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Disampaikan pada seminar harian GIIAS 2019, 23 Juli 2019
"Challenge of Future Vehicle Technology and Regulation"

Development of xEV Component Testing Facility

Oleh: Budi Susanto

Industri Otomotif

Jalan menuju Indonesia *Automotive* 4.0

	Horizon 1 — 2021	Horizon 2 — 2025	Horizon 3 — 2030
	3-5 tahun	5-10 tahun	10-15 tahun
Inisiatif utama	Memperkuat **produksi lokal kendaraan ICE**[1]	Memulai produksi lokal sepeda motor listrik	Memulai produksi lokal **kendaraaan listrik**
Aktivitas utama	• Meningkatkan **kapabilitas produksi bahan baku**, yakni baja dan bahan kimia • **Meningkatkan produktivitas dalam kendaraan ICE dengan mengadopsi teknologi** • Memperkuat **kapabilitas manufaktur komponen lokal** dengan mengakselerasi produksi FDI dan transfer teknologi	• Menetapkan **rencana keluar jelas untuk motor berbasis bahan bakar** dan membangun **infrastruktur** yang diperlukan & **memberi insentif pada adopsi motor listrik** • Membangun **pusat Litbang** untuk **komponen EV** terutama baterari dan **purwarupa cepat** • Membangun **kapabilitas produksi domestik** untuk motor listrik sepanjang **rantai nilai**	• Menetapkan **rencana keluar jelas untuk mobil ICE** seraya membangun infrastruktur dan **memberikan insentif pada adopsi EV** • Mendorong **peningkatan berkelanjutan produksi komponen EV** • Membangun kapabilitas produksi domestik **untuk** mobil listrik sepanjang ***value chain***
Produk fokus	Kendaraan ICE		Kendaraan Listrik
	Mengakselerasi ekspor, mulai dari MPV dan LCGC	Memulai ekspor 2W electric MC ke negara berkembang	Memulai ekspor mobil listrik ke pasar yang berkembang

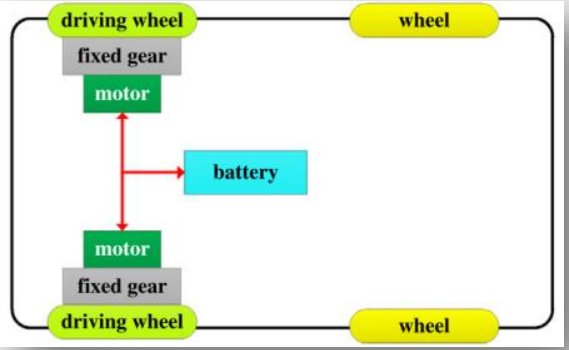
1. *Internal Combustion Engine*

Sumber: Making Indonesia 4.0, Kementerian Perindustrian

PRIMARY COMPONENTS OF AN ELECTRIC VEHICLE

Battery

E-motor



Drive system

Motor controller

Regenerative braking

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PRIMARY COMPONENTS electric vehicle STANDARDS

		SAFETY		PERFORMANCE	
No.	**Component type**	**E-PTW**	**EV**	**E-PTW**	**EV**
1.	Battery	ISO 18243 or UNR 136 - II	ISO 12405-3 or UNR 100 - II	ISO 18243	ISO 12405-1, 12405-2, &12405-4
2.	Motor controller	*	*	*	*
3.	Electric motor	*	*	*	ISO 21782-2
4.	Regenerative braking	*	*	UNR 13 (asumsi)	UNR 13 (asumsi)
5.	Drive system	*	*	*	*
6.	Charging station	ISO 18246	IEC 61851-1 ISO 17409	*	*
7.	Charging connector	IEC 62196-4	IEC 62196-3	*	*

E-PTW : Electric powered two wheeler

* belum mendapatkan informasi

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TECHNICAL COMMITTEE 43-02

Electric-Powered Highway Vehicles

To accommodate participation of National stakeholder, TC 43-02 will create three working group as follows:

- System and Component of Electric Vehicle
- Safety Aspect of Electric Vehicle
- Charging system and infrastructure of Electric Vehicle

