Introduction to Garment Screen Printing

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Definition: Screen printing is a printing technique in which a woven mesh is used to support an attached stencil. The attached stencil is created to form open areas of mesh through which the ink may travel and closed areas blocking the transfer of ink to the substrate below. The ink is placed on the upper side of the screen mesh and a squeegee is used to move the ink across the screen and through the open areas of mesh. The ink that passes through the screen is deposited onto the substrate. The ink is then cured using either air, heat or both, until it has adhered to the substrate and created a permanent or semi-permanent bond.
SCREEN PRINTING AT A GLANCE

1) Create or Edit Artwork
2) Print Film Positive
3) Degrease and Dry Screen
4) Coat Screen with Emulsion and Dry Thoroughly
5) Place Film on Screen and Expose to UV Light
6) Rinse Screen With Water Until Image Appears and is Clear
7) Load Screen With Ink and Run the Squeegee Across Until Image Appears Crisp and Bright.
8) Dry Ink to Appropriate Temp
9) SELL IT AND MAKE MONEYSS

DYNAMIC
SUPPLY INCORPORATED
Step-by-Step

1. **Job Evaluation**
   a. The first step to a successful print is to consider the entirety of the job ahead.

2. **Screen Selection and Preparation**
   a. After completing step one you will be able to easily determine what screen type or types will work for the job ahead.
   b. Once you have selected the screen, you will prepare the screen for printing.
      i. **Degreasing:**
         1. The first step in screen preparation is the degreasing process. This is a process wherein dirt and oils that have been transferred to the screen are washed away so that the surface is clean and able to adhere evenly to the emulsion.
      ii. **Coating:**
         1. Step two is to apply a layer of emulsion to the screen that you will later expose with a UV light source. The ink type determines the emulsion that you use in this step. Ink type should have been determined during the job evaluation process.
      iii. **Drying:**
         1. Your screen will need to dry with the print side facing down until the emulsion has had time to evaporate the water within. This can take from 2-24 hours depending on the conditions in your work space.

3. **Artwork Preparation**
   a. At this point you will either create or edit the art that you will use to make your film positive.
      i. Artwork is most often created via computer using programs such as Corel Draw or Adobe Illustrator. Hand-drawing is also an effective method for artwork creation although it is less popular due to the slow and unforgiving nature of its creation.

4. **Film Output**
   a. In this step your finished artwork is printed out onto a transparent film so that it can be used to expose your emulsified screen.
      i. *Hand-drawn films are often drawn directly onto the film and thus eliminate the need for this step.*

5. **Screen Exposure**
   a. During exposure, the film created in the previous step is placed upon the screen so that it sits between the emulsified screen and the light source. Light is then shone upon the screen for a predetermined amount of time until the emulsion is hardened. If done correctly the dark portion of your film will have blocked the light from exposing
that area of the screen and will allow the emulsion to wash away in that area when the screen is rinsed. The screen will need to have time to dry before it can be used.

6. **Press Setup and Registration**
   a. In this step you will make the appropriate adjustment to your press and align the screen within the print head so that your image will appear straight and aligned when printed upon the substrate.

7. **Printing**
   a. Using a squeegee you will push ink across the screen. Ink will pass through the open mesh areas and will be deposited upon the substrate.

8. **Curing**
   a. Curing techniques will vary depending upon the type of ink used. Some ink will dry and adhere to the substrate simply by being left in the open air. Other inks will need to be exposed to a heat source that allows the ink to reach a desired temperature and maintain that temperature for a predetermined amount of time.

9. **Clean-up**
   a. Although often the least enjoyed part of the job, clean-up may also be one of the most important. Properly cleaning will save you time and money both now and in the future. Be sure to keep the proper tools and products on hand to ease the burden.

### Ink Types

Although screen printers may utilize a multitude of different ink over the course of their career, most are likely to use just two or three for printing on garments. Because water based and plastisol inks are the two most widely used for garment printing, we will focus on those.

- **Plastisol Ink**
  - Because of its high opacity and ability to sit on screen for long periods of time without drying, plastisol ink is arguably the most widely used garment ink in the United States. Other factors such as durability, flexibility, and versatility have also led to the popularity of plastisol ink. Specialty plastisols are also widely used and often offered as additives, bases or in premixed containers that are ready for use.
  - Specialty inks include but are not limited to:
    - High density
      - Makes the ink come straight up off of the garment with no arching.
    - Puff
      - Makes the ink pop off of the garment with an arch so that it looks puffy and soft.
- Soft hand
  - Reduces the viscosity of the ink and allows for a softer print. May also reduce opacity.
- Reducer
  - Thins the ink and reduces both viscosity and opacity; very similar to soft hand.
- Suede
  - Dulls the print and gives it a flat, low gloss finish.
    - With all additives and bases it is a good idea to mix small batches and test them before you alter your larger containers of ink.

