

| <b>TEST REPORT</b><br><b>UL 2849</b><br><b>Outline of Investigation for Safety of Electrical Systems for eBikes</b> |                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Report Number.....:                                                                                                 | S03A25070444U00201                                                                                                                                                            |
| Test Date.....:                                                                                                     | 2025-07-29~ 2025-08-12                                                                                                                                                        |
| Date of issue.....:                                                                                                 | 2025-09-08                                                                                                                                                                    |
| Total number of pages.....:                                                                                         | 31                                                                                                                                                                            |
| Tested by (name + signature).....:                                                                                  | Jony Huang<br>                                                                              |
| Reviewed by (name + signature).....:                                                                                | Jason Xu<br>                                                                                |
| Approved by (name + signature).....:                                                                                | Rod Liu<br>                                                                                 |
| Testing Laboratory Name .....                                                                                       | Guangdong ESTL Technology Co., Ltd.                                                                                                                                           |
| Laboratory address .....                                                                                            | Room 101, 201-208, Unit 1, Room 201, Unit 4, Building 1, No. 9 and Room 101, Unit 2, Building 1, No. 11 Headquarters 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China |
| Applicant's name.....:                                                                                              | FOSHAN ZENITH SPORTS CO., LTD.                                                                                                                                                |
| Address.....:                                                                                                       | No.3 Hengsan Road, Xiayi industrial Zone, Heshun, Lishui Town, Nanhai District Foshan City, Guangdong, China                                                                  |
| Test specification:                                                                                                 |                                                                                                                                                                               |
| Standard.....:                                                                                                      | ANSI/CAN/UL2849:2022                                                                                                                                                          |
| Test item description.....:                                                                                         | E-bikes                                                                                                                                                                       |
| Trade Mark.....:                                                                                                    | N/A                                                                                                                                                                           |
| Manufacturer.....:                                                                                                  | Same as applicant                                                                                                                                                             |
| Address.....:                                                                                                       | Same as applicant                                                                                                                                                             |
| Factory.....:                                                                                                       | Same as applicant                                                                                                                                                             |
| Address.....:                                                                                                       | Same as applicant                                                                                                                                                             |
| Model/Type reference.....:                                                                                          | AM-ZNH-02-26SR                                                                                                                                                                |
|                                                                                                                     | Load Weight Limit: 150kg                                                                                                                                                      |
|                                                                                                                     | Maximum assistance speed: 32km/h                                                                                                                                              |
| Ratings.....:                                                                                                       | Battery: 48V, 10.4Ah, 499.2Wh                                                                                                                                                 |
|                                                                                                                     | Operating Temperature: 0-40°C                                                                                                                                                 |
|                                                                                                                     | IP rating: IPX4                                                                                                                                                               |



| <b>[X] TESTS TO BE CONDUCTED:</b> |      |                                        |                                                              |
|-----------------------------------|------|----------------------------------------|--------------------------------------------------------------|
| Test No.                          | Done | Test Name                              | <b>[ ] Comments/Parameters<br/>[ ] Tests Conducted by ++</b> |
| --                                | --   | General                                | --                                                           |
| 1                                 | X    | Input Test                             | 27                                                           |
| 2                                 | X    | Temperature Test                       | 28                                                           |
| --                                | --   | Isolation Resistance Test              | 29                                                           |
| --                                | --   | Dielectric Strength Test               | 30                                                           |
| --                                | --   | Humidity Conditioning Test             | 31                                                           |
| --                                | --   | Abnormal Operations Tests              | 32                                                           |
|                                   |      | Overcharging test                      | 32.2                                                         |
| --                                | --   | Component fault tests                  | 32.3                                                         |
| --                                | --   | Forced ventilation/blocked ventilation | 32.4                                                         |
| 3                                 | X    | Locked rotor motor test                | 32.5                                                         |
| 4                                 | X    | Running overload test                  | 32.6                                                         |
|                                   |      | Short circuit test                     | 32.7                                                         |
|                                   |      | Imbalanced charging test               | 32.8                                                         |
|                                   |      | Shock test                             | 32.9                                                         |
|                                   |      | Thermal cycling                        | 32.10                                                        |
| 5                                 | X    | Impact Test                            | 33                                                           |
| 6                                 | X    | Mold Stress                            | 34                                                           |
| 7                                 | X    | Flexing Test                           | 35                                                           |
| --                                | --   | Ingress Protection Tests               | 36                                                           |
| --                                | --   | Permanence of Marking                  | 37                                                           |
| 8                                 | X    | Vibration Test                         | 38                                                           |
| --                                | --   | Complete device                        | 38.1                                                         |
| --                                | --   | Batteries/battery packs                | 38.2                                                         |
| --                                | --   | Strain Relief                          | 39                                                           |
| --                                | --   | Strain relief - pull test              | 39.2                                                         |
| --                                | --   | Strain relief - push back test         | 39.3                                                         |
| 9                                 | X    | Startup Assistance Mode Test           | 40                                                           |
| 10                                | X    | Motor Assistance Control               | 41                                                           |
| 11                                | X    | Reverse Pedaling Test                  | 41.2                                                         |
| 12                                | X    | Pedal Cessation Test for EPACs         | 41.3                                                         |
| 13                                | X    | Cutoff When Braking Test               | 41.4                                                         |
| 14                                | X    | Cutoff at Maximum Speed Test           | 41.5                                                         |

**[X]** The test facility was deemed to have the environment and capabilities necessary to perform the tests included in this data package.

Test Equipment- See "TEST EQUIPMENT INFORMATION"  
Samples – See "TEST SAMPLE IDENTIFICATION"

**Instructions –**

+ - When all tests are conducted by one person, can insert printed name and signature here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.  
 ++ - When test conducted by more than one person, can insert printed name and signature of person conducting the test next to the test name instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

**Special Instructions -**

☐ Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.

Ambient Temperature, °C 5 - 35 Relative Humidity, % N/A Barometric Pressure, mBar N/A

☐ No general environmental conditions are specified in the Standard(s) or have been identified that could affect the test results or measurements.