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TECHNICAL COMMITTEE 43-02

SNI Published

No	SNI Number	Title	Adopted Standard
1	SNI ISO TR 8713:2017	Kendaraan berpenggerak (propulsi) listrik - Kosakata	ISO TR 8713:2012 Electrically propelled road vehicles — Vocabulary
2	SNI IEC 62660-1 :2017	Sel ion Lithium sekunder untuk penggerak kendaraan listrik Bagian 1 : Pengujian Performa	IEC 62660-1 Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 1: Performance testing
3	SNI IEC 62660-2:2017	Sel ion-lithium sekunder untuk penggerak kendaraan listrik – Bagian 2: Pengujian keandalan dan penyalahgunaan	IEC 62660-2 Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 2: Reliability and abuse testing
4	SNI ISO/TR 13062:2018	Sepeda motor dan mopeds elektrik - Terminologi dan klasifikasi	ISO/TR 13062:2015 Electric mopeds and motorcycles - Terminology and classification
5	SNI ISO 13063:2018	Sepeda motor dan mopeds elektrik - Spesifikasi keselamatan	ISO 13063:2012 Electrically propelled mopeds and motorcycles — Safety specifications
6	SNI ISO 13064-1 :2018	Kinerja - Moped dan Sepeda Motor Baterai-Listrik - Bagian 1 : Konsumsi dan jangkauan energi acuan	ISO 13064-1 Battery-electric mopeds and motorcycles — Performance — Part 1: Reference energy consumption and range
7	SNI ISO 13064-2 :2018	Kinerja – Moped dan sepeda motor Baterai-listrik Bagian 2 : Karakteristik pengoperasian jalan	ISO 13064-2 Battery-electric mopeds and motorcycles — Performance — Part 2: Road operating characteristics

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SNI Published

No	SNI Number	Title
8	SNI 0038:2009	Lead-Acid Batteries for Four Wheels Vehicle or More
9	SNI 4326:2013	Lead-Acid Batteries for Vehicle L Category
10	SNI 04-2051.1-2004	Primary Batteries – Part 1: General
11	SNI 04-2051.2-2004	Primary Batteries – Part 2: Physical and Electrical Specifications
12	SNI 04-6392-2000	Cell and Secondary Battery for Use of Individual Photovoltaic Power Generation Systems – General Requirements and Testing Methods

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TECHNICAL COMMITTEE 43-02

National Program Standard Formulation (PNPS)

No	Title	Adopted Standard
1	Kendaraan berpenggerak listrik -spesifikasi uji kemasan dan sistem baterai traksi lithium ion - Bagian 3: Persyaratan kinerja keselamatan	ISO 12405-3 Electrically propelled road vehicles — Test specification for lithium-ion traction battery packs and systems — Part 3: Safety Performance requirements
2	Sel baterai litium-ion fero fosfat sekunder untuk digunakan pada kendaraan listrik	-
3	Modul baterai litium-ion fero fosfat sekunder untuk digunakan pada kendaraan listrik	-
4	Kendaraan berpenggerak listrik – spesifikasi uji kemasan dan system baterai traksi lithium ion- Bagian 3: Persyaratan kinerja keselamatan	IEC 62660-3:2016 Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 3: Safety requirements

TECHNICAL COMMITTEE 43-02

National Program Standard Formulation (PNPS)

No	Title	Adopted Standard
5	Kendaraan berpenggerak listrik – Karakteristik pengoperasian jalan raya	ISO 8715:2001 Electric road vehicles - Road operating characteristics
6	Kendaraan jalan raya berpenggerak listrik – Spesifikasi uji pak dan sistem baterai litium- ion traksi - Bagian 4: Pengujian unjuk kerja	ISO 12405-4 *Electrically propelled road vehicles --Test specification for lithium-ion traction battery packs and systems – Part 4: Performance testing* or UNR 100
7	Moped dan sepeda motor berpenggerak listrik - Spesifikasi uji dan persyaratan keselamatan untuk sistem baterai litium-ion	ISO 18243:2017 *Electrically propelled mopeds and motorcycles – Test specification and safety requirements for lithium ion battery system* or UNR 136
8	Kendaraan berpenggerak listrik - Konsumsi energi dan jarak tempuh acuan – Prosedur pengujian untuk mobil penumpang dan kendaraan komersial ringan	ISO 8714:2002 *Electric road vehicles - Reference energy consumption and range – Test procedures for passenger cars and light commercial vehicles*

TECHNICAL COMMITTEE 43-02

National Program Standard Formulation (PNPS)

No	Title	Adopted Standard
9	Kendaraan jalan raya berpenggerak listrik- Penentuan tenaga untuk penggerak kendaraan listrik listrik hibrid	ISO 20762:2018 Electrically propelled road vehicles -- Determination of power for propulsion of hybrid electric vehicle
10	Battery Management System	

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ELECTRIC VEHICLE

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Battery ELECTRIC vehicle

ISO 12405-1

Untuk high power application

Deskripsi
Merupakan standar prosedur uji karakterisitk dasar unjuk kerja, reliability, dan abuse test untuk battery pack

Parameter Uji
Performance, reliability, abuse test

ISO 12405-2

Untuk high energy application

Deskripsi
Merupakan standar prosedur uji karakterisitk dasar unjuk kerja, reliability, dan abuse test untuk battery pack

Parameter Uji
Performance, reliability, abuse test

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Battery ELECTRIC vehicle

ISO 12405-3

Untuk persyaratan keselamatan / safety requirement

Deskripsi

Mempunyai kriteria keselamatan pass/fail

Parameter Uji

General, mechanical, climate, simulated vehicle accident, electrical test, system functionality

