



## **TRADITIONAL PRACTICES OF AUTOMOBILE MAINTENANCE IN GHANA: AN ANALYSIS IN THE REMOVAL OF AUTOMOBILE ENGINE THERMOSTAT**

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### **ABSTRACT**

*The removal of thermostats from automobile engines in Ghana is a wide spread practice, and its effects cannot be over emphasized. It is claimed by some vehicle operators and mechanics that the engine thermostat in automobiles is the primary cause of overheating of engines in our part of the world. This work seeks to confirm or debunk the practice using a survey to establish how wide spread the practice is and to ascertain the motivating factor behind the practice. The overall methodology employed was a survey. A survey approach is particularly suited to research that seeks to investigate the prevalence of a phenomenon, in this case the removal of thermostats from automobile engine. A total of 476 questionnaires were administered to four automobile stakeholders namely vehicle operators (202), auto mechanics (198), used vehicle dealers (45) and garages (30) in four cities specifically, Takoradi, Tamale, Kumasi and Accra in Ghana. The respondents were purposively sampled from the general populations in the four cities. The study revealed that auto-mechanics practice removal of engine thermostat in an attempt to solve engine overheating problems and also used vehicle importers practice engine thermostat removal to satisfy their customers' wish. Results of this work suggest that the practice of engine thermostat removal affect engine performance, fuel consumption, and cause excessive smoke emission.*

**Keywords:** automobile, used vehicles, engine thermostats, and overheating

### **1.0 INTRODUCTION**

The removal of thermostats in automobile engines is a prevailing phenomenon in Ghana. This phenomenon, is claimed by the practitioners, forestalls overheating of automobile engines. To what extent the phenomenon is practiced needs to be ascertained and the possible consequences revealed. An automobile engine thermostat is supposed to help an automobile engine to reach operating temperature more quickly, regulate automobile engine temperature to prevent overheating, and regulate flow to promote more even cooling. Most automobile engines operate close to 80 degrees Celsius or 200 degrees Fahrenheit (Mudd, 1972). Below this value the operating temperature is considered cold and the engine needs more fuel to run properly. On older carbureted engines, a choke was used to add more fuel. With fuel injected engines the pulse-width of the fuel injector is increased. Increasing pulse-width also drastically decreases fuel mileage or kilometer. This is why it is desirable to reach operating temperature as quickly as



possible. When the engine is cold the thermostat blocks flow to the radiator and opens the bypass circuit.

In this mode the water pump circulates coolant only inside the engine. The coolant is prevented from flowing through the radiator where it would be cooled. Instead coolant flows through the bypass and back to the water pump. The effect is a quick increase in engine temperature. Several vehicle operators including Abed et al., (2013), Farmer (2014), Johnson (2013), and Oppong (2014) complained of their automobile engine thermostat removal by their mechanic's. According to the vehicle operators, the reasons assigned to the engine thermostat removal include the following: (1) thermostat was not necessary in Africa indicating it would only make the car overheat, (2) thermostat was used in much colder countries to keep the radiator water and engine oil from freezing, (3) thermostat in automobiles is the primary cause of overheating of engines in the tropics.

In Uganda, like the rest of East Africa, mechanics always removed the engine thermostats when the car first arrived in the country. They called this "tropicalizing" the vehicle with the aim of avoiding overheating (Farmer, 2014). Other researchers including Miller (2015), Asante (2013), Nice (2015), and Mitchell (2017) have strongly argued that the automobile engine thermostat is not the primary cause of overheating in automobile engine and that the basic purpose of thermostat is to trap the coolant and water around the engine block in order to help the engine reach operating temperature more quickly.

This work seeks to ascertain the facts as claimed by traditional automobile maintenance practitioners with regards to the removal of automobile engine thermostat against fiction, with the view to understanding the motivations for the removal of automobile engine thermostat. The objective of this study is to investigate the rationale behind the maintenance practice of the removal of engine thermostats and the effect on the engine performance.

