2 Wheelers (Electric and Conventional) In Malaysia

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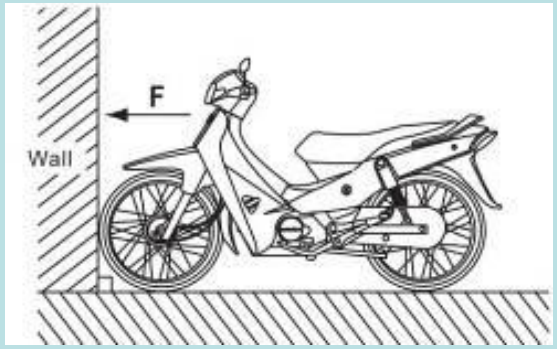
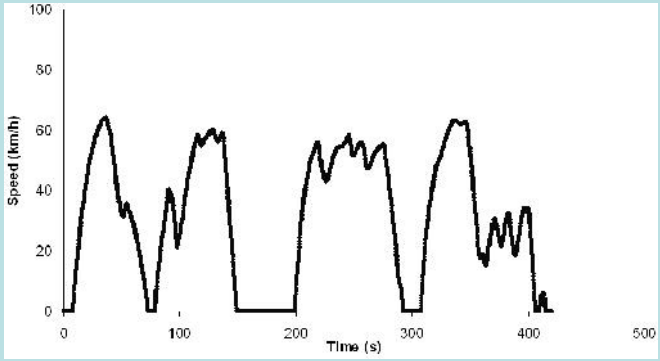
Focus Applied Technologies

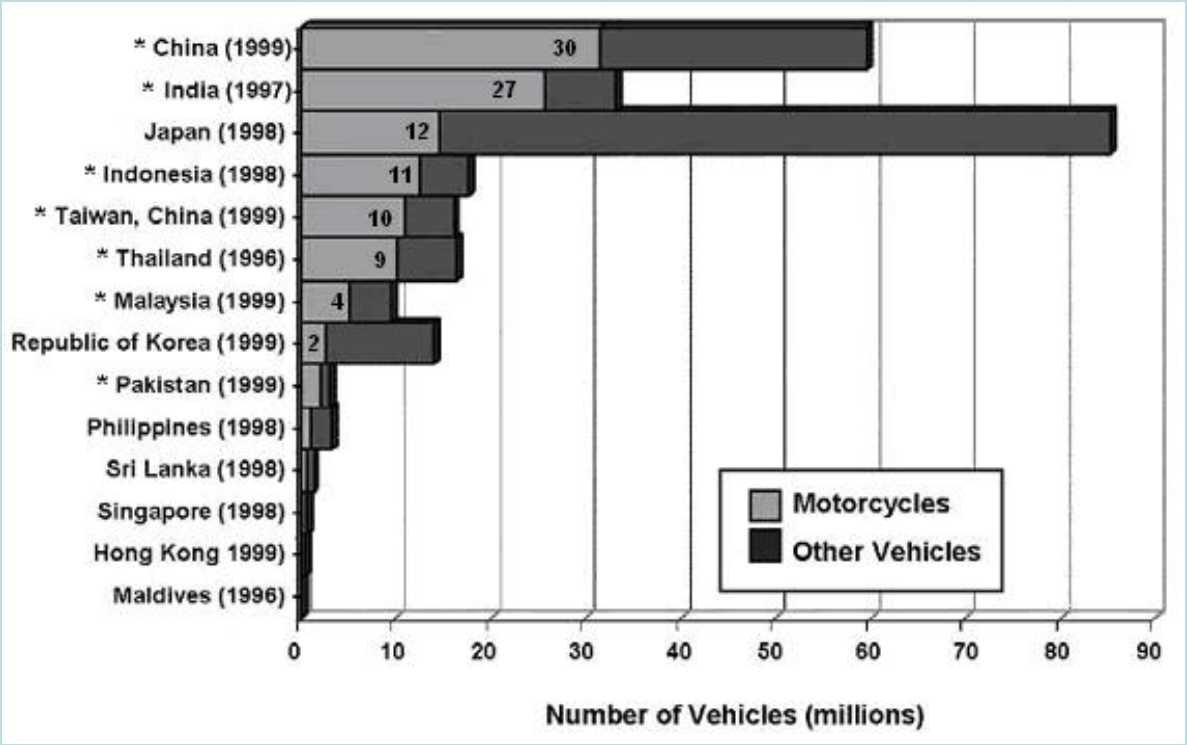
E2W Market
Standards
Testing
Policy





ASEAN 2-Wheeler Market

Due to their low cost 2-wheelers dominate small transportation units in developing countries.
Typical vehicle life spans are well over 20 years.
•Cost ~ 1,000$
•Top speed 55-70 mph
•55 km/liter
It is estimated that there are 200M units worldwide.



Malaysia has about 10M 2-wheelers on the roads

For about half of the world, 2-wheelers are the basic transport of choice.

Transportation Efficiency

How much energy should a 30km commute require?

