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DEVICE FOR HEAT REMOVAL FOR PARKED CAR

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This report is presented in
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"I declare this report is on my own work except for summary and quotes that I have mentioned its sources"

Signature	:
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Date	: 05APRIL 2010

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Dedicated

To my beloved Father and Mother,

To my respectful Supervisor,

To my honourable Lecturers,

&

To my fellow Friends.

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Mohd Aizat Bin Mohd Noor

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ABSTRACT

Heat is defined as any spontaneous flow of energy from one object to another, caused by a difference in temperature between the objects. Sunlight heats the sheet metal of the car, and it streams in through the windows to heat the interior. It can be affected the air inside the car become very hot and stuffy. Hence, its take times for an air-conditioner to effectively start cooling the passenger compartment on vehicle start-up. Besides, excessive heat can also damage an automobile's interior as well as personal property kept in the passenger compartment. So, a study is conducted to measure the temperature inside of the cars that all directly exposed to the sun, with no major shadows on any of them and activities to choose the suitable apparatus that will be use to develop a device for dissipating heat from a car. The selected car was parked facing sun rise on the free space area (field) with no major shadows on it. Eight different points were measured throughout the four to five hour long experiment. Method of the experiment was to collect temperature every 15 minutes by using a data logger which is connected to a laptop. The data logger used is type USB TC-08 and 8 thermocouple wires were connected to the data logger to collect the temperature rise. Then the experiment was repeated with the device was attached to the car and the result of the experiment was recorded in graph. As a conclusion, this device for heat removal inside a car has been designed so that its function is able help to cooling down the temperature in the car and reduce the excessive heat felt by the passenger of the car on vehicle start-up, besides reduce the damage an automobile's interior as well as personal property kept in the passenger compartment was achieved and successful.

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ABSTRAK

Haba ialah sebarang pengaliran tenaga dari sebuah objek kepada objek yang lain, disebabkan oleh perbezaan suhu antara dua objek tersebut. Cahaya matahari memanaskan kepingan besi pada kereta, dan menyerap masuk melalui tingkap ke bahagian dalaman kereta. Ini akan menyebabkan udara didalam kereta itu menjadi panas. Ia juga menyebabkan penyaman udara memerlukan lebih banyak masa untuk sepenuhnya menyejukkan kereta tersebut. Selain itu haba berlebihan ini juga akan menyebabkan kerosakan kepada bahagian dalaman kereta dan juga barang-barang yang disimpan didalam kereta tersebut. Oleh itu, satu kajian akan dijalankan untuk menyukat suhu didalam kereta yang terdedah kepada cahaya matahari dan juga aktiviti untuk merekabentuk alatan untuk membuang haba di dalam kereta. Kereta yang terpilh telah diletakkan menghadap arah matahari terbit dengan tiada langsung bayang di atasnya. Lapan tempat berbeza telah disukat di dalam ekperimen selama empat hingga lima jam. Ekperimen ini telah menggunakan pengelog data yang dihubungkan kepada komputer riba untuk mengumpul bacaan suhu setiap 15 minit. Pengelog data yang digunakan adalah jenis USB TC-08 dan 8 sambungan termogandingan telah disambungkan kepada pengelog data untuk mengumpul bacaan kenaikan suhu. Selepas itu, ekperimen diulang dengan alat yang telah direka dipasang di dalam kereta tersebut dan keputusan ekperimen telah ditunjukkan dalam bentuk graf. Sebagai kesimpulan, alat ini telah berjaya direkabentuk dan fungsinya untuk mengurangkan haba di dalam kereta semasa diletakkan di tempat terdedah telah berjaya dan berhasil.

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LIST OF SYMBOLS

Q	=	Heat
T	=	Temperature (°C)
J	=	Joule
W	=	Watt (J/s)

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`CHAPTER 1

INTRODUCTION

The number of cars was increased day by day, and car parking is indeed a problem. Car that was parked on the roadside without any shelter to protect it from the sun's heat, the air inside the car will become very hot and stuffy (Chin S.C. 1998). There have been available on the market many types of sun-shielding devices, such as sun-shielding fabrics and protective covers that are adapted to cover the car to help protect it from the sun. Such covers are inconvenient and time-consuming to use in covering the car, especially when the distance between the car and adjacent car are short.

