Thermometers - Guidelines for Using Thermometers in Support of Paranormal Investigations

Thermometers of all types are amongst the most useful tools for paranormal investigation. Many people will have heard reports of or even experienced a temperature drop before and during paranormal activity. In reality the temperature may also rise at these times. It is important therefore to be able to measure this change in temperature both as early warning and possible confirmation of a potential paranormal event-taking place.

There are several types of thermometer and it is advisable to have a number of different ways to measure temperature. A paranormal investigator should also have sufficient thermometers to cover the location properly - an absolute minimum of one per average size room should be considered as essential.

Direct Reading Digital Probe Type Thermometer

These are the cheapest and the most commonly used thermometers, the temperature is recorded via a simple probe on the end of a cable or wire, sometimes the temperature sensor is inside the device. The probe often contains a 'Thermistor', which alters its electrical resistance in response to changes in temperature.

The resistance is measured and is converted to a temperature measurement.

Accuracy is around 2 - 5% of the reading and the display is updated once or twice every minute or more frequently on more expensive models. Battery life too, is excellent and most thermometers of this type are easily portable meaning they can be placed close to any areas of interest. Readings normally need to be taken manually.

Some models have a MAX / MIN mode that permit the user to easily see the limits of any temperature changes during a vigil session. Many digital thermometers also have several additional features that may include a clock and a relative humidity measuring capability.

Although basic, with careful use and positioning these thermometers can provide a great deal of valuable data to the paranormal investigator. The low cost means that several can be used throughout a location to gain the maximum amount of information.

Limitations of Use

These thermometers are amongst the cheapest available and can be found from just a few pounds. This cost saving can be a sign of lower quality control by the maker and the choice of components will affect the reliability and the accuracy of the device.

The actual temperature sensing device is fragile and easily sustains damage so the makers normally encase it within a sealed protective cover normally made from metal or sometimes plastic.

This method of protecting the sensor means that in effect the temperature sensor is now measuring the temperature of the it's protective cover. This can seriously affect the speed at which the thermometer

can indicate changes in the temperature - any change in the environment has to first heat or cool the protective cover before the sensor will respond.

More expensive thermometers of this type use either a protective cover that has holes or slots to allow the air to circulate over the sensor or in some cases the cover is made from metal alloys that respond more quickly to changes in the surrounding air temperature.

Likewise where the maker has chosen to place the sensor inside the thermometer itself any changes within the environment may take additional time before being indicated by the thermometer as a change.

In both of the above cases, probe type thermometers the delay caused by the protective cover or internal placement of the sensor may mean that very rapid changes of temperature may not even be indicated at all and therefore not recorded by the investigator or person recording the measurements.

Location, Location, Location

The location chosen for the sensor probe also plays a critical part in the accuracy of the subsequent temperature measurements. If the probe is placed upon a surface then it will obviously measure the temperature of that surface as well as the air surrounding it. Some surfaces store or emit heat - a black surface for example may be warmer than a light coloured one. The material the surface is made from will also affect its temperature.

For the best results it is important when wanting to observe any changes in the air temperature to place the probe away from any surfaces that may affect the readings - a simple trick is to attach the probe using a small piece of Blu-Tac to the tip of a 1.5 metre garden cane - the cane can then be attached with tape to a camera tripod or similar item to hold it in position.

This allows measurements to be taken in the ‘free air’ space well away from any surfaces that may cause the reliability of the measurements to be affected.

Most thermometers of this type have a cable that is fixed in length usually between 0.5 and 1 metre. This may mean that some slight compromise may be needed when positioning the probe and the meter so that readings can be easily taken.

In many models of this type of thermometer the display is updated periodically depending on the model this can be from once per second to as much as once every 30 minutes. The ‘sampling rate’ is an important factor that needs to be considered when choosing and using this type - or indeed any type of thermometer. Temperature changes are associated with possible paranormal activity are often reported as being quite rapid in their nature. If the thermometer is only sampling at a slow rate - less than once every 1 - 10 seconds then it is likely that such changes may not be indicated at all by the thermometer. However, for general use a sampling rate of around once every 10 - 30 seconds is usually adequate for baseline observations to be made.

