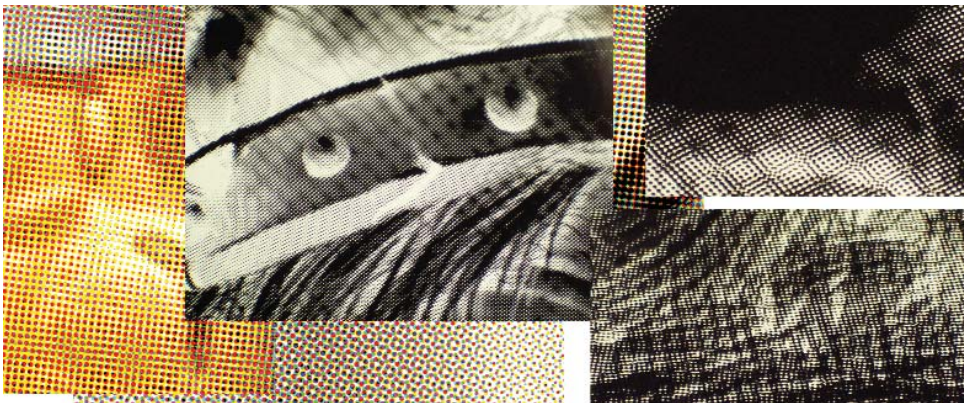
# Ten Tips to Avoid Halftone Moiré in Garment Printing



Unpredictable and unwanted, moiré can devastate your halftone and process color work. Take action to reduce the occurrence.

When you screen print halftones, one thing you can absolutely count on is moiré. No matter how careful you are, the dreaded patterns will appear in your prints from time to time. You may go for months without experiencing moiré problems, then get hit with a rash of images in which moiré seems uncontrollable.

After printing halftones and process-color for more than 30 years, I have come to the conclusion the problem of moiré cannot be eliminated entirely using current technology. You can, however, take steps to greatly reduce the occurrence of moiré in your prints. Here are 10 tips you can use to help keep moiré at bay.

### 1. Be systematic and organized.

This is the critical beginning point upon which everything else is built. If you are not systematic in your approach to printing, you will be doomed to experience moiré. Being systematic means keeping track of everything. Eventually, you will be able to narrow the variables you have to observe. In the beginning, however, there is no substitute for good records and organization.

If you do not have a data sheet where you can record screen-making parameters, press settings and other aspects of the job, make one. Keep copies of the sheet on clipboards posted in the art department, the screen room and near the press. When moiré occurs, record every detail about the current job parameters. The systematic organization of data will allow you to identify patterns of occurrence and the written record will make it easy to spot similar circumstances that might be responsible for the moiré.

### 2. Work from a constant set of values.

When producing halftone images, keep all production variables constant. Use the same set of halftone angles each time you do the same type of work. Use the same line count. Keep mesh tension within +/-1-2 N/cm and use mesh with the same mesh count and thread diameter from the same vendor. If you randomly substitute variables, it's like being lost in a forest when night is falling. Standardization is critical in helping to identify the problem areas that lead to moiré.

### 3. Never assume what you have is correct.

This is an important issue. Most printers work from the assumption that the materials they work with have accurate specifications. This is usually not the case. Mesh counts are rounded to the nearest 5 threads/inch from the woven metric equivalent. The halftone line-count value we print is only accurate when the angle of the halftone is 0° or 90°. For all other angles, there are fewer lines per inch because there are fewer dots per inch in an angled halftone grid. Additionally, the RIPs that drive many imagesetters and inkjets will override specified angle settings, as will many design programs. So it's important to verify all halftone angles with a protractor or angle determiner. Be very wary of all your materials and tools. I strongly suggest you personally verify all values and tolerances for yourself before you move forward in adopting a set of parameters as your standard. This is especially significant when you switch vendors.

### 4. Keep halftone angles 30 degrees apart for contrasting colors.

The least damaging moiré pattern is the rosette pattern. This is a nondestructive moiré, which means it is pleasing to the eye. The rosette is formed when angles are located at 30° and 60° relative to one an-

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other. It is also possible to have a correctly formed dot if two angles are located 45° apart from each other. As long as you have 30° between each of the three primary contrasting colors (cyan, magenta and black) you will form a rosette. Yellow is a non-contrasting color and can be inserted at 15° between any of the other colors.

### 5. Rotate the full halftone set four to eight degrees off the lithographic angles.

In lithographic printing, it is common to start with yellow at 0°, followed by a 15° rotation for cyan, black at 45° and magenta at 75°. Alternately, cyan is frequently set at 105° (really 15° + 90°) and magenta at 165° (75° + 90°). Rotating these angles four to eight degrees is an approach used very successfully over the years by both screen printers and flexographers. To determine how far you should rotate the angle set, you must consult with your pre-press supplier, service bureau or RIP software manufacturer. They can tell you what angles are supported at the halftone line count you are using. The two most common ones are Y 5°, C 20°, K 50° and M 80° or Y 7.5°, C 22.5°, K 52.5° and M 82.5°. Contrasting colors can be printed at any of these angles. When your separations are output, remember to verify the rotated angle positions with a protractor or angle determiner.