ISO 12405-4

Menggantikan 12405-1 dan 12405-2

Deskripsi

Merupakan standar prosedur uji karakterisitk dasar unjuk kerja

Parameter Uji

Performance test

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Battery ELECTRIC vehicle

UNR100 PART II

Untuk persyaratan keselamatan / safety requirement kendaraan kaetegori M dan N

Deskripsi

Mempunyai kriteria keselamatan pass/fail

Parameter Uji

mechanical, climate, electrical test, system functionality, emission

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E-MOTORCYCLE SAFETY AND PERFORMANCE TESTING FACILITY

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Electric Motorcycle Safety & Performance Standard

ISO 13063:2012 Electrification Safety

UNR 136 Part II or ISO 18243:2017 Battery Testing & Safety

ISO 13064-1:2012 Electric Consumption

ISO 13064-2:2012 Vehicle Performance

ISO 18246:2015 Charging System

IEC 62196 Charging Connectors

KEMENPERIN

KEMENHUB

ESDM, BPPT, LEMBAGA LAINNYA

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ISO 13063:2012 Electrification Safety

Standard

ISO 13063:2012
Electrification Safety

Test Purpose

Requirements for functional safety means, protection against electric shock, and the on-board rechargeable energy storage system when used in normal condition

Equipment

Electrical Safety Analyzer for Electrical Isolation Test, Withstand Voltage, and Continuity Test

Electrical Safety Analyzer

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UNR 136 Part II or ISO 18243:2017 Battery Testing & Safety

Standard

UNR 136 Part II or ISO 18243:2017 Battery Testing & Safety

Test Purpose

To determine the essential characteristics on performance, safety & reliability of lithium-ion battery packs & system

Equipment

For :

- pre-conditioning cycles
- standard charge/discharge cycle
- Energy & capacity test at RT
- Energy & capacity at different temperature & discharge rates
- No load SOC loss
- SOC loss at storage
- Cycle life

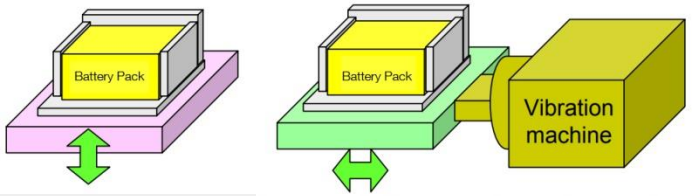
Power & internal resistance

Battery Pack Testing Facility (refer next slide for range of equipment) for safety & reliability test

Battery Analyzer

UNR 136 PART II Battery Testing & Safety

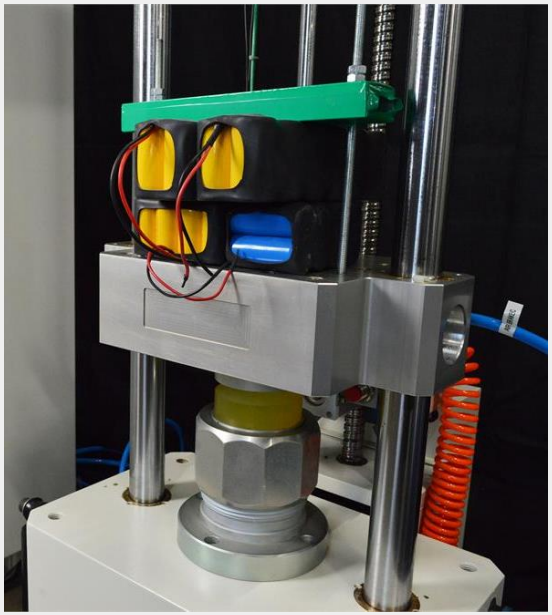
- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection



To simulate vibration during the normal operation of the vehicle

UNR 136 PART II Battery Testing & Safety

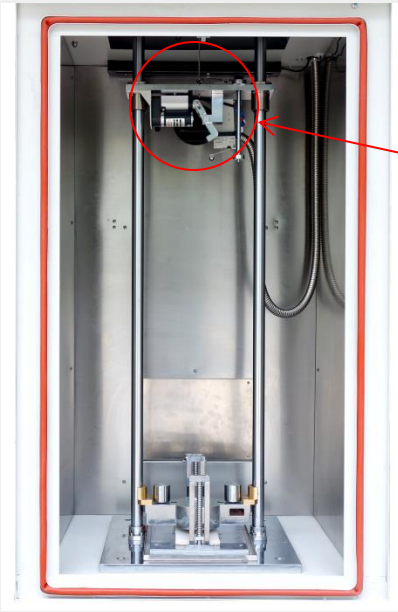
- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection



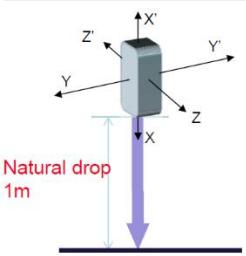
To simulate crash hazard/fall on the side from stationary/parked situation

UNR 136 PART II Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection



Battery Pack



To simulate free fall from a specific height (1 m)

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UNR 136 PART II Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection

To simulate rapid and extreme temperature changes or to imitate humid environment

UNR 136 PART II Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection

To simulate fire hazard (fire exposure)

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UNR 136 PART II Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection

To verify the performance of the short circuit battery

UNR 136 PART II Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection

Battery Analyzer overcharge/discharge value

To test the performance of the overcharge/discharge protection

Standard untuk pengujian kendaraan roda 2 yang lain adalah ISO 18243, di mana perbedaannya adalah adanya 3 parameter tambahan untuk ISO 18243, yaitu: *dewing test*

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ISO 18243:2017 Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Dewing Test
- Water Immersion
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection
- Salt Spray

To simulate rapid and extreme temperature changes or to imitate humid environment

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ISO 18243:2017 Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Dewing Test
- Water Immersion
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection
- Salt Spray

To simulate water immersion due to test the battery pack against indirect short circuit

ISO 18243:2017 Battery Testing & Safety

- Vibration Test
- Mechanical Shock
- Drop (Free Fall)
- Thermal Shock
- Over-temperature Condition
- Dewing Test
- Water Immersion
- Fire (Flammability Test)
- Short Circuit Protection
- Overcharge & Over-discharge Protection
- Salt Spray

To simulate corrosive attack to test the resistance of the battery packs

UNR 136 Part II berisi pengujian komponen baterai yang mirip dengan ISO 18243. Perbedaannya adalah pada UNR 136 terdapat uji emisi, tetapi tidak ada uji *dewing, water immersion*, dan *salt spray*

ISO13064-1:2012 Electric Consumption

Standard

ISO13064-1:2012

Electric Consumption

Test Purpose

To measure the reference energy consumption and reference range of electric motorcycles and mopeds with only a traction batteries as power source for vehicle propulsion

Equipment

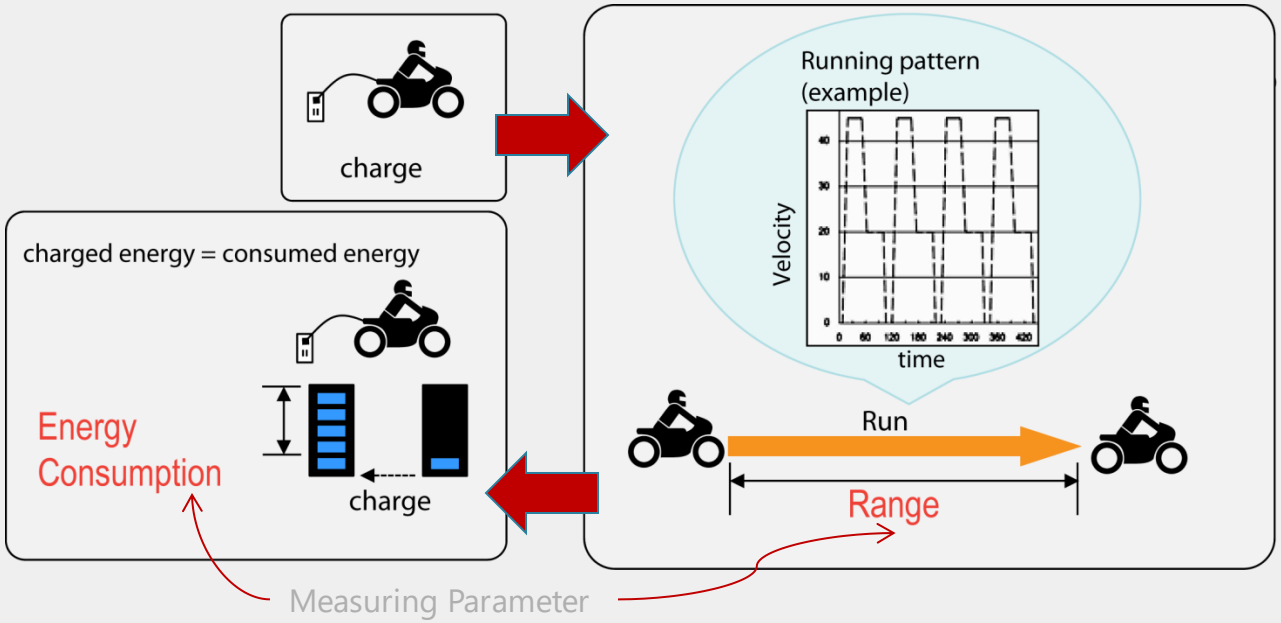
Chassis Dynamometer System

Current/Voltage DAQ System

ISO13064-1:2012 Electric Consumption

Test Procedure

- Battery Charge (normal overnight charging procedure)
- Application of designated test sequence & distance measuring
- Charging the traction battery & measuring energy
- Calculation of reference energy consumption



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ISO13064-2:2012 Vehicle Performance

Standard

ISO13064-2:2012

Vehicle Performance

Test Purpose

To measure the road performance of electric motorcycles and mopeds with only a traction batteries as power source for vehicle propulsion.

