火花塞质量测试文件 / Spark Plug Quality Test Document

河北勃硕汽车科技有限公司
Hebei Boshuo Automotive Technology Co., Ltd.

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目录 / Table of Contents

1. 文件概述 / Document Overview
2. 适用范围 / Scope of Application
3. 引用标准 / Referenced Standards
4. 术语和定义 / Terms and Definitions
5. 测试设备和仪器 / Test Equipment and Instruments
6. 测试项目和方法 / Test Items and Methods
7. 质量控制要求 / Quality Control Requirements
8. 测试记录和报告 / Test Records and Reports
9. 安全注意事项 / Safety Precautions
10. 附录 / Appendices

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1. 文件概述 / Document Overview

本文件旨在规范河北勃硕汽车科技有限公司火花塞产品的质量测试流程、方法和标准，确保产品符合相关国家和国际标准以及客户要求。通过本文件的实施，将有效提升火花塞产品的可靠性、性能和安全性，为公司赢得市场竞争优势。

This document aims to standardize the quality testing procedures, methods, and standards for spark plug products of Hebei Boshuo Automotive Technology Co., Ltd., ensuring that products comply with relevant national and international standards and customer requirements. The implementation of this document will effectively enhance the reliability, performance, and safety of spark plug products, gaining a competitive advantage for the company in the market.

2. 适用范围 / Scope of Application

本文件适用于河北勃硕汽车科技有限公司生产、销售的所有型号火花塞产品的质量测试与评估。这包括但不限于新产品开发阶段的验证测试、生产过程中的质量控制测试以及市场抽检和客户投诉分析。

This document applies to the quality testing and evaluation of all types of spark plug products manufactured and sold by Hebei Boshuo Automotive Technology Co., Ltd. This includes, but is not limited to, verification tests during new product development, quality control tests during the production process, and market spot checks and customer complaint analysis.

3. 引用标准 / Referenced Standards

本文件在制定过程中参考了以下国际和国家标准，以确保测试的科学性、严谨性和国际通用性。在执行测试时，应遵循最新版本的标准。

This document refers to the following international and national standards during its formulation to ensure the scientific rigor and international applicability of the tests. The latest versions of the standards should be followed when performing tests.

- ISO 11565:2024 - 道路车辆 — 火花塞 — 测试方法和要求 / Road vehicles — Spark-plugs — Test methods and requirements
- GB/T 7825-2006 - 火花塞 / Spark plugs (Chinese National Standard)

- SAE J549 - 火花塞和火花塞测试 / Spark Plugs and Spark Plug Testing (Society of Automotive Engineers Standard)

4. 术语和定义 / Terms and Definitions

为确保本文件内容的准确理解，特对以下关键术语进行定义：

To ensure accurate understanding of this document, the following key terms are defined:

- **火花塞 (Spark Plug):** 一种用于内燃机点火系统的装置，通过产生电火花点燃气缸内的混合气。 / A device used in the ignition system of an internal combustion engine to ignite the air-fuel mixture in the cylinder by generating an electric spark.
- **热值 (Heat Range):** 火花塞散热能力的指标，表示火花塞从燃烧室吸收和散发热量的能力。 / An indicator of the spark plug's ability to dissipate heat, representing its capacity to absorb and dissipate heat from the combustion chamber.
- **间隙 (Gap):** 火花塞中心电极与侧电极之间的距离，对点火性能有重要影响。 / The distance between the center electrode and the ground electrode of a spark plug, which significantly affects ignition performance.
- **绝缘电阻 (Insulation Resistance):** 火花塞绝缘体阻止电流通过的能力，反映其绝缘性能。 / The ability of a spark plug insulator to resist the flow of electric current, reflecting its insulation performance.
- **耐压强度 (Dielectric Strength):** 火花塞在不发生击穿的情况下所能承受的最高电压。 / The maximum voltage a spark plug can withstand without breakdown.

5. 测试设备和仪器 / Test Equipment and Instruments

进行火花塞质量测试需要使用专业的测试设备和精密仪器，以确保测试结果的准确性和可靠性。所有设备应定期校准并维护。

Professional testing equipment and precision instruments are required for spark plug quality testing to ensure the accuracy and reliability of test results. All equipment should be regularly calibrated and maintained.

