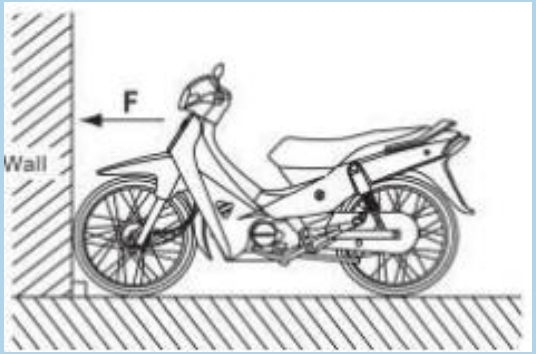
ASEAN E2/3W STANDARDS & POLICY

United Nations Environment Program

MOTIVATION
STANDARDS
POLICY



Prof. Dr. Horizon Gitano

Rev 2

UN environment programme

FOCUS APPLIED TECHNOLOGIES

Electric Power Assist Bicycles

EPAB's are generally to be "assist" only (ie. you have to actively pedal to make it go, not a "twist and go" small motorcycle). This is popular in Europe and Japan for older people who still want to keep up with grandkids.
Max speed 25kph

E-“Moped” 25-50kph class

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

Old folks, kids, mothers with small children and “contractors” like their convenience (and lack of regulation!)

The national standard was recently accepted, but road use policy is still a work in progress.

E-Motos: >50kph

These are higher speed vehicles preferred by the government for local production.

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.

Quality Factors of Electric Vehicles

What do customers care about? Just look at adverts:

Cost
Speed
Range
Power
Vehicle Life Span
Carrying Capacity

Our standards cover the highlighted areas above.

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 express ways 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

Policy Challenges

Standards testing requires the appropriate facilities.
Fortunately for E2W's this is not prohibitively expensive.
(~200k$ for all but EMI/EMC)

Larger challenges include: (most acute for "moped" class)

- Road Usage – Which roads should these vehicles be allowed on?
- Safety Equipment – Are helmets/Shoes to be required?
- Registration – Should individual vehicles be taxed/licensed? Driver licensed?
- Insurance – Required? If so at what "rate"?

Additional problems:

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

Accident Stats not tracked because police don't have a category for "EVs" on the accident investigation form

Charging is problematic for 2W at apartment buildings as the bikes are in the rain, and generally don't have access to power sockets.

Chargers are often not weather-proof, thus hazardous when used outside.

Standards Generation

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

For example if the maximum gradient (slope) on gazette roads in Malaysia 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 backwards.

The Chinese have more Electric Bicycles than any other countries, so we looked over their specs. However Malaysia is tropical, so we had to add a tropical rain/flood fording test.

Standards Generation

SE 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)