**RISK ANALYSIS RELATED TO TESTING PERFORMANCE:**

The following types of risks have been identified. Take necessary precautions. This list is not all inclusive.

|                                                            |                                                              |
|------------------------------------------------------------|--------------------------------------------------------------|
| <input checked="" type="checkbox"/> Electric shock         | <input type="checkbox"/> Radiation                           |
| <input checked="" type="checkbox"/> Energy related hazards | <input checked="" type="checkbox"/> Chemical hazards         |
| <input checked="" type="checkbox"/> Fire                   | <input checked="" type="checkbox"/> Noise                    |
| <input checked="" type="checkbox"/> Heat related hazards   | <input checked="" type="checkbox"/> Vibration                |
| <input checked="" type="checkbox"/> Mechanical             | <input checked="" type="checkbox"/> Other (Specify)Explosion |

#### Safety Precautions When Conducting Testing -

Follow all battery SOPs when handling, testing, storing or disposing of battery samples. Follow appropriate procedures to prevent inadvertent shorting of battery and cell terminals during handling, storage and disposal of batteries. Follow MSDS sheets and battery SOPs when handling batteries where there is evidence of electrolyte leakage.

Some lithium batteries are capable of exploding when subjected to battery tests. It is important that personnel be protected from the flying fragments, explosive force, fire and sudden release of heat and noise that results from such explosions. For protection, the testing should be conducted in a room separate from the observer.

The test area is to be well ventilated to protect personnel from possible harmful fumes or gases that may be emitted during battery testing.

As an additional precaution, the temperatures on the surface of the battery casings shall be monitored during testing. All personnel involved in the testing of lithium batteries are to be instructed never to approach a lithium battery while the surface temperature exceeds 90°C (194°F).

## IMPORTANT TEST PARAMETERS:

|                                      |                                                           |
|--------------------------------------|-----------------------------------------------------------|
| BATTERY PACK:                        |                                                           |
| Manufacturer                         | LN Energy Technology Co., Ltd.                            |
| Model No.                            | LN-DYC-001                                                |
| Configuration                        | 4P/13S                                                    |
| Capacity                             | 10.4AH                                                    |
| Standard Charging Current            | 2A                                                        |
| Standard Full Charging Voltage       | 54.6V                                                     |
| End of Charging Current              | 0.208A                                                    |
| Maximum Charging Current             | 3A                                                        |
| Maximum Charging Voltage             | 54.6V                                                     |
| Standard Discharging Current         | 2.08A                                                     |
| End-of-Discharge Voltage (EODV)      | 37.7V                                                     |
| Maximum Discharge Current            | 20A                                                       |
| Charging Temperature Range           | 0-40°C                                                    |
| Discharging Temperature Range        | -20-40°C                                                  |
| Overcharge Voltage Protection        | 4.225V-4.25V/Cell                                         |
| Over-discharging Current Protection  | 25-35A                                                    |
| Thermal protection                   | OTP for Charging: 50-60°C<br>OTP for Discharging: 60-70°C |
| CHARGER:                             |                                                           |
| Manufacturer                         | Guangzhou Ji Yin Power Electronics Co., Ltd.              |
| Model No.                            | JY-546200                                                 |
| Input Voltage Rating                 | 100-240Vac                                                |
| Input Current Rating                 | 2.5A                                                      |
| Output Voltage Rating                | 54.6V                                                     |
| Output Current Rating                | 2A                                                        |
| EBIKE:                               |                                                           |
| Manufacturer                         | FOSHAN ZENITH SPORTS CO., LTD.                            |
| Model No.                            | AM-ZNH-02-26SR                                            |
| Electrical Ratings                   | 48V/10.4Ah                                                |
| Operating Temperature Specifications | 0-40°C                                                    |
| Load Weight Limit, lbs/kg            | 150kg                                                     |
| IP rating                            | IPX4                                                      |
| Maximum assistance speed, mph/kmh    | 32km/h                                                    |
| Hazardous voltage circuit (Y/N)      | N                                                         |

## TEST SAMPLE IDENTIFICATION

The table below is provided to provide correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

| Sample Card No.   | Date Received                                                                                                                                                                 | <input checked="" type="checkbox"/> Test No. | Sample No.                    | Manufacturer, Product Identification and Ratings |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------|--------------------------------------------------|
| A25070444002      | 2025-07-24                                                                                                                                                                    | See Individual Test Datasheet                | See Individual Test Datasheet | See page 5                                       |
| Testing location: | Room 101, 201-208, Unit 1, Room 201, Unit 4, Building 1, No. 9 and Room 101, Unit 2, Building 1, No. 11 Headquarters 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China |                                              |                               |                                                  |

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

☐ Sampling Procedure -

## GENERAL

### DEFINITIONS CRITICAL TO TESTING -

**ELECTROLYTE LEAKAGE** – A condition where liquid electrolyte escapes from a battery through a rupture or crack, or other unintended opening in the casing or enclosure, and is visible external to the battery.

**EXPLOSION** – A condition when the battery contents are forcibly expelled and the casing or enclosure is torn or split into two or more pieces.

**NORMAL OPERATING REGION** – That region of voltage, current and temperature within which a lithium ion battery can be safely charged and discharged repetitively throughout the anticipated life of the battery. The battery manufacturer specifies these values, which are then used in the safety evaluation of the battery.

**OBSERVATION PERIOD** – Unless noted otherwise in the individual test methods, the observation period used for testing is 1 hour.

**RUPTURE** – A mechanical failure of a battery enclosure induced by an internal or external cause, resulting in exposure or spillage, but no ejection of materials.

**TOP OFF VOLTAGE** – The manufacturer's recommended (i.e. standard) maximum voltage as outlined in the Table of Important Cell Parameters. This is the open circuit voltage for the fully charged condition.

**VENTING** – A condition when the cell electrolyte is emitted as vapor from a designed vent or through an opening in a seal.

### TEMPERATURE MEASUREMENTS

Temperatures were measured by thermocouples. The temperature measurements on the batteries were made with the measuring junction of the thermocouple held tightly against the outer casing of the component cell.

### THERMOCOUPLES

Thermocouples consist of wires not larger than 24 AWG (0.21 mm<sup>2</sup>) and not smaller than 30 AWG (0.05mm<sup>2</sup>) and shall be attached in accordance with SOP 00-LC-S0298.

### TEST TRACK

If conducted on a test track, the test track is to be level and the wind speed is to not exceed 3 m/s (6.7 mph).

## SAMPLES AND CONDITIONING

## SAMPLES:

Fresh samples representative of production were used for testing.

| Test                                                                               | UL 2849 Section | Number of Samples with Batteries* (fully charged) |
|------------------------------------------------------------------------------------|-----------------|---------------------------------------------------|
|                                                                                    | --              | --                                                |
| 1.                                                                                 | --              | --                                                |
| 2.                                                                                 | --              | --                                                |
| 3.                                                                                 | --              | --                                                |
| * - Testing may be done on a single sample in sequence as noted in the above list. |                 |                                                   |

## CONDITIONING:

Unless indicated otherwise, the battery modules were fully charged in accordance with the manufacturer's specifications as noted under Important Test Parameters section of these datasheets. After charging and prior to conducting testing, the batteries were allowed to rest for a period of 8 hours at room ambient.