- **火花塞测试台 (Spark Plug Test Bench):** 用于模拟发动机工作环境，测试火花塞的点火性能、耐压性能和热值。
    - Used to simulate engine operating conditions and test the ignition performance, dielectric strength, and heat range of spark plugs.
- **绝缘电阻测试仪 (Insulation Resistance Tester):** 用于测量火花塞绝缘体的电阻值，评估其绝缘性能。
    - Used to measure the resistance value of the spark plug insulator and evaluate its insulation performance.
- **间隙测量仪 (Gap Gauge):** 用于精确测量火花塞电极间隙。
    - Used to precisely measure the spark plug electrode gap.
- **高压发生器 (High Voltage Generator):** 用于进行火花塞的耐压测试。
    - Used for spark plug dielectric strength testing.
- **光学检测设备 (Optical Inspection Equipment):** 如显微镜或内窥镜，用于检查火花塞电极、绝缘体和壳体的外观缺陷。
    - Such as microscopes or endoscopes, used to inspect the appearance defects of spark plug electrodes, insulators, and shells.
- **万用表 (Multimeter):** 用于测量火花塞的电阻值，包括中心电极和电阻器的电阻。
    - Used to measure the resistance value of spark plugs, including the resistance of the center electrode and resistor.

6. 测试项目和方法 / Test Items and Methods

火花塞的质量测试涵盖多个方面，旨在全面评估其性能和可靠性。以下是主要的测试项目及其方法：

Spark plug quality testing covers multiple aspects, aiming to comprehensively evaluate its performance and reliability. The following are the main test items and methods:

6.1 外观检查 / Visual Inspection

- **目的 / Purpose:** 检查火花塞是否存在物理损伤、制造缺陷或异常磨损。
    - To check for physical damage, manufacturing defects, or abnormal wear on the spark plug.

- **方法 / Method:** 目视检查火花塞的陶瓷绝缘体、金属壳体、电极（中心电极和侧电极）以及密封垫圈。检查是否存在裂纹、烧蚀、腐蚀、变形或污染物。
    - Visually inspect the ceramic insulator, metal shell, electrodes (center and ground electrodes), and gasket of the spark plug. Check for cracks, ablation, corrosion, deformation, or contaminants.

- **标准 / Criteria:** 无明显物理损伤、裂纹、烧蚀、严重腐蚀或变形；电极清洁，无积碳或油污。
    - No obvious physical damage, cracks, ablation, severe corrosion, or deformation; electrodes clean, free of carbon deposits or oil stains.

6.2 电阻测试 / Resistance Test

- **目的 / Purpose:** 测量火花塞内部电阻器的电阻值，确保其在规定范围内，以抑制无线电干扰并保护点火系统。
    - To measure the resistance value of the spark plug's internal resistor, ensuring it is within the specified range to suppress radio interference and protect the ignition system.

- **方法 / Method:** 使用万用表测量火花塞顶部端子与中心电极之间的电阻。对于带电阻的火花塞，通常电阻值在几千欧姆到几十千欧姆之间。
    - Use a multimeter to measure the resistance between the top terminal and the center electrode of the spark plug. For resistor-type spark plugs, the resistance value is typically between several thousand ohms and tens of thousands of ohms.

- **标准 / Criteria:** 根据火花塞型号和制造商规范，电阻值应在指定范围内（例如，4 kΩ - 8 kΩ）。
    - According to the spark plug model and manufacturer's specifications, the resistance value should be within the specified range (e.g., 4 kΩ - 8 kΩ).

6.3 间隙测量 / Gap Measurement

- **目的 / Purpose:** 测量火花塞中心电极与侧电极之间的距离，确保其符合发动机制造商的推荐值，以获得最佳点火性能。
    - To measure the distance between the spark plug's center electrode and ground electrode, ensuring it meets the engine manufacturer's recommended value for optimal ignition performance.

- **方法 / Method:** 使用间隙测量仪（如塞尺或圆盘式间隙规）测量电极间隙。
    - Use a gap gauge (e.g., feeler gauge or disc-type gap tool) to measure the electrode gap.

- **标准 / Criteria:** 间隙值应符合产品规格或发动机制造商的推荐值（例如，0.8 mm - 1.1 mm）。
    - The gap value should comply with product specifications or engine manufacturer's recommendations (e.g., 0.8 mm - 1.1 mm).

6.4 绝缘电阻测试 / Insulation Resistance Test

- **目的 / Purpose:** 评估火花塞绝缘体在高压下的绝缘性能，防止漏电或击穿。
    - To evaluate the insulation performance of the spark plug insulator under high voltage, preventing leakage or breakdown.

- **方法 / Method:** 将火花塞置于绝缘电阻测试仪上，施加规定电压（例如，500V DC），测量绝缘电阻值。
    - Place the spark plug on an insulation resistance tester, apply a specified voltage (e.g., 500V DC), and measure the insulation resistance value.

- **标准 / Criteria:** 绝缘电阻值应大于规定最小值（例如，50 MΩ）。
    - The insulation resistance value should be greater than the specified minimum (e.g., 50 MΩ).

6.5 耐压强度测试 / Dielectric Strength Test

- **目的 / Purpose:** 验证火花塞在极端高压下不发生击穿的能力，确保其在发动机点火系统中的可靠性。
    - To verify the spark plug's ability to withstand extreme high voltage without breakdown, ensuring its reliability in the engine ignition system.