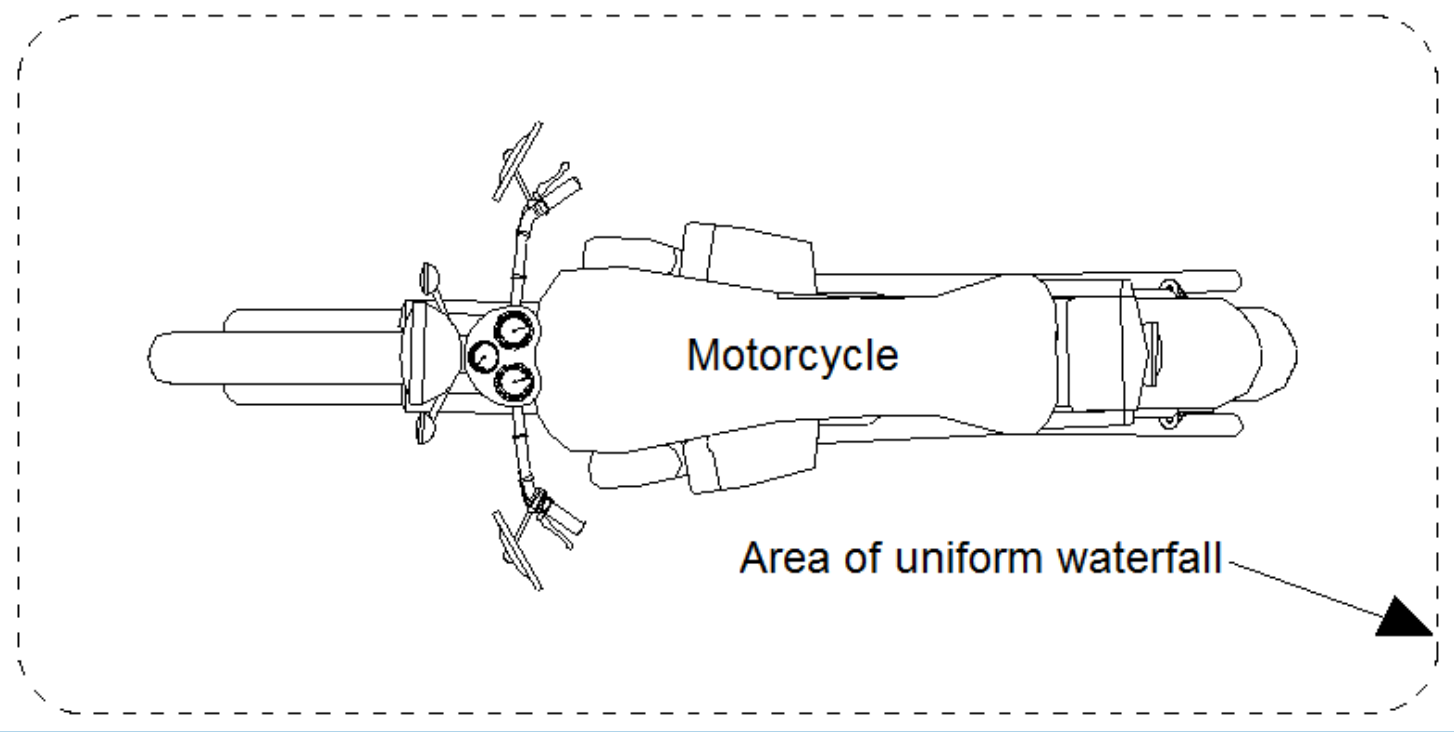
Requirement for water resistant test shall be as follows:

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 ºC to 35 ºC; and

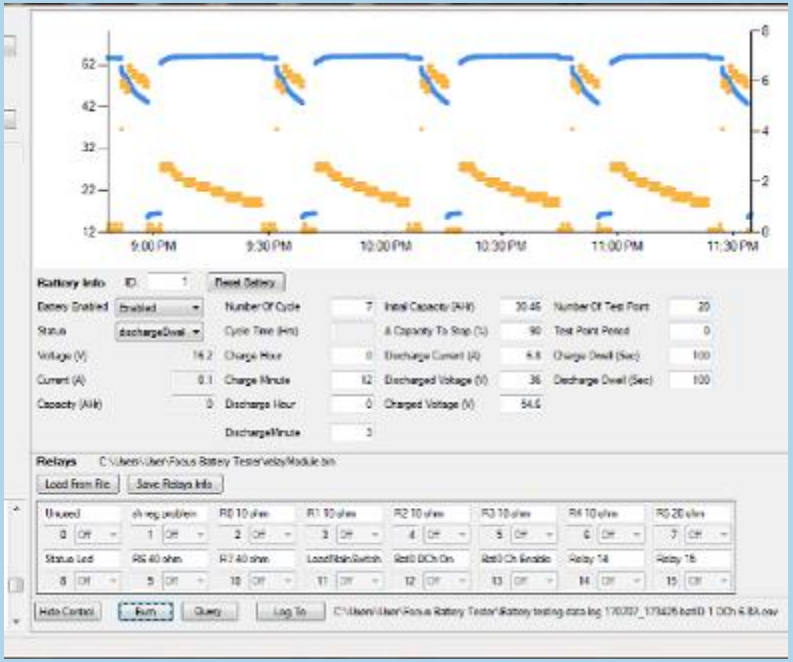
d) test shall be carried out for 8 h.