### 6. Choose a halftone line count and mesh that gives the highest mesh-to-dot ratio.

Mesh-dot-ratio is the ratio of mesh threads to halftone dots. Over the years, I have heard all kinds of theories about what this ratio should be, most commonly 4:1 or 3.5:1. In truth, this is just another example of something you shouldn't believe. Relationships like mesh-to-dot ratio only serve as a guide because there are so many factors that influence them. For instance, the thread count is a continuous variable based on tension. The higher the tension, the fewer threads per inch. Also, the line count of a halftone is only accurate at the 50 percent tonal value, where one dot is fully formed and a fully formed space is present. For all other values, the area covered by the halftone dot is much less than the actual line count specified. In fact, the relationship of dot-to-mesh is continuously changing. Your best course of action is always to select the highest possible mesh count and lowest possible halftone line count in an effort to maximize the ratio. The fact is: the higher the ratio, the less chance for moiré to occur.

### 7. Choose the mesh with the highest percent open area and thinnest thread possible.

By making these choices, you seek to minimize interference between the halftone dot opening in the stencil and the mesh thread. Another fact is: the finer the thread, the less chance of interference. There is a compromise, however. As the thread gets thinner, the ability of that mesh count to sustain higher printing tensions is reduced. Generally speaking, it is most desirable to seek finer threads (sometimes referred to as S thread) for any given mesh count. Some of my favorite mesh-count/thread diameter combinations are 305 threads/inch with a 34-micron thread diameter, 380 threads/inch with a 30-micron thread diameter and 420 threads/inch with a 27-micron thread diameter. It is important that all of these meshes be specified as plain weave.

### 8. When using direct emulsion, maintain 8 to 12 microns emulsion-over-mesh.

The amount of emulsion-over-mesh (EOM) is critical for assuring a fully formed halftone dot. If the EOM is less than 8 microns, it is not possible to form a stencil edge that properly gaskets the image area during printing, so the resulting printed dot will be improperly formed. Additionally, thread eclipsing will be exaggerated and moiré will be prevalent. With EOM greater than 12 microns, capillary action will prevent finer dots from transferring to the substrate. Simply put, the ink will hang in the mesh. Higher EOMs require higher mesh tension to promote complete ink transfer. EOM measurement devices are usually magnetic thickness testers and are available from major stencil manufacturers. If you do not have access to one of these devices, you can improve the EOM with a combination of the emulsion and coating sequence. Use a dual cure photopolymer/diazo emulsion with at least 45 percent solids. Coat this emulsion with a dull scoop coater (blade edge 1mm radius) two passes wet-on-wet on the print side followed immediately with three passes wet-on-wet on the squeegee side. Dry it print side down. When you expose and wash out the stencil, you should be able to just feel the edge of the emulsion against the mesh.

### 9. Use pin registration to align positives to screens.

When transferring your halftone image from the positive to the mesh, you must ensure the halftone angle is accurate relative to the orientation of mesh threads. You can accomplish this by maintaining physical stops for the screen and using pin registration to accurately position the positive relative to the screen. If you are simply eyeballing the positive's position, you sacrifice accuracy. Using stops and pin-register systems ensures accurate image position on the screen. This is particularly important when you have a marginal math relationship. Accuracy counts!

### 10. Maintain full vacuum and correct integrated exposure.

With full vacuum, you see the formation of Newton's Rings on the positive surface. This rainbow-like texture is clearly visible when the screen and positive are under vacuum, and it indicates the positive is in complete contact with the emulsion. Full vacuum is necessary to avoid undercutting during exposure.

The biggest danger during exposure is overexposure. This can result in halation or the undesirable scatter of light, which also leads to undercutting of the positive, as well as ragged formation of halftone dots. Additionally, overexposure can close up fine dots or change the size of the dots as they are exposed on the screen. This makes it impossible to determine at which dot or tonal percentage moiré is occurring. You can control exposure best with the use of a good light integrator. The integrator sensor should be placed on the vacuum frame, not on the lamp head. This allows for accurate compensation if the lamp-to-frame distance changes.

### Put the Ten Tips into Action

So, there you have them — 10 tips to help you overcome moiré. I could easily add another 10 or 15 pointers to this list, but these are the ones that address the most common and frequent sources of moiré.

As a final thought, I'd like to reemphasize the importance of being consistent, systematic and organized in your work. There are simply too many changing variables to approach halftone screen printing with a hit-or-miss attitude.