Many types of window tint are available in the market for a wide variety of uses from solar heat reduction to Ultra Violet (UV) protection, privacy to safety and security, decorative applications to heat retention. Heat rejection films are normally applied to the interior of flat glass windows to reduce the amount of infrared, visible light, and ultraviolet (UV) radiation entering windows. Such films are either died or metalized (which can be transparent to visible light) to convert incoming solar radiation to infrared radiation, which is then rejected back through the glass to the exterior. Tinted film is one of the added devices used to reduce excessive heat in car and it is also good to use. Tinted windows are also inconvenient. It is illegal if we use high percentages of darkness or low visibility films and the good or legal tinted film was to expensive (Richmond J.C. 1996).

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It takes times for an air-conditioner to effectively start cooling the passenger compartment in the car. So the passenger of the car will feel the heat in the car extremely before the air-conditioner fully cooling the interior of the car. Excessive heat can also damage an automobile's interior as well as personal property kept in the passenger compartment. High quality reflective sun shields cannot protect the dash and fabrics from direct sun bleaching and damage, this can make a huge difference in the longevity of car interior rubber and vinyl areas (Richmond J.C. 1996).

1.1 Problem Statement

For a car that has been parked under the sun's heat for a period of time, the time required is long for an air-conditioner to effectively start cooling the passenger compartment on vehicle start-up. So the passenger of the car will feel the heat in the car extremely before the air-conditioner fully cooling the interior of the car. Besides, excessive heat can also damage an automobile's interior as well as personal property kept in the passenger compartment.

1.2 Objective

The goal of this project is to design a device for heat removal inside a car which will help to cooling down the temperature in the car and reduce the excessive heat felt by the passenger of the car on vehicle start-up, besides reduce the damage an automobile's interior as well as personal property kept in the passenger compartment.

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1.3 Scope

The scope of this project will cover on how to design a device for heat removal inside a car, and more particularly to a device capable of drawing out hot air from the car. The device will help to cooling down the temperature in the car and reduce the excessive heat felt by the passenger of the car on vehicle start-up, besides reduce the damage an automobile's interior as well as personal property kept in the passenger compartment. This project was covered on activities to measure the temperature inside of the cars that all directly exposed to the sun, with no major shadows on any of them and activities to choose the suitable apparatus that will be use to design the device. The proper design of the device will not be cover in this project and the device was expected to be recharge in the car instantly when the car is moving using built-in DC adaptor from the cigarette light plug jack.

The second law of thermodynamics states that the total entropy of any system cannot decrease other than by increasing the entropy of some other system. Hence, in a system isolated from its environment, the entropy of that system cannot decrease. It follows that heat cannot flow from a colder body to a hotter body without the application of work (the imposition of order) to the colder body (Jammer M. 1973).

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CHAPTER 2

LITERITURE REVIEW

2.1 Heat in Thermodynamic Concept

In thermodynamics, heat Q**,** is the process of energy transfer from one body or system due to thermal contact, which in turn is defined as an energy transfer to a body in any other way than due to work performed on the body. A related term is thermal energy, loosely defined as the energy of a body that increases with its temperature (Yunus *et al*. 2007). Heat is also known as "Energy".

Energy transfer by heat can occur between objects by radiation, conduction and convection (Robert 2008). Temperature, T is used as a measure of the internal energy or enthalpy that is the level of elementary motion giving rise to heat transfer. Energy can only be transferred by heat between objects or areas within an object with different temperatures (as given by the zeros law of thermodynamics). This transfer happens spontaneously only in the direction of the colder body (as per the second law of thermodynamics). Transfer of energy by heat from one object to another object with an equal or higher temperature can happen only with the aid of a heat pump via mechanical work (Yunus *et al*. 2007).

The First Law of Thermodynamics states that energy is neither created nor destroyed in the conversion of heat to or from other forms of energy.

The Second Law of Thermodynamics states that a transfer of heat from one body to another proceeds naturally and continuously from the warmer to the cooler body.

