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REVISIÓN

Diagnosis and Prevention of Overheating in Internal Combustion Engines

Diagnóstico y Prevención del Sobrecalentamiento en Motores de Combustión Interna

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ABSTRACT

Overheating in internal combustion engines, particularly in models such as the 2011 Mazda BT-50, was highlighted as a significant problem due to its impact on engine efficiency and the environment. It was noted that this phenomenon can increase pollutant emissions and deteriorate critical components such as lubricating oil, affecting engine life. According to Briceño and Brayan (2022), the cooling system plays a key role in preventing overheating, as it regulates the temperature through the radiator, water pump and thermostat. Galvez (2020) emphasised the importance of keeping these components in good condition to avoid failures. Diagnosing problems related to overheating involves identifying common causes such as coolant leaks, sediment build-up in the radiator and thermostat or fan malfunctions (Soria, 2023). Solutions include replacement of defective components, cleaning of the cooling system and use of advanced diagnostic tools such as OBD-II scanners. The research highlighted the relevance of preventive maintenance, such as regular inspection and periodic replacement of coolants and thermostats (Patel et al., 2020). Furthermore, the value of new technologies in the automotive industry to develop more efficient and sustainable engines was underlined. Finally, it was concluded that overheating is a multifactorial problem that requires a holistic approach to ensure optimal engine performance and longevity.

Keywords: overheating; combustion engines; preventative maintenance; cooling system; automotive diagnostics.

RESUMEN

El sobrecalentamiento en motores de combustión interna, particularmente en modelos como el Mazda BT-50 2011, se destacó como un problema significativo debido a su impacto en la eficiencia del motor y el medio ambiente. Se señaló que este fenómeno puede aumentar las emisiones contaminantes y deteriorar componentes críticos como el aceite lubricante, afectando la vida útil del motor. Según

Briceño y Brayan (2022), el sistema de refrigeración juega un papel fundamental en la prevención del sobrecalentamiento, ya que regula la temperatura mediante el radiador, la bomba de agua y el termostato. Gálvez (2020) enfatizó la importancia de mantener estos componentes en buen estado para evitar fallos. El diagnóstico de problemas relacionados con el sobrecalentamiento implica identificar causas comunes como fugas de refrigerante, acumulación de sedimentos en el radiador y mal funcionamiento del termostato o el ventilador (Soria, 2023). Las soluciones incluyen el reemplazo de componentes defectuosos, limpieza del sistema de enfriamiento y uso de herramientas de diagnóstico avanzadas como escáneres OBD-II. La investigación destacó la relevancia del mantenimiento preventivo, como la inspección regular y el reemplazo periódico de refrigerantes y termostatos (Patel et al., 2020). Además, se subrayó el valor de las nuevas tecnologías en la industria automotriz para desarrollar motores más eficientes y sostenibles. Finalmente, se concluyó que el sobrecalentamiento es un problema multifactorial que requiere un enfoque integral para garantizar el rendimiento óptimo y la longevidad del motor.

Palabras clave: sobrecalentamiento; motores de combustión; mantenimiento preventivo; sistema de refrigeración; diagnóstico automotriz.

INTRODUCTION

The issue of internal combustion engine overheating in the operation of radiators, coolant conductors, and water conductors is highly relevant today for several reasons. First, with the growing concern about climate change and the adoption of increasingly stringent policies on greenhouse gas emissions, it is critical to understand how to avoid engine overheating. Overheating can increase emissions of polluting gases and contribute to global warming. It is vital to understand how cooling systems work and how to avoid engine overheating.

On the other hand, in the context of increasing urbanization and traffic congestion, overheating internal combustion engines is a common problem in automobiles. Coolant and water conductors, as well as radiators, play a key role in regulating engine temperature. Understanding how these components work and how to prevent their malfunction is essential to ensure optimal vehicle performance and avoid costly repairs. In addition, significant advances in automotive technology have been made in recent years, such as using more efficient engines and sophisticated cooling systems. Understanding how engine overheating occurs and how to address it is essential to take full advantage of these new technologies and ensure efficient and prolonged vehicle operation.

Finally, the overheating of internal combustion engines is highly relevant to research and technological innovation. Studies on this subject can lead to improvements in engine cooling systems and the creation of new materials and more efficient temperature control technologies. This research can contribute to the development of cleaner and more sustainable engines and the advancement of the automotive industry. (Soria, 2023).