Direct Reading Digital Thermocouple (T/C) Thermometer

Slightly more expensive although similar in appearance to the thermistor probe type, the temperature is recorded via a thermocouple at the end of a cable or wire. A thermocouple is made from two dissimilar metals or metal alloys. As the junction between the two metals changes temperature a voltage is produced that is directly related to the temperature at the bi-metal junction.

Accuracy is normally better than 1% for general models increasing to an accuracy of around 0.1% for models costing around £100. These thermometers are capable of rapid sampling rates - most models update their display between 1 - 10 seconds whilst some of the more expensive models have a sample

rate of 10 - 50 times every second, allowing the user to see even the smallest changes in temperature. Battery life is normally excellent and whilst they are often slightly larger than the 'probe' type models they are still easily portable meaning they can be placed close to any areas of interest. An additional benefit of this type of thermometer is that extra thermocouples may be obtained fairly easily to any required length - up to around 50 metres or more. Thermocouples can also be easily made in a couple of minutes by anyone who can use a soldering iron. Rolls of special T/C wire are available from a number of suppliers and works out to be quite inexpensive. This has the added advantage that T/C's can be easily replaced if they get broken or damaged during use.

In most cases the readings from these types of thermometer need to be taken manually although there are models that can store many thousands of measurements to an internal memory for later reading with a computer.

Some models have a MAX / MIN mode or other additional modes that allows the user to easily see the limits of any temperature changes during an investigation session.

The increased accuracy and faster response and sampling rates make this type of thermometer an extremely useful tool for measuring temperature changes with a greater degree of accuracy. It is also a better type of meter for recording rapid fluctuations of temperature, often a feature of paranormal reports.

Limitations of Use

This type of thermometer addresses many of the weaknesses of the 'probe' thermometer described earlier. However, some makers save money by using a slower sampling rate for the display. The T/C thermometer is capable of measuring the most rapid fluctuations of temperature in the surrounding environment, when selecting a device of this type it is essential that you choose one where the manufacturer hasn't then opted for a low sample rate (less than once / second).

Location of the sensor - the T/C junction at the end of the wire is just as critical as with the probe type thermometers, perhaps more so as this method is potentially even more accurate and it would be a shame to lose that extra accuracy by poor sighting of the sensor T/C junction.

The same methods can be employed to help with placement of the sensor junction and the ability to have cables made to custom lengths means that optimal sensor positioning can be accomplished while still having the meter itself in the most suitable place for taking readings.

The thermocouple wires themselves are thin and although they are quite resilient they can get damaged more easily than the thermistor probe cables that tend to be thicker and more flexible. Extra premade T/C's are normally easily available from some of the electronic component suppliers such as RS and Maplin. The special bi-metal cables are also readily available on rolls of various lengths together with the industry standard small two pin T/C plug used by just about every manufacturer that makes this type of device. Anyone who can use a soldering iron can quickly make a T/C in a couple of minutes to any length they may require. Using simple techniques even a fixed length T/C wire can be extended to several metres in a few minutes.

One thing that must be taken into account when ordering or making up extra T/C's is the type of T/C it is. The meter's electronics will normally be calibrated for a specific type of T/C - the most frequent being the Type-K. There are many other types of T/C available depending upon the temperature range that is being measured and the degree of accuracy that is required. It is important therefore to specify the correct type of T/C for your meter when ordering replacements.

The manufacturer always clearly indicates either on the meter or in the instruction manual which type of T/C is needed.

Indirect (Non-Contact) Reading Thermometers

These take a number of forms, most often in the form of a ‘gun type’ device.

Some models have an additional laser pointer to allow the user to more accurately aim it and take temperature measurements from an area of interest.

The temperature is recorded via an Infrared sensitive diode behind a lens; many objects emit Infrared energy, the hotter the object the more IR energy is given off and vice versa. This principle is used by the non-contact thermometer to indicate the temperature of the object. Accuracy is normally better than 2% of the reading and the display updates 4 - 10 times every minute, some more expensive models have a continuously updating display allowing the user to see even the smallest changes in temperature.

Battery life is usually excellent and most models have a backlit and the ability to quickly change the units of measurement between Celsius and Fahrenheit. Some also have the ability to provide useful additional information such as Average, MAX / MIN indications.