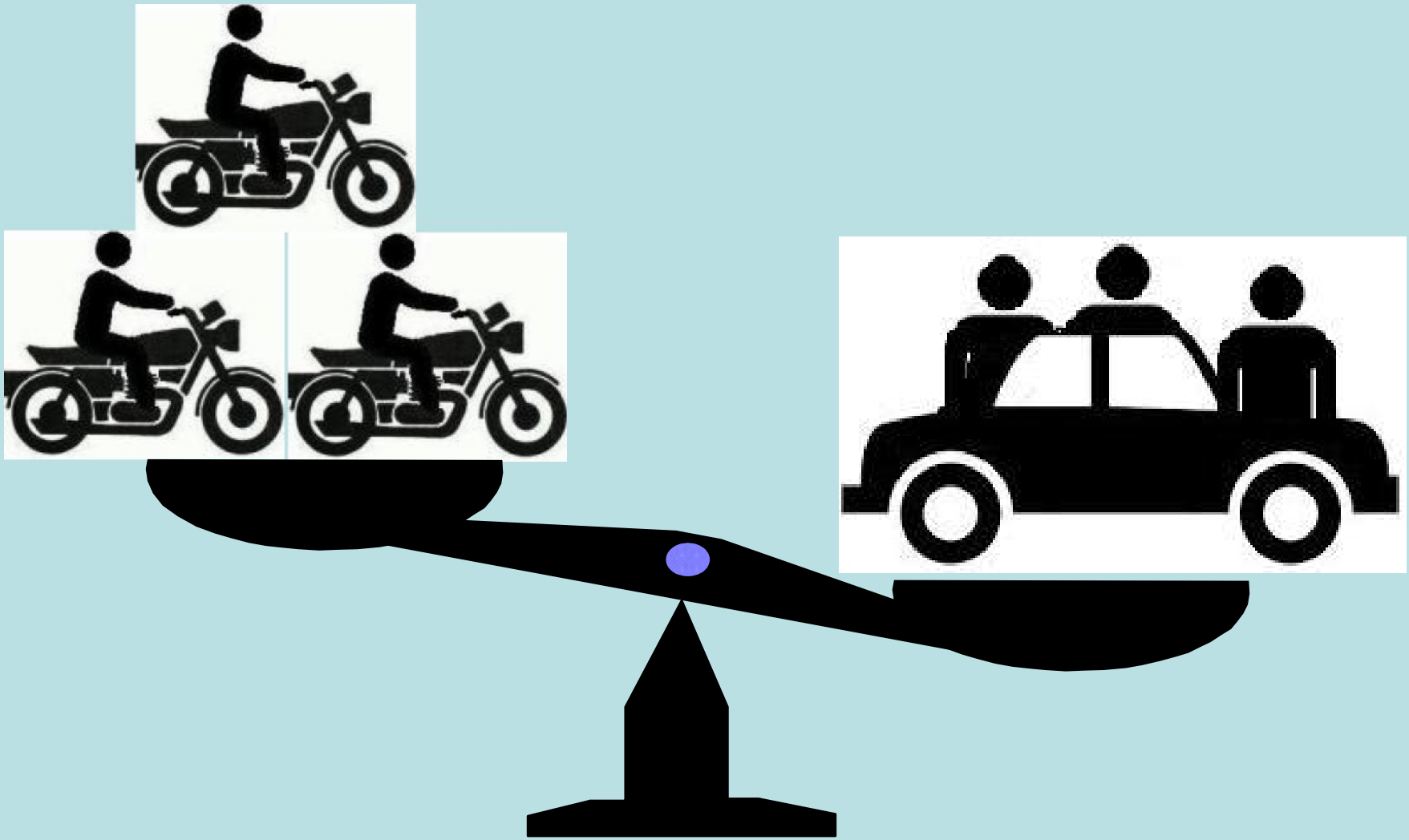
MODE & LODE	Liters Fuel	Pax-km/liter
Car (Solo)	2.5	12
Car (2 pax)	2.5	24
Car (3 pax)	2.5	36
Conventional Motorbike (1.2 pax)	0.7	51
Electric “scooter” (Solo)	0.4	75
Bus (with 20 others)	7.5	80
Diesel Train (with 200 pax)	30	200
Electric Train (with 200 pax)	20	300

The ***passenger kilometers per unit fuel consumed*** is the important measure.

2-Wheelers are much more efficient than cars
Electric 2-Wheelers can be even more efficient than conventional motorcycles
Electric Mass Transit is the most efficient form of transport

Transportation Efficiency

3 guys on 3 bikes is more efficient than 3 guys in 1 car!



2-Wheelers are so efficient, their actual efficiency is often overlooked.

Electric Motorcycle: 1M Units in ASEAN

In SE-Asia up to 2% of the 2-wheeled fleet are electric bikes.
Most are ~35kph “scooters” but the >50kph class are showing up:

M’sian Manufacturer	Price ($)	Top Speed (kph)	Range (km)
Modenas: * Failed	**1,000**	**60**	**25**
Eclimo:	**3,000**	**80**	**100**
Roda Prestasi:	**1,300**	**58**	**75**
Zesparii:	**2,250**	**65**	**120**
Treeletrik:	**1,100**	**60**	**80**

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

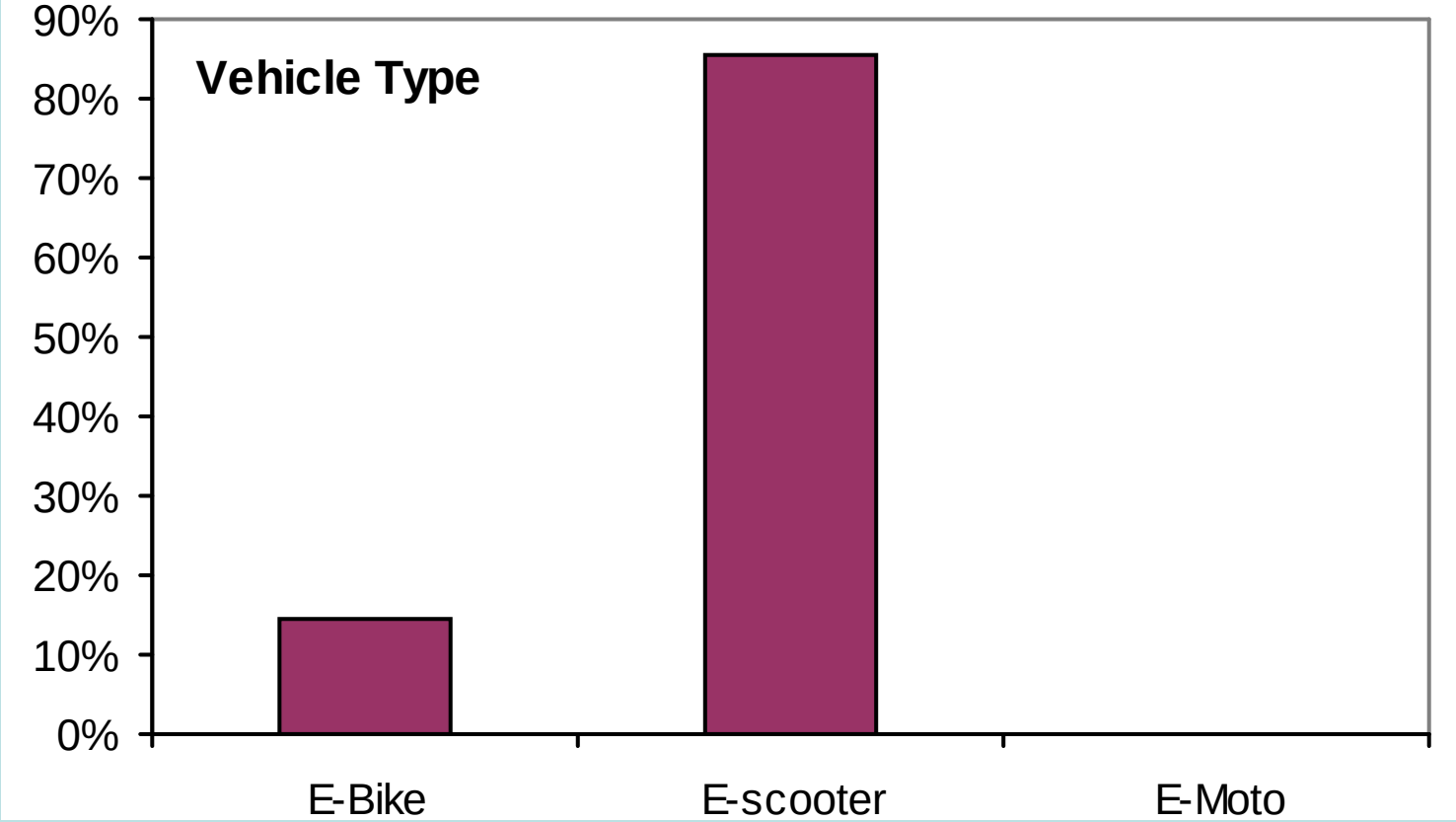
Hub Motor

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

This standard is also applied to “light electric vehicles of up to 4 wheels” (along with other additional regulations).
All of these standards include Hybrids by default.

