

## ENVIRONMENTAL MANAGEMENT IN THE CONTEXT OF GNOMONICS

Clearly the elements impact sundials. Over the centuries, rain absorbs noxious chemicals and the resulting precipitation may erode the dial. However, taking a short term view of the situation, how can the elements of snow and ice be managed, which this article seeks to address.

In this day and age, few people seem to carry pocket watches. Thus by deduction, the populace is relying on the random placement of sundials for their guidance. Yet after an ice or snow storm, those very dials may be somewhat impractical. The clear responsibility lies on the diallist to ensure that their dials are not only clearly visible to that demographic group of the populace who have no pocket watches, but that those very dials be usable at all appropriate times.

As a rule, there are two main threats. One is snow, the other is ice. And there are two main methods to reduce their impact, one is preventative anti-icing, the other is remedial de-icing. Techniques for achieving this may include fans to blow air as an anti-snow measure, the use of ducted hot air for preventative and remedial measures, and similarly through the use of electricity. The use of chemical solutions is frowned upon since, unlike an airport where the excess falls on concrete or tarmac, in a garden the local soil climate may be damaged.

The author happens to have been in an earlier life a flight engineer on the B727, and later a pilot on the B737, and thus brings fresh insights to this perplexing problem. After all, at flight level 370, ice is an ongoing issue for the flight crew.

### WHAT IS THE PROBLEM

Issues exist for both the gnomon and the dial plate. A vertical dial usually has no significant dial plate snow or ice concerns. However, the sloped gnomon can build up accumulations thus displacing the style, having the effect of generating errors in the local apparent displayed time.

A horizontal dial has problems in addition to those faced by the vertical dial. First, the dial plate may become non-visible, the style may be distorted (as in the vertical dial), but worse still the nodus becomes elevated, thus distorting the apparent calendar information.

- Erroneous time information
- Erroneous date information

While erroneous time information has the effect of causing people to be late in the morning hours and early in the afternoon hours (for horizontal dials), assuming all garden dials in a village have the same snow and ice accretions, this will have little impact. The entire village would be late or early together.

However the incorrect calendar or date information is more insidious. First, the mere fact that ice and snow is visible creates mild disorientation, at least it does in the Sonora desert where the author resides. That phenomena is aggravated seriously by what is termed cognitive dissidence. Cognitive dissidence is the feeling of unease when the facts portrayed and the facts as demonstrated and determined are in disagreement. The villager, walking about, knows the approximate date, after all dates change slowly day by day compared to the time which changes by the second. When a villager knows the date but sees a different date on the dial, then cognitive dissidence is generated. This unease surfaces in the form of village riots.

### THE SOLUTION TO SNOWFALL

Snow accumulations on a dial may be marginalized through the use of an electric fan situated on the dial at the polar end so that it will not interfere with the shadows. This fan runs off a battery charged by a small solar panel, much like the safari hats with built in solar electric fans.

The triggering mechanism can be a temperature sensor in series with an accumulated weight switch. This prevents discharge of the battery during rain storms.

When the temperature is such that precipitation is likely to be snow, and some snow has fallen, then the circuit is complete and the fan blows from the pole to the equator thus diverting the snow from accumulating on the dial plate and gnomon.

## THE SOLUTION TO HEAVIER SNOW AND ICE

The forced air method is practical only in areas where snowfall is light, such as in the Sonora desert where the author resides. For heavy accumulations of snow, and for ice storms more aggressive methods must be employed.

The available tools are:-

- forced heated air
- electrical heating of the style and dial plate

As a flight engineer, one can pick up for very low cost an Auxiliary Power Unit (APU). Such an APU is a gas turbine which has many uses. Especially when a generator is still intact on the APU. The user must lay in a supply of jet-a fuel, however paraffin or diesel could also be used, and neither presents significant fire hazards. The APU is started with a heavy duty battery, typically a couple of large NiCad's. The starting current may run as high as 185 amps, thus cabling concerns must be considered. As the APU approaches an appropriate speed, the generator can be placed online to recharge the NiCad's and a separate battery bank for the use of an inverter whose AC output can be used for heating elements. Those generators can put out about 100 kw and thus an added benefit is the provision of power to neighboring houses. However grid tied applications require what are called anti-islanding circuitry and there may be a few building codes to consider. Being a gas turbine, the compressor stage provides very hot air that can be bled off and used not only as forced air, but also heated air. This can be ducted underground to each dial. However, the average diallist may not have access to surplus APUs, and further, they consume fuel. The following sections suggest more practical means.