- **方法 / Method:** 使用高压发生器对火花塞施加逐渐升高的电压，直至观察到击穿或达到规定电压值。测试通常在空气中或特定介质中进行。
    - Use a high voltage generator to apply gradually increasing voltage to the spark plug until breakdown is observed or a specified voltage value is reached. The test is usually performed in air or a specific medium.

- **标准 / Criteria:** 火花塞应能承受规定电压（例如，25 kV - 35 kV）而不发生击穿。
    - The spark plug should be able to withstand the specified voltage (e.g., 25 kV - 35 kV) without breakdown.

6.6 点火性能测试 / Ignition Performance Test

- **目的 / Purpose:** 模拟发动机实际工作条件，评估火花塞的点火可靠性和火花能量。
    - To simulate actual engine operating conditions and evaluate the spark plug's ignition reliability and spark energy.
- **方法 / Method:** 在火花塞测试台上，模拟不同转速、负荷和温度条件，观察火花塞的点火情况、火花强度和稳定性。可使用高压示波器或专用点火分析仪进行测量。
    - On the spark plug test bench, simulate different RPM, load, and temperature conditions, and observe the spark plug's ignition, spark intensity, and stability. A high-voltage oscilloscope or dedicated ignition analyzer can be used for measurement.
- **标准 / Criteria:** 火花塞应在各种模拟工况下稳定可靠地产生火花，火花能量和持续时间应符合设计要求。
    - The spark plug should consistently and reliably produce sparks under various simulated operating conditions, and the spark energy and duration should meet design requirements.

7. 质量控制要求 / Quality Control Requirements

为确保火花塞产品质量的持续稳定和可靠，河北勃硕汽车科技有限公司将严格执行以下质量控制要求：

To ensure the continuous stability and reliability of spark plug product quality, Hebei Boshuo Automotive Technology Co., Ltd. will strictly implement the following quality control requirements:

- **原材料检验 / Raw Material Inspection:** 所有用于火花塞生产的原材料（如陶瓷粉、金属材料、电阻材料等）在入库前必须经过严格的质量检验，确保符合相关标准和采购规范。
    - All raw materials (such as ceramic powder, metal materials, resistance materials, etc.) used for spark plug production must undergo strict quality inspection before warehousing to ensure compliance with relevant standards and procurement specifications.
- **生产过程控制 / In-Process Control:** 在火花塞生产的各个环节，包括绝缘体烧结、电极焊接、壳体加工、组装等，都应设立关键控制点，并进行实时监控和检验，确保产品质量符合设计要求。

    - In all stages of spark plug production, including insulator sintering, electrode welding, shell processing, assembly, etc., key control points should be established, and real-time monitoring and inspection should be carried out to ensure product quality meets design requirements.
- **成品检验 / Finished Product Inspection:** 所有生产完成的火花塞产品必须经过全面的成品检验，包括本文件第六章所述的所有测试项目，确保每一批次产品都符合出厂标准。
    - All finished spark plug products must undergo comprehensive finished product inspection, including all test items described in Chapter 6 of this document, to ensure that each batch of products meets ex-factory standards.

- **不合格品控制 / Non-conforming Product Control:** 对在检验过程中发现的不合格品，应进行隔离、标识、记录和评审，并采取相应的纠正和预防措施，防止不合格品流入下一道工序或出厂。
    - Non-conforming products found during the inspection process should be isolated, identified, recorded, and reviewed, and corresponding corrective and preventive measures should be taken to prevent non-conforming products from flowing into the next process or leaving the factory.

- **设备维护与校准 / Equipment Maintenance and Calibration:** 所有测试设备和仪器应建立完善的维护和校准计划，并严格按照计划执行，确保设备的准确性和可靠性。
    - All testing equipment and instruments should establish a sound maintenance and calibration plan and strictly implement it to ensure the accuracy and reliability of the equipment.

- **人员培训 / Personnel Training:** 所有参与火花塞质量测试和质量控制的人员都必须经过专业的培训和考核，具备相应的知识和技能，确保操作的规范性和测试结果的准确性。
    - All personnel involved in spark plug quality testing and quality control must undergo professional training and assessment, possess corresponding knowledge and skills, and ensure the standardization of operations and the accuracy of test results.

8. 测试记录和报告 / Test Records and Reports

所有火花塞质量测试过程中的数据和结果都必须进行详细、准确的记录，并形成规范的测试报告。测试记录和报告是产品质量追溯和问题分析的重要依据。

All data and results during spark plug quality testing must be recorded in detail and accurately, and standardized test reports must be generated. Test records and reports are important bases for product quality traceability and problem analysis.