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The first law of thermodynamics states that the energy of an isolated system is conserved. Therefore, to change the energy of a system, energy must be transferred to or from the system. Heat and work are the only two mechanisms by which energy can be transferred to or from a control mass (Reif 2000). Work performed on a body is, by definition an energy transfer to the body that is due to a change of the external parameters of the body (such as the volume, magnetization, center of mass position in a gravitational field). Heat is the energy transferred to the body in any other way. This definition of heat applies generally: it does not appeal to any notion of thermal equilibrium.

In case of bodies close to thermal equilibrium where notions such as the temperature can be defined, heat transfer can be related to temperature difference between bodies. It is an irreversible process that leads to the bodies coming closer to mutual thermal equilibrium.

The unit for the amount of energy transferred by heat in the International System of Units SI is the joule (J). The unit for the rate of heat transfer is the Watt (W = J/s).

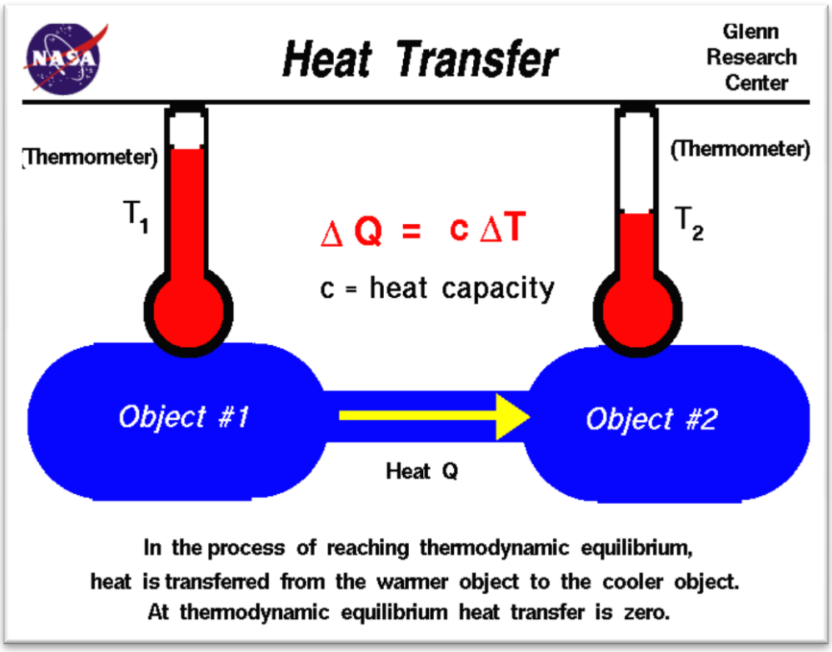

Figure 2.1.0: Heat transfer illustration

(Source: http://www.grc.nasa.gov, (2003))

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2.2 Principal of the Greenhouse Effect

Kiehl, J.T. and Trenberth, K. (1997) state that parts of our atmosphere act as an insulating thickness blanket, trapping sufficient solar energy to keep the global average temperature in a pleasant range. The 'blanket' means here is a collection of atmospheric gases called 'greenhouse gases' based on the idea that the gases also trap heat like the glass walls of a greenhouse.

