

Last month saw the premature death of Alan Dunn one of the most influential people in the development of the modern screen printing process. Alan was totally committed to process control and process improvement. His specialty was the production of high quality stretched mesh on robust frames. He knew that the foundation of the process was the correct mesh at the correct tension (that equated to elongation) mounted on a frame whose deformation was within acceptable tolerances. This applied to both Polyester and steel meshes. It is crucial to the continuing development of the screen printing process that we keep in mind the fundamentals when we use the process.

THE FRAME

The stability of the screen frame is of paramount importance to the performance of the finished stencil. Unstable frames will mean that tension will be lost, registration accuracy will be degraded and ink film thickness will vary. Simply the process would be out of control.

Even with the strongest frame when the mesh is tensioned and adhered to the frame, the frame will distort. The distortion will take the form of bowing along the length and a twist that will affect the flatness. It is the amount of distortion that is critical. If you were to take a frame 1 metre square the +/- tolerance on flatness should be 10% of off contact. Therefore if the off contact were 5mm the tolerance on flatness would be +/- 0.5 mm. The bow along the length should not exceed 50% of the off contact that is 2.5 mm. If your frame is distorted more than this the effects will be apparent in the print because the mesh will not release evenly from the tack of the ink and or the image will be distorted. If you are printing halftones this could result in moiré.

This rule will apply to most frames. Very large frames 3 metres upward will need you to make a judgement. The key aspect of distortion is the effect that it has on off contact. If there is an unacceptable variation in off contact across the frame that is compromising print quality then the frame must be replaced. Typically a frame should be replaced every 25 or so re-stretchings. This is because when the mesh is re-stretched the frame is ground to remove the adhesive and roughen the frame. This process removes metal that over time weakens the frame and distortion will occur. Frames are seen where the ground surface is as thin as foil or even holed. Remarkably sometimes these are still re-stretched. This is simply stupid. One of the causes of this condition is that the bean counters consider frames as capital items and want to depreciate them in the normal way. No, they are consumables just like the tyres on the car the Financial Director drives.

When buying frames deal with a screen printing frame supplier not just a geezer down the road who welds aluminium extrusions, state your application, the mesh you use and the tensions you work at. This will result in the correct frame will be selected for you. There are specialist frame profiles designed specifically for screen printing frames. The best suppliers have software packages that will calculate the optimum frame for you application. The largest supplier of these is Hurtz; they have a comprehensive range and are recognised as world leaders.

If you are considering using wooden frames for anything but the most basic printing application, don't. No matter how beautifully mitred the joints are or how well finished the grain on these specially selected constructions they will produce dimensional instabilities that would be unacceptable to all but a small band of hobby "silk screen printers."

RE-TENSIONABLE FRAMES

Re-tensionable frames sometimes known as roller frames are used extensively in the USA. With the exception of the Textile Industry they have not become popular in Europe. Large format re-tensionable frames are very heavy and expensive. Not having to glue the mesh has obvious advantages. High tensions are possible with this system. The geometry of the mesh is not as precise as conventional stretching on solid frames. This is not acceptable by most printers. The main reason for using these devices other than the apparent ease of stretching is that it is possible to move the image on the stencil to obtain accurate registration if a substrate has altered in size during processing a multicolour job. As soon as this is done the process is out of control. Other users say that multiple application of increasing tensions work hardens the polyester and improves its performance. This is simply cobblers. Much of what is spoken about re-tensionable frames comes into this category. If you insist in using them then recognise that the threads in the stretched mesh will be distorted as compared to a well-stretched welded frame. This will mean that the usable area for fine registration will be reduced. This is what is known as the "sweet spot". If they work for you, fair enough just be aware of their shortcomings.

FUNDAMENTAL MESH CHARACTERISTICS

Polyester thread as all polymers has three phases when under tension. The first phase is when it is elastic. That means it will stretch (elongate) and return to its original length. The second phase is its plastic phase when it will stretch but not return completely to its original length. The final phase is total failure where it stretches and there is no return. In screen printing the mesh must stay within its elastic phase because the force produced by its return to its original length is used to overcome the tack of the ink. The factors that can influence the performance of the mesh within its elastic phase on the press are:

The snap (off contact) distance. Excessive snap distance will quickly take a mesh out of its elastic phase and it will lose tension that cannot be recovered, sometimes this can happen with the very first print.

Peel off. This is when the leading edge of the frame is lifted as the squeegee moves along the stencil. Excessive lift will overstress the mesh and tension loss will occur. Applying peel off is not good practice. A well-balanced stencil will not need to have peel off applied.

Excessive squeegee pressure. Why people insist on whacking four or five times the required pressure on a squeegee never ceases to amaze me (Ed. He's off again). A correctly set squeegee closes the snap distance and moves through the ink film across the stencil with minimum pressure applied. The excessive pressure damages the

squeegee edge, overstretches the stencil and distorts the image. Of course you also have an uneven ink deposit.

Ink with a high tack can also overstress the mesh. In the electronics industry one of the reasons we use steel meshes is because they can generate greater forces to overcome the tack of the viscous printing pastes used without damage.

Using a re-tensionable frame can mean you inadvertently take the mesh into its plastic phase.

INDUSTRIAL SCREEN PRINTING

Screen printing is increasingly being adopted in areas other than graphics printing. The laying down of various materials in a controlled film thickness on many different substrates is ideally suited to the process. This means that different meshes can be used in creating layers of various materials. Not only different meshes but a range of stencil thickness and chemistries. It is important to realise that work carried out in development often over smaller areas will not necessarily transfer without modification to larger formats. It can be equivalent to changing from driving a Reliant Robin to racing Formula 1. There need to be two development stages, first proving the principle and then developing it for production. Failure to do this can result in expensive mistakes. Some of the areas to be wary of are registration, film thickness and machine settings. It is recommended that anybody wanting to scale up a print should look at applications where larger machines are being used on different applications to see the key elements of process control. They may be completely outside your area of expertise or market sector but you will discover aspects that you had not discovered in proving the principle. Any credible machine supplier will be able to introduce you to reliable users. This will enable a much smoother introduction to this wonderful process.

Very soon there will be information about some innovative developments in stencil production that were the brainchild of Alan Dunn. These will be particularly useful in the industrial field and maybe very high quality graphics. His legacy lives on.