E2W Popularity by Type

The 25-50 kph class is the most popular, as customers wanting performance tend to buy a conventional motorcycle.



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.

General Standards Development

Standards need to address 3 main areas:

Safety (for user, and other road users)

Product Quality
Basic quality measurements, *not designed to be ultra stringent*
Does the product achieve it's advertised claims?

Compatibility
Insures interoperability/compatibility with existing infrastructure

We strive to be "technology blind" to avoid prohibiting technological advances.

Standards Committee: Broad

Government Departments:
- Highway Enforcement
- Transportation
- Standards
- Road Safety
- Environment

Also included:
- Academia *(Not too many as they tend to talk a lot!)*
- Industrial Partners

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

We followed a few basic rules of standards generation:

1) The safety of consumers and road users is priority #1
2) The protection of the consumer from poor quality is #2
3) Do ***only*** what is necessary.
4) Do ***all*** of what is necessary.
5) If you can't measure it, don't spec it.
6) Whenever possible follow EU specs.
7) Adapt, add or drop specs as required for the local situation.

Standards are regularly updated with additions, simplifications and clarifications

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]	Probably
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 s 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	None	>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

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

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

Making 2-Wheelers safer

2-Wheelers are a very efficient first/last mile option.
One way to encourage efficiency is to make 2-wheeler riding safer.
Malaysia leads in Motorcycle Only Infrastructure.

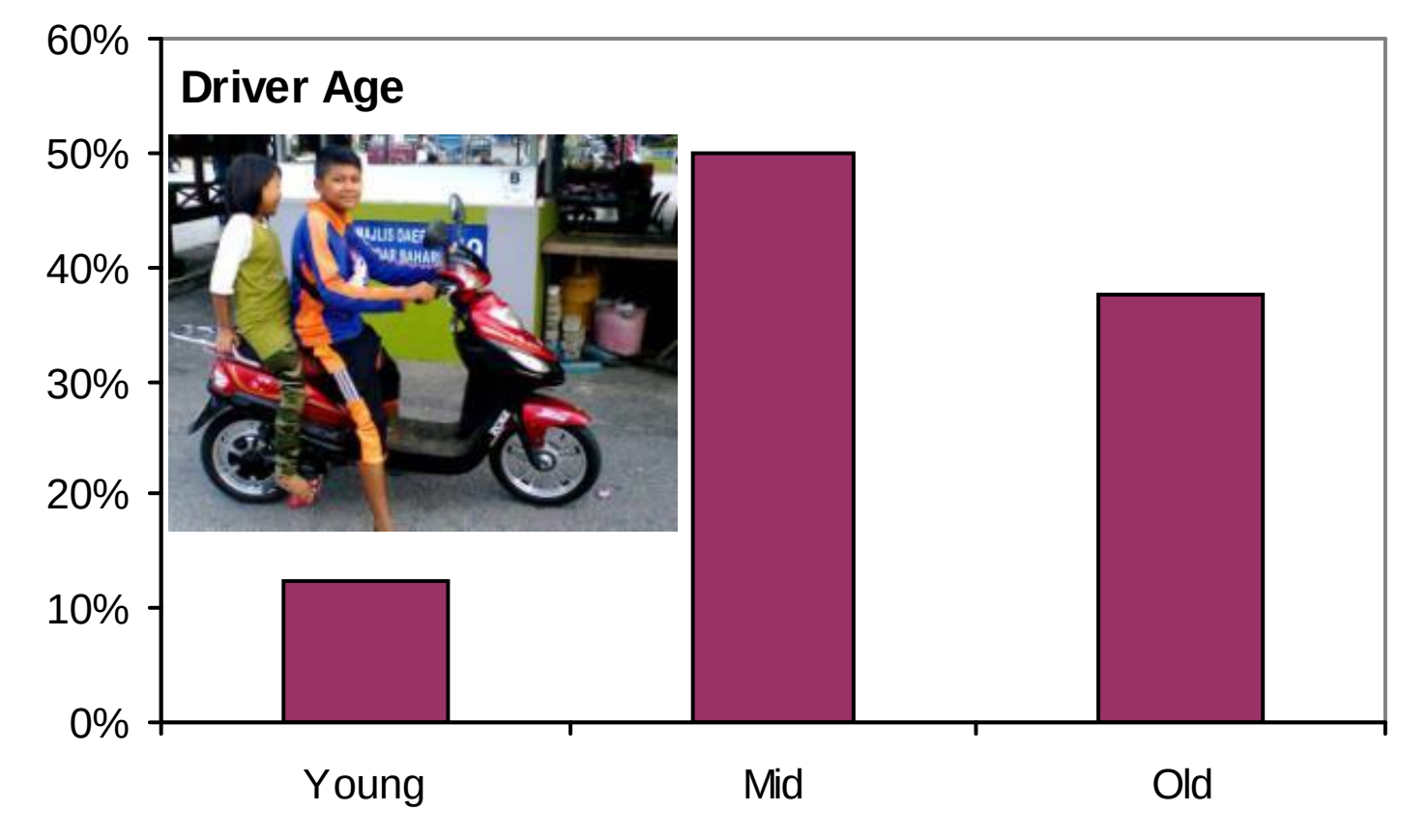
River Crossing

Intersection By-Pass

Sequestered Highway Lane

Highway Crossing

Important Local Data: E-Bikes



Older riders like that there is no kick starting, shifting or filling up with gasoline.

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)

