

Environmental Monitoring and Control for All

Museums realise that monitoring the environment within their building for relative humidity and temperature is important but many individuals are bewildered by the wide range of equipment available and are not sure about what approach to take. This article will take a pragmatic approach to monitoring and explore the options open to all museums from the smallest volunteer run museum to the large nationals.

All museums have one thing in common - a lack of budget for environmental monitoring. So what are the options?

Electronic humidity and temperature sensors these days are very accurate and stable and are more than capable of performing well in a museum environment over many years. Calibration and accuracy are therefore less of an issue for museums than it used to be. Museums are also not so worried about whether the relative humidity is 58%rh or 60%rh, rather whether it is stable and how fast it is changing. Accuracy should therefore not dominate users selection process when they look at what to buy.

Low cost meters (min/max)

Simple relative humidity and temperature displays start from just £19.50, this sort of money would buy you a HK55 display that you could pop into displays cases, galleries and stores to see what is going on. Staff and /or volunteers could write down readings on a regular basis to build up a picture of what is happening in those areas.



One of the major developments in this field of measurement over the past couple of years has been the way that the major manufacturers have introduced their best sensors into meters that cost just a fraction of what

they were charging just a few years ago. One of the best examples of this is



the Testo 608 range that uses Testo's excellent industrial sensor and a large clear display with a minimum and maximum facility from just £48.40.

These have the added advantage of providing minimum and maximum readings since it was last reset which enables users to see what fluctuations have happened since they last took a reading.

Already one can see how even the smallest museum can afford to monitor and collect data for several locations for just a small investment.

One issue that often arises with min/max meters is their use in display cases as you either have to open the case to take readings which is not desirable from a security and cleaning point of view or you have to forsake the min/max readings and just use the display.

Dataloggers

Periodic readings are fine but the most interesting data comes from equipment that allows you to monitor the conditions continuously 24 hours a day, 7 days a week. This type of comprehensive data will show you the fluctuations that happen when the museum is closed, when it opens, when there is a function and when the heating turns on or off. The simplest way to collect this data is with a datalogger. Prices for which have tumbled over the past ten years.



The Tinytag Ultra 2 logger offers continuous temperature and relative humidity monitoring for just £99. The Tinytag range also includes a logger with a display (Tinytag View2) giving the best of both worlds for £165. The Tinytag range

has led the development of low cost, small loggers in the UK throughout the 90's and into this Century. It is nice to note that



this is a British company leading the way in a very competitive market place.

The new range of Testo loggers is again an example of putting an industrial quality sensor into a low cost, miniature package. One of the nice features of the Testo range is that they all come with a rubber jacket, which means they will withstand being dropped.

The Kimo loggers from France can monitor temperature, humidity and lux – or any combination of the three. The KH100 even has a display which show the current temperature and humidity reading. This triple sensor model costs from just £147.

Button loggers are small and discreet enough to monitor in any display case



and at just £75 per logger with the basic graphing software provided free of charge these offer an excellent start for logging on a small budget.

Downloading loggers

Both Tinytag, Testo and Kimo have confronted the problem that establishments with many loggers face, the time it takes to download all of the loggers and transfer the data to a computer. Testo and Kimo have done this with a small memory stick or handheld device that downloads the data in



seconds from a logger and then resets it to start collecting data again. The memory stick can then be connected to the computer and the data from all of the loggers downloaded in one go. Tinytag get around this problem by providing a

version of their software for the Palm PDA's. The Palm has all of the functions of the computer software but is obviously a lot easier to carry than a notebook computer and saves a lot of time against taking each logger back to a desktop computer. When required the data from the Palm can be downloaded to a computer.

Dataloggers and display cases

Another problem that datalogger users face is the same problem that was raised earlier with regard to min/max meters and displays cases, accessing the data without disturbing the case. With the Tinytag the serial cable is only £5 and therefore it is not unreasonable to suggest that one buys a serial cable for every logger and leaves it permanently attached to the logger. The lead can be positioned in the case so that it can be accessed without requiring the case to be opened or maybe just access the cable through the facility tray in the bottom of the case.

For £185.00 you can purchase a Tinyview fitted with an external sensor on the end of a cable which is perfect for placing the sensor inside a display case while the logger remains outside for easy access.

HygroClip

If the above solution does not suit then this is one of the areas that museums start to look at manufacturers like Rotronic who are known for their quality and adaptability. A few years ago Rotronic launched the HygroClip range, which radically improved the way that users could monitor, and control. The HygroClip is a humidity and temperature probe that can be interchanged with numerous products without the need for set up or calibration. The range of products that a HygroClip can be used with includes hand-helds, dataloggers, controllers, transmitters, radio telemetry systems, Building Management Systems and Conservation Heating Humidistats. This means that when



required a museum can move the probe between products, which can save both on acquisition costs and downtime if a probe is broken. The HygroClip comes in a wide range of shapes and sizes from 3mm diameter upwards and as well as being interchangeable between products it is just as simple to add a HygroClip cable. This means that if you want to separate the HygroClip from its logger in a case with a 2-metre cable for example this can be done in seconds.

