

Human Comfort

Tech to Tech Column September 07

“Make daily deposits to your box of knowledge, soon it will have many reference cards.”--Randal S. Ripley

If I had a dollar for every time I have heard a technician say “it ain’t rocket science”, in reference to the HVAC-R trade, I swear I would be the wealthiest guy in the industry.

First off, let me say that these technicians are right, it isn’t rocket science but everything we do is based on real science that can be duplicated any where in the world given the same conditions.

Technicians often talk about loads, electrical components, sizing, duct work, etc, but how many really understand why we do what we do?

We install heating and air conditioning to maintain **human comfort** as it relates to temperature & humidity. So would you agree that we install air conditioning to keep hot ambient air temperature from over heating our bodies and heating to add heat to our bodies to prevent us from freezing?

If you agreed with this statement you got this one wrong. Unfortunately there is a lot of misinformation, misunderstanding or out right confusion about how our body controls its temperature.

Your body must maintain an internal temperature of 98.6 degrees Fahrenheit for you to feel comfortable. Even small variances to this temperature such as when you have a fever, will make the average person uncomfortable and in some cases high tail it to a physician. The body surface area (skin) is usually about 93-94 degrees.

The reason we install heating & air conditioning is to help our bodies regulate its heat loss. That’s right, heat loss. Your body is never in need of heating, it is always giving off heat and in constant need of cooling. The equipment allows us to maintain a temperature differential that will allow the body to give off this heat in a comfortable manner. No technician can fully understand why we do what we do without understanding and accepting this fact.

You are a very inefficient walking furnace that produces much more heat than it needs to. Every thing you eat and many of the things you drink are the fuel that keeps this furnace going. This furnace never shuts off and if it does you better call Houston because you definitely have a problem.

The heat output of the human furnace depends on the activity of its owner. If you are just sitting around being a couch potato you are not going to put off the same amount of heat that you would jogging or doing some other strenuous exercise.

Keep in mind even when sleeping your body is giving off heat. If you have any doubt about this consider this example: if you go into a cold room, and get into the bed that is cold, where do you think the heat comes from that will eventually warm the blankets and make you feel comfortable again? The obvious answer is your body.

This method of heat transfer is known as **Conduction**, the transfer of heat from one item to another that are in contact with each other. Your body is in contact with something all the time whether it is the surrounding air, your feet on the ground, your clothes, the surface of your bed when you lie on, etc. If a temperature differential exists, heat transfer will take place.

Let's take a look at heating for a moment. If your body maintains a temperature of 98.6 and you set the temperature to 70 degrees Fahrenheit, how could this possibly keep you warm? It couldn't if we absorbed heat.

A basic rule of thermal dynamics is that **hot will seek cold**, just as a high pressure will seek low pressure. Since your body is warmer than the air surrounding it the heat transfer is to the air. The heat added to the space only reduces the temperature differential between your body and the ambient temperature. This reduces the heat loss to a rate that will allow you to maintain comfort.

Now take this same 98.6 degree body temperature and an ambient air temperature of 30 degrees and you are now going to feel cold. The reason you are cold is because **the greater the temperature differential the greater the heat transfer, so heat is leaving your body at a faster rate.**

It works the same in air conditioning or refrigeration. Go from a hot and humid outside temperature of 95 degrees into an air conditioned space that is 70 degrees and the 20 degree differential feels pretty refreshing; now try going from the same outside temperature into a walk-in freezer that is below freezing at 20 degrees and see how quickly this 70 degree differential will make you uncomfortable.

This method of heat transfer is called **Convection**, which is the transfer of heat by means of movement of a fluid either liquid or air.

You are constantly in contact with the air that surrounds you. The heat from your body is passed to this surrounding air by conduction (Just like a furnace heat exchanger). When air is heated it becomes less dense and will rise allowing cooler air to fall creating what is known as convection currents. The human body has convection currents around it all the time.

As the hot air rises taking heat with it, the cooler air moves in and becomes heated, then rises and the cycle continues on and on cooling the body as more heat is taken away. An example of this in the field is when the blower is not working and has cause the furnace to go off on limit. If you put your hand over the vent you will feel some heat rising out of it because of convection.

Whether it is your body or a furnace heat exchanger, airflow aids the convection process. If you are hot and a breeze blows over your body, you feel cooler. We use a fan to create an artificial breeze in order to get more heat from the exchanger and push it out of the supply diffusers. Now put your hand in front of the supplies, you will feel much more heat coming from them.

If the body is always trying to give off heat and heat transfers through temperature differential then why wouldn't the body absorb heat in 100+ degree weather and kill everyone in that region?

When the outside ambient becomes too hot for heat transfer your bodies comfort controller calls in the sudoriferous glands (better known as the sweat glands) another one of its many cooling systems and you start to perspire or in HVAC-R technician lingo "sweat you're...off."

This is called **evaporative** cooling. Water like refrigerant absorbs heat when it evaporates helping to remove the heat being generated by your body. Your comfort controller can also turn this gland off to prevent heat loss through sweating.

Evaporative cooling works well on days with low relative humidity and in places like Las Vegas with its very low relative humidity, you may not even realize you are sweating because the water evaporates so quickly.

What about when it is hot and the relative humidity is high making it so your body can't evaporate this water to the air that is already saturated and can't hold much more water vapor?

The answer to this is that the water or other fluids you drink absorb heat while in your body taking this heat with it when it leaves in the form of sweat. This moisture is not going to evaporate from your skin, because of the high relative humidity, leaving you soaked and uncomfortable but alive.

An example of this that an HVAC-R technician might find humorous is "If you drink a cold glass of beer, is it warm or still cold when it exits your body?" I rest my case.

Your bodies comfort controller is known in scientific terms as the "Hypothalamus." This organ is located in your brain and determines which one or combination of heat regulating systems that your body will use to regulate your heat rejection and maintain your comfort.

The nerves (sensors) located at the skin, relay information to the hypothalamus so that it can take the appropriate action to regulate both surface and internal temperature.

Some of the other ways the Hypothalamus controls heat rejection:

- On hot days when there is little temperature differential, it signal the blood vessels to dilate or expand, causing blood to run closer to the surface for better heat rejection and will also signal the skeletal muscles to relax and make you feel lazy, resulting in less heat produced.
- On a cool to cold day the hypothalamus signals the blood vessel to narrow and move away from the skin surface, for less heat loss.
- When the body is cold the hypothalamus can cause the body to shiver, increasing muscle activity that will create more heat production.

We have discussed the "Hypothalamus" and three of the four heat transfer methods that relate to human comfort.

The last method is **Radiation**, the transfer of heat by heat rays.

The best examples of radiant heat I can give are the heat you feel from the sun on your face, even on a cold winter day, standing around a fire or fire place, etc. The heat you are feeling is radiant heat.

Radiant heat can also work in the reverse. On a cold winter day stand next to a window that does not have a supply grill blowing air over it and you will start to feel cooler even though the room temperature is fine. This is because there is enough of a temperature differential for your body to lose heat to the window.

If you enjoy the columns please tell others so they can get on the email club list.

If you want to rant at me or send short video clips of people doing dumb things or anything else you think I would be interested in, my email address is randal@totalairsupply.com

Randal