## INPUT TEST

## Section 27

## METHOD

A sample of the eBike or eBike electrical system, is subjected to this test.

The battery shall be fully discharged based on manufacturer's specifications. The sample is then connected to a source of supply and energized at rated voltage and frequency. The input current to the sample is then measured and recorded.

If any other system associated with the sample can be energized at the same time (e.g., lights), those systems are also operated as intended to measure the maximum input current.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | B1   |
| Lab Ambient, °C   | 23.4 |
| Lab Humidity, %RH | 41   |

Charger ☐ On board ☒ Off board

| Model No.      | Condition                     | Voltage (V) | Frequency (Hz) | Rated Current (A) | Measured Current (A) |
|----------------|-------------------------------|-------------|----------------|-------------------|----------------------|
| AM-ZNH-02-26SR | Fully discharged battery pack | 54.6        | --             | 2.0               | 1.98                 |

☒ The measured current ~~did~~ **did not** exceed 110% of the rated value.

☒ The measured current ~~did~~ **did not** exceed the rated output current of the external charger.

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NOTE TO LAB STAFF:

No observation period is required after this test.

## TEMPERATURE TEST

## Section 28

## GENERAL

A sample of the eBike is subjected to this test. Both test methods are to be performed.

## METHOD A (BATTERY CHARGING CIRCUIT AND BATTERY)

The sample is provided with a fully discharged battery (i.e. discharged to EODV) and was conditioned within a chamber set to the upper limit charging temperature specifications of the eBike manufacturer.

After thermal stabilization in the chamber, the battery pack is to be connected to a charging circuit input representative of anticipated maximum charging parameters provided by the specified charger.

The battery pack shall then be subjected to maximum normal charging while monitoring voltages and currents on cells until it reaches the manufacturer's specified fully charged condition.

Temperatures were monitored on temperature sensitive components including cells, enclosure, and all parts within the charging circuit that are temperature sensitive, including any user accessible surfaces.

While still in the conditioning chamber, and after allowing temperatures to stabilize, the fully charged battery pack shall then be discharged in accordance with the manufacturer's specifications representative of maximum weight and operating conditions for loading down to the manufacturer's specified end of discharge condition while monitoring voltage and current on cells until the battery pack reaches its specified end of discharge voltage (EODV).

**Note:**

The method of simulating the maximum continuous electrical load for discharging the batteries may vary according to the vehicle design and should be a method agreed upon by the manufacturer and organization testing the vehicle. The methods to simulate this loading can include the use of a dynamometer or other mechanical loading means, or manipulation of the electrical and electronic control circuit(s) to simulate loading on the motor. Factors to be considered when determining the maximum continuous electrical load during discharge include maximum weight of rider, maximum speed of movement, and loads from auxiliary devices such as lights, audio, etc. that may be operating when the vehicle is moving. If there is a need to consider the surface impact to loading, concrete is to be used to represent typical outdoor operating surfaces.

Temperatures were monitored on temperature sensitive safety critical components including cells, enclosure, and all parts within the charging circuit that are temperature sensitive, including any user accessible surfaces.

The charge and discharge cycles were then repeated for a total of 2 complete cycles of charge and discharge. The test was then repeated with the representative unit in a chamber set to the eBike System manufacturer's lowest specified operating ambient for 2 complete cycles of charge and discharge.

If the battery pack would not operate at the lowest ambient rating, then a temperature as close as possible to the lower ambient rating which allows the battery pack to operate shall be used..

During the temperature test, the voltage and current during discharge and charging of the component cells was monitored to determine that they are not outside of the specified cell manufacturer's operating region.

## TEMPERATURE TEST(CONT'D):

## Section 28

## METHOD B (EBIKE SYSTEM)

The sample is powered from a source that represents the battery pack used on the vehicle. The vehicle system is then operated at maximum load, including motor loads and auxiliary loads such as lights, audio, etc., until thermal stabilization of the measured temperatures.

Temperatures were monitored on temperature sensitive components, enclosures, and user accessible surfaces. Measured temperatures on components are not to exceed their specified maximum temperatures.

A temperature is determined to be stabilized when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 15 minutes, indicate no increase greater than 2°C (4°F)

At the conclusion of this test, the battery pack tested under the battery method is placed back into the eBike system. Any hazardous voltage circuits are subjected to an Isolation Resistance Test (without humidity conditioning) or a Dielectric Strength Test.

## TEMPERATURE TEST(CONT'D):

## Section 28

## RESULTS B

|                   |      |
|-------------------|------|
| Sample No:        | P1   |
| Lab Ambient, °C   | 23.9 |
| Lab Humidity, %RH | 55   |

|                                                                                       |                |
|---------------------------------------------------------------------------------------|----------------|
| Model No.                                                                             | AM-ZNH-02-26SR |
| Specified Max. Ambient, °C:                                                           | 40             |
| Maximum specified rider weight, lbs/kg:                                               | 150kg          |
| Determined maximum continuous discharge current based upon loading considerations, A: | --             |
| Method to achieve maximum continuous discharge current load on sample:                | --             |

| Location                                                                  | Condition A (°C) | Condition B(Shift to Tma=40 °C)(°C) | Condition (°C) | Specified Limit (°C) |
|---------------------------------------------------------------------------|------------------|-------------------------------------|----------------|----------------------|
| 1.Start-up button                                                         | 33.4             | 46.1                                | --             | 85                   |
| 2.Handle Bar                                                              | 31.5             | 46.8                                | --             | 75                   |
| 3.Instrument display panel                                                | 37.5             | 53.1                                | --             | 85                   |
| 4.Power wire for Instrument display panel                                 | 33.2             | 46.5                                | --             | 80                   |
| 5.Front LED light cover                                                   | 39.5             | 59.3                                | --             | 80                   |
| 6.Dischaging connector on the eBike for battery pack                      | 36.2             | 55.2                                | --             | 80                   |
| 7.External Part of Metal frame near the Dischaging connector on the eBike | 37.5             | 57.5                                | --             | 70                   |
| 8.External part of Metal frame near Controller                            | 33.6             | 51.3                                | --             | 70                   |
| Below parts on the motor                                                  | --               | --                                  | --             | --                   |
| 9.Power connector of the motor                                            | 51.2             | 68.3                                | --             | 80                   |
| 10.Motor winding 1                                                        | 95.3             | 110.5                               | --             | 180                  |
| 11.Motor winding 2                                                        | 96.0             | 110.7                               | --             | 180                  |
| 12.Motor winding 3                                                        | 97.2             | 112.6                               | --             | 180                  |
| 13.PCB near the motor winding                                             | 85.1             | 99.3                                | --             | 130                  |
| 14.Power wire of the motor                                                | 85.3             | 98.1                                | --             | 105                  |
| 15.Controller surface                                                     | 53.2             | 63.3                                | --             | 90                   |
| 16.Ambient                                                                | 23.9             | --                                  | --             | --                   |

Temperatures measured **[did]** **[did not]** exceed their specifications.