Reference hand-held

The one instrument that is universally useful for all establishments is the reference hand held. An instrument that you can really trust, one that can be used to check other instruments, to take spot check readings quickly and reliably and is simple to calibrate against a known source. Monitoring is all very well but if you are collecting the wrong data due to poor calibration and accuracy or are unable to prove that you are correct to institutions that are lending you material and maybe doubt your conditions then you have a problem.

You need a hand-held that when you take it into a space to take a measurement it will reach temperature and humidity equilibrium and give you the right reading before the user gets bored and moves on to the next space. Some hand-helds require 45-60 minutes to reach equilibrium and are therefore not suitable. Five minutes is what you should be looking for but standing in a gallery and waiting for 5 minutes can still seem like a lifetime. This is where the Rotronic HygroPalm with its HygroClip sensor has an advantage. On its display arrows appear to tell you when the temperature and humidity have reached equilibrium, the user therefore knows that he must not take the reading until the arrows tell him that it is safe to do so.



Calibration

The other issue for a hand held is the ability to calibrate other instruments. Although we have yet to discuss their use because sales of new hair dials and hair thermohygrographs are in decline there are thousands of them in use in museums across the world. These types of instruments use human hair to make their measurements with the expansion and contraction of the hair moving a needle either on a gauge or a chart. This process is very delicate and should be calibrated every time it is moved and certainly every time a chart is changed. The calibration should be noted directly onto the chart paper. The hand held instrument is very useful for calibrating these types of equipment.

As a way of emphasising just how important calibration is I can tell you that the Victoria and Albert Museum for years used conservation students to regularly change the charts on their many hair thermohygrographs. When the current head of the Science Section arrived at the museum he reviewed the charts and saw that there was no reference on the charts relating to the calibration history. Upon investigation it became clear that there was no documented history at all for the calibration of the thermohygrographs. Such is the unreliable nature of the hair thermohygrographs that the charts for the previous 10 years were all destroyed.

Most of the electronic instruments that we mentioned at the start of this article for monitoring the minimum and maximum readings or the dataloggers do not have external probes so that you can attach a calibration standard directly to them and check them. Although they are very accurate and far better than probes used to be it is always best to check them once a year so that you know how accurate they are and you have a documented history to show any doubters.

A simple solution is to buy a fish tank, fill it with a magnesium nitrate mixed with distilled water (take the water direct from your dehumidifier!), make a platform from chicken wire and place the probes inside sealing the top of the tank with cling film. This provides a low cost calibration chamber into which your probes can be inserted along with your hand-held reference. The magnesium nitrate, depending on the amount of water you have added, will create an environment with relative humidity of around 53%rh, perfect for museum conditions. Leave the instruments together for a day and then make a note of how accurate each one is against the reference hand-held.

Calibrating the reference

If we are to trust our reference instrument then we need to calibrate it against something slightly more sophisticated and be able to adjust it if required.



Again this is an area that Rotronic are much stronger than their rivals. For example the HygroPalm can calibrate all of the HygroClip probes that a museum might have. Attach the HygroClip to the HygroPalm and push a calibration chamber



over the Clip (which is available from Rotronic and is therefore a perfect fit). Insert one of the traceable calibration standards into the chamber and press the calibration button on the HygroPalm. The HygroPalm will then test the Clip and tell you how accurate it is and give you the option for adjustment if you want it. If calibration is required then the HygroPalm will do the adjustments thereby ensuring that no mistakes are made. It is possible to use the HygroLog datalogger as a reference as it is available with a display and can be calibrated using the Rotronic computer software. The software has the advantage of storing the results of the calibration using the digital signature of the HygroClip and producing a calibration certificate if required. The investment in the special calibration chamber for the Clip and the standards need not cost more than £100 at the most, and this is enough for 5 years of calibration for one Clip. The chamber makes up almost half this cost and is a solid lump of stainless steel that will last forever. The calibration standards are traceable to the National Standard in either Britain or Switzerland and cost £25 for a pack of five.

Radio Telemetry



Moving upwards in price and sophistication we come to the radio telemetry system that was first installed by the Victoria and Albert Museum using a meaco radio system in the early 1990's. This type of system allows you to monitor relative humidity,

temperature, light and UV and visitor numbers with all of the data being collected via radio and loaded onto a computer automatically.

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This method saves the users a lot of time in data collection as the data comes to him/her. As the data tends to be transmitted every 15 minutes it means that the users can spot any alarming changes in conditions much more quickly. This type of system has now been installed in hundreds of museums across Europe and is now becoming the norm. In larger establishments or organisations with more than one site radio is unable to travel the distance between the transmitter location and the receiver. This problem is overcome by using the IT network that has become the norm in most organisations in recent years. Radio receivers local to the transmitters can be plugged into local network points and the data downloaded into the users computer across the network just as easily as if it was connected directly to it. Several receivers could be positioned across the network to cover very large sites.