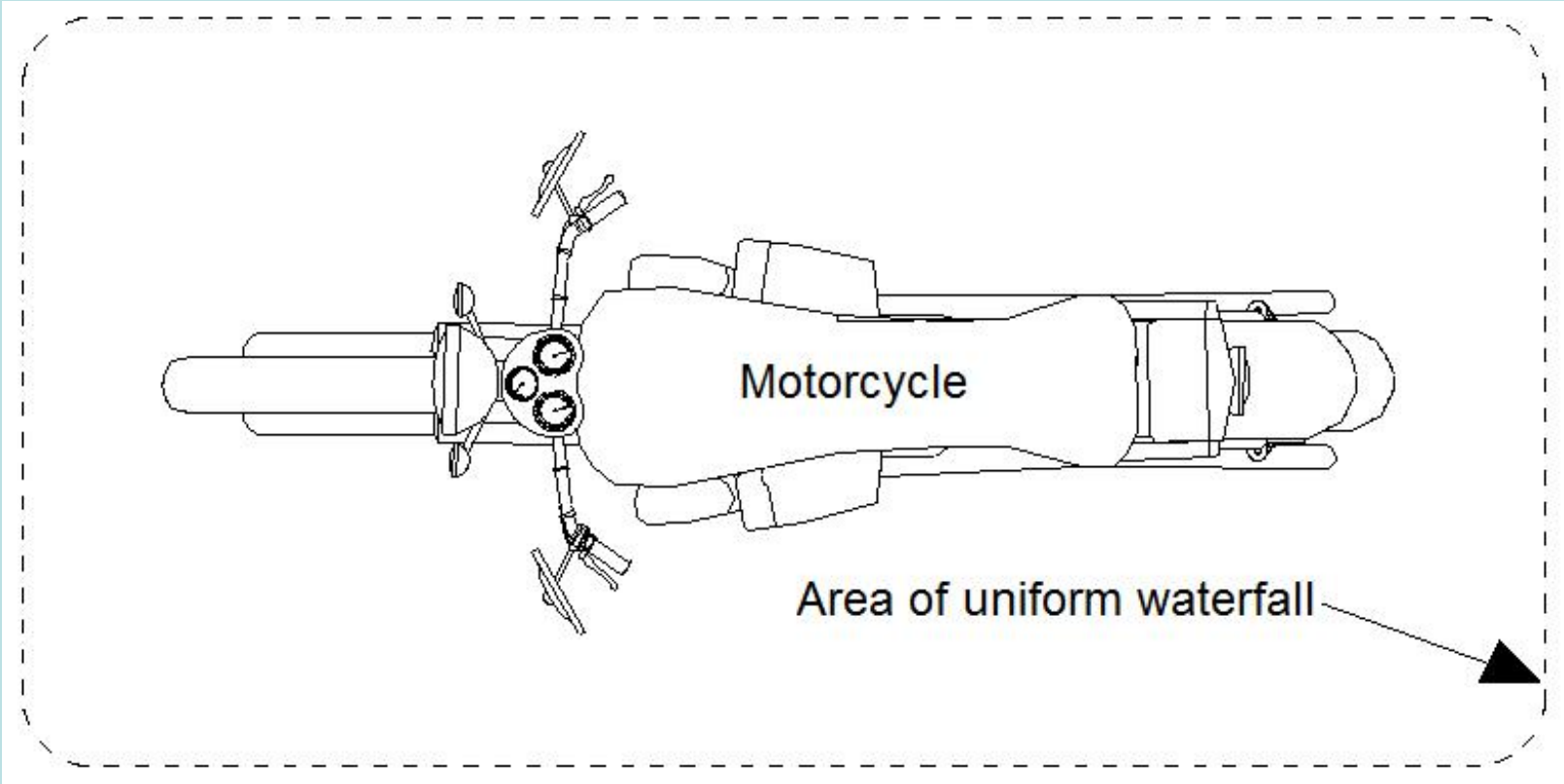
Requirement for water resistant test shall be as follows:

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

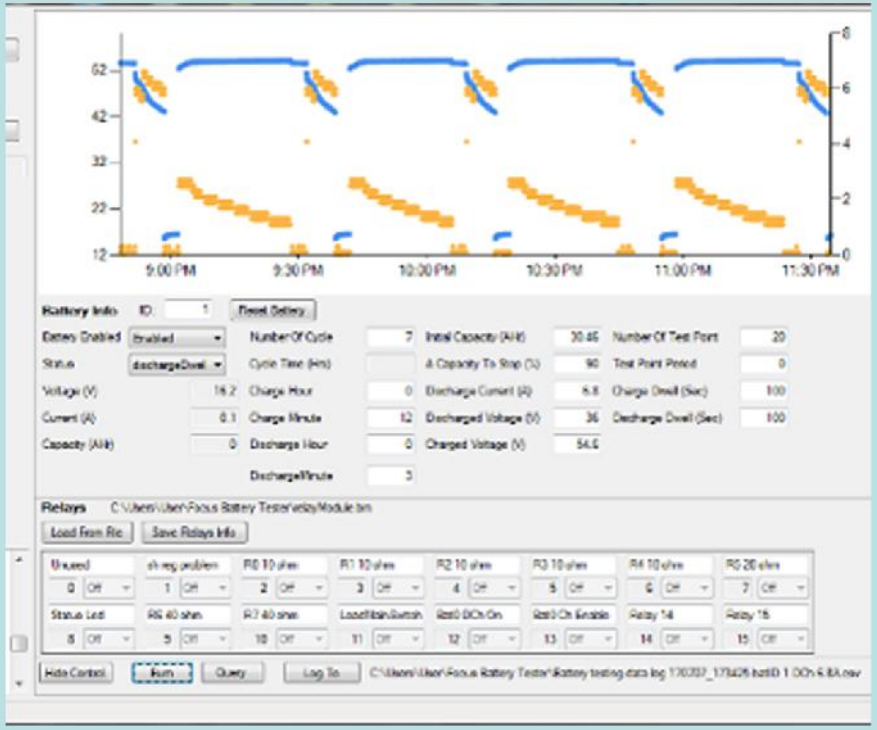
d) test shall be carried out for 8 h.



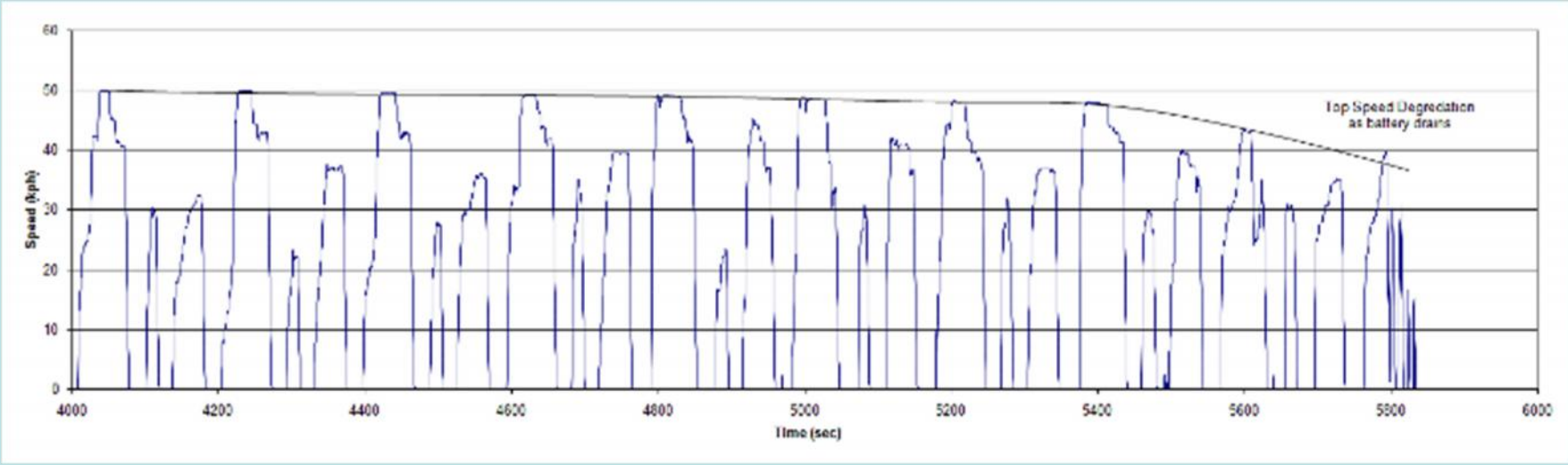
EV Standards Testing

Battery Life Test:

80% capacity for >=300 cycles

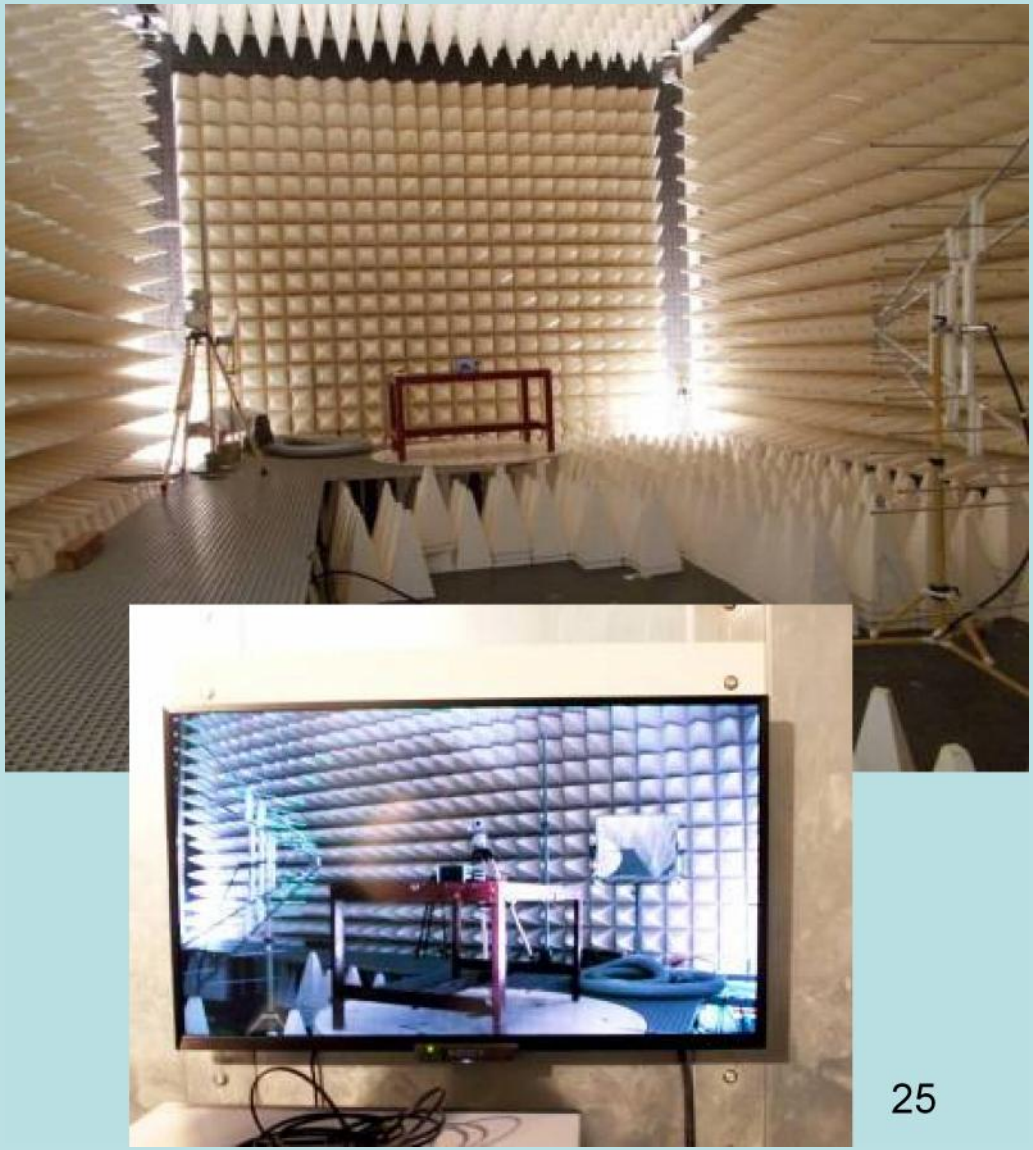


Range Test: Automated as vehicles run >130km on ECER40



Conformity Testing: EMC

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



Conformity Testing:

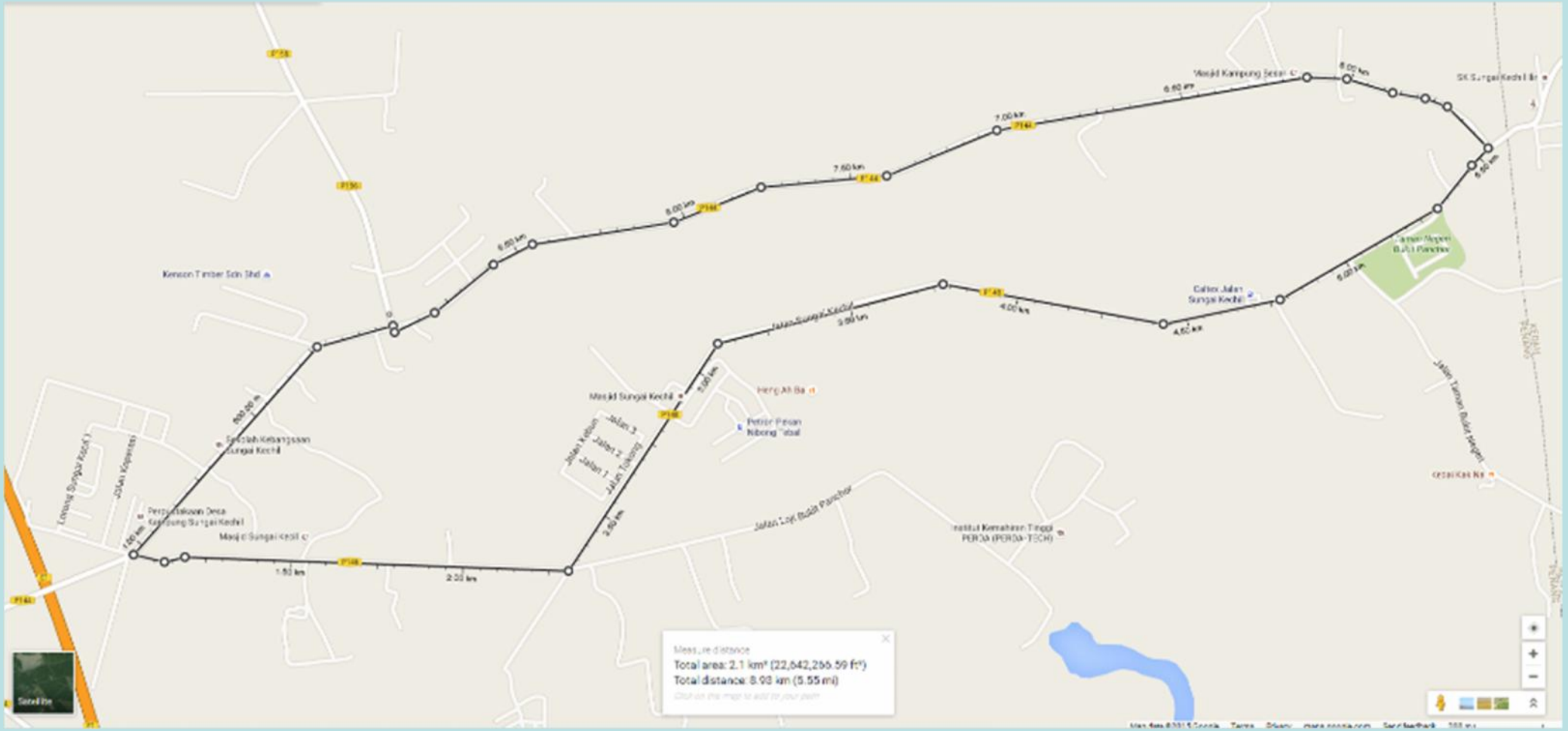
Vehicle and batteries must have clear markings indicating that it is an EV, Battery Chemistry, and requirements for recycling batteries.