## **2.0 MATERIALS AND METHODS**

The automobile industry has played a major role in the socio-economic development of many countries, and can be considered an important measure of development of a country, as it generates huge added value to the economy (Lee, 2011). Ghana's manufacturing industry gets good support from the local government which has enabled it to become one of the 40 fastest growing industrial productions in the world. The manufacturing industry currently accounts for a quarter of the Gross domestic product (GDP) but by 2021 it is expected to account for at least 30% of the GDP and the main driver for the growth will be the automobile industry (Kwakwa and Aboagye, 2014). The automobile industry is a major industrial and economic force in Ghana. It has been a driver of growth of the country as it is one of the most visible sectors to receive foreign investment. The total registered vehicle population in Ghana as of 2010 is approximately one million with concentration in the four biggest cities, namely Accra, Kumasi, Takoradi, and Tamale (Hesse and Ofofu, 2014). This research sampled views from these cities which is a fair representation of the geographical locations in Ghana.



## 2.1 *Sampling Techniques*

The study adopted a quantitative research approach. The research design used was a survey which is suitable for research that seeks to investigate the prevalence of a phenomenon (Chamber and Skinner, 2003). The population involved in this survey is auto mechanics, vehicle operators, used car dealers, and garages. Stratified sampling was employed. Each stratum was sampled as an independent sub-population, out of which individual elements were randomly selected. Automobile users with different levels of education, professions and experiences were sampled and questionnaires administered. The mechanics were grouped into masters, chief apprentices and apprentice, and equal number of questionnaires administered to each. This was expected to help to determine the background of users who remove engine thermostats

## 2.2 *Data Collection*

Data for the study was collected using questionnaires. Questionnaires were pretested on 10 automobile users and 10 mechanics. The essence of the pre-test was to identify any inconsistencies in the research instrument and make the necessary corrections before the actual survey. It also helped the researcher to know how the questioning should be done to get the right responses from respondents. Questionnaire were translated into the local dialect and administered by researchers because of the perceived low level of education among respondents. Four (4) sets of questionnaires were designed accordingly for the targeted sources identified in the automobile industry. The questionnaire was predominantly made up of closed ended questions with few open ended questions to solicit further explanations from respondents. The questionnaire was structured under the following themes: 1) availability of back-up spares; 2) knowledge on the importance of engine thermostats; and 3) Causes of overheating. A population of road worthy certification vehicle as of 2013 was 388,756 in four cities in Ghana where the automobile industry is making strides. These cities are Takoradi, Tamale, Kumasi and Accra. These cities were selected because they are also among the top ten cities with high population and major economic activities in Ghana (Ghana Statistical Service, 2015). The following factors influenced the choice of the administration mode. (1) Costs of transportation, (2) Coverage of the target population, (3) Flexibility of asking follow-up questions, (4) Respondents' willingness to participate, (5) Response credibility. Category of people identified to work directly on vehicle thermostats were auto mechanics, vehicles operators, used vehicle dealers and garages. A census of these groups of people in the study areas was conducted to generate a sampling frame.

At the end of the census, a total of 408 auto mechanics, 45 used vehicle dealers and 30 garages. Based on the sampling frame for the auto mechanics and vehicle operators, the Epi Info 7 Software (developed by the United States Centre for Diseases Control) was used to estimate the sample size at a confidence level of 95% and an error margin of 5%. This resulted in a sample size of 198 for auto mechanics, while a convenience sampling technique was used to select 203 for vehicle operators. The researchers selected all the vehicle dealers and garages for the study since the numbers were manageable. They were selected based on their availability and willingness to participate in the study. The questionnaires were cleaned, coded and entered into the Statistical Package for Social Scientist (SPSS version 21). Analysis was done using frequencies and percentages. In addition, the transport department of Kwame Nkrumah University of Science and Technology (KNUST) was also purposively sampled to get their



views on the subject matter. This is because they have wealth of experience and knowledge in automobile engineering.

### 3.0 RESULTS AND DISCUSSION

Out of a total sample of 476, 475 responded positively to the study indicating a response rate of 99.7%. Specifically, the number of respondents per each work group is as follows: auto mechanics (198), vehicle operators (202), used vehicle dealers (45) and garages (30) .