Damp monitoring

Damp can be a real problem - especially in stores which often aren't always in the most suitable of places. There are several methods of testing surface humidity with either a handheld meter such as the Testo 606 (£135.00) or with an electronic indicator such as the Dampguard (£55.00) which uses LED lights to indicate the surface humidity levels.



These devices do not measure air humidity but do measure the humidity level on surfaces such as walls to provide an alert to possible damp problems.

Dry Rot can be monitored using simple monitors that are placed within a small hole made in the timber or masonry to be monitored. The sensor is a simple to install treated wooden dowel that changes colour, from blue to yellow, in the presence of incipient Dry Rot



Control

Collecting all of this data is great but what about control? For the vast majority of museums with control it will either be passive, portable humidifiers, portable dehumidifiers or conservation heating.

Passive

This can mean the use of silica gel or Artsorb to condition a display case or simply buying a very well sealed case and closing it when the conditions are correct and not opening it again (for as long as possible). A new development in this area is the use of the electronic silica gel cassette. These units are filled with silica gel and have a tiny amount of self-indicating silica gel in a clear display window. When the gel needs to be recharged you remove the cassette, plug it into the mains over night and then put it back into the display case the next day. This system can be recharged thousands of times and is a lot less messy than other techniques. The self-indicating gel was very popular with museums because you knew exactly when to recharge, that was until it was classified as being carcinogenic. These new cassettes use a tiny and safe amount of the gel behind a sealed window. In the next few years they should be available with the new forms of self indicating gel that are currently being developed that are 100% safe.

Dehumidifiers

There are two types of dehumidifiers available to museums - refrigerant and desiccant. By far the most popular is the refrigerant type. This is because they are cheaper, more widely available, easier to install and easier to handle. A refrigerant dehumidifier draws the air from the space in over a set of cooling coils, this reduces the temperature of the air until the available water condenses and drips into a bucket. The air is then reheated back to room temperature and blown into the space. These machines start from as little as £125.00 (though museums would tend to ignore the cheaper models without



humidistats) and come in portable and wall mounted versions. The collected water can either be emptied manually or drained away continuously via a hosepipe. Always look for a dehumidifier with a humidistat (these start from £300.00) so you know what relative humidity your dehumidifier is drying down to.

Desiccant dehumidifiers

Desiccant dehumidifiers tend to be used in larger spaces, or metals stores where the relative humidity needs to be lower (refrigerant machines cannot dry below 35%rh). They are also more efficient at drying in low temperatures. This type of dehumidifier works by drawing air over a wheel that contains a desiccant to dry the air. You end up with part of the wheel dry and part of the wheel moist. In order to dry the moist section of the wheel hot air is blown through this section and needs to be discharged somewhere. Some desiccant dehumidifiers therefore needed to be ducted not only for the air coming into them from the gallery but also the air going back into the space and the excess, hot, damp air to be exhausted somewhere outside of the building. Newer models are more self contained and the warm air given out can be very useful in cold and damp stores

Prices start from £300.00 and then go up from there; an average gallery would cost around £6000 plus installation.

Evaporative Humidifiers



Evaporative humidifiers are very common in museums and are the only type of humidifier completely safe to use in a gallery situation from both a humidification and a health and safety point of view. The evaporative humidifier works by dripping water over a filter to make it wet. Air is drawn in from the space over the wet filter and then back into the space, this humidifies the air. It is a very simple process. Humidifiers do though need a lot of maintenance especially in hard water areas as lime scale will form all over the machine and if the water is not

changed at least once a month bacteria will form in the tank. Humidifiers can also start to smell if sunlight gets to the water, as algae will form. Evaporative humidifiers are though not a source of the legionella disease that many worry about. Legionella can only be transmitted through droplets of contaminated water that are then inhaled. Evaporative humidifiers do not give off droplets of water and are therefore not a source.

Evaporative humidifiers start at £165.00 and can go up to many thousands for large units though £1790.00 will buy you a machine that can control 1000 cubic metres and that is ample for most.

Conservation Heating

Conservation Heating is a technique that has been in use in museums and historic houses for numerous years to control the relative humidity in a room via the heating system or oil filled portable radiators. The idea is that when the humidity goes above a pre set level (say 60%rh) a heater is turned on, when the humidity falls as a result the heater is turned off.

If the temperature ever gets too low or too high (8°C or 18°C for example), then the heater is automatically turned on or off regardless of the humidity.

The advantage of such a system is that it provides humidity control and frost protection without the need for human intervention. This is particularly useful over the winter in stores or historic houses. Costs are around £360.00 for the humidistat plus the heater.

*All prices and model information given is for illustrative purposes only. For current prices and availability please contact Meaco Measurement and Control Limited.