Portable and easy to use they do however have some limitations for paranormal work.

Smaller ‘pocket size’ models are available and are in normally every bit as accurate and as useful as the larger models.

Limitations of Use

Contrary to most peoples perception of the way these thermometers work they DO NOT use the Laser light as a means of measuring the temperature of a surface or object. The laser is ONLY there to help the user aim the sensor window at the area of interest that is to be measured. This type of thermometer relies upon Infra Red energy being emitted from a solid surface they cannot detect cold or hot spots in the middle of a room . The IR energy is then collected by a lens that focuses the IR energy onto a sensor behind it. The same principle is used by PIR motion detectors of the type found in many home security systems.

They can also be affected by smoke or misty conditions that block the IR energy from reaching the sensor.

To ensure maximum accuracy and reliability of the measurements the IR sensor also needs to be ‘calibrated’ to the correct IR emission value of the surface being measured. This is called Emissivity. The majority of solid objects have an emissivity value of around 0.95. However, surfaces that are highly reflective or unusually dull may have a higher or lower value. The material that an object is made from can also affect its emissivity value. In turn this can affect the accuracy of the temperature readings unless the thermometer is re-calibrated to the correct emissivity value.

Some models of non-contact thermometer allow the user to alter this value and in many cases the maker also supplies charts with the emissivity values for many common materials to assist the user with setting up their machine.

If however, you own a thermometer that only permits readings to taken at a fixed (0.95) emissivity value then you should be aware that the indicated temperature will sometimes be a degree or two less accurate depending upon the type of material or surface that is being measured.

A more serious limitation is range or distance from the object being measured. The IR sensor window works like any lens - the further an object is away from the lens the more of the object is seen by it but the less clear it becomes.

Thus the further away you are from the object whose temperature you are seeking to measure, the less accurate the resulting indication will be and the greater the area will be 'seen' by the sensor.

Currently most thermometers of this type have a small diagram on the meter itself that shows the optimal distance and measured area as a series of scales. Unless one is paying several hundreds of pounds for your thermometer most will not be at all accurate at distances of more than 1.5 - 2 metres. At this distance the sensor will be 'seeing' and measuring a circular area of around 2 metres diameter. It is clear then that small hot or cold spots will simply be 'averaged' by the sensor and will not be noticed by the user. The manufacturers recommend that all measurements be taken from as close as possible and therefore as small a target area to maximise the accuracy and reliability of the subsequent measurements.

Recently some makers have started to help the user by placing a special lens over the laser aiming aid. This causes the laser to project a circle of light that corresponds to the view of the sensor window - anything within the circle is being seen and measured by the sensor. This simple addition greatly increases the accuracy and repeatability of the any measurements that are made. It still needs to be taken into account that no object more than 2 metres away can be measured with any real accuracy although a general indication of temperature values may be obtained by users working with a good knowledge of the equipment limitations.

Readings normally need to be taken manually; most often a button is pressed and held whilst the temperature of the surface is continuously indicated. Holding the button whilst slowly 'scanning' a surface for regions that are at a different temperature is easily and accurately done with a little practise. Some models even allow the user to take measurements for up to an hour then displaying the Average, Max and Min temperatures for that period. This can be suitable for observing transient temperature changes or for noting any temperature changes to 'trigger' objects without touching them or attaching a probe or T/C to them.

With careful use, the limitations can be easily worked around and the non-contact thermometer is a most useful addition to any paranormal investigators kit box.

Datalogger Thermometers

These extremely useful devices allow the investigator to obtain temperature information over a period of time and provide an excellent baseline set of measurements to compare other instrument readings against.

Simple to use, most models simply plug into the USB port of any PC or laptop.

The software then allows the investigator to set various parameters such as how often the temperature is recorded and what time to commence recording - this means they can be set-up prior to the investigation and there is no need to have a computer available during the investigation - handy as not everyone has access to a laptop or doesn't want the hassle of taking a full size PC with them.

Small - about the size of a marker pen and very portable they can be placed in any area of interest. Battery life is excellent - some models claim to have a battery life of a year before it needs to be changed! At the completion of the investigation period the device is simply plugged back into the PC or laptop and the data is presented as a graph of temperature / time or may be printed as a text file. The data may also be imported into other programs such as MS Excel.

