Genevac® Evaporation pure and simple

Not very Conductive at all

Microtitre plates do not conduct heat well at all. It should be said straight away; this is perhaps the most important aspect of a Microtitre plate (MTP), when it comes to drying samples. If they were made of aluminium, for example, things would be very different.

The implications of the poor conductivity are manifold:

- If you are using a safe approach to drying, (see next page) then you will need to conduct heat into the MTP from the swing. The shape of the MTP can play a crucial part in this. The contact between the individual wells and the swing will define how well heat flows into the MTP. (See page 4 for more details of how to optimise this)
- Samples will often dry at very different rates, based on positions in the MTP. In general, edge and corner wells dry first (because they have fewer cold neighbours as they are drying), centre wells dry last. In contrast, an aluminium block with several tubes in will sit at very much the same temperature all over the block because it is so conductive, and all tubes will dry in similar times (if they have similar substances in)
- Mixtures prone to freezing (e.g. HPLC fractions featuring a volatile solvent plus water, see February newsletter) will do so worst in a sample holder that has poor conductivity

Choose your next Microtitre plate carefully, Mr Bond.

Genevac are aware of more than one issue that has forced a customer to change MTP manufacturers.

In one case (and this has been observed at two different unrelated sites), TFA leaked through the base of the wells. It wasn't that the wells were perforated in any way - the very low surface tension and high acceleration of the solvent simply permitted it to pass through the plastic. This was proven, by placing filter paper between the plate and the swing and observing 96 spots where TFA had been in contact with the filter paper after a spell of centrifuging.

In another case, plasticiser leaching out of the plates into an aqueous solution contaminated an aqueous sample, slowing evaporation hugely. This was proven in the end by comparison with other plates and also by mass spectrometry of the "contaminated" water.

Of course, there are other things that affect the decision to buy a particular make of MTP:

- there might well be implications for other processes upstream or downstream of the drying operation
- you might be drying a solution where, at the end, the very last bit of solvent is hard to remove from the almost dry solid at the bottom of the well. In this case a flat bottomed well is better than a pointed or rounded well because the solid is spread over a wider area and forms a thinner layer from which the solvent needs to diffuse.
- see page 4 for another consideration which might affect your choice of which MTP to buy.

THE QUEEN'S AWARDS FOR ENTERPRISE

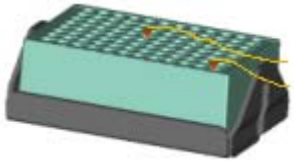
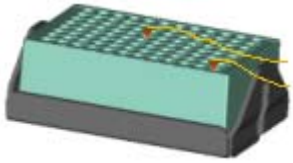
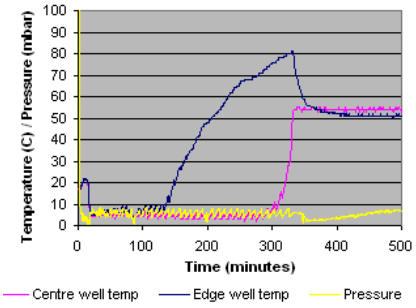
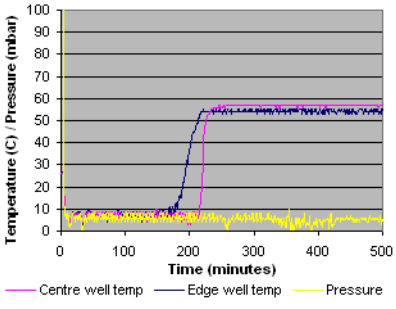
Never Shine Heat Lamps directly onto the MTP

Traditionally, samples in plates have been dried in centrifugal evaporators, using a holder with no base, so the infrared heat lamps would shine straight onto the base of the Microtitre plate. At first sight this may seem a good idea because the heat gets straight to where it is needed. Some Genevac users still use this approach (perhaps because the benefits of the alternative have not been fully explained).

There are a number of reasons why this is not the best way:

- If the compounds within the plate are sensitive to UV and your evaporator is not equipped with means to filter the harmful wavelengths, exposing your compounds directly in the path of the UV source for hours at a time could be harmful.
- If the heat is falling directly on the plate, proper temperature control is impossible
  - You have nowhere to insert a temperature probe in an MTP (if you're using a Genevac HT Series II)
  - The PIR temperature sensor expects to see the floor of a metal swing (if you have a Genevac DD-4) and so when looking at plastic will report incorrect temperatures
  - Measuring the temperature of the swing is meaningless as the MTP might well be hotter (since it does not receive its heat from the swing, but directly from the lamps)
  - Controlling the process by measuring the sample is unsafe because temperature will overshoot at the end due to the energy stored in the MTP
- (most importantly) if lamp heat is still being applied and any one sample dries, the dry well can reach very high temperatures because there is no boiling solvent to take away the heat that is being supplied directly to it from the lamps

This last one is absolutely crucial. Using Genevac's onboard temperature measurement, it is possible to study just how bad this approach really is, and how much safer the recommended approach is.

Open bottomed swing	Swing with a base
	
Lamps shine directly on base of microtitre plate Full lamp power until central well is dry, NO temp control	**Samples protected by intermediate metal "floor" in sample holder** Max Temperature controlled at 55°C.
	
Drying Slow, samples damaged	**Drying faster, samples safe**

The same principle applies to any sample holder where the light can shine directly onto something other than the base of the swing. For example, years ago it was considered appropriate to have a tube holder, which was a quite open, rack and which exposed the base of each tube to the IR lamp heat.