#### 3.1 Background of Respondents

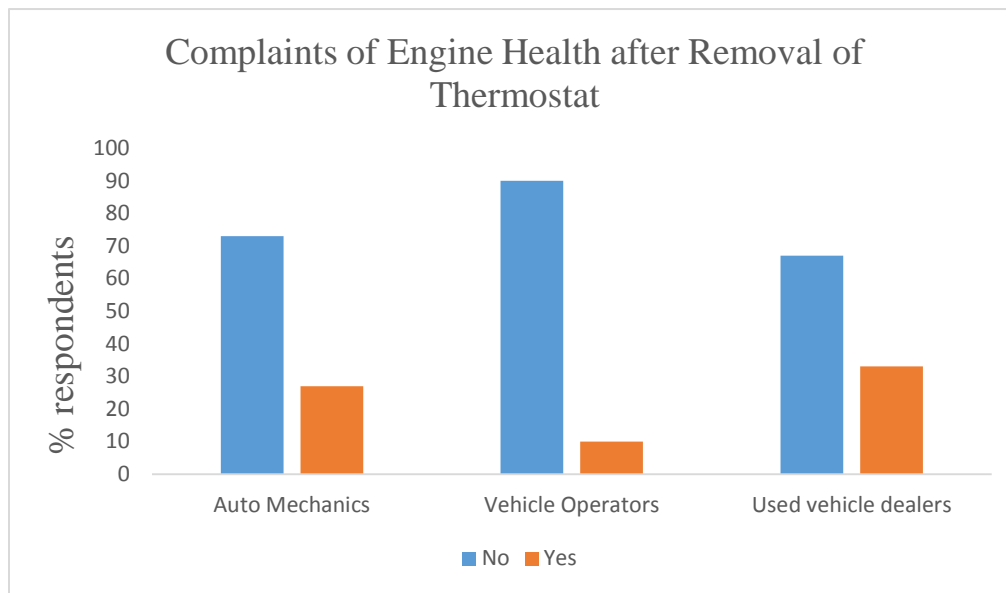
The auto-mechanics who participated in the study were classified as *masters*, *chief apprentices* and *apprentices*. Approximately 38% were masters, 35% were chief apprentices and 27% apprentices. The auto-mechanics were largely educated. Specifically, 70% had attained basic education, 5.3% were technical school graduates and 18.8% had no formal education. Vehicle operators considered in the study used seven specific vehicle models. Out of the total number of vehicle operators considered, 31.2% operate Toyota, 24.7% operate Nissan 17.3% operate Mitsubishi, and 15.3% operate Hyundai. The remaining 11.4% operate Honda, Mercedes and Kia. Approximately 55% were vehicle owners, 37% were commercial drivers and 8% were institutional drivers. Of all these people, only 15% had secondary education, 28% had tertiary education, 36% had basic education and the remaining 21% did not have any formal education. The garages the study covered were: Toyota Ghana Company Limited, Japan Motors, CFAO, Stallion Motors Ghana Limited, Mantrac Ghana Limited, Mechanical Lloyd, Joe Auto company, Rana Motors Delta Equipment Limited (Africa Motors Division) and Alliance Motors Limited. The respondents from the garages were quite educated compared to the other category of respondents. They had all received some form of tertiary education either from the university, polytechnics or a technical school. Specific participants were the garage's technicians, supervisors, and maintenance engineers.

#### 3.2 Rationale for the removal of engine thermostats

The study revealed most vehicles had their thermostats removed. For instance, 81% of the auto mechanics admitted to removal of engine thermostat whilst 74.5% of the vehicle operators admitted to have checked for the presence of the automobile engine thermostat in their vehicles and 24.5% admitted to not checking for the presence of engine thermostat. About 57% of auto-mechanics indicated that the engine thermostat is not designed for warm climatic condition as the situation in Ghana and that the automobile engine will overheat and fail. From the survey conducted, 89.5% of the vehicle operators admitted to have had overheating of their vehicle engines. Over 80% of the vehicle operators send their vehicles to the auto mechanic after experiencing overheating and the solution prescribed by the auto mechanics is the removal of the engine thermostat. Considering the fact that auto-mechanics are considered to be knowledgeable in vehicle maintenance, 90% of the vehicle operators agree to the removal of the engine thermostat to avoid overheating and loss of the engine which according to all vehicle operators is very successful and thus protects their vehicles. The complaints on engine health from vehicle operators were confirmed by approximately 68% of the auto mechanics who claim their recommendation of removing the thermostat yields the best result. Figure 1 shows that most respondents are satisfied with the removal of engine thermostat. Therefore, responses to the



question on complaint of automobile engine health after thermostat removal is represented in figure 1.