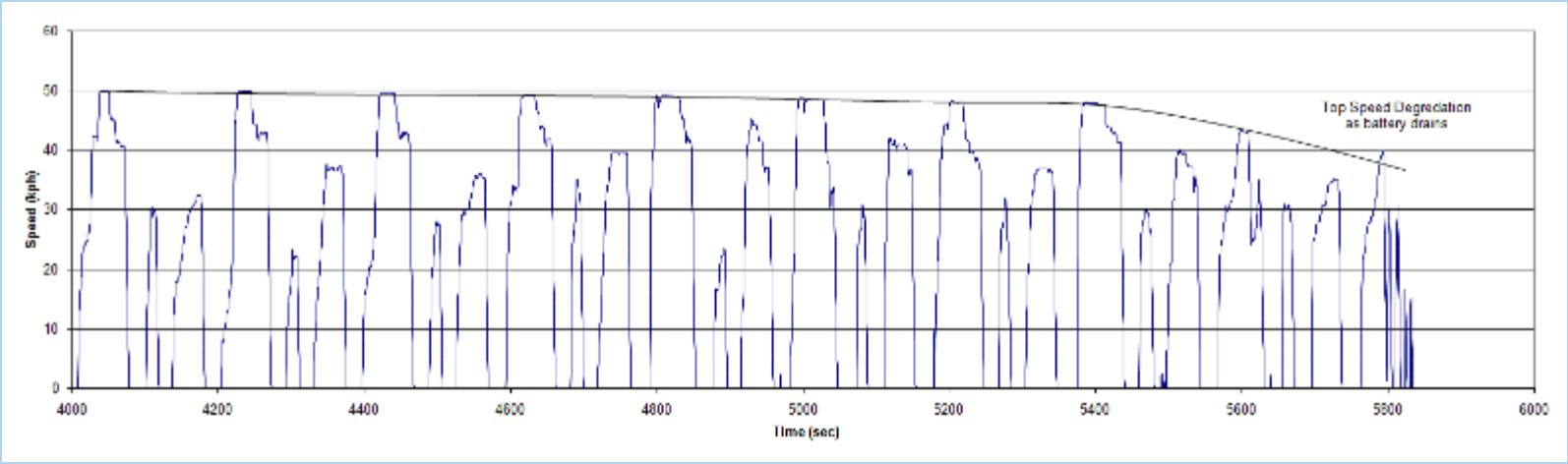
EV Standards Testing

Battery Life Test:

80% capacity for >=300 cycles



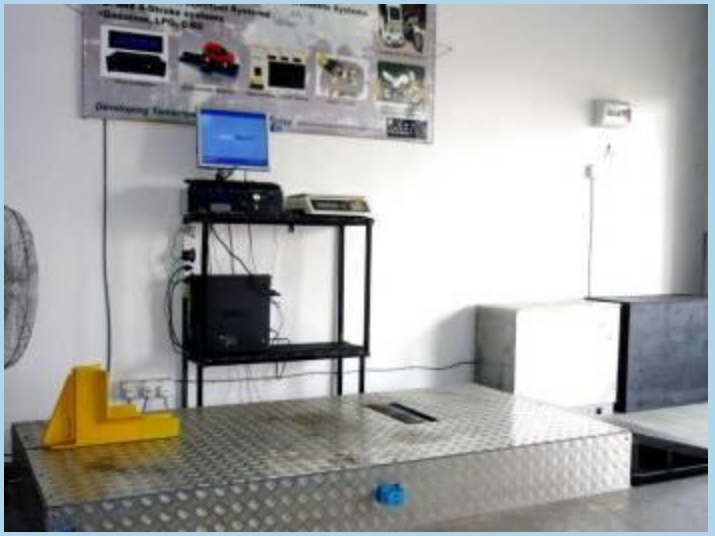
Range Test: Automated as vehicles run >130km on ECER40



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

Conformity Testing:

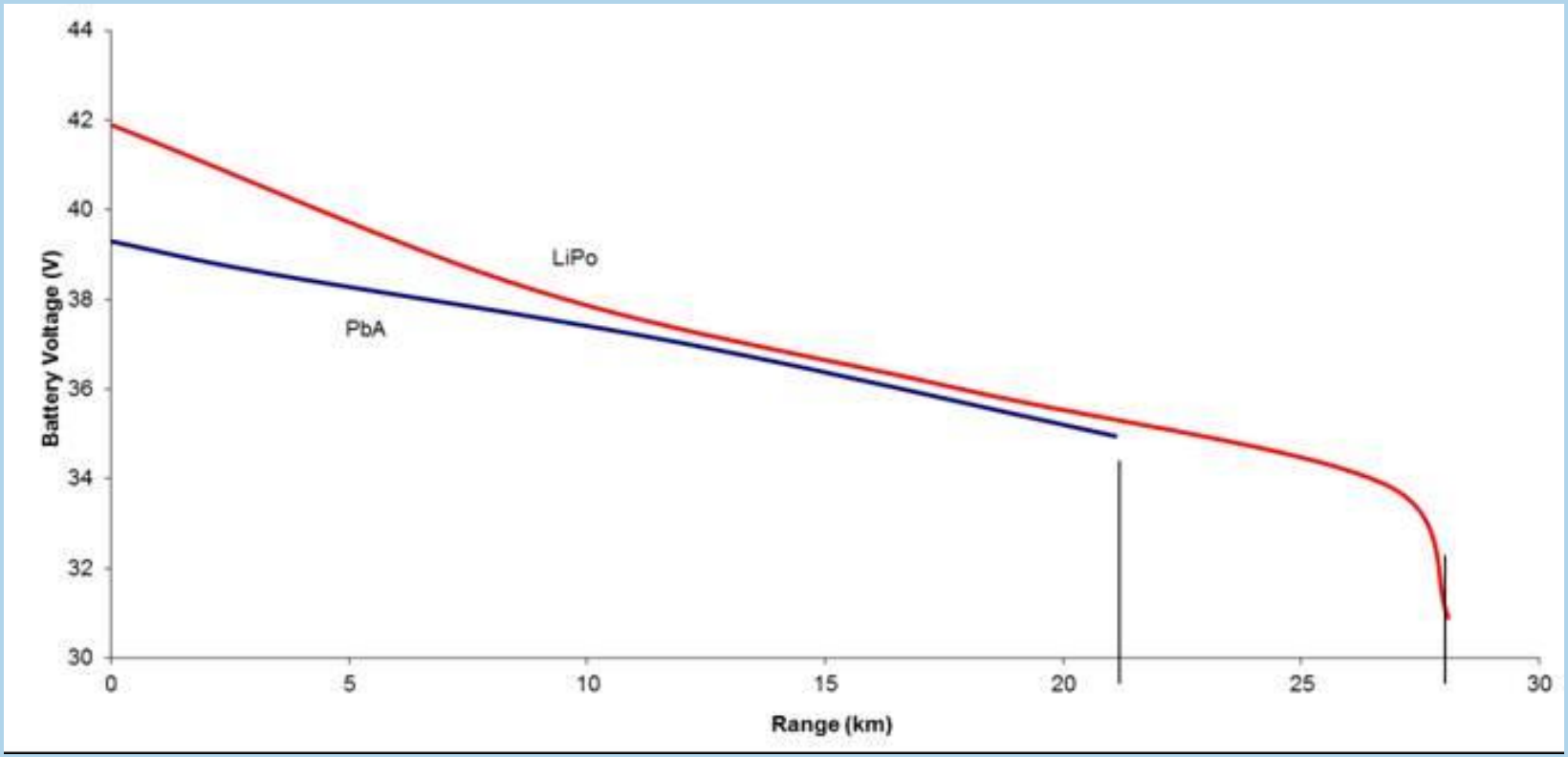
Vehicle and batteries must have clear markings indicating that it is an EV, Battery Chemistry, and requirements for recycling batteries.

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



Conformity Testing:

Breaking Test

Breaking (DRY) 20kPh LIMIT: 5 m	
Trial	**Meters**
1	3
2	2.8
3	2.9
4	2.4
5	2.5

Avg: **2.72** **m** **PASS**

Breaking (WET) 20kPh LIMIT: 10 m	
Trial	**Meters**
1	4.2
2	3.8
3	3.8
4	3.8
5	3.3

Avg: **3.78** **m** **PASS**

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.

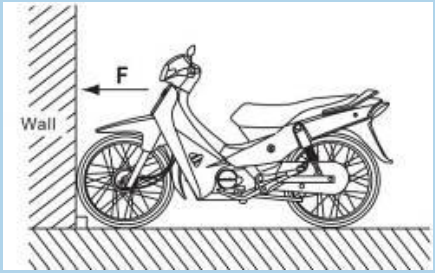
Conformity Testing: Drop Test

Weight Distribution is important in drop tests. It is a fast, simple test that'll expose weak components and designs.