In use, the user can set many of the features of the data logger via the software - this includes the sample rate - from 10secs to many hours. Alarms can be set to notify the user of high or low temperatures - this is normally via coloured LED's on the device that flash to tell the user an alarm value has been exceeded. The starting time can be set too. Most current models can take up to around 16,000

readings before the memory is filled. This translates into about 45 hours at the highest sample rate to periods of many weeks at lower sampling rates.

The case of many temperature data loggers is also weatherproof or waterproof meaning that they can safely be left in damp or inhospitable places or even outdoors.

Basic models record the temperature. For a few pounds more there are models with additional features such as the ability to record the temperature and the humidity.

Temperature data loggers are an excellent method of recording and establishing a set of baseline measurements for a location, they save the often laborious manual recording of data every few minutes and for that reason they are essential items of kit for the paranormal investigator.

Limitations of Use

The first problem is that currently most of the temperature data loggers require Windows as an operating system and there are currently none easily available for MAC or LINUX operating systems. This is due to change in the near future though.

Because they also use the USB port to make a connection to the device they are difficult to make work with Windows 95 and some Windows 98 PC's.

Drivers are supplied for Windows 98SE and above but you still may need to have your Windows disc available when installing the software.

The sensor, which is a Thermistor, is internal to the device and is therefore partially shielded from the environment by the device. In practise this means that they cannot reliably record temperature changes more frequently that once every 10 seconds.

This makes them ideal for establishing a baseline but they have limitations when one is attempting to measure rapid fluctuations in temperature.

The user must take care when setting up the device too - the time is taken from the PC's internal clock and if this is incorrectly set then so will the time on the data logger. The user is able to programme a start time in advance - the device then turns itself on at the allotted time. It then runs until the memory is full or until it is plugged back into a PC and turned off.

If you remove the device at the end of an investigation you need to record the time it was taken from its position - it will continue to record the temperature regardless of whether it is in your hand, pocket or bag and that may be confusing if you did not note the time it was taken out of the investigation location. The data loggers usually use a small Lithium battery that allow it has a long life can be quite difficult to find - it is not a type that is normally stocked by most high street stores. They are available from suppliers like Maplin and RS and it may be worth having a spare battery or two just in case. They cost around £5 or less.

Analogue Thermometers

This group of thermometers include all of the old favourites - the Mercury in glass and coloured liquid (alcohol or water) in glass types. In both types the liquid expands as it warms or contracts as it cools. The liquid is allowed to expand and contract within a thin glass tube and the temperature can be read off a scale at the point where the top of the liquid column reaches. Some models have small metal or plastic 'floats' that move with the liquid and can record the maximum and minimum temperatures reached during any period of time.

Such thermometers are normally very accurate and are still used in scientific studies where critical temperature measurement is required, they have an advantage of being readily available for the domestic market and are normally low in cost.

Analogue thermometers also include those that use a Bi-metal strip attached to a pointer on a scale. These use the principle that different metals expand and contract at different rates depending upon the temperature - the expansion gap in rail lines is another example of this principle. The temperature is read from position of the attached pointer moving over a calibrated scale. These type of thermometers are becoming rarer and less used nowadays but can still be found for some scientific and domestic markets.

Limitations of Use

The major problem with all analogue thermometers are the fact that the user needs to take additional care whenever they take a reading. Unless one is careful to align the top of the liquid column or the tip of the pointer with their respective scales then it is easy to be several degrees out with the measurement. Some models try to get around this problem by placing alignment mirrors behind the scale to help visual alignment.

The second major drawback with these types of thermometer are the fact that they are often quite fragile when compared to their electronic stable mates. The glass tubes easily break when dropped and the bi-metal strip is often attached to the pointer by a number of mechanical linkages that may be damaged or become dirty preventing proper movement to take place.

Temperature changes may not be registered quickly on some types of analogue thermometer or small changes may even go unnoticed by the user.

With care and due attention these thermometers still have a useful place with the paranormal investigators tool kit. Particularly for the establishing of baseline observations prior to and during an investigation. Their low cost may permit several to be used for the same cost as one more expensive digital model and for investigators on a budget they should not be ignored as a serious option.

