

# TROUBLESHOOTING REGISTRATION PROBLEMS

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Registration is one of those things that requires constant attention. It is not something that can be set once and forgotten. It is also a source of continued frustration, particularly for beginning and intermediate printers. In this month's column I thought it would be good for us to go through the process of "dialing in" registration on the press and give some tips on how to maintain optimum performance in this area.

Before we get into the mechanics of the process, we should establish some ground rules and definitions. The first is tolerance. This refers to the  $\pm$  range of acceptable variation that you wish to establish for your printing. For general printing  $\pm 0.010$ " ( $\pm 1/100$ ") will give good results. For process printing the range is much tighter, generally not more than  $\pm 0.002$ ". In our facility we strive for  $\pm 0.00075$ ". The tighter you can achieve, the sharper your printing will look. In process printing, very fine tolerances are required so as to minimize dot gain with wet-on-wet printing. Since some of the dots that we will be printing are just bigger than .001" in diameter, tolerances of  $\pm 0.002$ " could easily double the size of the dot.

The second term is radial error. This refers to the deflection that occurs at the extreme ends of the platen. This is a particular problem with manual presses that do not have side clamp bars. The greater the distance from the registration locking point, the greater the radial error. Think of this as a slice of pie. The further out from the center, the greater the slice. Therefore, an error of .002" at the locking point can be magnified very easily to .020" or more 18" from the locking point.

The objective of a good registration system is to guarantee that all of the colors printed will fall into the same space on each and every printing platen. There is color to color registration and image to substrate registration. The first is much more difficult to control than the second.

All registration difficulties can be classified under two groups. The first is misalignment or miscalibration and the second is uncontrolled movement. In the first case the equipment itself is at fault. It may not have been properly set up in the first place, but more than likely it has simply gone out of alignment with daily use. Regardless, it must be re-aligned. There are several very easy things you can check or do before you do a complete calibration.

Start by examining the locator fork(s) and register bearings. They should be perfectly clean and free of adhesives, lint balls, tape, grease, or any other foreign objects. Any contamination on these critical parts can cause a register movement. Clean the fork(s) and bearing with solvent until they are down to bare metal. Apply a thin coating of lithium-based grease, or whatever is recommended by the maker of your equipment.

The second thing that you can do is to NEVER lean on a platen. This is the single fastest way to destroy your registration. The weight of your body levered against the bearing and fork(s) can throw you out of register by many thousandths.

Each manufacturer of presses has its own registration device that consists of a dial indicator and a jig clamp. If you adjust your machine on an annual basis, the factory technician will make the registration adjustments for you. If you have more than one machine or if you adjust your machine on a frequent basis, consider purchasing a register device for yourself. Registration has a funny way of going out right in the middle of that deadline run when there is no technician available. By learning how to do it yourself, you will save money in the long run as well as remain in control of those critical time situations. Think of it as a regularly scheduled oil change or tune-up for your car.

After we have gotten the machine in alignment, we can begin to focus on the uncontrolled movement aspect of registration. This can be very complicated and unpredictable. This is why you must approach the register error in a systematic manner, working your way through each level. I find it easiest if you think of it as a step-by-step progression from the beginning to the end of the process.

## The artwork

Begin by examining the camera-ready art. Do the positives fit? Is there an overlap built into the film? A very small overlap is desirable (.003"). If your equipment is in very good condition, you may use "butt registration" where there is no overlap at all built in. Accurate fit results in the slight growth of an image due to ink spread with wet-on-wet printing. If your film is off, every print will be off in the same direction and amount when printed on each platen.

While we are on the subject of art and positives, let's take a second to look at our registration marks. Too often I see fat lines and rough positioning of "register stickers." These are the register marks that come on a roll and are self-adhesive. These targets lack opacity and are very difficult to align. I much prefer targets that are photographically imaged onto the film positive and are thin. By thin I mean having crosshairs that are no more than 1/100th" in thickness. Since this is the tolerance that I am shooting for, it makes sense to have register marks that will show how close I am. These marks will allow you to make adjustments of .005" or less, resulting in very fine registration. Many of the new computer programs will allow you to design and photographically place your targets as digital images on a "registration layer."