Challenges: Bicycle Components

Standard bicycle parts may not be strong enough for the heavier “E-Bikes” as evidenced by these failures

Policy Guidelines for Light Duty Electric 2- and 3-wheelers for Southeast Asia



Dr. Horizon Gitano-Briggs
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UN environment programme

INTERNATIONAL CLIMATE INITIATIVE (IKI)

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based on a decision of the German Bundestag

Wide Range of E-2 and -3 Wheelers in SE Asia

Why we need Standards

1) SAFETY
Standards help insure that products on the road are safe to use.

2) QUALITY
Standards can set a minimum level of quality, reducing the amount of “disappointing” poor quality products in the market.

3) COMPATIBILITY
Standards can help insure that products are compatible with infrastructure.

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) KNOLEDGE
Standards workers will require continuous training on the latest technologies.

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

Points to Consider when Developing Standards

Don’t specify what you can not measure

Only specify what is required to insure the goals
(Safety, Quality, Compatibility)

It is useful to refer to external standards

Make sure to test to LOCAL conditions

Proposed Vehicle Categories

Category	Top Speed (kph)
Pedestrian	Less than 10
Slow	10 - 25
Low Speed	25-50
Intermediate	50-100
High Speed	Greater than 100

Categories are primarily based on vehicle speed

Proposed Vehicle Categories

	Maximum Weight (kg)		
Class	**2-Wheelers**	**3-Wheelers**	**4-Wheelers**
Pedestrian	40	100	200
Slow	40	100	200
Low Speed	60	200	350
Med. Speed	200	300	400
High Speed	400	400	400

Categories and secondarily based on vehicle weight

Proposed Vehicle Categories

Maximum Motor Power (W)

Top Speed (kph)	2-Wheelers	3-Wheelers	4-Wheelers
10	N/A	N/A	N/A
25	250	300	350
50	1,000-1,500	1,500	4,000
100	5,000	5,000	15,000
>100	Unlimited	Unlimited	Unlimited

Power is also considered

Cross Reference to European Categories

	UNECE "L Categories"		
Class	**2-Wheelers**	**3-Wheelers**	**4-Wheelers**
Pedestrian	L1e-A	L2e	L6
Slow	L1e-A, L1e-B	L2e	L6
Low Speed	L1	L2	L6 Maximums: 45kph, 4kW, 350kg
Med. Speed	L3, L3e-A2	L4, L5	L7 Maximums: 400kg 550kg for good carrier
High Speed	L3, L3e-A3	L4, L5	L7 Maximums: 400kg 550kg for good carrier

Standard Terminology

Controller
An electrical power control module supplying throttle-controlled power to the motor from the traction battery.

Battery Charger
The battery charger is the device converting mains AC line voltage to electrical power to charge the traction battery. This may be separate from the vehicle (referred to as an External Battery Charger) or fixed permanently within the body of the vehicle (Internal Battery Charger).

Battery Management System
The Battery Management System (BMS) is circuitry associated with the battery, often contained inside the battery housing, which helps control and monitor the battery during charging and/or discharging to protect the battery and vehicle.

High Voltage rechargeable electrical energy storage system (traction battery)
A high voltage traction battery is defined as any traction battery having nominal voltage higher than 60 Vdc or 30 VAC rms.

Hybrid vehicle
A vehicle where the primary propulsion energy can be provided by electrical traction batteries and/or an internal combustion engine during normal vehicle operation.

Standard Terminology

Motor
Electrical motors which convert the stored electrical power to tractive effort (motion) of the vehicle.

Traction battery
Electrical power storage system, i.e. batteries or similar device.

Removable traction battery
A removable traction battery is defined as any traction battery where the end user can remove the battery (either for storage or charging) on a daily basis without requiring special tools.

State Of Charge
The State Of Charge (SOC) is a measure of how much energy remains in the battery, being 100% at full charge, and dropping to 0% on a depleted battery. Note: Some manufacturers may limit the upper end or lower end of the SOC in order to prolong battery life (eg. Only allow charging to 90% full and discharging down to 10% full).

State Of Health
The State Of Health (SOH) of a battery is the maximum charge capacity available as a fraction of the original charge capacity. For example, as traction batteries age, the amount of energy they can deliver per charge is reduced.

