A Primer for Staying Cool in a Van*

By Russ King, 07/31/25

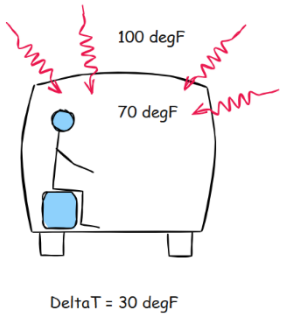
*or car, trailer, bus, RV, truck, tent, house, etc.

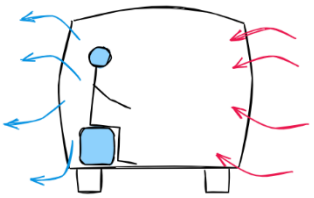
Definitions (simplified for the purpose of this discussion):

BTU - British Thermal Unit, a unit of heat energy about equal to the heat stored in a wooden kitchen match. It helps to think in terms of heat vs. lack of heat rather than hot vs. cold. Coldness is the lack of heat, just like darkness is the lack of light. You don't add darkness to a room when you turn off the lights, you stop adding light. Similarly, you don't add coldness to a room to make it cold, you remove heat. Heaters add BTUs. Air conditioners remove Btus. (Note: countries that use the metric system use joules instead of Btus, but the concepts are the same.)

Btuh - BTUs per hour. How we measure the movement of heat. The ability of a heater to heat a space or an air conditioner to remove heat from a space is quantified in Btuh. Electric heaters are also rated in watts. 1 watt is equal to 3.41 Btuh.

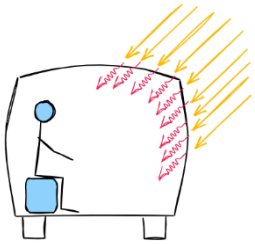
Conduction - Heat moving through a solid material, such as metal or glass that is driven by a temperature difference (deltaT) on either side of the material. When you put hot coffee in a cup and feel that heat through the side, that heat is moving through the side of the cup via conduction. Conduction is proportional to the deltaT. If you double the deltaT, you double the rate at which heat is crossing the surface.





Convection - Heat moving into a space by means of moving air, aka leakage or infiltration. Convection is also proportional to the deltaT between the air inside the space and the air coming into the space. If you double the deltaT, you double the rate at which heat is coming in.

Radiation - Heat caused by electromagnetic radiation (sunlight) striking a surface. The amount of heat created depends on the reflectance of the surface, which is also related to its color. Darker colors will create more heat than lighter colors. Radiation is not dependent of air temperature. A car parked in the sun can get hot even on a cold day.

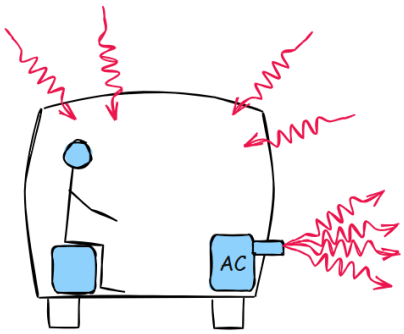


Emittance - The ability of a surface to radiate heat when it gets hot. Related to color. Generally light colors will emit less heat than darker colors. Shiny materials even less. Some shiny materials are marketed as "radiant barriers" because they reduce the amount of heat emitting into a space. For these materials to work, they must have an air space on the inward side. If anything comes in contact with the surface, the radiant barrier properties are lost – just as though you painted it.

Temperature - A measurement of how many Btus are in a volume of air or in an object. Some materials can absorb a lot of heat without getting hot (e.g., concrete, water, etc.). We say these have good "thermal mass". Some materials (e.g., air) get hot when you add just a few Btus. When you add Btus to an object of volume of air, it gets hotter. When you remove Btus, it gets colder.

