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Smart Power Trainer

(征求意见稿)

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Foreword

This document was drafted in accordance with the rules of the GB/T 1.1-2020 *Directives for Standardization - Part 1: Rules for the Structure and Drafting of Standardizing Documents*.

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Drafting organizations:

Main drafters:

Smart Power Trainer

1 Scope

This standard specifies the service conditions, general requirements, requirements, test methods, marking, packaging,transportation and storage of smart power trainer products (hereinafter referred to as the trainer).

This standard is applicable to direct-drive and indirect-drive trainer products.

2 Normative References

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 8170 Rules of rounding off for numerical values & expression and judgement of limiting values

GB 17498.1 Stationary training equipment - Part 1: General safety requirements and test methods

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Power Trainer

Any device having riding training function used in conjunction with a bicycle to measure user output power through the system.

3.2Smart Power Trainer

A power trainer (3.1) that controls resistance precisely and outputs its corresponding power through the control system.

3.3 Direct-drive Smart Power Trainer

A smart power trainer (3.2) that is installed on a bicycle with the rear wheel disassembled and is directly driven by manual bicycle.

3.4 Indirect-Drive Smart Power Trainer

A smart power trainer (3.2) that is installed on a complete assembly bicycle and is driven by the friction resistance between tire and device.

3.5 Working Mechanism

3.5.1 Electromagnetic Mode

The mode in which the external power supply is connected to the trainer, and the electromagnetic coil generates electromagnetic field; through the rotation of the damping wheel, the trainer generates the eddy-making resistance in the electromagnetic field of the electromagnetic coil.

3.5.2 Permanent Magnet Mode

The mode in which the trainer generates the eddy-making resistance in the magnetic field of the permanent magnet through the rotation of the damping wheel.

3.5.3 Self-generating Mode

The mode that only relies on human riding, driving the motor of the trainer to generate electricity and electromagnetic resistance.

3.6 Operating Mode

3.6.1 Resistance Level Mode

The mode in which users can set the expected resistance level so that the smart power trainer (3.2) maintains a certain resistance during riding.

3.6.2Slope Simulation Mode

The mode in which users can set the expected slope so that the smart power trainer (3.2) can calculates and outputs the resistance according to the set slope and instant speed, and stimulates the grade resistance experienced by the users during riding.

3.6.3 Target Power Mode

The mode in which users can set the expected power so that the smart power trainer (3.2) can calculates and outputs the resistance according to the set power and instant speed, and stimulates the resistance experienced by the users during riding at a fixed power.

4 Service Conditions

4.1 The electromagnetic trainer is connected to AC power through an adapter and can operate normally in the supply voltage range of 100 V ±10 % or 240 V ±10 %.

4.2 The ambient temperature of the trainer is (0～35)℃.

4.3 The ambient humidity of the trainer is (20～80)% RH.

4.4 Compatible specification of the rear wheel: 26～29 in, MTB/700C RD; Compatible size of rear hub of rear wheel set: 130/135 mm quick release, 12 mm × 142 mm, 12 mm × 148 mm thru-axle.

5 General Requirements

5.1 According to the driving mode, the trainer can be divided into direct drive type and indirect drive type; according to the working mechanism, the trainer can be divided into electromagnetic mode, permanent magnet mode and self-generating mode.

5.2 The trainer shall have resistance level mode; and it can have slope simulation mode and target power mode, etc.
5.3 The trainer shall have power data output; it shall be able to output data such as torque, speed, cadence and other data.
5.4 The trainer shall support wired or wireless protocols.

6 Requirements

6.1 Performance Indicators

6.1.1 Power Accuracy

Under the specified working conditions, the power accuracy of the trainer shall meet the requirements in Table 2.

Table 2

Product Grade	A+	A	B	C
Power Accuracy	≤ 1.5%	＞ 1.5%～3 %	＞ 3%～5 %	＞ 5 %～10 %

6.1.2 Minimum Controllable Power

Under the specified working conditions, the minimum power measured and controlled by the trainer shall not be greater than the nominal value.

6.1.3 Maximum Torque

Under the specified working conditions, the maximum torque of the trainer shall not be less than 98% of the nominal value.

6.1.4 Maximum Power

Under the specified working conditions, the maximum power of the trainer shall not be less than 98% of the nominal value.

6.1.5 Response Time

Under the specified working conditions, the time from the issuance of the trigger instruction to the realization of the target power on the trainer shall not be more than 2 s.