There **[was]** **[was no]** indication of fire, explosion, rupture, electrolyte leakage or electric shock.

**[ ]** There **[was]** **[was no]** evidence of dielectric breakdown.

**[ ]** The insulation resistance **[was]** **[was no]** less than 50,000  $\Omega$ .

## LOCKED ROTOR MOTOR TEST

## Section 32.5

## METHOD

The motor is operated at the voltage used in the eBike application and with its rotor locked for 7 h or until steady conditions are established. The motor is to be tested while on the eBike and temperatures on windings are to be monitored. As an alternative, the motor can be tested outside of the eBike.

If the design or size of the motor prevents the measuring of temperatures on the windings, the test may be conducted with the motor removed from the eBike and instead of monitoring temperatures, the motor is to be supported on a surface covered with a single layer of tissue paper with the motor covered with a single layer of cheesecloth.

If the motor contains a hazardous voltage circuit, the motor shall be subjected to a Dielectric Voltage Withstand Test, or Isolation Resistance Test, (without humidity conditioning).

If monitoring temperatures on windings during the locked rotor test, the temperatures on the windings shall not exceed the values noted in Table 32.1. If not monitoring temperatures on windings during the test, there shall be no sign of ignition of the tissue or cheesecloth at the conclusion of the test.

Table 32.1 – Motor winding temperature limits during locked rotor

| Thermal Class                                                                 | Temperature Limits, °C (°F) |                  |                  |                  |
|-------------------------------------------------------------------------------|-----------------------------|------------------|------------------|------------------|
|                                                                               | Class A<br>(105)            | Class E<br>(120) | Class B<br>(130) | Class F<br>(155) |
| Type of Protection:                                                           |                             |                  |                  |                  |
| Protection by inherent or external impedance                                  | 150 (302)                   | 165 (329)        | 175 (347)        | 200 (392)        |
| Protection by any protective device that operates during the first hour       | 200 (392)                   | 215 (419)        | 225 (437)        | 250 (482)        |
| Protection by protective device:                                              |                             |                  |                  |                  |
| • maximum after first hour (automatic)                                        | 175 (347)                   | 190 (374)        | 200 (392)        | 225 (437)        |
| • maximum after first hour (thermal cutoff)                                   | 150 (302)                   | 165 (329)        | 175 (347)        | 200 (392)        |
| • arithmetic average during the 2nd hour and during the 72nd hour (automatic) | 150 (302)                   | 165 (329)        | 175 (347)        | 200 (392)        |

## LOCKED ROTOR MOTOR TEST (CONT'D):

## Section 32.5

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P1   |
| Lab Ambient, °C   | 23.1 |
| Lab Humidity, %RH | 43   |

|                                        |                          |
|----------------------------------------|--------------------------|
| Model No.                              | AM-ZNH-02-26SR           |
| Insulation Class Temperature Limit, °C | 200                      |
| Type of Locked Rotor Protection:       | Over Current Protection* |

| Test:<br>In eBike or on Bench | Location of<br>Thermocouples   | Maximum Temperature on<br>Windings, °C | Ignition of<br>combustibles? Y or<br>N |
|-------------------------------|--------------------------------|----------------------------------------|----------------------------------------|
| On Bench                      | 9.Power connector of the motor | 28.2                                   | N                                      |
|                               | 10.Motor winding 1             | 27.3                                   | N                                      |
|                               | 11.Motor winding 2             | 26.5                                   | N                                      |
|                               | 12.Motor winding 3             | 27.6                                   | N                                      |
|                               | 13.PCB near the motor winding  | 26.1                                   | N                                      |
|                               | 14.Power wire of the motor     | 26.3                                   | N                                      |

| Insulation Check <input type="checkbox"/> Dielectric Strength Test <input type="checkbox"/> Isolation Resistance Test |                                                             |                                                    |                                     |                                 |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------|-------------------------------------|---------------------------------|
| Model No.                                                                                                             | Location                                                    | Dielectric Voltage<br>Withstand Test<br>Voltage, V | Dielectric<br>Breakdown,<br>Y or N? | Resistance<br>Measured,<br>Ohms |
| --                                                                                                                    | Insulation between positive terminal and accessible parts   | --                                                 | --                                  | --                              |
| --                                                                                                                    | Insulation between negative terminal and accessible parts   | --                                                 | --                                  | --                              |
| --                                                                                                                    | Insulation between charging circuit and accessible parts    | --                                                 | --                                  | --                              |
| --                                                                                                                    | Insulation between discharging circuit and accessible parts | --                                                 | --                                  | --                              |

☒ Temperatures on windings ~~did~~ **did not** exceed the values noted in Table 32.1 for the class of insulation.

☒ There ~~was~~ **was no** sign of ignition of the tissue or cheesecloth at the conclusion of the test.

☐ There ~~was~~ **was no** insulation breakdown during the Dielectric Voltage Withstand Test.

☐ The isolation resistance ~~was~~ **was not** below the 50,000 ohms.

## RUNNING OVERLOAD TEST

## Section 32.6

## METHOD

The motor is to be tested while in the eBike and temperatures on windings are to be monitored. As an alternative, the motor can be tested outside the eBike.

The motor is first operated under maximum normal load conditions. The load is then increased so that the current is increased in appropriate gradual steps with the motor supply voltage being maintained at its original value. When steady state temperature conditions are established the load is again increased. The load is thus progressively increased in appropriate steps until either the overload protection device operates or the motor winding becomes an open circuit.

The motor winding temperatures are determined during each steady period and the maximum temperature recorded shall not exceed the value in Table 32.2.

Table 32.2 – Motor winding temperature limits during overload

| Thermal Class              | Class A (105) | Class E (120) | Class B (130) | Class F (155) |
|----------------------------|---------------|---------------|---------------|---------------|
| Temperature Limit, °C (°F) | 140 (284)     | 155 (311)     | 165 (329)     | 190 (374)     |

If the design or size of the motor prevents the measuring of temperature windings, the test may be conducted with the motor removed from the eBike and instead of monitoring temperatures, the motor is to be supported on a surface covered with a single layer of tissue paper with the motor is covered with a single layer of cheesecloth.