Vehicle Performance Standards

Top Speed

Hill Climb Capability (20%)

Dry Breaking Distance

Wet Breaking Distance

Vehicle Performance Standards

Maximum Range

Category	Minimum Range (km)
Pedestrian	10
Slow	25
Low Speed	45
Intermediate	60
High Speed	80

Number of Charge/Discharge cycles to achieve 80% of the initial Range.

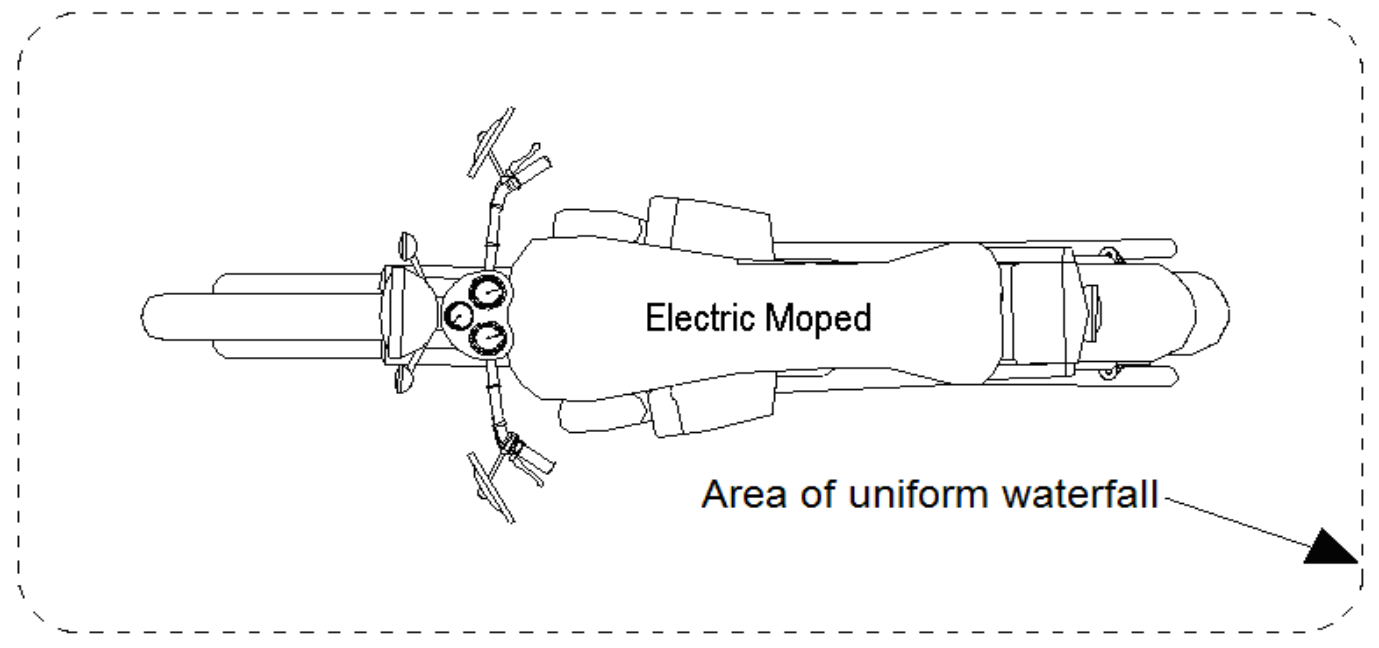
Mechanical Safety Standards

Switch Modes

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).

Environmental Robustness Standards

Tropical Rain Test: 8 hours in 25cm/hour “rain”



Environmental Robustness Standards

Flood Fording Test: 20cm deep for 50m

Mechanical Robustness Standards

Vibration Test: 3G, 8Hz-100Hz, 3-Axis for 8 Hours

Drop Test: 50cm drop, 6 x

Knock-Over Test

Electrical Safety Standards

Insulation Resistance (Wet and Dry)

Hi-pot Test

Overload Protection (Overload cutoff)

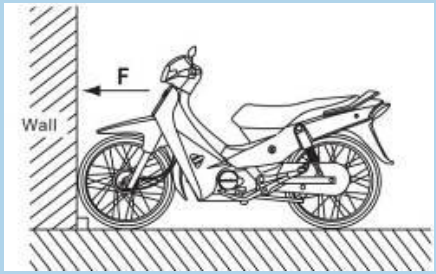
Short-Circuit Protection

Overcharge Cutoff

Over-Discharge Prevention

Maximum Mains Current Draw

Charger water Ingress Protection (IP)



