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Test method of reliability for motorcycles and mopeds

摩托车和轻便摩托车可靠性试验方法

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Table of Contents

Test method of reliability for motorcycles and mopeds

1 Scope

This document specifies the test conditions, test procedure, test data processing and test report for the reliability test of motorcycles and mopeds.

This document applies to the reliability test of motorcycles and mopeds (unless otherwise specified, hereinafter referred to as “motorcycles”).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB 4569, Limit and measurement method of noise emitted by stationary - Motorcycles and mopeds

GB/T 5359.1, Term for motorcycles and mopeds - Part 1: Types of vehicles

GB/T 5373, Measuring method of dimensions and masses parameter for motorcycles and mopeds

GB/T 5378, Methods of road test for motorcycles and mopeds

GB/T 7031, Mechanical vibration - Road surface profiles - Reporting of measured data

GB 7258, Technical specifications for safety of power-driven vehicles operating on roads

GB 14622, Limits and measurement methods for motorcycle pollutant discharge (China stage IV)

GB 15742, Performance requirements and test methods of horn for motor vehicles

GB 15744, The limits and measurement methods of fuel consumption for motorcycles and mopeds

GB 16169, Limit and measurement method of noise emitted by accelerating - Motorcycles and mopeds

GB 18176, Limits and measurement methods for emissions of pollutants from mopeds (CHINA IV)

GB/T 18387, Limits and test method of magnetic and electric field strength from electric vehicles

GB 20073, Performance and measurement method for braking of motorcycles and mopeds

GB 24155, Safety specifications for electric motorcycles and electric mopeds

GB/T 24156, Electric motorcycles and electric mopeds - Power performance - Test methods

GB/T 24157, Test methods of range and indication for the state of charge for electric motorcycles and electric mopeds

GB 34660, Road vehicles - Requirements and test methods of electromagnetic compatibility

JTG B01, Technical standard of highway engineering

QC/T 903, Fault-types for motorcycles and mopeds

3 Terms and definitions

Terms and definitions determined by GB/T 5359.1, and the following ones are applicable to this document.

3.1 Reliability

The ability of motorcycles to ensure specified functions and technical and economic indicators under specified conditions of use and within a specified period of time.

3.2 Customer usage correlation

Reproduce the working load of the target user on the proving ground or on the test bench.

3.3 General reliability test

Reliability test carried out according to certain specifications on general roads.

3.4 Accelerated reliability test

Reliability test – with a certain strengthening factor – that is carried out on the proving ground or on the test bench according to customer usage correlation.

4.2.4 Before the performance test, the vehicle under test shall be run-in and maintained according to the instruction manual or the manufacturer's product technical documents. During the test, the parts and assemblies shall not be adjusted or replaced at will, and detailed driving inspection records shall be made.

4.2.5 If the driving range of electric motorcycles and electric mopeds (hereinafter referred to as "electric motorcycles") is too short (less than 30 km), the battery pack can be replaced for testing, which shall be recorded.

4.3 Test conditions for termination

If any of the following situations is found during the test, the test shall be terminated.

a) Steering, braking and other systems cannot ensure driving safety.

b) The frame or its welds are broken, de-soldered or otherwise damaged, so that the test cannot be continued.

c) The assembly to be assessed in the test is severely damaged and needs to be replaced.

4.4 Test road

4.4.1 The driving road for the reliability test shall generally include:

a) Urban road: main streets of communication in large and medium-sized cities; the unevenness of the road surface shall be above grade C specified in GB/T 7031;

b) Expressway: multi-lane highway – meeting the requirements of JTG B01 – that is exclusively for motor vehicles to drive in different directions and lanes, and where all access and exit are controlled;

c) Ordinary highway: in line with the requirements of the national primary and secondary highway, of wide and straight road surface, and good vision;

d) Mountain road: average slope greater than 4%, unevenness of road surface above grade C specified in GB/T 7031.

4.4.2 The reliability test can be carried out on a closed road in the proving ground, or on a road section with small traffic flow, which is convenient for driving speed and is conducive to the safety of the test. When conditions permit, the road surface for the reliability test can also be used for an accelerated reliability test to shorten the test cycle.

5 Test procedure

5.1 Vehicle parameter measurement and adjustment

5.1.1 Measurement of vehicle dimensions and masses parameter

Carry out measurement of vehicle dimensions and masses parameters in accordance with the methods determined in GB/T 5373.

5.1.2 Key torque measurement and adjustment

According to the requirements of product technical documents provided by the manufacturer, measure and adjust the torque of fasteners in key parts.

5.1.3 Running-in

5.1.3.1 Before running-in, check the indicated value of the speedometer according to the provisions of GB/T 5378, and use it to correct the relevant mileage.