If the motor contains a hazardous voltage circuit, the motor shall be subjected to a Dielectric Voltage Withstand Test, or Isolation Resistance Test, (without humidity conditioning).

If monitoring temperatures on windings during the overload test, the temperatures on the windings shall not exceed the values noted in Table 32.2. If not monitoring temperatures on windings during the test, there shall be no sign of ignition of the tissue or cheesecloth at the conclusion of the test.

## RUNNING OVERLOAD TEST (CONT'D):

## Section 32.6

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P1   |
| Lab Ambient, °C   | 23.5 |
| Lab Humidity, %RH | 47   |

|                                        |                |
|----------------------------------------|----------------|
| Model No.                              | AM-ZNH-02-26SR |
| Insulation Class Temperature Limit, °C | 180            |

| Test:<br>In Device or on Bench | Location of<br>Thermocouples     | Maximum Temperature on<br>Windings, °C | Ignition of<br>combustibles?<br>Y or N |
|--------------------------------|----------------------------------|----------------------------------------|----------------------------------------|
| On Bench                       | 10.Motor winding 1               | 70.3                                   | N                                      |
|                                | 11.Motor winding 2               | 125.2                                  | N                                      |
|                                | 12.Motor winding 3               | 127.3                                  | N                                      |
|                                | 13.PCB near the<br>motor winding | 127.1                                  | N                                      |
|                                | 14.Power wire of the<br>motor    | 100.7                                  | N                                      |

| Insulation Check <input checked="" type="checkbox"/> Dielectric Strength Test <input type="checkbox"/> Isolation Resistance Test |                                                                |                                                    |                                     |                                 |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------|-------------------------------------|---------------------------------|
| Model No.                                                                                                                        | Location                                                       | Dielectric Voltage<br>Withstand Test<br>Voltage, V | Dielectric<br>Breakdown,<br>Y or N? | Resistance<br>Measured,<br>Ohms |
| --                                                                                                                               | Insulation between positive terminal and<br>accessible parts   | --                                                 | --                                  | --                              |
| --                                                                                                                               | Insulation between negative terminal and<br>accessible parts   | --                                                 | --                                  | --                              |
| --                                                                                                                               | Insulation between charging circuit and<br>accessible parts    | --                                                 | --                                  | --                              |
| --                                                                                                                               | Insulation between discharging circuit and<br>accessible parts | --                                                 | --                                  | --                              |

☒ Temperatures on windings ~~did~~ **did not** exceed the values noted in Table 39.1 for the class of insulation.

☒ There ~~was~~ **was no** sign of ignition of the tissue or cheesecloth at the conclusion of the test.

☐ There ~~was~~ **was no** insulation breakdown during the Dielectric Voltage Withstand Test.

☐ The isolation resistance ~~was~~ **was not** below the 50,000 ohms.

## IMPACT TEST

## Section 33

## METHOD

The sample is to be subjected to an impact of 5 foot-pounds (6.8 J) on any surface that is exposed to a blow during normal use. This impact is to be produced by dropping a steel sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 pounds (535 g), from a height of 51 inches (1.29 m) to produce the 5 foot-pound impact. For surfaces other than the top, the steel sphere is to be suspended by a cord and swung as a pendulum, dropping through a vertical distance of 51 inches to strike the surface.

The impact test is conducted with or without any attachment specified by the manufacturer so as to result in the most severe test.

When the part under test is made of polymeric material, the impact test is to be first conducted on a representative unit or units in the as-received condition. The test is then to be repeated on a different unit or units that have been cooled to room temperature after being conditioned for 7 hours in an air oven operating at specified temperature. While being conditioned, a part is to be supported in the same manner in which it is supported on the unit.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 24.0 |
| Lab Humidity, %RH | 43   |

|                              |                             |
|------------------------------|-----------------------------|
| Part                         | Battery and near controller |
| Material                     | Plastic and Metal           |
| Conditioning Temperature, °C | 24.0                        |
| Observation                  | --                          |

**[X]** The sample ~~[did]~~ **[did not]** show signs of cracking or other deleterious effects from the oven conditioning.

**[X]** The sample ~~[did]~~ **[did not]** distort so as to result in a risk of injury to persons.

The sample **[withstood]** ~~[did not withstand]~~ the impact without making any uninsulated live part or internal wiring accessible to contact by the articulated accessibility probe.

## MOLD STRESS TEST

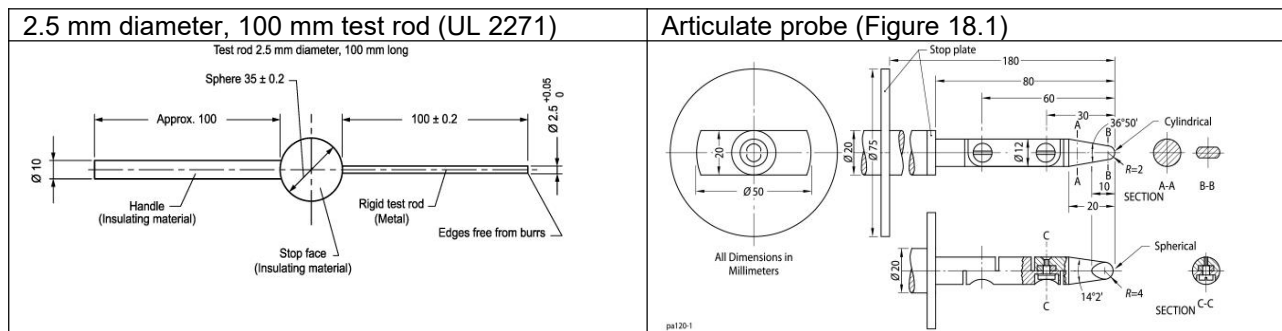
## Section 34

## METHOD

A sample of the enclosure was placed in a full-draft circulating-air oven maintained at a uniform temperature of 70°C (158°F) or 10°C (18°F) higher than the maximum temperature observed on the part during the Temperature Test, Section 28, whichever is higher. The sample remained in the oven for 7 h.

To inhibit hazards from overheating energized cells, units shall be fully discharged prior to conditioning.

After careful removal from the oven and return to room temperature, the sample was examined for evidence of mechanical damage, such as cracking or warping of the enclosure or openings created that would allow access to hazardous parts using the 2.5 mm diameter, 100 mm long test rod probe and articulate probe.