Stay Cool

Staying cool is an exercise in minimizing Btus coming into your van. If you are lucky, you might have an air conditioner that can remove Btus at least as fast as they are coming in from the outside. This allows you to maintain a comfortable temperature. If it can't keep up, the Btus come in faster than the AC can remove them and the temperature goes up. Since convection and conduction are proportional to deltaT, as the inside temperature goes up, the deltaT goes down and eventually the AC can keep up, but it will be at a warmer temperature.

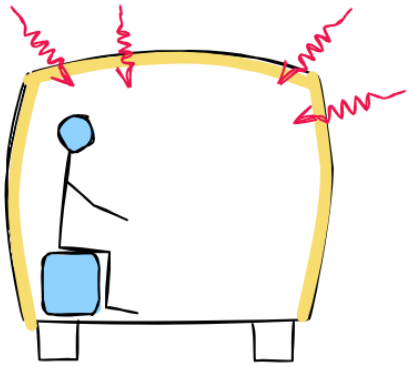


Heat out = Heat in
Indoor temperature remains constant

Assuming you do not have AC and that the outside temperature is warmer than the inside temperature and assuming that it is daytime, Btus are going to come into your van and the air in the van will begin to warm up. There is no way to stop this, but there are two ways to slow this down. 1. Reduce the rate at which the Btus are coming into the van. 2. Have some thermal mass to absorb the Btus rather than let them warm up the air. #2 is not as practical in a van as it is in a home, but know that anything relatively heavy or dense can absorb Btus better than air. If you have a big jug of water and it gets cool at night (cooler than the desired daytime temperature inside your van) you can set it outside at night and bring it inside during the day (aka, "charging your thermal mass").

Let's focus on #1: reducing the rate at which heat is coming into the van.

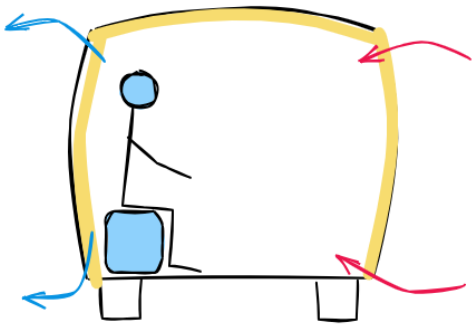
Reducing Conduction



Assuming you have no control over the outdoor temperature, conduction is reduced by increasing the R-value of the surface across which the heat is conducting. This is usually the walls and ceiling of your van. Any insulating materials help, rock wool, fiberglass batts, rigid foam board, spray foam, etc. The R-value of most of these materials is proportional to thickness. Avoid compression, wherever possible. Also avoid thermal bridging from metal or wood that allows heat to shortcut through the insulating materials.

Reducing Convection

Most vans are relatively airtight, but any kind of exhaust fan will increase convection, aka infiltration. Remember: for every cubic foot of air you bring in, one has to leave and vice versa. Every time you open a door to enter or exit your van, hot air comes in and cool air leaves. The tricky part is that we need some "fresh" air to breath, so a certain amount of "ventilation" is necessary. The difference between ventilation and infiltration is that ventilation is intentional and controlled; infiltration is

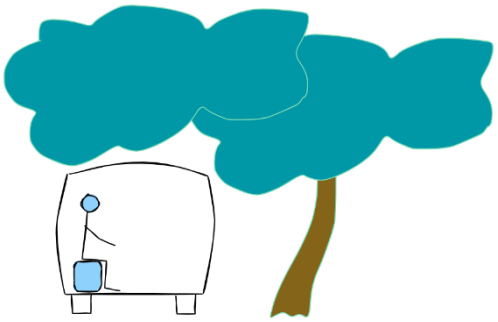


unintentional and uncontrolled. Wind will increase infiltration, but it can also prevent heat from building up around the outside of the van. A little bit of outdoor circulation around your van is generally better than none, but strong, hot winds will force hot air into your van.