5.1.3.2 The vehicle under test shall run in on a flat road according to the provisions of the product technical documents. The running-in mileage of motorcycles shall not exceed 1 000 km; the running-in mileage of mopeds shall not exceed 250 km. It can also be run-in to the specified mileage according to the requirements of the manufacturer's product technical documents.

5.1.3.3 During the running-in period, the fastening and working conditions of each part of the vehicle shall be checked frequently, and any failure found shall be eliminated in time and included in the failure statistics.

5.2 Vehicle performance test

5.2.1 Inspection before performance test

After running-in, maintain according to product technical documents, and drive no longer than 50 km for inspection, so that the vehicle under test is in good mechanical condition.

5.2.2 Vehicle performance test content

5.2.2.1 The performance test content of the motorcycle with internal combustion engine is as follows:

a) starting performance test, carried out according to GB/T 5378;

b) maximum speed test, carried out according to GB/T 5378;

c) minimum stable speed test, carried out according to GB/T 5378;

d) acceleration performance test, carried out according to GB/T 5378;

e) sliding distance test, carried out according to GB/T 5378;

f) gradeability test, carried out according to GB/T 5378;

g) measurement of noise emitted by stationary, carried out according to GB 4569;

Brake to stop at least twice every 50 km or 1 h.

5.3.1.2.4 Driving on mountain road

When driving on a mountain road, stop and start uphill at least once every 100 km; use the service brake to stop on a slope not less than 7%; put the transmission in neutral; then, use the parking brake to stop (if equipped); then, proceed hill starting as normal.

5.3.1.2.5 Driving at night

The mileage ratio at night shall not be less than 10% of the total mileage of the test. Driving with lights on during the day is allowed instead.

5.3.1.3 Driving specifications

5.3.1.3.1 Reliability test includes routine operation and reliability driving test on various roads.

5.3.1.3.2 Routine operation items and requirements shall be in accordance with the provisions in Appendix A. During the specific test, appropriate adjustments can be made according to different vehicle models and test purposes.

5.3.1.3.3 All kinds of roads shall be composed of loops in proportion as much as possible, and be mixed for driving.

5.3.1.3.4 During the driving test, the vehicle under test shall be inspected, adjusted and maintained in accordance with the product technical conditions or the regulations in the instruction manual. All kinds of failures and replacement of parts (other than those specified in the technical documents or instruction manuals attached to the vehicle) shall be included in the failure statistics. See B.1 of Appendix B for failure classification principles. See B.2 for failure modes and classification.

5.3.2 Accelerated reliability test

5.3.2.1 Test mileage distribution

According to the customer usage correlation (see Appendix C) or the proving ground specification, determine the mileage and working condition distribution of the test vehicle on different types of roads in the proving ground.

5.3.2.2 Driving operation

According to the customer usage correlation, determine the driving operation of different roads in the proving ground, and reproduce the driving conditions of different roads.

5.3.3 Daily operation of the vehicle

According to the vehicle configuration, carry out daily operation inspection in accordance with Appendix D, and make appropriate adjustments according to different vehicle models and test purposes during specific tests. Operate according to the instruction manual of the motorcycle product to ensure the normal operation of the vehicle. For special functions in the configuration, e.g., driving modes (such as sports mode, economic mode or snow mode), it is necessary to perform corresponding operations in the driving test according to the requirements of the product instruction manual.

5.4 Discovery, judgment and handling of failure

5.4.1 Basic principles

Failures are generally judged by senses, and for failures that are not easy to judge, determine by other auxiliary means (such as marking, non-destructive testing).

5.4.2 Failure discovery

Ways to find failures include:

-- Pick-up inspection: check according to 5.3.3 daily operation of the vehicle;

-- Parking inspection: carry out regular parking inspection, mainly checking the looseness, leakage and damage of various parts;

-- Inspection during driving: pay attention to the working condition of the motorcycle, and stop and check if there is any abnormality;

-- Regular maintenance inspection: during maintenance operations, in addition to item-by-item maintenance according to regulations, attention shall also be paid to checking for abnormal phenomena, such as wear, cracks, and deformation of parts and assemblies;

-- Performance testing and vehicle breaking inspections.

5.4.3 Failure judgment

According to the failure classification principles in Appendix B, perform failure classification and failure mode judgment according to the method described in QC/T 903.

5.4.4 Failure handling

5.4.4.1 The vehicle, in case of failure, shall be stopped immediately for inspection. In principle, the failure shall be eliminated in time.