A sample with hazardous voltage circuits was subjected to a dielectric voltage withstand test or an isolation resistance test (without humidity conditioning).

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 23.7 |
| Lab Humidity, %RH | 45   |

|                                                                               |    |
|-------------------------------------------------------------------------------|----|
| Test Chamber Ambient, °C                                                      | 70 |
| <input type="checkbox"/> Isolation resistance limit, $\Omega$ / $\Omega$ /Vdc | -- |
| <input type="checkbox"/> Dielectric voltage test value, V                     | -- |

After careful removal from the oven and return to room temperature, the sample **[did]** **[did not]** show evidence of mechanical damage, such as cracking or warping of the enclosure or openings created that would allow access to cells and protection circuits with the test probes.

☐ There **[was]** **[was no]** evidence of dielectric breakdown.

☐ The insulation resistance **[was]** **[was no]** greater than or equal to 50,000  $\Omega$ .

## FLEXING TEST

## Section 35

## METHOD

Wiring that is subjected to movement at times other than installation and servicing is to be tested by cycling the moving part through the maximum travel intended for the construction. The duration of the test is to be 500 cycles.

After wiring has been subjected to flexing, the unit is subjected to the Dielectric Voltage-Withstand Test and the wiring is to be examined for damage to determine where any conductors are broken or where individual strands have penetrated the insulation.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 24.1 |
| Lab Humidity, %RH | 39   |

~~[ ] There **[was]** **[was no]** evidence of dielectric breakdown.~~

~~[ ] There **[was]** **[was no]** damage to the wiring where any conductors are broken or where individual strands have penetrated the insulation.~~

## VIBRATION TEST - COMPLETE DEVICE

## Section 38.1

## METHOD

A sample of eBike was subjected to this test.

The sample was mounted to a test fixture. The sample was subjected to a vibration for one hour at a frequency of 10 to 55 Hz and back to 10 Hz, with a linear sweep time of two minutes for the sweep cycle. The amplitude was 1.0 mm, +0.1 mm/-0 mm p-p displacement limit in a vertical plane.

After this test, the representative unit shall be subjected to a minimum of one charge/discharge cycle at the manufacturer's maximum specified values.

The test was followed by a 1-h observation time prior to conclude the test and the temperatures on surface of at least one cell/module within the DUT are to be monitored during the test for safety and information purposes.

☐ After this test, the sample is subject to a ☐ dielectric or ☐ isolation resistance test.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 24.0 |
| Lab Humidity, %RH | 53   |

|                       |       |
|-----------------------|-------|
| Operating Voltage (V) | 54.13 |
|-----------------------|-------|

☐ Dielectric Strength Test

| Location of insulation under test                           | Test Potential [ Vdc][ Vac] | Breakdown? Y or N |
|-------------------------------------------------------------|-----------------------------|-------------------|
| Insulation between positive terminal and accessible parts   | --                          | --                |
| Insulation between negative terminal and accessible parts   | --                          | --                |
| Insulation between charging circuit and accessible parts    | --                          | --                |
| Insulation between discharging circuit and accessible parts | --                          | --                |

☐ Isolation Resistance Test

| Location of Insulation Under Test      | Measured insulation resistance, Ohms |
|----------------------------------------|--------------------------------------|
| Positive Terminal and Accessible Parts | --                                   |
| Negative terminal and accessible parts | --                                   |
| Charging circuit and accessible parts  | --                                   |

☒ The sample ~~did~~ [did not] emit flame or molten metal or result in a risk of fire, electric shock, or injury to persons when subjected to the test.

☐ There ~~was~~ [was no] evidence of dielectric breakdown between the locations tested.

☐ Insulation resistance ~~was~~ [was not] at least 50,000  $\Omega$  in the as received condition.

## START UP ASSISTANCE MODE TEST

## Section 40

## METHOD

The representative eBike or EPAC was provided with a fully charged battery for this test. The test can be performed on a test track or on a test bench that keeps the assisted wheel free of the ground during the test.

Motor current was monitored throughout the test. Prior to any start of pedaling (stand by condition), the motor current was measured and recorded. This is considered the no-load current point. During the test, the current to the motor will increase due to motor assist. The test was terminated when the motor returns to this no-load current point.

The unit is to be operated for 5 minutes at a speed equal to 80 percent of its marked maximum assistance speed and then the representative eBike or EPAC is stopped. The startup assistance mode is activated and run for 1 minute. At the end of the 1 minute, the maximum speed is recorded.

At the end of the 1 minute duration, the activation control is released and the motor current is observed. When the motor current returns to the no-load current point, the test is ended.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 24.1 |
| Lab Humidity, %RH | 48   |

Performed on ☐ Test Track ☒ Test Bench

|                                       |       |
|---------------------------------------|-------|
| Marked Maximum Assistance Speed, km/h | 32    |
| Wind Speed, m/s                       | 0     |
| No-load Current Point, A              | 0.163 |
| Start-up assistance speed, km/h       | 3.243 |

When operated under assistance mode the maximum speed ~~did~~**[did not]** exceed 6km/h (~3.7 mph).

## Reverse Pedaling Test

## Section 41.2

## METHOD

The sample is provided with a fully charged battery for this test. The test can be performed on a test track or on a test bench that keeps the assisted wheel free of the ground during the test.

Motor current is monitored throughout the test. Prior to any start of pedaling (stand by condition), the motor current is measured and recorded. This is considered the no-load current point. During the test, the current to the motor will increase due to motor assist. The test is terminated when the motor returns to this No-load current point.

The pedals are operated in reverse and the motor current value is observed. The motor current value is recorded during this operation and shall not exceed the non-assist current value.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 23.4 |
| Lab Humidity, %RH | 48   |

Performed on ☐ Test Track ☒ Test Bench

|                                    |       |
|------------------------------------|-------|
| Wind Speed, m/s                    | 0     |
| No-load Current Point, A           | 0.171 |
| Current during reverse pedaling, A | 0.170 |

When the pedals were operated in reverse there ~~[was]~~~~[was no]~~ power assist delivered to the driving wheel.

## Pedal Cessation Test for EPACs

## Section 41.3

## METHOD

The sample is provided with a fully charged battery for this test. The test can be performed on a test track or on a test bench that keeps the assisted wheel free of the ground during the test.

Motor current is monitored throughout the test. Prior to any start of pedaling (stand by condition), the motor current is measured and recorded. This is considered the no-load current point. During the test, the current to the motor will increase due to motor assist. The test is terminated when the motor returns to this no-load current point.