Conformity Testing:

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

Conformity Testing: Road Testing

Road testing is always important to confirm range and speeds.
In some vehicles road testing is still used for official range test.

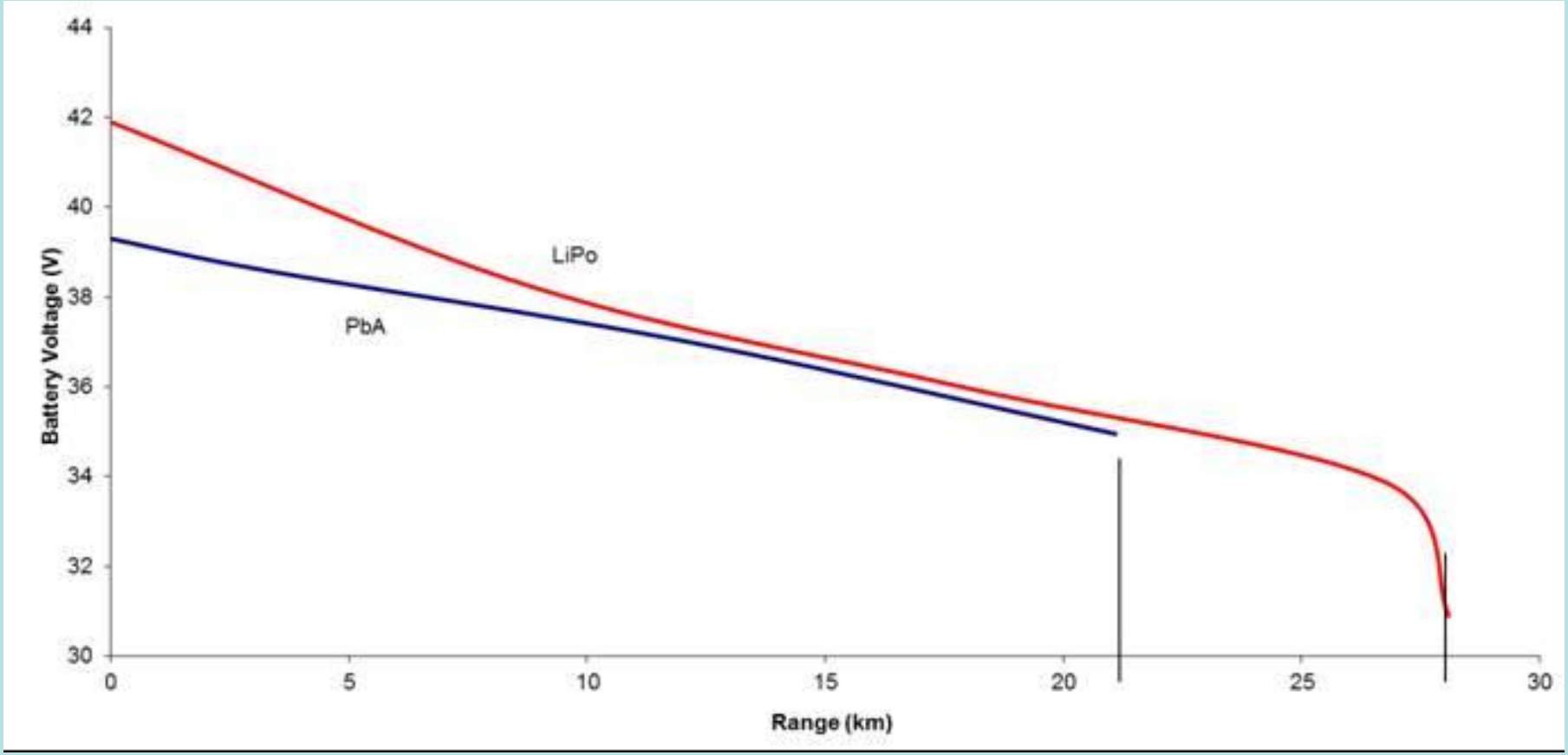


Conformity Testing: EPAB Range

Range testing of EPAB vehicles is currently done on the road as the ranges are modest (~25km) and performed at steady speeds:

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**

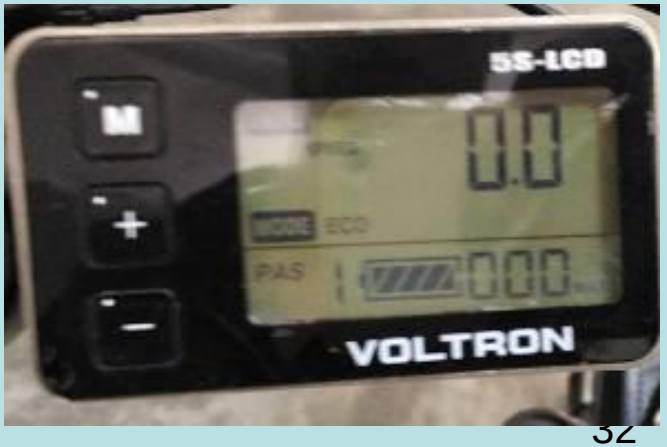
Breaking (WET)	20kPh	LIMIT:	10	m

Trial	Meters
1	4.2
2	3.8
3	3.8
4	3.8
5	3.3

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

Conformity Testing:

Water ingress testing (tropical rain) has been progressively simplified so anyone can perform it at low cost.