Vehicle Accessories Standards

Lights:

- Headlight
- Tail Lights
- Turn indicators

Horn

Noise Device

Labeling Standards

EV Labeling

High voltage Labeling

Battery Recycling Labeling

Motor Vehicle Identification Number

Electromagnetic Compatibility Standards

Emissions

Frequency range (MHz)	**Broadband** dB (µV)	**Narrow band** dB (µV)	**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 (µV)	**Narrow band** dB (µV)	**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 µs, period 4 600 µs	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 µs (8/20 µs) 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 µs, period 4 600 µs	ISO 11451-2

Interoperability Standards

Battery Charger

240VAC +/- 10%

Maximum current draw 10A

Removable Batteries and Battery Swapping

This is ongoing and To Be Determined

Road Usage Policy

Class	Road Usage
Pedestrian (<10kph)	Off Road Only (Sidewalks, Bike Paths which allow lower speeds)
Slow (10-25kph)	Off Road Only (Bike paths, Sidewalks which allow higher speeds)
Low Speed (25-50kph)	Low Speed Roads (Urban, Residential)
Medium Speed (50-100kph)	All (Some countries prohibit Expressways)
High Speed (>100kph)	All roads

Vehicle Registration Policy

Class	Vehicle Registration Requirement
Pedestrian	Decided by Local Authority (City)
Slow	Decided by Local Authority (City)
Low Speed	Yes: Requires “Low Speed” plate number
Medium Speed	Yes: Requires standard plate number
High Speed	Yes: Requires standard plate number

Operator Age Requirement Policy

Class	Minimum Driver Age
Pedestrian	No limit – 14 years
Slow	14 – 16 years
Low Speed	16 years (or minimum national drivers licence age limit)
Medium Speed	As per drivers' licence
High Speed	As per drivers' licence

Driver Licence Requirement Policy

Class	Operators Driver License Requirement
Pedestrian	Not Required
Slow	Not Required
Low Speed	Recommended
Medium Speed	Yes: Standard Drivers Licence
High Speed	Yes: Standard Drivers Licence

Safety Equipment Requirement Policy

Class	Safety Equipment Required
Pedestrian	Decided by Local Authority (City)
Slow	Decided by Local Authority (City)
Low Speed	Yes: Helmet
Medium Speed	Yes: Helmet
High Speed	Yes: Helmet, closed shoes

Insurance Requirement Policy

Class	Insurance Requirement
Pedestrian	Decided by Local Authority (City), probably not required
Slow	Decided by Local Authority (City), possibly not required
Low Speed	Recommended: 1-time fee, government policy
Medium Speed	Yes: standard motorcycle Insurance
High Speed	Yes: standard motorcycle Insurance

20cc of displacement = 1kW of electrical motor power

Annual Road Tax Requirement Policy

Class	Annual Road Tax
Pedestrian	Nor Required
Slow	Not Required
Low Speed	One-time fee at registration (eg. 5 to 10USD)
Medium Speed	As per standard motorcycle tax
High Speed	As per standard motorcycle tax

Additional Policy Recommendations

Vehicle Tax Rationalization

Road going vehicles are subject to a number of taxes including importation duties, sales/excise tax, as well as annual road usage or licensing/registration fees. In order to encourage the adoption of efficient vehicles, such as the 2- and 3-wheeled electric vehicles referred to in this document, it is recommended to rationalize these taxes and fees, reducing them on lighter and more efficient vehicles, and increasing them on larger, less efficient ones. The fundamental idea here is to transfer the costs, including environmental costs, of vehicle ownership and operation to the less efficient vehicles.

Additional Policy Recommendations

Insurance Rationalization

Similar to taxation rationalization, insurance rates can also be controlled to favor lighter, lower speed vehicles, which will cause less damage to others on the roads. In this case, larger and faster vehicles should be subject to much higher insurance premiums, while more efficient, smaller and slower vehicles should have their insurance premiums reduced using surplus funds from the larger vehicles. In some cases, such as the 25-50kph 2-wheelers, it may even make sense to have universal basic insurance covered by the government using the extra funds extracted from the premiums of the faster, heavier vehicles such as combustion engine four-wheelers.