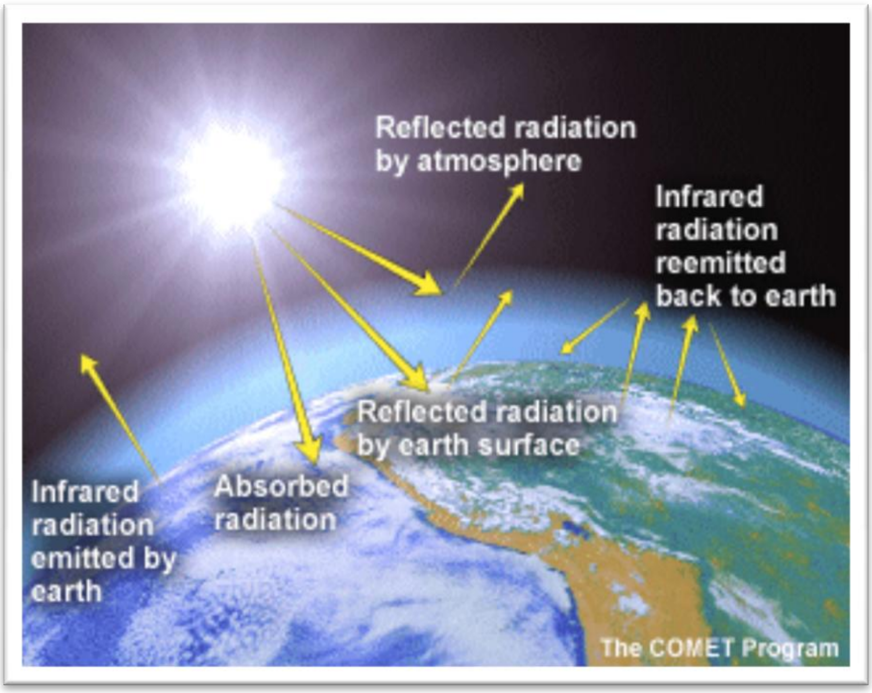

Figure 2.2.0: Greenhouse effect illustration

(Source: UCAR, (2001))

Our Earth receives most of its energy, called radiation, from the Sun. This energy is electromagnetic radiation in the visible spectrum, with small amount of IR and UV radiation. The incoming solar energy has a very short wavelength and unaffected passes through the atmospheric gases to reach the Earth's surface.

The Earth's surface absorbs the solar energy and releases it back to the atmosphere as infrared (IR) radiation, some of which goes back into space. Some of the IR radiation emitted by the Earth is absorbed by gases in the atmosphere that re-emit the energy as heat back toward the Earth surface.

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Kiehl, J.T. and Trenberth, K. (1997) also state that there are three main gases in our atmosphere that contribute to the greenhouse effect are carbon dioxide, methane and water. These gases absorb the infrared radiation emitted by the Earth and re-radiated the energy as HEAT back toward the Earth, causing a warming known as the Greenhouse Effect.

With increasing carbon dioxide emissions from humans, the greenhouse effect has become radically blown up. This has caused a hazardous global warming process that is threatening our current environment by melting polar ice caps and raising sea levels around the globe. Most materials absorb IR in a wide range of wavelengths, which causes an increase in the temperatures of the materials. The result is a continuing increase in the temperature to the Earth.

Is the warming of a car interior when parked in direct sunlight a greenhouse effect? Yes, the effect is accurately the same, because the exchange of gases between the car interior and the outer environment is blocked by the glass and body shell (Nasif Nahle, 2007).

2.3 How is Interior of Car Parked under Sun is Much Hotter than Atmosphere

Jonathan and Grabianowski (2002) state that we've probably noticed that the interior of our car is at all times much hotter inside than the outside temperature if it's been sitting under sunlight for a while. The sun's rays enter through our car's windows. Some of the heat from the sun is absorbed by the seats, the dashboard, the carpeting and floor mats. When those objects release this heat, it doesn't all get out through the windows and some is reflected back in. The heat radiated by the seats is a different wavelength than the light of the sun that made it through the windows in the first place, and the window glass would not let as much of that wavelength through. Certain amount of energy is going in, and less energy is going out. The result is a gradual increase in the temperature inside our car.

