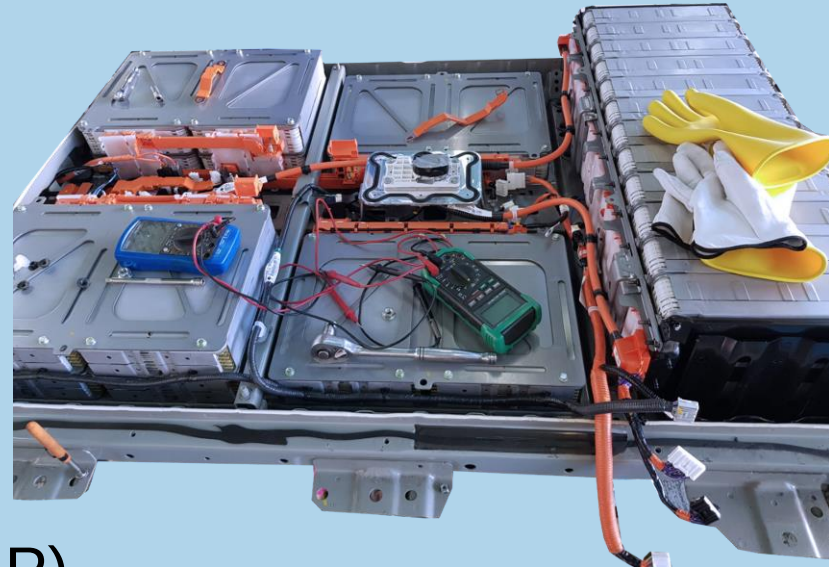
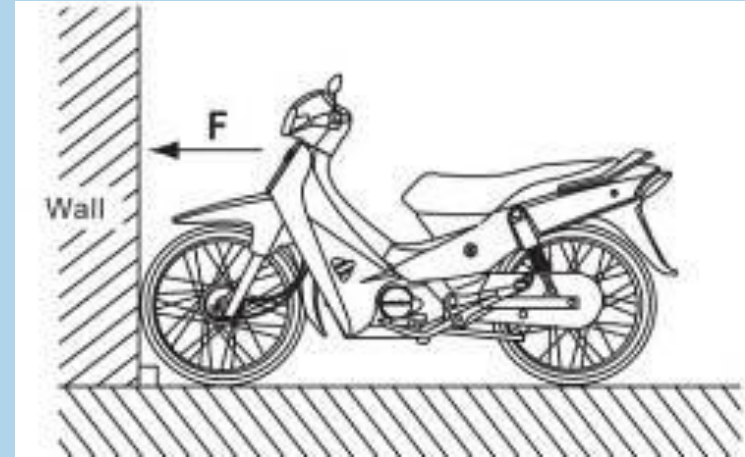
Short-Circuit Protection

Overcharge Cutoff

Over-Discharge Prevention

Maximum Mains Current Draw

Charger water Ingress Protection (IP)



Conformity Testing: Hi-pot

Care must be taken when hi-pot testing as the 500-1000V can destroy components if incorrectly connected.



Conformity Testing: Vibration

Vibration testing is important for finding weaknesses in the frame. A few hours on a shake table is equivalent to years of operation on the road, and can expose fatigue failure of the structure.

3G, 8Hz-100Hz,
3-Axis for 8 Hours



Mechanical Safety Standards

Switch Modes:

This is intended to prevent “accidental” actuation (movement) when charging or “idle”...

There is no “engine noise” to alert the rider and children love to twist the throttle

Mode	Operation
OFF	Vehicle is disabled, and the motors may not be actuated.
ON	Vehicle has power to accessories and display, but the motors are not active.
RUN	Motors are armed, and when the throttle is actuated the motors will operate unless overridden by other safety features (i.e. side stand deployment or overload condition).

Vehicle Accessories Standards

Lights: Headlight
 Tail Lights
 Turn indicators

Reflectors

Horn

Acoustic Vehicle Alerting System (AVAS) Noise
Device

Might be required on “low-medium” speed LDEVs

Interoperability Standards

Battery Charger: Not a big problem for LDEVs

240VAC +/- 10%

Maximum current draw 10A

Removable Batteries

Limited to 10kg per battery (for easy handling)

Special “drop test” for removable batteries

Battery Swapping

This is ongoing and **SHOULD be coordinated at INTERNATIONAL level!**

Challenge: Wide Range of EVs in SE Asia



EV Standards ASEAN

These standards have been presented at the ASEAN level, and have been copied by several countries

In addition the Philippines is introducing both E-Tricycle and E-Jeepney standards roughly based on these standards



Harmonization of standards will improve overall efficiency and aid local industries by expanding commonality within ASEAN

Exclusive 2-Wheeler Infrastructure

Some countries have “Motorcycle Only” infrastructure.

Motorcycles can bypass intersections, use short cuts across rivers and freeways, and prevents car-bike accidents.

There is growing interest in this globally.



FOCUS: *We DO Technology!*

Engine Dynamometers



Chassis Dynamometers



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Smart Valve Technology

Envirofit's SIM/GPS SmartGas Valve, enables families to use their phone to prepay for gas as they cook using mobile money.