-- Failure mileage: the difference between the odometer reading when the failure is found and the odometer reading during sampling multiplied by the odometer correction coefficient;

-- Failure description: use simple and clear language to describe the failure phenomenon, and write down the specific value for all possible quantitative descriptions. If necessary, draw a schematic diagram or take a photo, and indicate the shape and size of the failure location, etc.;

-- Failure cause analysis: determine the cause of the failure through observation and analysis, as well as size measurement, etc. of the failure phenomenon. The failure causes include vehicle factors and human factors, and vehicle factors can be further divided into design problems and manufacturing problems;

-- Failure consequences: parking, performance degradation, traffic accidents, etc.;

-- Handling measures: specific troubleshooting methods;

-- Failure run-out time: including waiting time, diagnosis time, repair time, debugging time, etc.

5.6.5 Maintenance record

During the test, when performing maintenance, the vehicle information and the maintenance record form shall be filled out (see Table E.4).

5.6.6 Replacement record

If it is necessary to replace parts or update software for the vehicle due to repair, maintenance or other reasons, it shall be noted in the driving record form (see Table D.2).

5.6.7 Dismantling and inspection record

5.6.7.1 During and after the motorcycle test, to check the wear and other abnormal phenomena of the internal structure of each assembly, the main assembly (including body, power transmission system, steering system, brake system, etc.) can be partially or completely dismantled and inspected according to the corresponding regulations, which shall be recorded.

5.6.7.2 The specific item content and requirements are in accordance with the product maintenance manual. If there are special requirements for personnel qualification on dismantling and inspection of some assemblies, professionals shall be arranged for dismantling and inspection, and shall sign on the dismantling and inspection record.

5.6.7.3 The detection method is generally sensory evaluation. Relevant measurements shall be carried out according to actual needs, which may include but not limited to: appearance, wear and deformation of moving parts, etc.

5.6.7.4 The failures found during dismantling and inspection shall be included in the failure statistics, and the time of dismantling and inspection shall be included in the repair time.

6 Test data processing

6.1 Test statistics

After the test, failure statistics and reliability statistics shall be carried out. For related examples, see Appendix E.

6.2 Failure statistics

6.2.1 All failures, for each vehicle, shall be filled in the failure statistics table (see Table E.5) according to the order of the mileage in which the failure is found.

6.2.2 Failures that have not been eliminated through improvement measures shall be counted only once; the failure categories shall be classified according to the most serious situation, and the corresponding mileage is the failure mileage.

6.2.3 Failures of different parts with the same mileage shall be counted separately. Failures of different modes in the same part shall also be counted separately; if several failures of the same mode occur in the same part, only one count shall be made, and the failure category shall be filled according to the most serious one.

6.3 Reliability statistics

6.3.1 Evaluation indicators

According to the calculation needs of the evaluation indicators, count the frequency of various failures, the average first failure mileage, the actual driving mileage, the average speed of the test, the troubleshooting time, the equivalent number of failures and the equivalent rate of failures, etc. separately for each vehicle (see Table E.6).

6.3.2 Evaluation indicator calculation

6.3.2.1 Equivalent number of failures

The equivalent number of failures is calculated according to Formula (1):

$$r_D = \sum_{i=1}^{4} \varepsilon_i r_i \qquad \cdots\cdots (1)$$

Where:

r_D – equivalent number of failures;

Appendix C

(Informative)

Customer usage correlation proving ground road driving reliability test specification design

C.1 Customer usage correlation proving ground road driving reliability test purpose and significance

Applying fatigue damage, friction loss and other theories, through typical customer usage correlation research, formulate a proving ground reliability test plan that represents the working conditions of typical customers of target models with a percentile value above 90, so that in the design and development stage, the driving conditions that are relatively consistent with typical customers can be obtained, and then the design can be optimized to avoid "over-design" and "under-design", to improve the design and development efficiency, shorten the design and development cycle, and reduce the design and development costs.

C.2 Customer usage correlation proving ground road driving reliability test specification design process

C.2.1 According to the customer usage correlation, perform the proving ground road driving reliability test specification design, which shall include the following contents:

a) Determine the target mileage of the model according to the design and development targets;

b) Identify factors affecting vehicle reliability, and obtain user characteristic information such as road types and mileage ratios, loading conditions, and driving operations through user surveys, user vehicle data collection, and other forms;

c) According to the customer usage correlation, collect the real vehicle social road load spectrum data and determine the benchmark load;

d) Perform acquisition of road load spectrum data on the proving ground for the arrangement, combination and optimization of the proving ground's characteristic roads, vehicle speed, loading and driving operations;

e) According to the actual situation of the proving ground, carry out the specification design of the road driving test on the proving ground.

C.2.2 See Figure C.1 for the customer usage correlation proving ground road driving reliability test specification design process. See Table C.1 for an example of the distribution of working conditions for accelerated reliability tests at the proving ground,

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