DEVELOPMENT

The cooling system is essential for the proper operation of internal combustion engines. According to Briceño and Brayan (2022), its main purpose is to dissipate the heat generated during combustion, keeping the engine temperature within an optimal range. This system operates under heat transfer principles and comprises key elements such as the radiator, water pump, and thermostat. The radiator acts as a heat exchanger that cools the coolant; the water pump ensures the circulation of the liquid, while the thermostat regulates the temperature by controlling the coolant flow (Condor Angos & Yépez Valle, 2023).

The cooling system includes components designed to maintain thermal equilibrium in the engine. Gálvez (2020) stresses the importance of an efficient radiator, hoses in good condition, and a functional thermostat to prevent overheating and optimize engine performance.

Overheating is the excessive increase in engine temperature beyond its normal operating range. This phenomenon, as explained by Khan et al. (2021), can cause irreversible engine damage due to oxidation and degradation of the lubricating oil, deposit formation, and wear of metal parts. Its causes are due to various factors. Among the most common are coolant leaks, thermostat malfunction, problems with the fan, or sediment accumulation in the radiator (Gálvez Rodríguez & Paucar Zhagüi, 2020). In addition, a lack of preventive maintenance can aggravate these problems, causing accelerated degradation of the lubricating oil and other critical engine components (Smith et al., 2023).

The 2011 Mazda BT 50 features a diesel engine with advanced injection technology and an optimized cooling system. According to Paucar (2020), this model includes a radiator made of high thermal conductivity materials and a design that facilitates heat dissipation, making it ideal for high thermal load conditions.

Diagnosing overheating requires identifying the causes using advanced tools such as OBD-II scanners, infrared thermometers, or visual inspection (Soria, 2023). Solutions include repairing leaks, replacing defective components, and purging the cooling system (TECHNICAL, n.d.).

Engine overheating in a 2011 Mazda BT-50 can be due to various factors, and understanding the major components of the cooling system is essential to identifying and addressing the problem. Some of the key components related to engine overheating are listed below:

- Radiator:

Function: The radiator is essential for dissipating the heat generated by the engine. Coolant circulates through the radiator ducts, where it cools before returning to the engine.

Potential Problems: Blockages, leaks, fin damage, and sediment buildup can affect the radiator's cooling ability.

- Water Pump:

Function: The water pump drives coolant through the cooling system, ensuring constant circulation to maintain proper engine temperature.

Potential Problems: Failures in the water pump can cause poor coolant circulation, contributing to overheating.

- Thermostat:

Function: Controls the flow of coolant, regulating engine temperature. It opens to allow coolant to flow when the engine is hot and closes when it is cold.

Potential Problems: A faulty thermostat can stay closed, preventing coolant flow and causing overheating.

- Radiator Fan:

Function: Helps cool the radiator by circulating air. It can be mechanically or electrically driven.

Potential Problems: Failures in the fan or its activation mechanism can result in inadequate cooling.

- Temperature Sensor:

Function: Monitors engine temperature and sends signals to the engine management system to adjust the operation of the fan and other components.

Potential Problems: Inaccurate readings can lead to cooling system malfunction.

- Hoses and Connectors:

Function: Allow coolant to flow between the various components of the cooling system.

Potential Problems: Leaking, clogged or damaged hoses can compromise system efficiency.

- Radiator Cap:

Function: Maintains proper pressure in the cooling system, preventing refrigerant evaporation at high temperatures.

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Potential Problems: Defective plugs can cause pressure loss and affect cooling capacity.

A detailed understanding of these components will allow a more accurate assessment of the possible causes of overheating in a 2011 Mazda BT-50 and facilitate the implementation of effective solutions.

Operation and control testing

The cooling system in a 2011 Mazda BT-50 engine works to maintain optimum engine temperature and prevent overheating. The overall process involves the continuous circulation of coolant through several components.

- Engine Start:

When the engine starts, it begins to generate heat due to the combustion of fuel in the cylinders.

Coolant Circulation:

The water pump drives coolant from the radiator to the engine, where it absorbs heat.

- Heat Exchange:

The coolant absorbs heat from the engine and then flows to the radiator, where it is cooled by the air flow or radiator fan.