Equipment

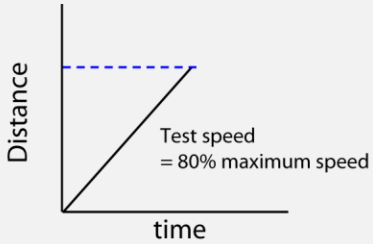
Chassis Dynamometer System

ISO13064-2:2012 Vehicle Performance

Test Procedure

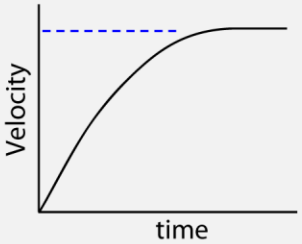
- Range at 80% maximum speed
- Complete battery discharge
- Partial battery discharge
- Maximum speed
- Acceleration ability
- Speed uphill

Range at 80% maximum speed

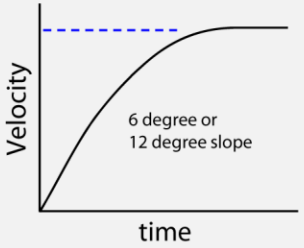


Complete & partial battery discharge

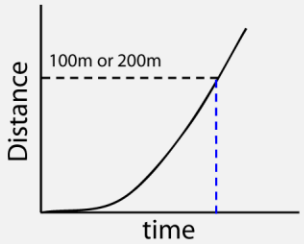
Maximum speed



Speed uphill



Acceleration ability



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ISO18246:2015 Charging Systems

Standard

ISO18246:2015
Charging Systems

Test Purpose

Safety requirements for conductive connection to an external electric power supply of electrically propelled mopeds and motorcycles.

Test Procedure

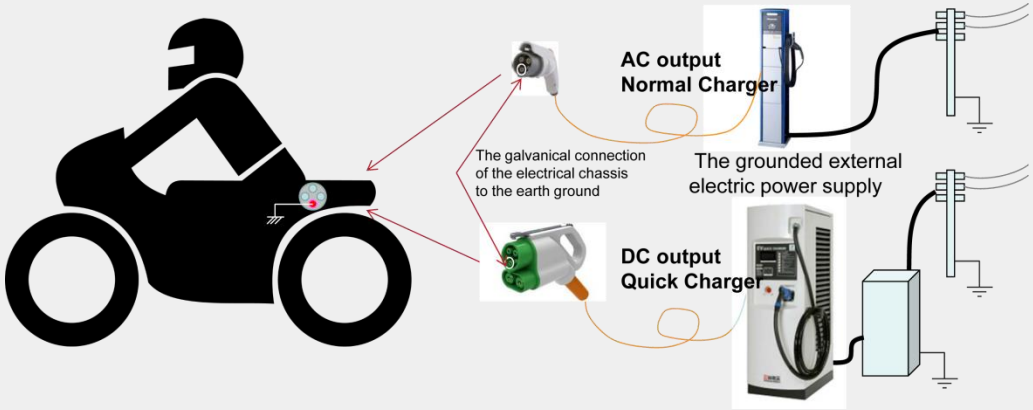
- **Connection between the plug or vehicle couplers & RESS of the vehicle**
- **Protection of persons against electric shock**
- **Other requirements for on-board charging system**
- **Marking, instructions, & indications**

ISO18246:2015 Charging Systems

Test Procedure

- **Connection between the plug or vehicle couplers & RESS of the vehicle**
- **Protection of persons against electric shock**
- **Other requirements for on-board charging system**
- **Marking, instructions, & indications**

***Compliance to this requirement may be demonstrated either by using the connector specified by the vehicle manufacturer, or by analysis.**

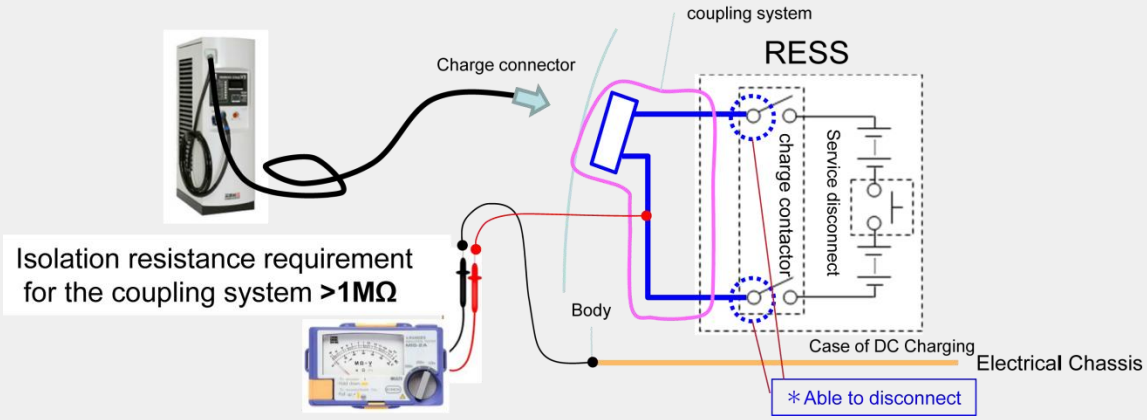


Terminal for the earth ground shall be provided & the connection of this terminal shall be connected before the voltage is applied.