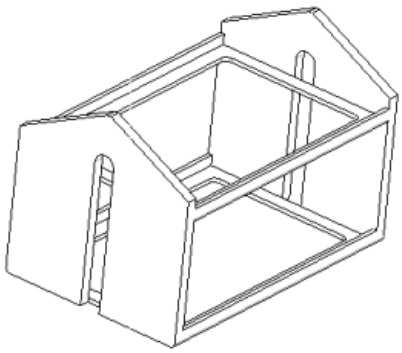
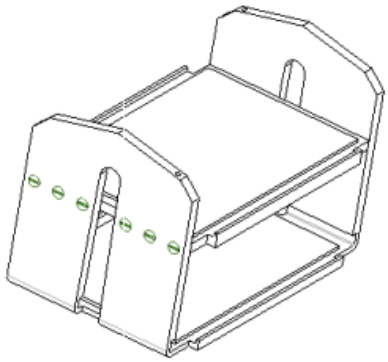
Particularly in view of samples drying at varying rates (HPLC samples a very relevant example of this), this is now known not to be appropriate at all. To use something like this safely, you have to turn off ALL lamp heat before any of the samples are dry, which is a very difficult thing to judge.

Now, if you have been using open swings like this in your Genevac Series II because you never realised, then see page 4 for what you might want to do differently.

Multiple Plates in a Single Position

Each position in a DD-4, HT-4, HT-8 or HT-12 can accept two deep-well MTPs or 4 shallow-well MTPs.
This is using a "FastStack" swing (pictured below right). It is an important principle (US and Worldwide patent applications pending) that the MTP is heated by conduction of heat from the swing, not from direct radiant heat.

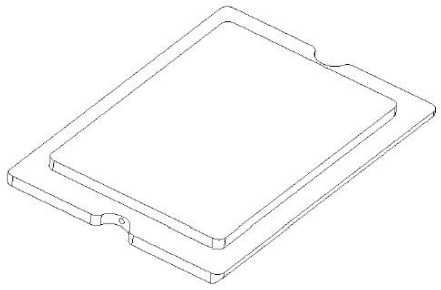
The comparison below shows the difference between an "open" based swing and one intended to heat by conduction.

System relying on radiant heat shining directly onto MTPs	Genevac system, conduction of heat from swing to MTP
	
Traditional 2 MTP Swing • Samples exposed to direct IR. • MTPs heated by direct radiation. • No meaningful temperature control. • Sample temperature can be VERY HIGH when dry • Upper MTP in shadow of lower so very slow to dry.	**Genevac "Deep Well FastStack" Swing** • Samples shielded from direct IR. • MTPs heated by conduction, upper samples dry soon after lower • Closed loop temperature control is meaningful • Optimum sample temperature when evaporating. • Maximum sample temperature controlled throughout.

As you can see, the swing design on the left is likely to cause heat damage to potentially thermolabile samples on the lower plate and extremely slow drying of the upper plate.

How to Run Plates in a Standard Open Swing

If you have been using an open swing for your plates and then on reading this document you've realised its not the best way, help is at hand.
If you look at the Genevac Accessories catalogue (available from the Genevac website, in PDF form) you'll find the following on page 16. The right hand column gives the part number.

	Provides an even sample drying condition. Max foot-print: 128.0 x 86.5 (mm) Mass = 200g	**10-1270**

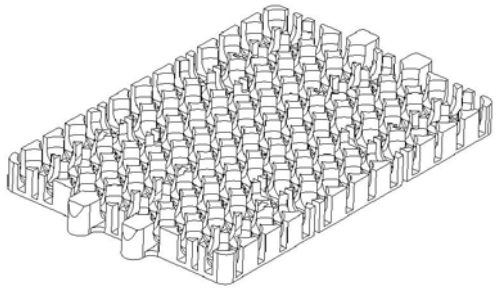
The item pictured sits in the standard swing beneath the MTP and allows safe drying. There is a hole for the thermocouple to be fitted. This means you have safe drying and good temperature control.

Another alternative is to replace the standard open swing with the "FastStack" deepwell swing type. Not only do these ensure safe drying (see previous page) but they also allow you to dry twice as many plates as the standard (open) swing.

Increasing the Conductivity

The problem of poor conductivity between the sample swing and the MTP is something that can be rectified. Genevac have a unique system of "heat transfer plates" (US and Worldwide patent applications pending), which can be inserted below the MTP, and which increase hugely the flow of heat. Drying times can be in some cases **halved**, such is the improvement.

The following shows another extract from the Genevac Accessories Brochure. It shows a "heat transfer plate" to be placed beneath an MTP.

	Compatible with: Axygen 2ml x 96 O Greiner 1ml x 96 O Nunc 2ml x 96 O Nunc 1ml x 96 O Whatman 1ml x 96 O	**10-1182**

The one pictured is for use in a FastStack deepwell swing (which means two are required for each swing). Note that all the shaped inserts are available in two forms. In the form shown above or in a form appropriate for use in the standard open swing with one MTP.

NOTE: Only Available For Certain MTPs

Inserts have been developed for a small range of specific MTPs. There are a few variants in the catalogue, and each one is accompanied by a list of the specific brands it supports.
If you have a particular brand of plate that is not supported, then you might actually consider changing plate suppliers if drying times are important to you.

Even Drying

Not only do samples dry far faster in MTPs using these inserts, but similar samples dry at the same rate. This is particularly important if you want to speed things up by:

- running at a higher SampleGuard temperature for the first part of the run
- dropping down to the "safe" SampleGuard™ temperature before any of the samples are dry

Such a "2 stage" temperature approach is dangerous in plates without inserts because the range of drying times is so wide that it is hard to say for certain when the first one will be dry. And any that are dry when you are still at the "high" temperature may be overheated.