6.1.6 Energy Efficiency Ratio

Under the specified working conditions, the ratio of the user output power to the electric power consumed by the electromagnetic trainer shall be greater than its nominal value.

6.2 Electrical Safety

6.2.1 Electrical Strength

The electromagnetic trainer shall be tested according to the specified method. During the test, no breakdown or flashover between the power circuit and the exposed conductive parts.

6.2.2 Heat Emission

The maximum external surface temperature of the external accessible and fixed parts of the trainer shall not be higher than 65℃.

The flywheel components shall be labeled with high temperature warning signs shown in figure 1.

Figure 1 Warning sign

6.3 Machinery Safety

6.3.1 External Structure

6.3.1.1 Edges

All edges and sharp corners on the surface of each bearing body of the trainer shall have a radius greater than 2.5 mm.

All other edges of accessories and components that are easily accessible or third party shall be smooth or protected.

6.3.1.2 Pipe End

The ends of easily accessible pipes shall be sealed with accessories or pipe plugs of device.

6.3.2 Stability

The trainer is tested according to the specified method without tilting.

6.4 Environment Adaptation

6.4.1 Noise

Under the specified working conditions, the noise of direct-drive trainer shall be less than 55 dB(A); the noise of indirect-drive trainer shall be less than 60 dB(A).

6.4.2 Resistance to Moisture

After the test is completed according to the specified method, the trainer shall not lose its normal use function, and the main appearance surface shall be free of obvious corrosion. The electrical strength of the electromagnetic trainer shall meet the requirements of 6.2.1.

6.5 Operating Manual

The trainer shall be attached with a manual, which can also be obtained by users through the client, network, official account and other ways. In addition to the operation instructions, the contents of the manual shall also include the following contents related to safety:

The following precautions shall be included in the operation manual of the trainer:

a) Install the trainer and fix the bicycle to the trainer as specified by the manufacturer;

b) Choose a smooth ground without obstacles and dangerous goods around, and ensure enough space for riding;
c) Make sure the power plug is firmly inserted (if applicable);
d) Keep the product away from water, fire and other obstacles during use;
e) Do not touch the moving parts of the trainer during use;
f) After long-time use, do not touch the inertia wheel of the trainer, the temperature of this part is too high, easy to scald;
g) After use, the bicycle shall be disassembled after the flywheel stops.

The following technical contents shall also be indicated in the manual:

- Product trademark, name, model;
- Protection category against electric shock;
- Rated voltage, V;
- Power accuracy, %;
- Maximum power, W;
- Maximum torque, N·m;
- Minimum controllable power, W;
- Response time, ms;
- Energy efficiency ratio;
- Weight, kg;
- Name of manufacturer;
- Date and number of manufacture.

7 Test Methods

7.1 Test Conditions

7.1.1 Test Environment

Unless otherwise specified, the test environment shall meet the following conditions:

a) Ambient temperature: (20~30)℃;
b) Relative humidity: (40~70)% RH.

7.1.2 Pre-test Preparation

The test sample shall be preheated before the following tests. Set the trainer at the speed of 100 r/min with the power of 100 W, and run the operation for 2 hours.

If the following tests are continuous, there is no need for multiple preheating. If the test is interrupted for more than 1 h, it needs to preheat again.

7.1.3 Speed Setting Value

The speed setting value of the performance test shall be selected according to the requirements of Table 3.

Table 3

Test Item	Speed Setting Value (r/min)	
	Direct-drive Trainer	Indirect-drive Trainer
Power Accuracy	200±1	$(200\times340^{a}/R^{a})$ ±10
Minimum Controllable Power	100±1	(100×340/R) ±10
Maximum Torque	470±1	(470×340/R) ±10
Maximum Power	470±1	(470×340/R) ±10
Response Time	200±1	(200×340/R) ±10
Energy Efficiency Ratio	200±1	(200×340/R) ±10

Spin-down Time	470±1	(470×340/R) ±10
a: 340 is the radius of 700C wheel set; b: R is the radius of friction roller, in mm. Note: After the speed setting value of the indirect-drive trainer is calculated, it shall be rounded to the single digit according to the rounding rule of 3.2 in GB/T 8170.		

7.1.4 Test Device

The test device for the performance test shall meet the provisions of Appendix A.

7.2 Performance Test

7.2.1 Determination of Power Accuracy

Install the trainer on the test device. After the preheating conditions are met, set the output speed of the test device according to Table 3.

Set the trainer resistance level to 20% and run stably on the measuring device for 2 min, and read the average power values displayed on the trainer and the test device, respectively.