- **测试记录 / Test Records:**
  - 每项测试都应有详细的记录，包括但不限于：测试日期、测试人员、火花塞型号和批次号、测试设备编号、测试环境条件、测试参数、原始数据和测试结果。
  - Each test should have detailed records, including but not limited to: test date, tester, spark plug model and batch number, test equipment number, test environmental conditions, test parameters, raw data, and test results.
  - 记录应清晰、完整、真实，并由测试人员签字确认。
  - Records should be clear, complete, and true, and signed by the tester.
- **测试报告 / Test Reports:**
  - 测试报告应包含以下基本信息：报告编号、产品名称、型号、批次号、测试目的、测试依据标准、测试设备、测试环境、测试项目及结果、结论、审核人、批准人及报告日期。
  - The test report should include the following basic information: report number, product name, model, batch number, test purpose, test basis standard, test equipment, test environment, test items and results, conclusion, reviewer, approver, and report date.
  - 对于不合格品，测试报告中应明确指出不合格项目、不合格程度以及建议的处理措施。
  - For non-conforming products, the test report should clearly indicate the non-conforming items, the degree of non-conformity, and recommended handling measures.
  - 测试报告应妥善存档，保存期限至少为产品有效期加两年。
  - Test reports should be properly archived, with a retention period of at least two years beyond the product's validity period.

9. 安全注意事项 / Safety Precautions

在进行火花塞质量测试过程中，必须严格遵守以下安全注意事项，以确保测试人员和设备的安全：

During spark plug quality testing, the following safety precautions must be strictly observed to ensure the safety of testing personnel and equipment:

- **个人防护 / Personal Protection:** 测试人员应佩戴适当的个人防护装备，包括但不限于安全眼镜、绝缘手套和工作服。
  - Testing personnel should wear appropriate personal protective equipment, including but not limited to safety glasses, insulated gloves, and work clothes.

- **电气安全 / Electrical Safety:**
  - 高压测试设备操作前，必须检查所有连接是否牢固，接地是否良好。
  - Before operating high-voltage testing equipment, all connections must be checked for firmness and good grounding.
  - 测试过程中，严禁触摸高压部件，防止触电。
  - During the test, it is strictly forbidden to touch high-voltage components to prevent electric shock.
  - 测试设备应定期检查和维护，确保其电气安全性能。
  - Testing equipment should be regularly inspected and maintained to ensure its electrical safety performance.

- **高温部件 / High Temperature Components:** 火花塞在测试过程中可能会产生高温，操作时应注意防烫。
  - Spark plugs may generate high temperatures during testing, so be careful to prevent burns during operation.

- **化学品安全 / Chemical Safety:** 如果测试过程中涉及清洁剂或其他化学品，应按照其安全数据表（SDS）的要求进行操作，并确保工作区域通风良好。
  - If cleaning agents or other chemicals are involved in the testing process, operate according to the requirements of their Safety Data Sheet (SDS) and ensure good ventilation in the work area.

- **紧急预案 / Emergency Plan:** 测试区域应配备急救箱和灭火器，并制定紧急情况下的应对预案。
  - The testing area should be equipped with first-aid kits and fire extinguishers, and emergency response plans should be developed.

10. 附录 / Appendices

附录 A: 火花塞测试记录表 / Appendix A: Spark Plug Test Record Form

测试项目 / Test Item	测试方法 / Test Method	标准要求 / Standard Requirement	测试结果 / Test Result	判定 / Judgment (合格/不合格 Pass/Fail)
外观检查 / Visual Inspection	目视检查 / Visual Inspection	无裂纹、无烧蚀、无腐蚀 / No cracks, no ablation, no corrosion	合格 / Pass	
电阻测试 / Resistance Test	万用表测量 / Multimeter Measurement	4 kΩ - 8 kΩ (示例) / 4 kΩ - 8 kΩ (Example)	合格 / Pass	
间隙测量 / Gap Measurement	间隙测量仪 / Gap Gauge	0.8 mm - 1.1 mm (示例) / 0.8 mm - 1.1 mm (Example)	合格 / Pass	
绝缘电阻测试 / Insulation Resistance Test	绝缘电阻测试仪 / Insulation Resistance Tester	≥ 50 MΩ (示例) / ≥ 50 MΩ (Example)	合格 / Pass	
耐压强度测试 / Dielectric Strength Test	高压发生器 / High Voltage Generator	≥ 25 kV (示例) / ≥ 25 kV (Example)	合格 / Pass	
点火性能测试 / Ignition Performance Test	火花塞测试台 / Spark Plug Test Bench	稳定可靠点火 / Stable and reliable ignition	合格 / Pass	

备注 / Remarks:

测试人员 / Tester: Jack ***日期 / Date:*** 2026/3/5

审核人 / Reviewer: 陈易甜 / Yi Tian Chen ***日期 / Date:*** 2026/6/6