ISO18246:2015 Charging Systems

Test Procedure

- **Connection between the plug or vehicle couplers & RESS of the vehicle**
- **Protection of persons against electric shock**
- **Other requirements for on-board charging system**
- **Marking, instructions, & indications**



***Compliance to this requirement may be demonstrated either by using the connector specified by the vehicle manufacturer, or by analysis.**

The isolation resistance shall be at least 1 MΩ when the charger coupler is disconnected. During the measurement, the REESS may be disconnected.

ISO18246:2015 Charging Systems

Test Procedure

- Connection between the plug or vehicle couplers & RESS of the vehicle
- **Protection of persons against electric shock**
- Other requirements for on-board charging system
- Marking, instructions, & indications

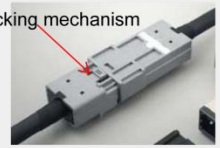
***Compliance to this requirement may be demonstrated either by using the connector specified by the vehicle manufacturer, or by analysis.**

a)

b)

and, with a locking mechanism

underneath the floor
and are provided with a locking mechanism



c)

The voltage of the live parts becomes equal or below DC 60V or equal or below AC 30V (rms) within one second after the connector is separated.

d)

For a service disconnect which can be opened, disassembled or removed without tools, it is acceptable if protection degree IPXXB is satisfied under a condition where it is opened, disassembled or removed without tools.

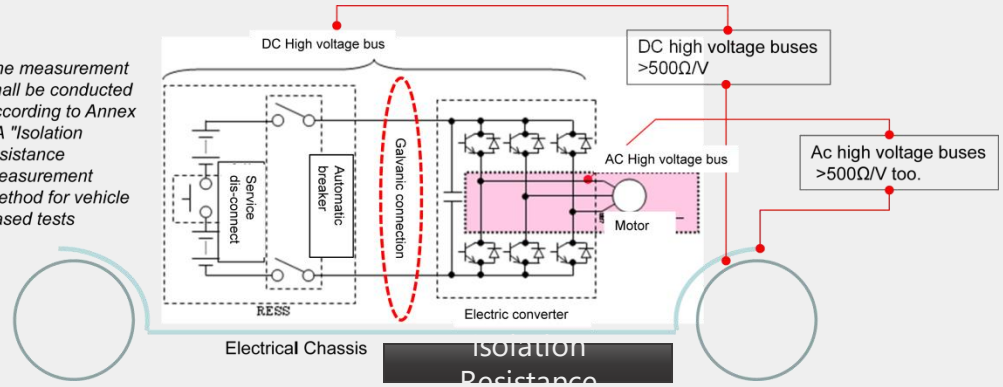
ISO18246:2015 Charging Systems

Test Procedure

- **Connection between the plug or vehicle couplers & RESS of the vehicle**
- **Protection of persons against electric shock**
- **Other requirements for on-board charging system**
- **Marking, instructions, & indications**

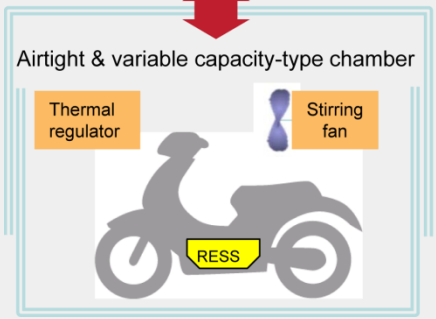
***Measurement of the quantity of hydrogen emission by vehicle equipped with open type traction batteries**

The measurement shall be conducted according to Annex 4A "Isolation resistance measurement method for vehicle based tests



Isolation Resistance

Gas Analyzer



Measuring Instrument
- Hydrogen Analyzer（Hydrogen）
- Temperature （Indoor & Battery neighborhood）
- Indoor/outdoor pressure
- Charger output（Voltage & Current）

The quantity of hydrogen emission calculated by the following calculating formula after the test.