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

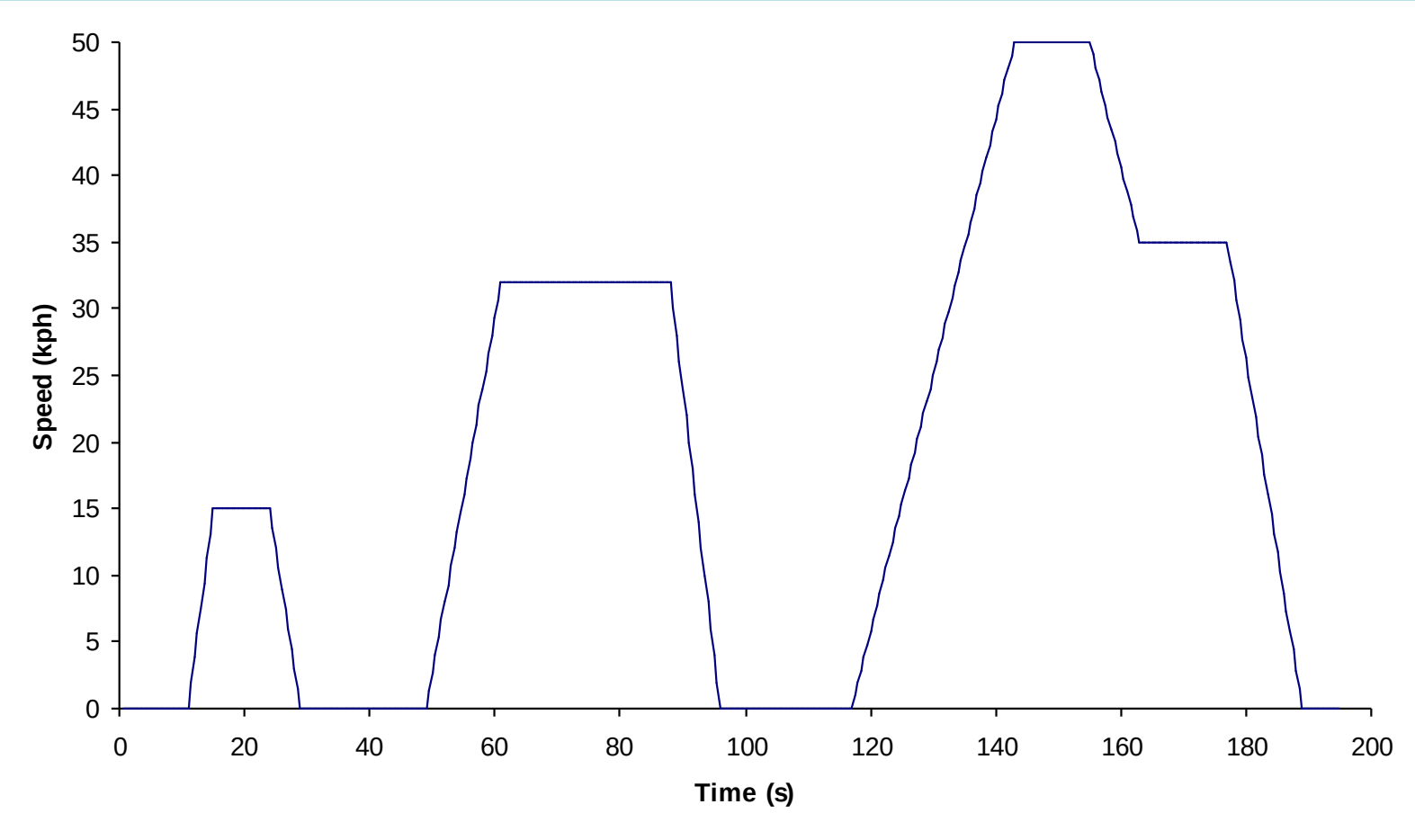
Vibration testing is important for finding weaknesses in the frame. A few hours on a shake table is equivalent to years of operation on the road, and can expose fatigue failure of the structure.

Conformity Testing: Drop Test

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

Conformity Testing

Range measurement may be a mix of steady state and drive cycle, typically using the ECE R40 test pattern:



Range Testing: Drive Cycle

Drive Cycle testing gets very boring after the first few minutes. Some bikes can take 8 hours to test!

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Focus Applied Technologies Drive Cycle Data Log										Vehicle: Rover 2000				Distance:	29.8	km					
2	File Opened: Tue 19/Jun/2012 06:35:48														Top Speed:	51						
3	Time	RPM	Torq(Nm)	%Load	Vbat	Ibat		Ch3	Ch4	Run	T Time	KPH										
4	0.295998	0	7.78E-06	0.4	0	9.765625	0.488281	0.371094	0	1	0.295998	0	0									
5	0.545998	0	5.44E-06	0.4	0	9.765625	0.488281	0.371094	0	1	0.545998	0	0					280				
6	0.795998	0	3.81E-06	0.4	0	9.765625	0.488281	0.371094	0	1	0.795998	0	0									
7	1.045998	0	2.67E-06	0.4	0	9.765625	0.097656	0.371094	0	1	1.045998	0	0									
8	1.2																					
9	1.5																					
10	1.7																					
11	2.0																					
12	2.2																					
13	2.5																					
14	2.7																					
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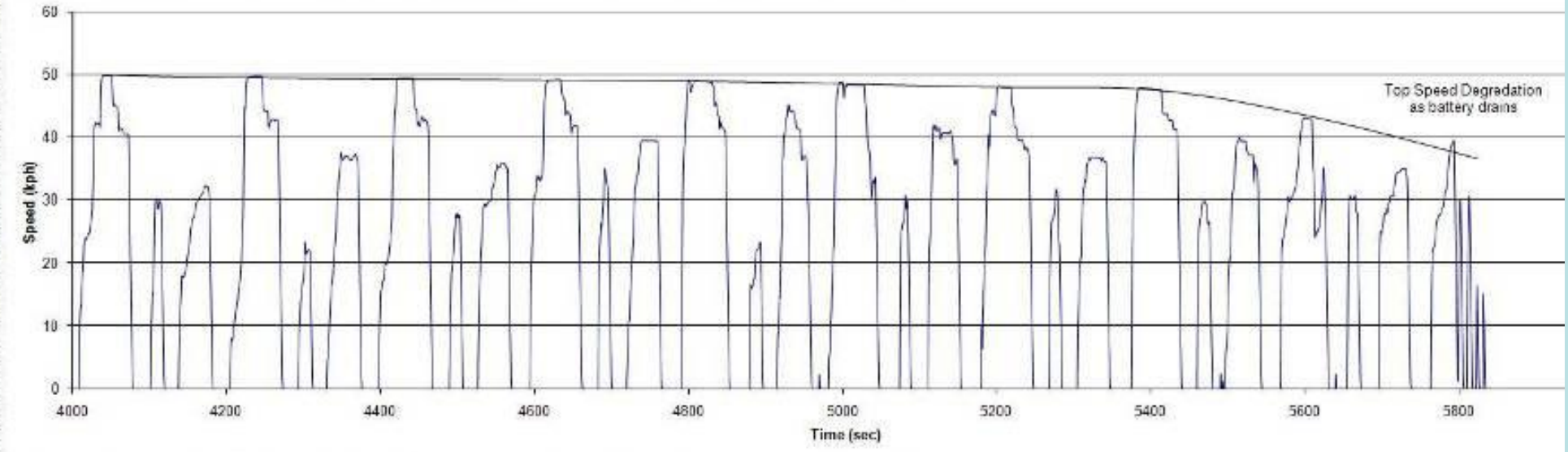
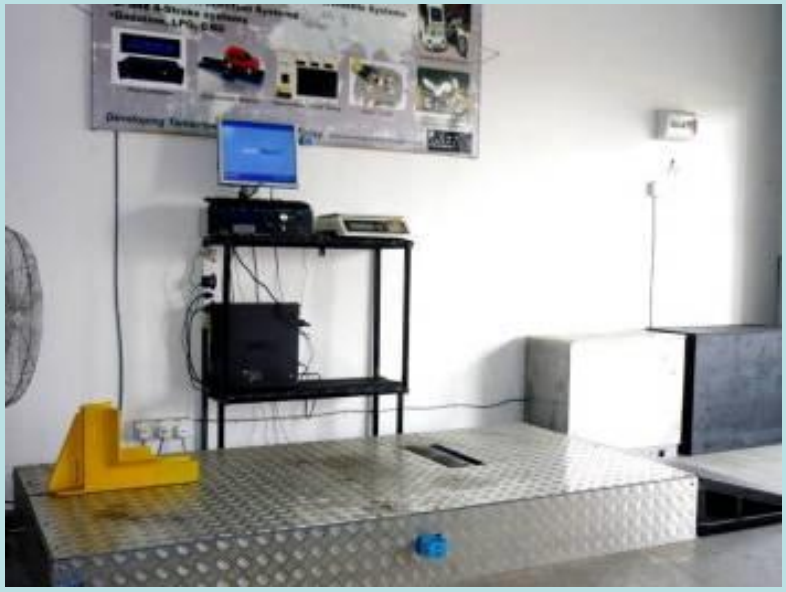
28	6.2																					
29	6.5																					
30	6.7																					
31	7.0																					
32	7.2																					
33	7.545998	0	2.50E-10	0.1	0	9.765625	0.097656	0.371094	0	1	7.545998	0	0									
34	7.795998	0	1.75E-10	0.1	0	9.765625	0.097656	0.371094	0	1	7.795998	0	0									
35	8.045998	0	1.23E-10	0.1	0	9.765625	0.097656	0.371094	0	1	8.045998	0	0									
36	8.295998	0	8.59E-11	0.1	0	9.765625	0.097656	0.371094	0	1	8.295998	0	0									
37	8.545998	0	0.0174	0.1	0	9.765625	0.097656	0.371094	0	1	8.545998	0	0									
38	8.795998	0	0.02958	0.1	0	9.765625	0.097656	0.371094	0	1	8.795998	0	0									
39	9.045998	0	0.038106	0.1	0	9.765625	0.097656	0.371094	0	1	9.045998	0	0									