Calculate the power accuracy S according to Formula (1):

$$S = \left(\frac{P_1 - P_0}{P_0}\right) \times 100\% \qquad (1)$$

Where:

P_1: the average power output by the trainer, in watt (W);

P_0: the average power of the trainer measured by the test device, in watt (W).

Set the resistance level of the trainer to 50% and 80% respectively, and calculate the power accuracy of the trainer according to the above method; take the maximum absolute value.

Further, set the output speed of the test device according to Table 3, and set the power as 150 W. After 2 hours of operation, set the resistance levels of the trainer at 20%, 50% and 80% respectively, and calculate the power accuracy according to Formula (1); take the maximum absolute value.

7.2.2 Minimum Controllable Power

Install the trainer on the test device. After the preheating conditions are met, set the output speed of the test device according to Table 3.

Define the operating target power as the nominal minimum controllable power of the product (e.g., 100 W required by the product). Run the trainer stably on the measuring device for 20 min, read the average power displayed on the trainer, and check whether it is not greater than the nominal value.

7.2.3 Maximum Torque

Install the trainer on the test device. After the preheating conditions are met, set the output speed of the test device according to Table 3.

In resistance level mode, set the resistance to 100%. Run the trainer stably on the measuring device for 1 min, and measure the maximum average torque value for consecutive 5 s within 1 min. Then, compare it with the nominal value.

7.2.4 Maximum Power

Install the trainer on the test device. After the preheating conditions are met, set the output speed of the test device according to Table 3.

In resistance level mode, set the resistance to 100%. Run the trainer stably on the measuring device for 1 min, and measure the maximum average power value for consecutive 5 s within 1 min. Then, compare it with the nominal value.

7.2.5 Response Time

Install the trainer on the test device. After the preheating conditions are met, set the output speed of the test device according to Table 3.

Set the operation target power as 200 W, and run the trainer stably on the measuring device for no less than 10 min; Through the upper computer to the increase the target power value of the trainer to 300 W; meanwhile, start the timer and record the time interval of the power reaching to 300 W (the error range meets the requirements of nominal power accuracy). Then, compare it with the nominal value.

7.2.6 Energy Efficiency Ratio

Install the trainer on the test device, and set the output speed value of the test device according to Table 3.

Set the target power of the trainer as 200 W, run for 20 min, and calculate the average power output to the trainer by the motor and the average input power of the trainer.

7.3 Electrical Safety

7.3.1 Electrical Strength

Turn the trainer on and connect the adapter to it. Connect the positive pole of the withstanding voltage tester to the input terminal of the adapter, and the negative pole of the withstanding voltage tester to the metal exposed part of the trainer (e.g. support frame).

The test voltage is 3,000 V, and the trip current is set as 10 mA, last for 1 min,and observe whether the requirements is met.

7.3.2 Heat Emission

Visually inspect the warning signs.

Place the trainer horizontally, and make sure that the flywheel is perpendicular to the highest end of the ground; arrange 2 contacts on its accessible outer surface.

Install the trainer on the test device, set the speed of the flywheel of the trainer platform base as 200 r/min and the target power as 200 W through the test system, train for three periods, each period lasts for 20 mins, rest for 5min after each period. At the end of the third period,measure the surface temperature.

7.4 Machinery Safety

7.4.1 External Structure

Check with visual inspection, dimension, and touching, etc.

7.4.2 Stability

The test shall be completed by a reliable tester of (100±5) kg, and all tests shall be carried out under the most arduous service conditions (maximum range of movement and maximum load):

- Incline 10 °in the direction of power;
- Incline 5 °in all other directions.

7.5 Environment Adaptation

7.5.1 Noise

Method 1:

Install the trainer on the test device, set the speed of the flywheel of the trainer platform base as 200 r/min and the target power as 200 W through the test system, and measure the noise value with a noise power meter at the central axial and radial directions 1 m away from the left and right sides of the flywheel of the trainer platform base.

If the difference between the background noise after test and the measured noise of the product is less than 6 dB(A), the test is regarded as invalid and shall be re-test after the background noise is reduced.

Method 2:

Recommended tire specification: 700c ×25c;

Direct-drive trainer: install the bicycle with the rear wheel disassembled on the trainer. Stop pedaling after riding to a speed over 200 r/min by test personnel, measure the noise value with a noise power meter at the central axial and radial directions 1 m away from the left and right sides of the flywheel of the trainer platform base.