While examining your positives, check for opacity. This is the ability of the film to hold light back. With fine detail, the minimum opacity is 3.0 with a transmission densitometer. If you don't have a densitometer, look through the black part of the film at a fluorescent light. If you can see the image of the light through the film, it is not opaque enough. This is a particu-

lar problem with diffusion transfer films. These are the films that have a light-sensitive base and second receiver sheet. Make changes to chemistry, development, or processing as necessary to increase your opacity. The opacity is important because a thin image will undercut during screen exposure, reducing or “choking” your image. The result is misregistration.

One last point is to make sure that your positives are emulsion-up. This will guarantee that the film emulsion is in close contact with the screen emulsion, thereby minimizing undercutting.

## The screen

A great deal of registration problems are the result of unstable mesh and inconsistent mesh tension. Unstable mesh occurs when conventional monofilament polyester is initially stretched and put into production. New mesh “cold flow” until it reaches equilibrium. This results in a drop in mesh tension. More importantly, the image grows as tension drops. If you use a set of screens that are of different age, the rate of cold flow will be different, and one or more colors will not fit. Even the new low elongation meshes are somewhat prone to this problem—although not nearly to such a high degree. Retensionable frames coupled with low elongation mesh offer significantly better ability to control the rate of cold flow and the resulting image misregistration.

If you are using retensionable frames, try to use screens that have about the same history of the mesh. Avoid using new mesh along with old mesh, especially if the run is long. Use your new mesh on short runs and runs that do not have tight registration. This will allow for some conditioning and “work hardening” that will ultimately stabilize the mesh.

Keeping tension constant over the screen is also very important. If the mesh is at

different tensions, the rate of cold flow will be different, resulting in localized misregistration. You will see this as three sides of the design in register, and the fourth out. The acceptable range of tension variation is dependent on how tight your design is. For very tight work,  $\pm 1$  N/cm is acceptable. For looser register you may be able to go as high as  $\pm 3$  N/cm. I do not recommend this large of a variation. Regardless of the range that you deem acceptable for your operation, a good calibrated tension meter is an absolute requirement.

Screen exposure also has a lot to do with your registration. If you overexpose your screens, you run the risk of undercutting your design and choking the image. The result is a light leak in the design, hence misregister. The angle and distance that your light source is from the vacuum frame have an impact. The closer the light to the frame, the more critical this becomes. Keep your light source at a minimum distance equal to the diagonal of the vacuum to avoid problems. If you are any closer, you run great risks of undercutting.

Keeping track of your exposures with a light integrator is the safest way to avoid overexposure. This device measures the actual amount of light that exposes the film and compensates for the age of the bulb and any voltage or distance variations. Overexposure is not a problem unless you are at least 2 times the normal exposure. This can be a problem with some of the new very fast photopolymer emulsions that can expose in as little as 6 seconds. In this case the integrator is essential.

## The press

With good prepress, eliminating registration errors boils down to the equipment itself. There are a number of major and minor troubles to deal with. Besides

having the machine properly registered, the platens must all be level and in the same plane. This will avoid what I call the “teeter-totter” effect. This is where a high platen on the opposite side of the register bearing is printed. The downward pressure of the screen on the platen causes the register bearing to disengage, resulting in misregister. This type of register problem is intermittent and inconsistent, depending on how many colors are being printed on the machine.

Low platens can also cause misregister as the off contact distance is changed and the resulting screen stretch distortion causes variation. This is also erratic and inconsistent from pallet to pallet, depending on how many colors are being printed.

With the machine true and level, the next step is to check for unnecessary movement or “play.” With the machine in the locked printing position, take each platen and gently flex it side-to-side, front-to-back, and up-and-down. Any movement indicates that it may be loose and that misregister is likely.

Place your screens in the screen heads and tighten. Check to make sure that the screen is securely in place. If you

are using frames with round bars, make sure that they are secure. Uneven clamp pressure will result in the screen moving or jumping during the run.

Try and flex each of the print heads on the machine to determine excess movement. Because of vibration during the printing cycle, bearings and locator bolts often loosen with age. Any flex can result in problems. The tighter the machine, the more likely your chances of accurate printing.

While these suggestions are by no means all of the potential causes of misregister, they will go a long way to bringing your variation under control. The most common things that I see among printers are a disregard for machine maintenance and the tendency to use too much force to tighten or adjust the equipment. Any excess force will result in distortion and premature wear. Wear results in movement that then causes misregister. If you follow reasonable care of your equipment and art preparation, there is no reason that you can’t expect registration tolerances in the range of  $\pm 1/100$ th” on a daily basis.