Automated Drive Cycle

Chassis dynamometers are capable of running automated drive cycle testing.

Motored Chassis Motorcycle Dyno

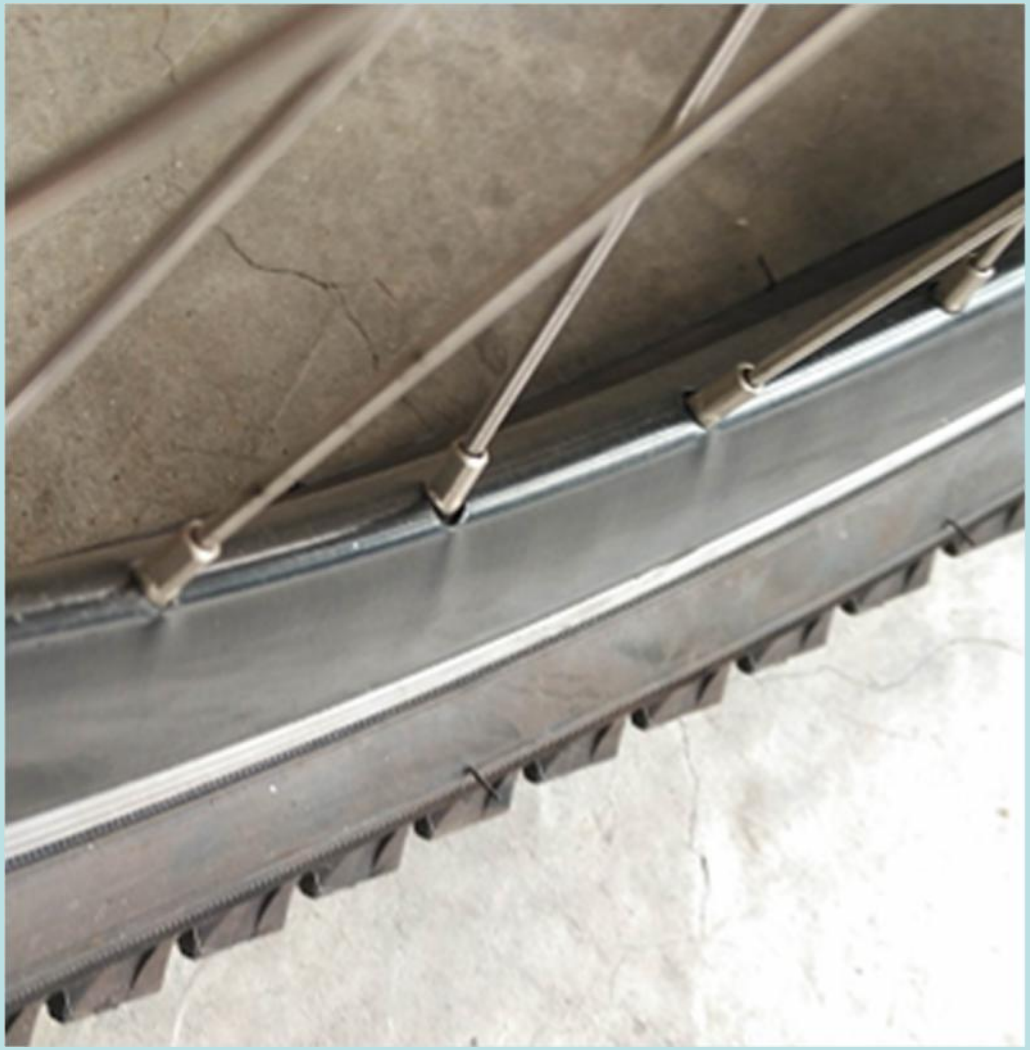


Low Profile Motorcycle Chassis Dyno

Inertia Matching Roller

Challenges: Bicycle Components

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



Comments/Observations

2-Wheelers are exceptionally efficient compared to cars

ASEAN traffic is ~50% 2-Wheelers

A new breed of Electric 2-Wheeler is growing in popularity and looks to be a key component of sustainable transportation especially as single commuter, and first/last mile transport.

CO2 Emissions per passenger-km should be the basis for evaluating vehicles to avoid “pet technologies”

Careful standards need to be applied to insure quality and safety of these E2Ws

Which roads to allow low-speed E2Ws on, licensing, and insurance are ongoing debates

Contact

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