The sample is operated at 90 percent of the marked maximum assistance speed or cut off speed and then pedaling is ceased or reversed. The distance traveled is measured from the time pedaling ceases or reverses to the time the motor current is at or below the no-load current point. No braking shall occur during this test.

If the EPAC braking devices (e.g. levers, back pedal) are equipped with cut-off switches, the motor current is measured at 5 m of travel distance. Otherwise, the motor current is measured at 2 m of travel distance.

The distance traveled can be determined in the test bench by calculation using the number of rotations of a given wheel size.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 22.4 |
| Lab Humidity, %RH | 50   |

Performed on ☐ Test Track ☒ Test Bench

EPAC braking devices ~~☐ are ☒ are not~~ equipped with cut-off switches.

|                                                                                               |       |
|-----------------------------------------------------------------------------------------------|-------|
| Marked Maximum Assistance Speed, km/h                                                         | 32    |
| Wheel size (perimeter), m                                                                     | --    |
| <input type="checkbox"/> Travel Distance Per revolution, m                                    | --    |
| Wind Speed, m/s                                                                               | 0     |
| No-load Current Point, A                                                                      | 0.170 |
| Duration from cessation of pedaling to motor current at or below the no-load current point, s | 0.173 |
| Distance traveled, m                                                                          | 1.39  |

☐ After cessation of pedaling forward, the motor current **[did]** ~~**[did not]**~~ drop to no-load current point within 2 m of travel distance.

☒ After cessation of pedaling forward, the motor current **[did]** ~~**[did not]**~~ drop to no-load current point within 5 m of travel distance.

## Cutoff When Braking Test

## Section 41.4

## METHOD

The sample is provided with a fully charged battery for this test. The test can be performed on a test track or on a test bench that keeps the assisted wheel free of the ground during the test.

Motor current is to be monitored throughout the test. Prior to any start of pedaling (stand by condition), the motor current is measured and recorded. This is considered the no-load current point. During the test, the current to the motor will increase due to motor assist. The test is terminated when the motor returns to this no-load current point.

The sample is operated at any convenient speed for this test. While pedaling, the brake device is actuated and the motor current shall be interrupted and begin to decrease. This test is repeated for each brake device that is provided with cutoff functionality, one brake device for each test.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 22.5 |
| Lab Humidity, %RH | 43.1 |

Performed on ☒ Test Track ☐ Test Bench

|                                  |       |
|----------------------------------|-------|
| Wind Speed, m/s                  | 0     |
| No-load Current Point, A         | 0.173 |
| Current During Braking (Left), A | 0.170 |

|                                   |       |
|-----------------------------------|-------|
| Wind Speed, m/s                   | 0     |
| No-load Current Point, A          | 0.173 |
| Current During Braking (Right), A | 0.169 |

Performed on ☒ Test Track ☐ Test Bench

Throttle assistance mode:

|                                  |       |
|----------------------------------|-------|
| Wind Speed, m/s                  | 0     |
| No-load Current Point, A         | 0.171 |
| Current During Braking (Left), A | 0.170 |

|                                   |       |
|-----------------------------------|-------|
| Wind Speed, m/s                   | 0     |
| No-load Current Point, A          | 0.172 |
| Current During Braking (Right), A | 0.169 |

When actuating the brake device, there ☐ was ☒ power assist delivered to the driving wheel.

## Cutoff at Maximum Speed Test

## Section 41.5

## METHOD

The sample is provided with a fully charged battery for this test. The test can be performed on a test track or on a test bench that keeps the assisted wheel free of the ground during the test.

Motor current is to be monitored throughout the test. Prior to any start of pedaling (stand by condition), the motor current is measured and recorded. This is considered the no-load current point. During the test, the current to the motor will increase due to motor assist. The test is terminated when the motor returns to this no-load current point.

The sample is to be operated for 5 minutes at a speed no less than 80 percent of its marked maximum assistance speed. After this duration, the speed is increased to the maximum speed the motor will allow but not more than 125 percent of the marked maximum assistance speed. The motor current shall be reduced to the no-load current point when, or before, the maximum speed of the sample reaches the marked maximum assistance speed.

## RESULTS

|                   |      |
|-------------------|------|
| Sample No:        | P2   |
| Lab Ambient, °C   | 23.9 |
| Lab Humidity, %RH | 53   |

Performed on ☐ Test Track ☒ Test Bench

Pedal assistance mode:

|                                                            |       |
|------------------------------------------------------------|-------|
| Marked Maximum Assistance Speed, km/h                      | 32    |
| Wind Speed, m/s                                            | 0     |
| No-load Current Point, A                                   | 0.172 |
| <input type="checkbox"/> Travel Distance Per revolution, m | --    |
| <input type="checkbox"/> Revolutions Per Second, Hz        | --    |
| Maximum assistance speed, km/h                             | 31.96 |

Throttle assistance mode:

|                                                            |       |
|------------------------------------------------------------|-------|
| Marked Maximum Assistance Speed, km/h                      | 32    |
| Wind Speed, m/s                                            | 0     |
| No-load Current Point, A                                   | 0.170 |
| <input type="checkbox"/> Travel Distance Per revolution, m | --    |
| <input type="checkbox"/> Revolutions Per Second, Hz        | --    |
| Maximum assistance speed, km/h                             | 31.98 |

The maximum speed where the motor provided assistance at ☐ was ☒ was not more than 25% from the marked maximum assistance speed.