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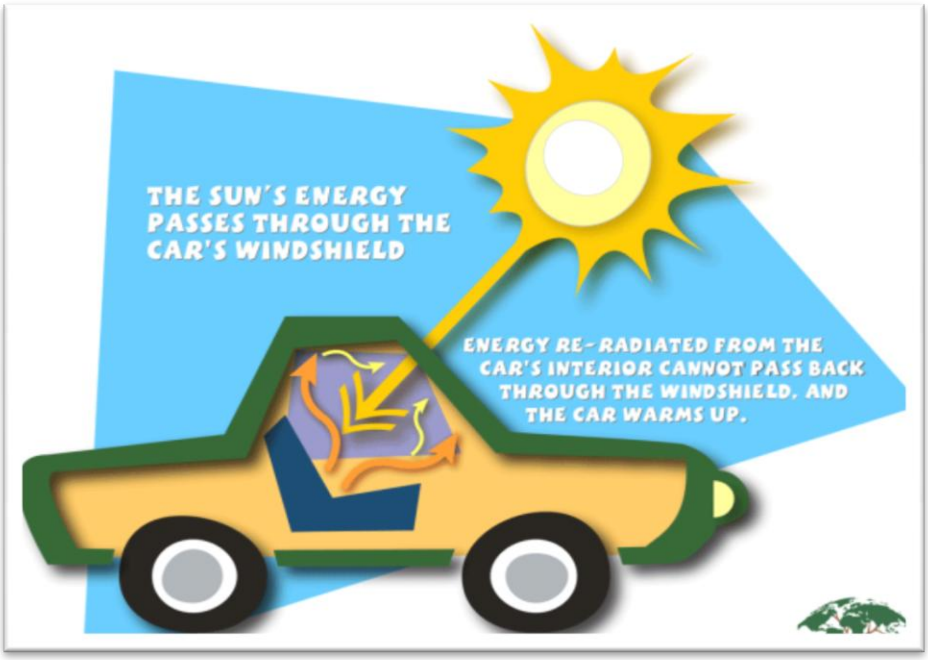

Figure 2.3.0: Car interior's heat illustration

(Source: Eric A. Davidson's, (2008))

Gas currents or the movement of fluid masses between the car interior and the outer environment has been blocked the when the cars leaved in direct sunlight with windows and doors closed, thus allowing only convection inside the car. Car interior atmosphere absorbs energy; it warms up only until it reaches a certain limit because a percentage of the heat is transferred from the internal environment to the bodywork of the car and from the bodywork to the external environment by means of conduction. After which, heat is again transferred to the air by convection and radiation.

Jonathan and Grabianowski (2002) state atmospheric heat passes through car windshields by means of conduction, where it then hits molecules of metal, plastic and cloth. Heat is absorbed by these materials their molecules and free electrons move more quickly and collide with each other emitting heat with a longer wavelength. The heat was transferred by conduction from the bodywork to the interior environment of the car and the gases absorb the heat and move faster. The colder masses of gas absorb heat from the hotter masses of gas by convection.

The heat hitting the gas molecules of the atmosphere inside the car is transformed into kinetic energy. This transformation of heat into kinetic energy and

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the ensuing molecular collisions generate heat with a longer wavelength and are transferred from the interior of the car to the bodywork by convection and slowly from there to the environment through conduction.

The heat in the car interior is uniformly distributed through the air trapped inside by convection. There is no heat transfer by convection to the external atmosphere because in tightly closing cars restrict the flow of air between the inside and outside environments. Under these conditions, the warming of the interior of our cars under direct sunlight does follow the greenhouse effect (Jonathan and Grabianowski 2002).

2.4 Window Tint Film

Concept of using window film for flat glass application was first introduced in the 1960s. Since that time, window tinting has become a huge market, with a wide range of colors and shades available. There are two basic types of tinted windows: metallic performance films, which provide a reflective surface, and the traditional non-reflective film. Tinted windows come in bronze, gray, gold, amber, and many other colors (Jorge P. 2000).

Window tint serves numerous functions on a car that often are not unconsidered. Not only do the darkened windows add a mysterious cosmetic touch to a vehicle, but they also have practical functions. Window tint makes a vehicle safer for its occupants. UV rays, which can be damaging to the skin and potentially cause cancer, are almost entirely blocked. Glare produced by the sun are also reduced, resulting in greater visibility for the driver. Furthermore, tinted glass sticks together when shattered and causes less damage to occupants. Not only will occupants be safer, but the upholstery will crack and fade slower, increasing the longevity of a vehicle. Finally, window tint provides privacy and reduced temperatures on sunny days (Jorge P. 2000).

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2.4.1 Type of Window Tint Film

1. Polyester Film

All types of window tinting for cars possess one thing in common. They all contain polyester film. This film goes between the window glass and the rest of the film. As its name suggests, it is made of polyester and is between 2 and 7 mils thick. Polyester film makers coat one side of the film with an adhesive that is either pressure sensitive or water activated in order to hold the film in place (Jorge P. 2000).