*Figure 1: Frequency of Complaint after Removal of Thermostat*

An assessment of these responses revealed that 60.8% of auto-mechanics and vehicle operators who indicated that the removal of engine thermostat was good for the engine health had no formal education. Surprisingly, 10% of those who are educated also share this opinion. This assertion held by auto-mechanics is totally erroneous. This is because studies suggest that the purpose of the thermostat is to keep the engine at the proper operating temperature (Pickerill, 2013), (Miller, 2015). Any liquid-cooled automobile engine has a device called thermostat that sits between the engine and the radiator. Its job is to block the flow of coolant to the radiator until the engine has warmed up. When the engine is cold, no coolant flows through the engine. Once the engine reaches its operating temperature generally about 80 degrees C, the thermostat opens, allowing circulation from the engine through the radiator. When the thermostat is closed, the engine warm up again. This engine-operating temperature accomplishes several goals including: helping engine oil to lubricate efficiently; removal of harmful deposits from the engine; reduces emissions and fuel consumption; and contributes to engine performance (Nice, 2015), (Mitchell, 2017). Expert view from KNUST transport department suggest that thermostats have the potential for failure, particularly with age they can seize up. If it seizes while it's too hot, it stays jammed open. If this is the case, it's pretty much the equivalent of removing the thermostat completely. It will be safe from overheating, but it will take longer to warm up as we covered earlier. Of course, if it seizes whilst cold, it will stay closed and the cooling system will remain obstructed, causing the engine to overheat quite quickly. Either way, it is best to replace the thermostat as soon as practicable in such cases, or even better; in advance as a preventative measure.



Garages or dealers of new vehicles are usually highly competent professionals in the field of automobiles. Garages usually serve as sales agents of automobile manufacturing companies and their technical knowledge on engine thermostats is significant to this work. 95% of the respondents showed that the presence of automobile engine thermostat is not responsible for causing engine overheating; rather it regulates the engine temperature for efficient working conditions. Thus, the assertion that automobile engine thermostats are not needed in warm climatic conditions, but rather needed in cold climatic regions was negated by these sales agents. Similarly, over 90% of used vehicle dealers claimed knowledge of automobile engine thermostat; however, those who responded to having knowledge of the engine thermostat shared different views of the function of the thermostat. 30% responded the function of the thermostat is to cool the engine, 35% also believe it causes overheating of the engine, and 35% said it regulates the temperature of the engine. 90% of the respondents attributed the overheating of the automobile engine to the presence of the thermostat in the engine, hence the reason for their removal. 78% of the used vehicle dealers admitted to the removal of the engine thermostats because it causes overheating of the automobile engine. 20% explained that they did not tamper with the engine thermostat.

#### **4.0 Effect of Engine Thermostat Removal on Automobile Engine**

Respondents were asked questions relating to the performance of automobile engine after removal of the engine thermostat. Questions asked bordered on engine vibration, fuel consumption, exhaust smoke, and engine oil level. 71% of the vehicle operators admitted to excess smoke from the exhaust after thermostat removal while 82% admitted to high fuel consumption of the engine after thermostat removal. 80% of the auto-mechanics responded that removal of engine thermostat has no effect on fuel consumption and about 16% had no idea on the effect of the removal of thermostats. Similarly, 70% of the used vehicle dealers had no knowledge on the effect of thermostat removal on fuel consumption. In contrast, 93% of the garages indicated that removal of engine thermostat will result in the automobile engine consuming more fuel, excess smoke from the exhaust, uneven engine cooling, and shorten the life of the engine. Figure 2 shows the distribution of responses to the question on fuel consumption. However it must be admitted that these garages do not have any data to substantiate their assertion because after the guaranteed period of service, owners of the vehicles rely on the services of auto mechanics. A source of reliable information pertinent to this study is the transport department workshop of KNUST. This workshop is responsible for the maintenance of the fleet of university vehicles. Brand new vehicles are acquired from the sales agents or the garages. The KNUST's mechanics have not been removing the thermostats and yet reports of overheating may be reported by the drivers after a number of years of operation of the vehicle. The inference is that thermostats as a system may malfunction and when not replaced may cause the overheating due to constriction of the flow duct in the event of seizure of the thermostat valve. Since replacement may be hard to come by at the auto mechanics' workshop, their obvious solution is to remove the thermostat. The question is, does the removal of the thermostat solve the problem of overheating and most of the mechanics will attest to the fact that removal stopped the overheating unless there were other factors to the overheating like blocked radiator tubes, faulty water pulley, burnt cylinder head gasket, and malfunctioned engine fan blade. The position of the garages matches the position of vehicle operators. 15% of vehicle