Gases Emissions

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ISO18246:2015 Charging Systems

Test Procedure

- Connection between the plug or vehicle couplers & RESS of the vehicle
- Protection of persons against electric shock
- **Other requirements for on-board charging system**
- Marking, instructions, & indications

Dielectric Withstand Characteristic: Multimeter

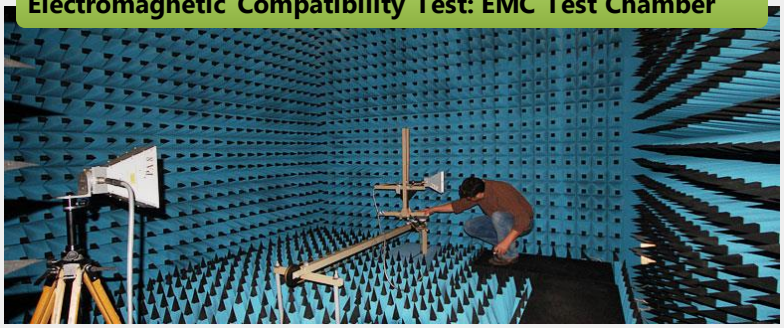
Creepage Distance Of On-board Equipment: Caliper Ruler

Touch Current: 7630 Touch Current Tester

Environmental Test: Environmental Test Chamber

Permissibly Surface Temperature: IR Thermometer

Electromagnetic Compatibility Test: EMC Test Chamber



ISO18246:2015 Charging Systems

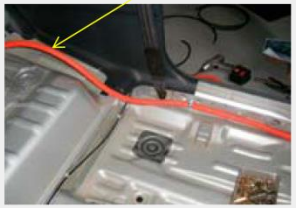
Test Procedure

- Connection between the plug or vehicle couplers & RESS of the vehicle
- Protection of persons against electric shock
- Other requirements for on-board charging system
- Marking, instructions, & indications

Mark the decoration of the RESS(@High voltage)

Mark the decoration of the enclosure for expose live parts of high voltage circuits

Distinguish the high voltage line by orange covering



To put the markings, necessary instructions, & indications at crucial spots/section

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Electric Motorcycle Safety & Performance Standard

Standard

IEC 62196-4 (Part 4)

Charging Coupler for Light Electric Vehicle

(Standard is still under preparation)

Requirement

Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles is an international standard for a set of electrical connectors for electric vehicles.

Vehicle coupler under IEC62196-2	Specification
Type 1 1 phase	Reflecting the SAE J1772/2009 automotive plug specifications
Type 2 1 phase & 3 phase	Reflecting the VDE-AR-E 2623-2-2 plug specifications
Type 3 1 phase & 3 phase with shutter	Reflecting the EV Plug Alliance proposal
Type 4 DC coupler	Reflecting the Japan Electric Vehicle Standard (JEVS) G105-1993 specifications

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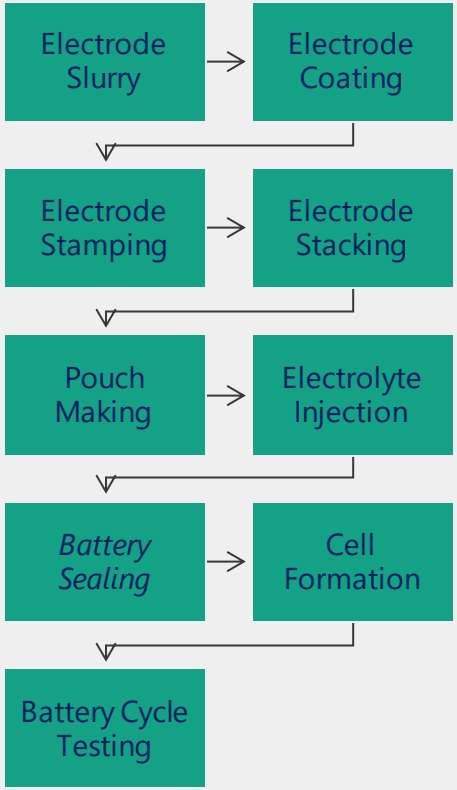

The BATTERY RESEARCH LABORATORY

Is able to produce lithium-ion battery cells

Pouch type

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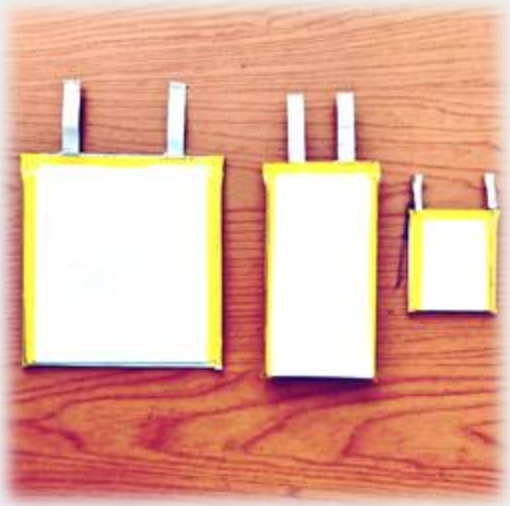
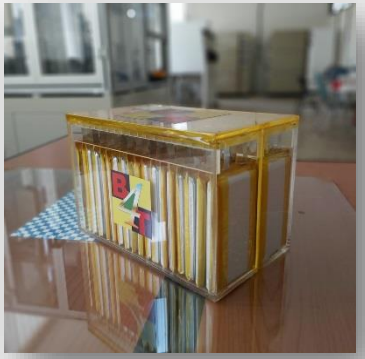
Research Products