Other Types of Thermometer

There are several other types of thermometer available such as the Optical Pyrometer but these tend to be for highly specialised roles or extremes of temperature and they are unlikely to find their way into any paranormal investigation kit. Therefore they will not be discussed within this article.

In Conclusion

Thermometers are amongst the most widely used and perhaps the most immediately useful of all the tools available to the paranormal investigator. Temperature changes are often reported by many witnesses as a component of their experience. Sometimes this may be a subjective experience and when measured, the temperature is found not to have changed at all, but without the ability to accurately measure temperature this information is lost to the investigator.

To accurately measure the temperature within a location it is necessary to have the right tools for the job and this means that every investigator should have more than one type of thermometer for the different tasks.

Baseline measurements need to be taken over the full duration of the investigation and a data logger can avoid the time consuming necessity of making perhaps many tens or even hundreds of manual readings. For the accurate measurement of rapid temperature changes a Thermocouple type device may be the better choice as they can respond to temperature changes several times every second.

Some Thermistor probe models have high sample rates that make them suitable too.

Don't neglect the outside temperature too - the temperature outside any location will have an effect on the temperature inside. There are several models of probe thermometer that have a weather-proof probe attached to the meter via a length of cable, these allow the user to remain inside whilst observing the external temperature.

For even more reliability the USB temperature dataloggers are supplied with a water-proof cover allowing them to be safely positioned out of doors to collect the data effortlessly.

When one is looking for areas where the surface temperature may be hotter or cooler than the surroundings a non-contact thermometer is the best choice, a user can quickly locate such areas by sweeping the device around the location.

All thermometers must be used correctly and the manufacturers instructions should be read and the device used in accordance with them. The limitations of use need to be understood too and the user should use that information to carefully select the right thermometer for the task.

Thermometers, like all items of equipment can malfunction and if any usual measurements are obtained then the user needs to be sure that the thermometer is working correctly. As an example - some models of non-contact thermometer give extremely low readings for a few seconds then return to normal before dropping suddenly again as the battery starts to go flat - this can be before any low battery warning is indicated on the display. This may appear to be exactly what the investigator is looking for. However it is simply time to change the battery and not evidence of paranormal activity. One quick way to check for a malfunction is to use a second thermometer to compare the reading with the suspect device.

If the probe or thermocouple is placed onto a warm or cold surface then again the temperature readings may appear unusually high or low, probe and T/C position is very important.

Accuracy of Your Measurements

One final point to bear in mind is that unless you are paying a great deal of money for a calibrated or 'reference' thermometer then you will often find that two thermometers - even of the same make and model placed side by side will read differently by one or two degrees. This is normal and simply a function of the electronic processing circuitry. Most models are stated to be accurate to within a degree or two. Thus if the actual temperature is 20c one thermometer may read 21c whilst another identical model may show 19c. Both are within the specified accuracy but the readings are 2 degrees apart. This is not a fault and it is something that every investigator using more than one thermometer will encounter.

Simple Calibration of your Thermometers

A simple solution is to place all the thermometers into a small chamber such as an airing cupboard. Take one thermometer (usually your most expensive) and nominate it as your reference thermometer - marking it as such with a waterproof label is a good idea.

Raise the temperature of the chamber till it reads 20c on your reference thermometer (any value close to this will do in reality). Leave ALL the thermometers in the chamber for at least 30 minutes - an hour is even better. Now check the displayed temperature on each thermometer in turn and write down the results.

Place a label on each thermometer showing by how many degrees plus or minus it differed from the displayed value of your reference thermometer. They are now calibrated relative to one another and each time you read the display for any thermometer you can add or subtract the calibration amount to get the actual temperature. The process can be repeated from time to time to check that the each

thermometer is performing to the expected standard.

The above process does not provide a true calibration of course but is a good way of removing those annoying little variations that occur between even identical models.

The technique also allows the user to spot any thermometers that are not functioning as they should be - most of the thermometers on test should be showing a measurement within a degree or two of the reference anyway - if they’re not then they may need some attention or repair.

Full calibration is an involved process that really isn’t required for general investigative use.