operators who inherited the vehicles without engine thermostat had no idea on the fuel consumption.

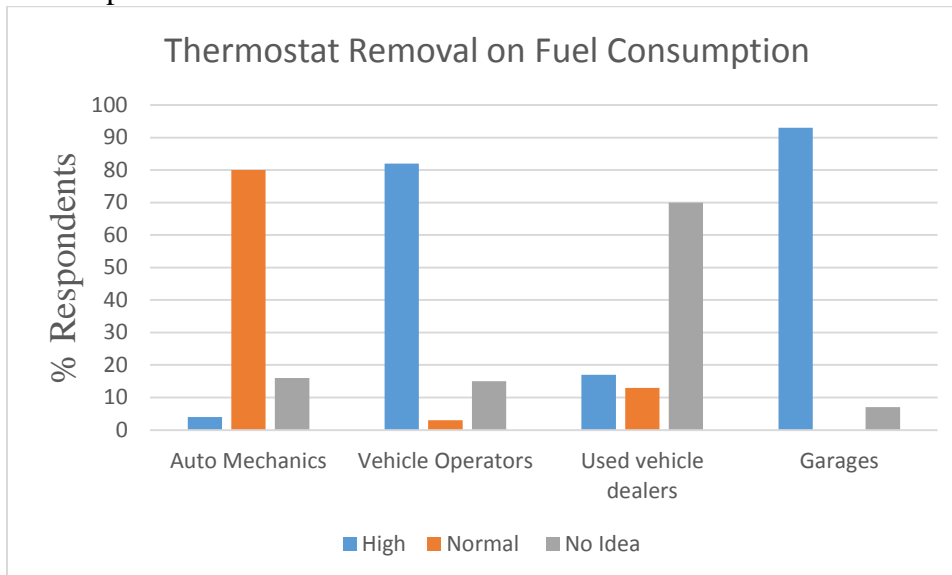


Figure 2: Effect of thermostat removal on fuel consumption.

The automobile engine operates efficiently at an optimum temperature of 80 Degrees Celsius (Mudd, 1972) and the engine thermostat is responsible for controlling the optimum temperature by admitting coolant from the radiator to the engine. Operating automobile engine without engine thermostat means cooling the engine when the optimum temperature is not attained. This will result in using more fuel to perform the same amount of work if engine had attained optimum temperature before cooling. This explains the position of vehicle operators and garages on the question of fuel consumption. In cold weather and early morning it takes a longer time for the engine to attain optimum temperature and removal of the thermostat will further delay the time for attainment of this optimum temperature.

## CONCLUSION AND RECOMMENDATIONS

The objective of this study is to investigate the rationale behind the traditional maintenance practice of removal of automobile engine thermostats and the result this practice has on engine performance. In achieving the above objectives, personnel from four identified stakeholders were sampled to draw their views for careful analysis. The study has revealed that auto mechanics face challenges with overheating and they remove the engine thermostat in an attempt to solve the overheating problems. Their motivation is that warm climate condition in the country makes it unnecessary to use engine thermostat in Ghana. Overheating stops after removal of engine thermostat. Many vehicle operators do not know the functions of engine thermostat and those who know the function of engine thermostat allow the auto mechanics to remove them because they are afraid the engine will overheat and fail. Mechanics who work in garages have very good knowledge of engine thermostat and do not remove them, instead they replace the engine thermostat anytime they find them removed or faulty. The removal of engine thermostat affects the performance of the engine. This traditional practice of automobile maintenance results in high fuel consumption, excessive smoke from the exhaust, uneven engine cooling, and may



shorten the life of the engine. The high fuel consumption of the engine is a huge drain on the economy. National Vocational Training Institute (NVTI), Council for Technical and Vocational Education and Training (COTVET), Technical and Vocational Education and Training (TVET), and Technical Institutions in collaboration with other stakeholders in the automobile industry should organize workshops for the auto-mechanics in order to educate them on the operation of thermostat. Further work needs to be carried out to ascertain the effect of thermostat removal on the performance of the engine.