Additional Policy Recommendations

Manufacturing Support

The five relatively large economies in Southeast Asia namely, Indonesia, Malaysia, Philippines, Thailand, and Vietnam, have traditionally provided fiscal and non-fiscal policies to support local manufacturing and assembly of motor vehicles. Many countries have vehicle manufacturing roadmaps that provide incentives, subsidies, and guidelines for, mostly, foreign companies to establish or strengthen local manufacturing and assemblies. Thailand has become the leader in manufacturing motor vehicles and exports completely-built-up units to the region and world. As such, many Southeast Asian countries are already well prepared to support local manufacturing of electric 2- and 3-wheelers. There should be a concerted effort from relevant government ministries to support research and development, local manufacturing and assemblies of these modes, as the region is poised to become a world leader in electric 2- and 3-wheeler vehicles

Additional Policy Recommendations

Public Transportation Integration

Motorcycle and 3-wheeled taxis abound in Southeast Asia. A significant percentage of society relies on these as their primary mode of transport and in many more cases they provide last-mile connectivity. Motorcycle and 3-wheeled taxis are also the main livelihood of many drivers in Southeast Asia. These modes of public transport should be properly integrated into the urban transport system, where efficiency, connectivity and safety issues are considered. There should be an assessment of the optimum number of units to be deployed in different localities to make sure operations are efficient and sustainable for drivers and consumers alike. Terminals should also be strategically located and integrated with the public transport (bus and rail) system.

To encourage electric 2-wheeler users to also use public transport, parking and charging can be provided at transportation hubs such as train or bus stops. A single car parking space can be turned into 5 or more electric 2-wheeler taxi parking spaces.

Additional Policy Recommendations

Light-Duty electric 2- and 3-wheeler Only Infrastructure

In some countries, notably Malaysia and Indonesia, there are already extensive “Motorcycle Only” infrastructure. This allows motorcycles to bypass dangerous intersections, use short cuts across rivers and freeways, and sequesters them from road going automobiles. This can greatly enhance the safety of these vulnerable vehicles, while also providing a big incentive to their use. However, providing exclusive lanes should for slow and non-motorized 2-wheelers should take precedent.

Additional Policy Recommendations

Public Awareness and Education

Finally, efforts can be made to encourage the use of these clean and efficient vehicles via public awareness campaigns. Vehicle labeling at the time of sales, indicating the annual or lifetime cost of energy is a good way to allow consumers greater insight into the long-term cost savings of electric vehicles, especially when applied to combustion vehicles as well. “Share the Road” public awareness campaigns can also have an effect in supporting greater acceptance, and hopefully adoption of light-duty electric 2- and 3-wheelers.

End of Main Presentation

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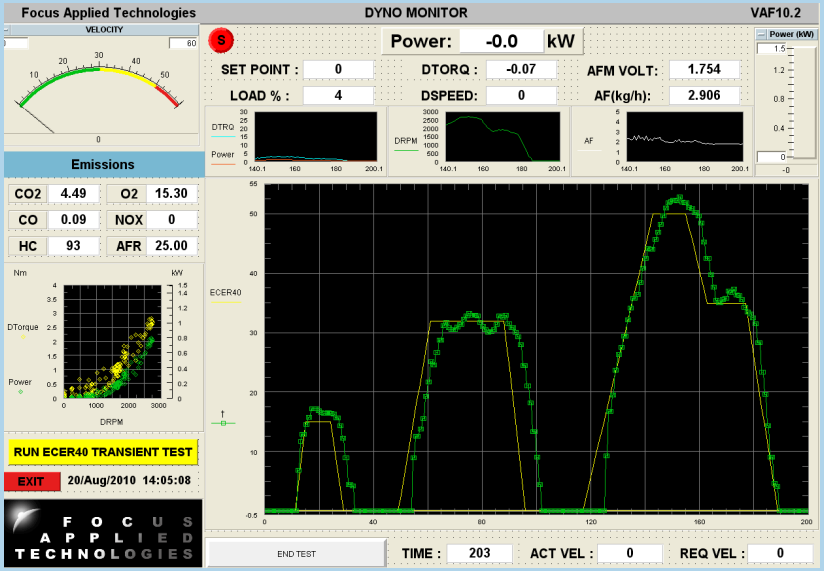

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