Recalling that ice and snow may occur at night, and the dials need to be ready for use as soon as the sun rises, clearly any anti or de-ice system must store the energy to be used.

## FORCED HOT AIR

Air space heating panels can be acquired or built for little cost. A two stage system is employed whereby the air is circulated between the hot air panel and a heavily insulated box containing rocks of high specific heat, and whose optimal size is about that of a cricket ball or base ball, maybe a little smaller. The hot air goes in at one corner and is retrieved back to the source heater from a diametrical orifice. Blower power comes from a small solar photo-voltaic panel.

Insulated two way ducting is laid underground to all the affected dials, along with electrical wiring, care being taken to ensure compliance with building codes. At each dial a temperature sensor and accumulation sensor feedback information to a controller. When conditions are right, hot air is taken from the storage box and routed on demand to the appropriate dial.

At this point, careful engineering is required. For example, when using hot ducted air, some air is diverted to the gnomon, and some to the dial plate or hour lines. Ensuring sufficient flow to all elements is important.

## ELECTRICAL SYSTEMS

The use of electricity demands a re-visit to the days of Tesla and Edison. While the use of direct current, DC, obviates the need for an inverter, losses are significant for low voltages, and high voltages produce serious shock hazards. This is especially true for birds resting on a gnomon whose DC electrical insulation has become fragile. Edison loses, Tesla wins.

Modern inverters run at about 96% efficiency and generate pure sine wave electricity, although a modified square wave (sales people refer to that as modified sine wave, which it is not) is practical for heating tape. The use of AC is safer, more efficient and uses heating tape readily available in hardware stores. Solar photo-voltaic panels provide the source power, stored in batteries, using inverters to provide AC power, see next page.

The triggering mechanism can be a temperature sensor with no accumulation sensor, however, the sensor must shut off once an appropriate deicing temperature has been reached, thus generating a cycling effect. This has the benefit of reducing power consumption, as well as not creating difficulties for itinerant birds who may like to rest on gnomons.

## PHOTOGRAPHS OF DIALS



The gnomon has a metal style which sharpens the shadow, and hides beneath it an electrical tape. The result is that much less snow is seen on the style than on nearby supports.



A sundial on a mailbox where the dial plate is not deiced. The gnomon, interestingly enough, is clear of ice, however the hours are not visible. This generates mild temporal disorientation, but luckily no cognitive dissonance.



Unlike the horizontal dial whose dial plate is obscured by snow, a vertical dial plate is less susceptible to such a limitation.



The azimuth dial to the right is completely unusable, however since the gnomon is thin and vertical, de and anti icing measures are limited just to the dial plate.



Globe dials tend only to have icing problems at lower latitudes where icing is less of an issue, and at the upper latitudes the dial plate band tends to be vertical. Thus globe dials are somewhat less susceptible to ice and snow problems.

Similarly, astrolabes and the like, being portable and usually in a protective box obviously need no such protective measures.

## PHOTOGRAPHS OF SYSTEMS

Sadly, covered by snow, is the space heating panel. The space heating panels themselves need de-icing measures, and the back flow damper had failed. One cannot be too careful in backup and protective measures.



To the left is a charge controller taking 1 kw of electricity from solar panels to the batteries. Below are some deep cycle batteries holding about 2200 amp hours at 12 volts.



To the left is a modified square wave inverter as well as a pure sine wave inverter, this allows the AC to run the deicing elements on the gnomons and dial plates.

## USE THE ELEMENTS ~ DON'T FIGHT THEM

In our culture we seem to fight the elements, hence the need for de and anti-ice measures. However, every cloud has a silvery lining, every problem has its opportunities, and the elements are no exception. To the right is a sundial made from snow. The time is shown as shortly before 11, however the style has partially melted, extending the hour shadow from the un-melted part, a more accurate time is displayed. An equinox line is shown, not easily visible in the picture, and the nodus is almost to the equinox line. It is short of it due to partial nodus melting. What a wonderful way to spend time in the snow, with the entire family making a sundial!