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### **6.0 REFERENCES**

- Abed, I., Mike, R., Lule, J. (2013). Cooling Systems Answers for You.  
<http://www.ehow324.com/coolingsystems/auto-how-net-net.php>. Retrieved November 11 2016
- Asante R. (2013). The function of engine thermostat (conversation). (Personal communication).  
[www.zapmeta.ws/communicating/thermostatsproblems](http://www.zapmeta.ws/communicating/thermostatsproblems) Retrieved October 25 2016
- Chamber, R. L. and Skinner, C. J. (2003). Analysis of Survey Data, John Wiley and Sons Inc., United Kingdom. 203 - 210
- Charles, R. G. (2014). Engine Thermostat in Heavy Duty Machines:  
<http://www.ehow.com/coolingsystems/auto-how-net-net.php>. Retrieved May 11 2016
- Farmer, M. (2014). Driving in Africa: On course with Mick Farmer.  
<http://www.pernille.typepad.com/louderthanswahili/2009/01/driving-in-africa—on-course-with-mick-farmer-in-uganda.html>. Retrieved from November 11 2016
- Ghana Statistical Service .(2015). Ghana Statistical Yearbook 201-2013  
[http://www.statsghana.gov.gh/docfiles/publications/2013%20statistical%20yearbook\\_website.pdf](http://www.statsghana.gov.gh/docfiles/publications/2013%20statistical%20yearbook_website.pdf) Retrieved June 15 2017
- Hesse, C.A. and Oforu, J.B. (2014). Comparative Analysis of Regional Distribution of the Rate of Road Traffic Fatalities in Ghana.”*Open Science Repository Mathematics*”, p.e45011802. Retrieved November 11 2016
- Johnson, S. W. (2013) Inventions of Automobile Engine Thermostat.  
[http://www.redorbit.com/education/reference\\_library/general/2/inventions/2583490/thermostat/](http://www.redorbit.com/education/reference_library/general/2/inventions/2583490/thermostat/) Retrieved May 11 2016
- Kwakwa, P. A. and Aboagye, S. (2014). Energy consumption in Ghana and the story of economic growth, industrialization, trade openness and urbanization. *Asian Bulletin of Energy Economics and Technology*, 1, 1-5.
- Lee, C.Y. (2011). The Rise of Korean automobile industry: Analysis and suggestions”. *International Journal of Multidisciplinary Research*. 1(6). 428- 480.
- Miller, J. (2015). The Automotive thermostat. South Africa: auto repair help.  
[http://www.auto-repairs /automotivemaintenatenance/ auto\\_thermostat.php\\_](http://www.auto-repairs /automotivemaintenatenance/ auto_thermostat.php_) Retrieved May 11 2016
- Mitchell, B. (2017). How an Automobile Engine Thermostat Works.  
<https://www.2carpros.com/articles/how-an-engine-thermostat-works> Retrieved May 11 2016





- Mudd, S. C.(1972). *Technology for Motor Mechanics*, Butterworth-Heinemann Ltd; 2nd edition, 212 - 213
- Nice, K. (2015). How Automobile Engine Thermostats Work (group conversation).  
<http://www.howstuffwork.com/home-thermostat.htm>. Retrieved May 11 2016
- Opong, I. (2013). The function of engine thermostat [conversation]. [http://www.auto-repairs-help.com/automotive\\_maintenatenance/auto\\_thermostat.php](http://www.auto-repairs-help.com/automotive_maintenatenance/auto_thermostat.php). Retrieved May 11 2016
- Pickerill, K. (2013). *Today's Technician: Automotive Engine Performance, Classroom and Shop Manuals*. Cengage Learning.
- Yeboah, I.E. (2003). Demographic and housing aspects of structural adjustment and emerging urban form in Accra, Ghana. *Africa Today*, 107-119.