Pouch Li-Ion Battery Cells



Battery Pack

Electric Motorcycle Battery Pack

Power Storage

Power Bank and Power House

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Pengujian berdasarkan :

ISO 13063

Electrification:Safety

- Dielectric strength
- Whitstand voltage
- Electric insulation
- Continuity test

ISO 18243

Battery Testing and Safety

Untuk parameter safety:

- Vibration
- Salt spray

ISO 13064-1

Electric Consumption

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RENCANA PENGEMBANGAN LABORATORIUM UJI

Years	PLANNING
2019	Development of electrical battery testing laboratory (from cell to portable device)
2020	Improvement testing ability (full safety parameter) from cell to portable device and get accreditation
2021	Development of motorcycle battery pack testing laboratory for safety parameter and get accreditation
2022	Development of passenger car battery pack testing laboratory for safety parameter
2023	Accreditation for electric vehicle battery testing laboratory for safety parameter
2024	Accreditation for electric vehicle battery testing laboratory for performance

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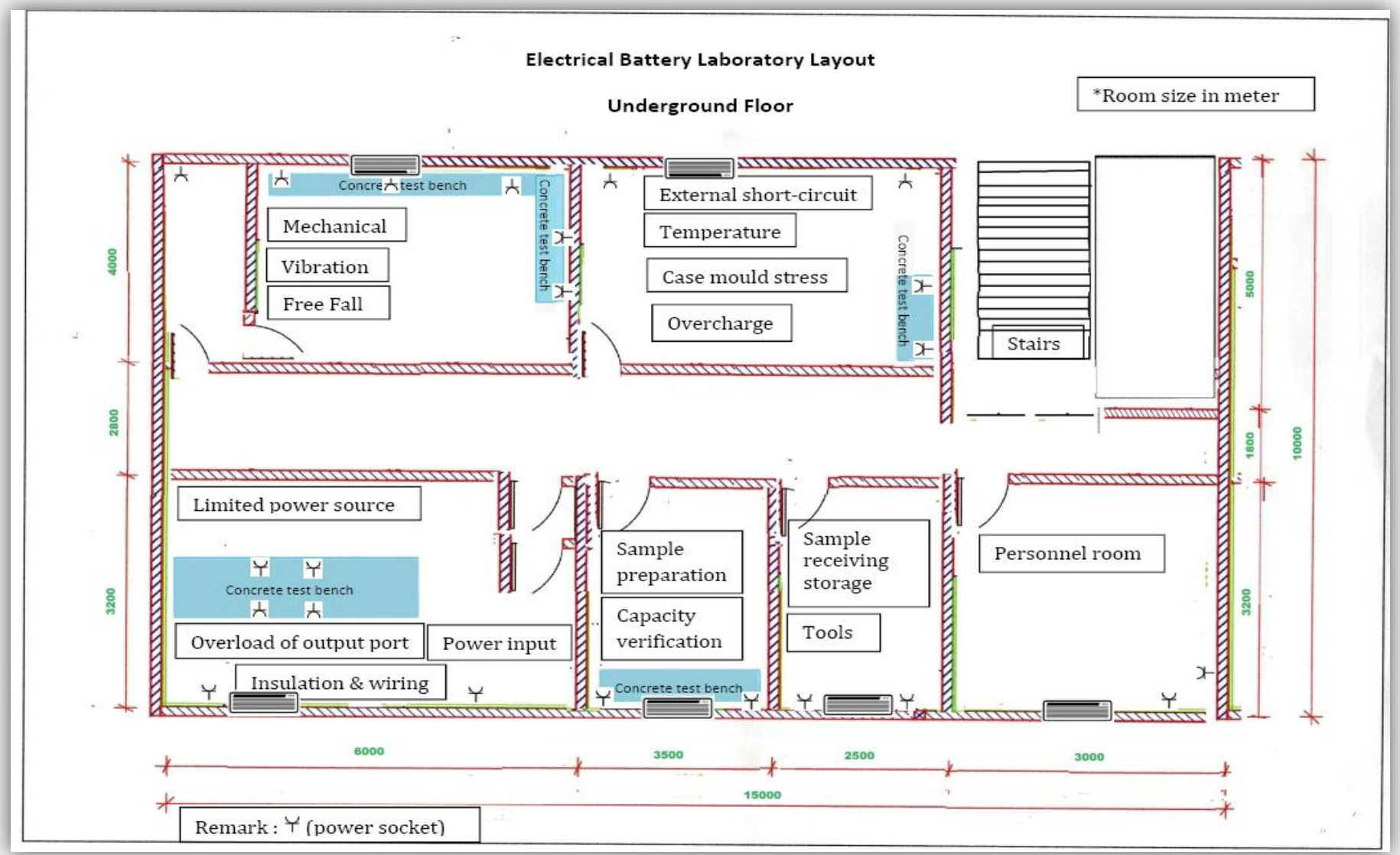
LAYOUT LABORATORIUM UJI BATERAI LISTRIK



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TERIMA KASIH