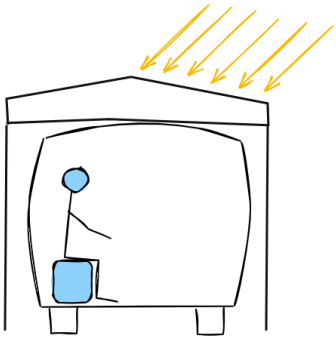
When you do ventilate, try to take the air from somewhere cool. Underneath your van is usually cooler than the roof. Knowing the right amount of ventilation is very complicated and personal. **Indoor air quality monitors are highly recommended. CO detectors are mandatory.** Ventilate accordingly.

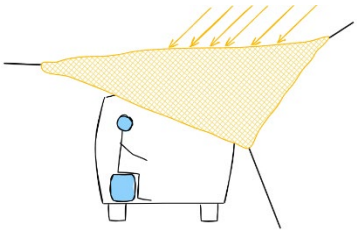
Reducing Radiant Heat Gains

Radiant heat gets into your van in two ways. 1. It hits the surface of your van, turns into heat then conducts into your van. 2. It shines through your windows, hits something inside your van, then turns to heat inside your van.

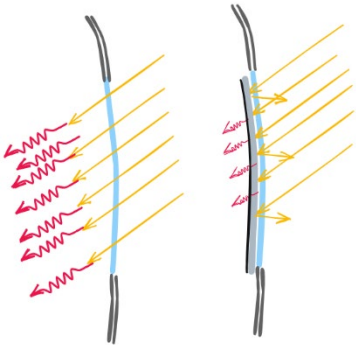


The best way to reduce radiant heat hitting your van and coming in through your windows is to park in the shade. If this is not possible, create your own shade with an easy-up or shade sail. The shade will absorb the radiant heat rather than your van. It is better to have an airspace between your van and the shade. i.e., don't lay the shade cloth directly on the van (unless it is reflective).

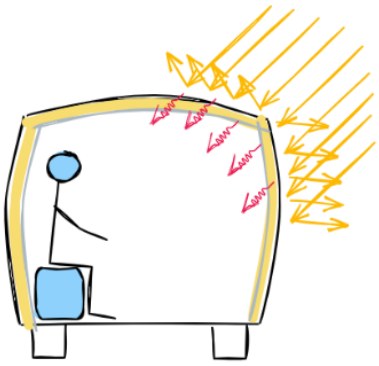




A white van will absorb less radiant heat than a black van. They also make paints that have additives that are more reflective than just the color. Covering your van with a mylar sheet (like a survival blanket) can help a lot.



Reflective window covers also help a lot, but keep in mind that it is much better to stop the heat before it passes through the glass. Once it passes through the glass, the heat is inside your van. Only a small amount is actually reflected back out of the glass. Consider exterior shading.



Heat can also radiate off the inside surface of your van and make your feel warm even if the air temperature is not that warm, like a heat lamp. Insulation will help with this but an additional way to prevent this is to line the inside of your van with lighter materials, or better yet, a reflective material, like silver bubble wrap.

Fans help because moving air feels cooler than still air on our bodies, but only as long as the air is lower than our body temperature. Once the air is warmer than out bodies, say 99 degrees F, fans don't help.

Drinking cold water helps you feel cooler too. Stay hydrated!

Spraying the outside of your van with water can help to. When water evaporates, it absorbs heat from (cools) whatever surface it is evaporating on. Misters help speed up evaporation.

Eventually, the heat will come into the van and the van will begin to warm up. Hopefully you can slow it down enough that it does not get too hot. Eventually the sun will go down and the outdoor temperature will drop. Once the outdoor temperature drops below the temperature of your van, you may as well open up and let the van air out. Precooling your van at night (letting it get as cool as the outside air) can utilize the thermal mass of the van itself and greatly slow down how fast it will heat up.

Hopefully this helps. Btw, these tips can also be used in reverse in cold weather. Keep the heat from escaping and let radiant heat come in!

Stay safe!