**View- 1**



**View- 2**



**View- 3**



**view- 4**



**view- 5**



**view- 6**



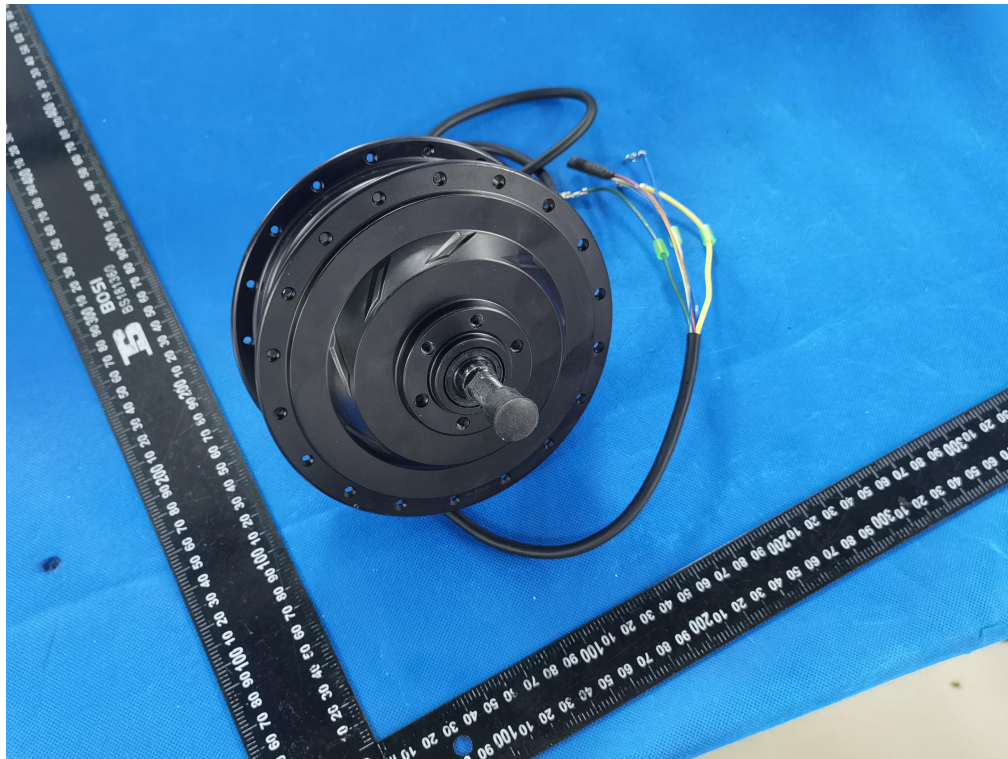
**view-7**



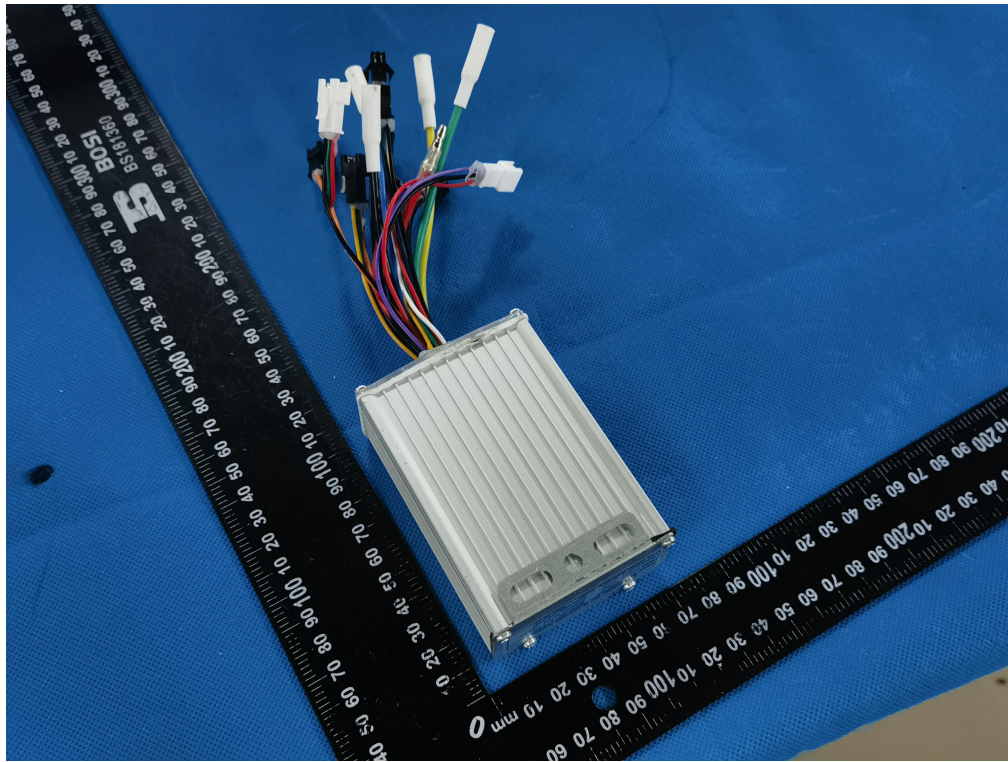
**view-8**



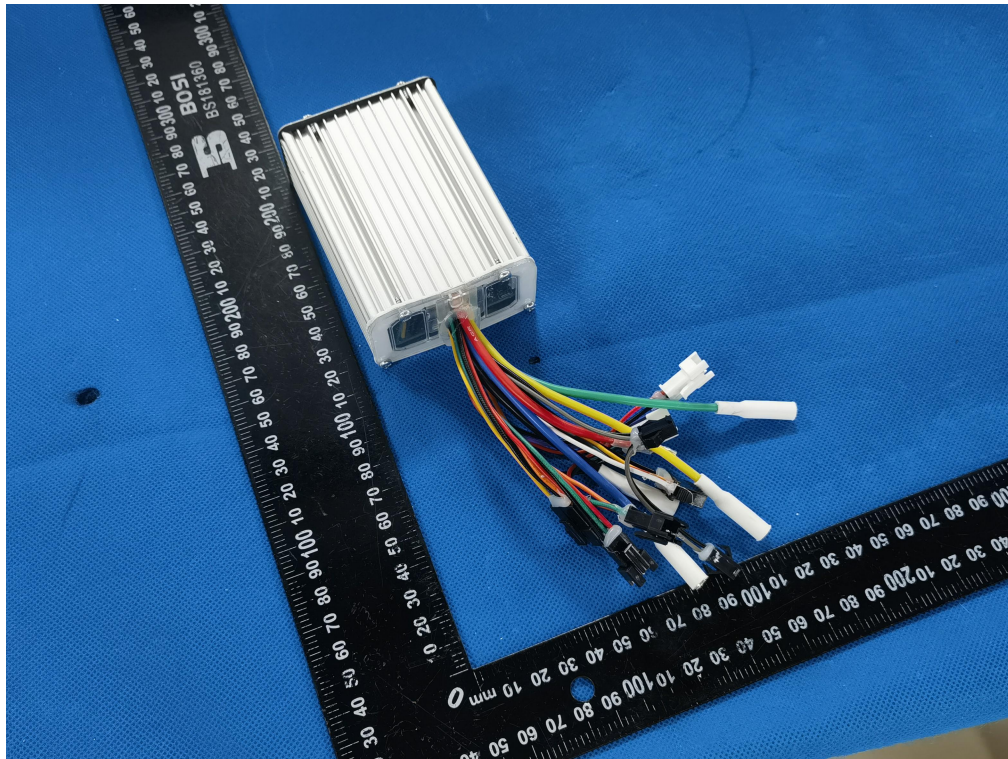
**view-9**



**view-10**



**view-11**



**view-12**

--- End of Report ---