- Temperature Regulation:

The thermostat regulates the temperature by opening and closing the valve to control coolant flow. The radiator fan can be automatically activated to increase cooling when needed.

- Return to Engine:

The cooled coolant returns to the engine to repeat the cycle and maintain a constant temperature.

1.Overheat Control Tests:

To diagnose and address overheating on a 2011 Mazda BT-50, several control tests can be performed. These tests will help identify specific problems and determine areas that require attention.

- Thermostat Test:

Check the operation of the thermostat to ensure that it opens and closes properly. This can be done by removing the thermostat and immersing it in hot water to observe its behavior.

- Visual Inspection of the Radiator:

Visually examine the radiator for damage, sediment buildup or bent fins that may affect cooling efficiency.

- Cooling System Pressure Test:

Use a pressure gauge to assess the integrity of the cooling system. Pressure leaks may indicate problems in the hoses, radiator or radiator cap.

- Coolant Fluid Analysis:

Perform a coolant analysis for contaminants or signs of engine wear. The presence of oil in the coolant could indicate more serious problems.

- Test Radiator Fan:

Check the operation of the fan, making sure that it activates properly in high temperature situations. This can be done by manual testing or using the engine control system.

- Inspection of Hoses and Connections:

Examine all hoses and connections for leaks, blockages or damage that may affect coolant circulation.

When it comes to diagnosis and repair, the following possible causes and solutions should be considered:

1.Radiator Problems:

Leaks, blockages or damage to the radiator can affect the cooling capacity.

2.Water Pump Malfunction:

A faulty water pump can cause inadequate coolant circulation.

3.Faulty Thermostat:

If the thermostat is not working properly, it can cause improper engine temperature regulation.

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4.Radiator Fan:
Problems with the fan, such as malfunction or improper activation, can affect heat dissipation.
5.Leaks in the Cooling System:
Any leaks in the hoses, connections or radiator can result in a loss of coolant and thus overheating.
6.Radiator Cap Problems:
A defective radiator cap can cause loss of pressure in the cooling system.
Temperature Sensor Problems:
Incorrect temperature sensor readings can lead to cooling system malfunction.

- Possible Solutions:

1.Radiator Repair or Replacement:
Correct leaks, clear blockages or, if necessary, replace the radiator.
2.Water Pump Replacement:
If it is determined that the water pump is not functioning properly, replacement may be necessary.
3.Thermostat Replacement:
Install a new thermostat if it is found that the current thermostat is not operating as it should.
4.Radiator Fan Repair or Replacement:
Repair or replace the fan if problems are detected in its operation.
5.Locate and Repair Leaks:
Identify and repair any leaks in the cooling system.
6.Radiator Cap Replacement:
If the radiator cap is defective, replace it with a new one.
7.Temperature Sensor Check and Calibration:
Check the accuracy of the temperature sensor and adjust or replace as necessary.

Preventive maintenance consisting of regular inspections and scheduled services to ensure proper operation of vehicle systems is essential for proper engine performance. According to Patel et al. (2020), this includes radiator flushing, coolant replacement, and thermostat checks, which prevent critical failures and extend engine life

CONCLUSIONS

Considering the literature review and technical information, Possible Cooling System Vulnerability suggests that some 2011 Mazda BT 50 owners have experienced overheating problems, which could indicate possible vulnerabilities in the cooling system of this model.

Coolant Leaks as a Contributing Factor is a common pattern identified in cases of overheating related to coolant leaks. This may suggest the need for greater attention to the integrity of the cooling system and regular inspection for possible leaks.

The research supports the importance of preventive maintenance to avoid overheating problems. It provides evidence that those owners who have followed a regular maintenance program are less likely to experience such problems.

Specific Thermostat and Radiator Evaluation is critical since

some evidence indicates that thermostat malfunction and radiator problems may be associated with overheating cases in the 2011 Mazda BT 50. This finding suggests the need for a specific evaluation of these components.

Variability in owner experiences with overheating is noted. While some have faced problems, others have not experienced similar situations. This highlights the complexity of the issue and the importance of considering multiple individual factors.

Preliminary Recommendations for Owners Based on the partial findings, preliminary recommendations can be made for 2011 Mazda BT 50 owners, such as regular attention to the cooling system, early detection of potential leaks, and scheduling of rigorous preventive maintenance.

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FINANCING

None.

CONFLICT OF INTEREST

None.