2. Dyed Film

This type of window tint for cars absorbs heat from the outside. It contains a film that is made of a dye. The dye absorbs the heat by rejecting the heat into the glass. The trapped heat dissipates into the outside air by the movement of the air outside of the car (Jorge P. 2000).

3. Deposited Film

This type of window tint for cars helps to hide the interior of the car. It contains a film that possesses a dark and much mirrored exterior. Often seen on limousines and security vehicles, deposited film reflects the images outside of the vehicle but allows those within the vehicle to see outside (Jorge P. 2000).

4. Sputtered Film

This type of window tint for cars helps to hide the interior of the car in a similar manner as the deposited film tint but with one important difference. This type of tint contains a film that possesses a mirrored exterior but is much lighter than the deposited film. Thus, while people outside the car will see their images reflected, those inside the vehicle might find it easier to see objects outside because they are not as dark as with the deposited film, although they will not enjoy the benefit of a sunglass (Jorge P. 2000).

5. Hybrid Film

This type of window tint for cars combines the qualities of the other types of tints. Hybrid film contains a film that possesses dye and metals. This combination makes the tint both reflective and light (Jorge P. 2000).

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2.5 Case Study

2.5.1 Heat in parked cars can be deadly

One of the better studies available was done by Jan Null, Adjunct Professor, Department of Geosciences, San Francisco State University. She measured interior vehicle temperatures of different colored vehicles while they were sitting in the sun. While several tests were done, here is a typical example of her results. On a 25C cloudless day, the vehicle interior temperature reached 35.6C in ten minutes, 41.1C within twenty minutes and 43.3C in half an hour. Letting the vehicle sit for a full sixty minutes, the temperature continued to climb to 50C. Letting it sit longer had no appreciable increase in interior temperature (Kerr, J. 2005).

Both dark blue and light grey vehicles were used. We all know dark vehicles heat up more. It is definitely wrong, while exterior surface temperatures may differ, Null found only minor differences in interior temperatures. Even though opening the side windows 1.5 inches made little difference in the end results (Kerr, J. 2005).

2.5.2 Cars develop killer heat, even on cooler days

"Even on relatively mild-temperature days, the internal temperature of a vehicle left in the sun quickly gets very warm - the average rise in one hour is 22°C," says lead author Catherine McLaren at Stanford University in Palo Alto, California. "My guess is that parents would be surprised that leaving children in the car is very much like leaving them in a sauna." (Gosline 2005).

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For example, in 2004, 35 children died of heat stroke in the US after being left unattended in a parked car. Previous research has shown that when ambient temperatures rise above 35°C, sealed cars reach a suffocating 65°C in just 15 minutes (Gosline 2005).

2.5.3 Heat stress from enclosed vehicles: moderate ambient temperatures cause significant temperature rise in enclosed vehicles.

Each year, children die from heat stroke after being left unattended in motor vehicles. In 2003, the total was 42, up from a national average of 29 for the past 5 years. Previous studies found that on days when ambient temperatures exceeded 86 degrees F, the internal temperatures of the vehicle quickly reached 134 to 154 degrees F. in the research done by McLaren, C. *et. al.*(2005), the objective of their study was to evaluate the degree of temperature rise and rate of rise in similar and lower ambient temperatures. In addition, they evaluated the effect of having windows "cracked" open.

In this observational study, temperature rise was measured continuously over a 60-minute period in a dark sedan on 16 different clear sunny days with ambient temperatures ranging from 72 to 96 degrees F. On 2 of these days, additional measurements were made with the windows opened 1.5 inches. Analysis of variance was used to compare how quickly the internal vehicle temperature rose and to compare temperature rise when windows were cracked open 1.5 inches.

The results of their study are regardless of the outside ambient temperature, the rate of temperature rise inside the vehicle was not significantly different. The average mean increase was 3.2 degrees F per 5-minute interval, with 80% of the temperature rise occurring during the first 30 minutes. The final temperature of the vehicle depended on the starting ambient temperature, but even at the coolest ambient temperature, internal temperatures reached 117 degrees F. On average, there was an approximately 40 degrees F increase in internal temperature for ambient temperatures spanning 72 to 96 degrees F. Cracking windows open did not decrease

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