Indirect-drive trainer: install the bicycle and trainer. Stop pedaling after riding to a speed over 200 r/min by test personnel, measure the noise value with a handheld noise power meter at the central axial and radial directions 1 m away from the left and right sides of the flywheel of the trainer platform base.

If the difference between the background noise after test and the measured noise of the product is less than 6 dB(A), the test is regarded as invalid and shall be re-test after the background noise is reduced.

7.5.2 Moisture Resistance

Place the trainer in an environment with a temperature of (40±2)℃ and a humidity of (90-96)% , after 48 hours, check the appearance of the trainer.

The electromagnetic trainer shall be tested for electrical strength within 0.5 h according to the method described in 7.3.1, and the test voltage shall be 85% of the specified value.

7.6 Operating Manual

Check with visual inspection

8 Marking

Each trainer shall have a durable nameplate at an obvious position, and the nameplate shall clearly indicate the following contents:

a) Product trademark, name, model;
b) Protection category against electric shock;

c) Rated voltage, V;
d) Power accuracy, %;
e) Weight, kg;
f) Name of manufacturer;
g) Date and number of manufacture.

9 Packaging, Transportation and Storage

9.1 Packaging

9.1.1 Ex-factory products shall be attached with product certificates, packing lists and other materials. And shall be moisture-proof sealed, and placed in an obvious position in the box.

9.1.2 The graphic marks for packaging, storage and transportation shall comply with GB/T 191.

9.1.3 Protective materials with supporting and buffering functions shall be used when packaging the trainer. The design of protective materials shall ensure that the flywheel is well protected.

9.2 Transportation

The packaging box with trainer shall be loaded, unloaded and transported according to the graphic marks for packaging and transportation. During handling, two or more persons shall be assigned to carry it, and it shall be handled lightly and shall not be thrown.

9.3 Storage

The products shall be stored in a ventilated, dry and non-corrosive place to avoid against rain and snow.

Appendix A
(Informative Appendix)
Power Test Device

A.1 Overview

The power test device is a device that uses a motor to simulate the user's riding input power and measures the torque, speed, and power of the trainer in real time through a torque sensor.

The power test device can measure the power accuracy, maximum power, maximum torque, minimum controllable power, spin-down time, response time and other items.

A.2 Composition

The test device consists of hardware, software and test bench frame.

Hardware includes computer host, USB hub, mouse, keyboard, wireless communication device (such as ANT stick/bluetooth).

The test bench frame includes motor (a), torque sensor (b) and test bench frame (c). An example of test bench is shown in Figure A.1.

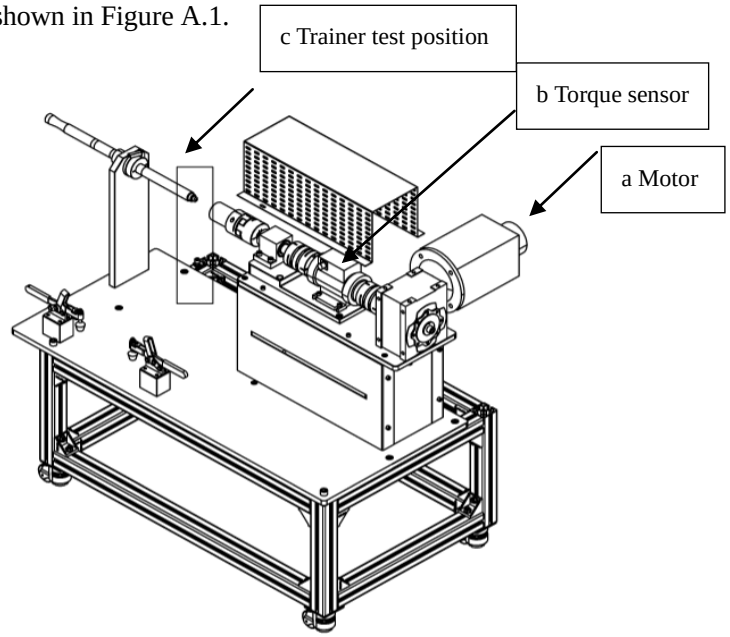

Figure A.1

A.3 Recommendations for Components Selection

Refer to Table A.1 for parameter selection for power test device.

Table A.1

Equipment Name	Index	Parameter
Motor	Power	3kW
	Rotate speed	2000 rpm
	Torque	15N • m
Torque Sensor	Range	0～100 N • m
	Rotate speed	6000 rpm
	Accuracy	0.2%