- Water Based Ink
  - Outside of the United States it could be argued that water based inks are the most popular garment inks in the world. Water based ink is popular because it saturates the fibers of the garment and in essence dyes the garment rather than resting on top of the fibers like plastisol. Because of this, the print is usually softer and more solid than with plastisol. While there are some distinct advantages to water based inks there are also some serious pitfalls that one should be prepared for.
    - Low opacity
      - Because they are thinner and do not retain their base when cured, water based inks can often have issues achieving high opacity. Some water based ink manufactures will claim high opacity but will often forego softness to achieve it. When this is done you may find that you can achieve the same or perhaps a better look and feel with a thinned plastisol.
    - Drying
      - Because water based inks cure via simple evaporation, they can often be problematic if used in very arid environments. Conversely, if water based inks are used in very humid environments you may never get them dry without a proper heat source.
    - Custom color matching
      - While custom colors can absolutely be made with water based inks, it is important to remember that they are semitransparent and may not appear the same when printed.

- In the end, water based inks are a great choice for printers of all skill levels and should always be considered a viable option. As long as you know what to watch for and how to properly
use them, water based inks can give you some of the best looking prints.

- **Discharge Ink**
  - Discharge ink is offered in both water based and plastisol varieties and works well both ways. Discharge inks work by removing the dye used to color the garment and replacing it with the pigmented ink color. These inks have gained popularity in recent years because they allow a printer to work on dark garments without the need for under basing. Important things to remember about discharge inks include:
    - **Garment selection**
      - Discharge inks will only work on 100% cotton garments. Additionally, printers should always let their garment supplier know if they are going to be using the garments for discharge as some garments are over-dyed and may cause issues during printing.
    - **Odor**
      - Some discharge inks will put off a heavy odor and should be used only in a well-ventilated workspace.
    - **Curing**
      - Discharge inks are activated by the heat of the dryer and must be dried thoroughly in order to work properly.
  
- As with any ink system, if you gather the proper information and do the proper testing, discharge inks can be a great addition to your print shop and may even save you time and money.

**Tools of the Trade**

- **Screens**
  - **Screen types**
    - **Static screens**
      - A static screen is a screen that is comprised of a rigid frame (usually made of wood or aluminum) that has been permanently adhered to a piece of stretched mesh.
      - Static screens are popular due to their ease of use and inexpensive pricing.
- Adjustable screens
  - Adjustable screens are usually made of aluminum and allow the user to stretch the screen mesh to the desired tension either by hand or with pneumatic equipment.
  - Adjustable screens are popular in any shop where images change rapidly. Because you can remove the mesh and simply replace it with a new piece, the need for cleaning of the old mesh is eliminated.
  - Because of the high tensions that can be achieved, adjustable screens are also popular in any shop where high detail images are being printed regularly.

- Emulsion

  - Liquid Emulsion Types
    - Photopolymer
      - Photopolymer emulsions are emulsions that are premixed with sensitizer by the manufacturer so that they are ready to use straight out of the container.
      - Most photopolymer emulsions will have a faster exposure time than will dual cure emulsions. Because these emulsions can go from under-exposed to over-exposed in a matter of seconds, they are most often less forgiving of errors during the exposure process.
      - Because exposure times must be accurate to within a few seconds, photopolymer emulsion is recommended for use in shops that have a very controlled prepress and exposure process.
    - Dual cure
      - Dual cure emulsion is a two-part product that arrives to the user in two separate containers. The user will mix the sensitizing agent with water and then stir the mix into the emulsion base.
      - Dual cure emulsion is most often slower to expose than is photopolymer emulsion.
      - Because dual cure emulsion allows for a variance of as much as 30 seconds in exposure time, it is a popular choice of beginners and shops with varying prepress and exposure processes.
Capillary Film

- Capillary film is an easy to use and inexpensive means of emulsifying screens. Capillary film is offered in sheets of varying size and thickness. Because capillary film allows a printer to take a screen out of the box and have it ready to print in a matter of minutes, it is quickly becoming the preferred method of busy shops.
- Capillary film allows printers to know with certainty that they are achieving optimum stencil thickness.

Film

Film Types

- Inkjet
  - Inkjet film is a transparent film that is coated with an emulsion layer that allows for the deposit of large amounts of ink.
  - Of the three film types, inkjet film allows for the greatest image opacity and edge definition.
  - Due to the ease and affordability of inkjet systems, inkjet film is popular among shops of all sizes.
- Laser
  - Laser film is transparent and designed for use with most laser printers.
  - Laser film is commonly less expensive than inkjet film.
  - Although the opacity of the image printed on laser film is not usually as high as an image printed on inkjet film, many printers use this product with success.
  - Darkening sprays can be used to enhance opacity but are toxic and should be avoided if possible.
- Vellum
  - Vellum is a thin white or off-white paper product that can be printed with most desktop printers.
  - Vellum is the least expensive film type.
  - Because vellum is not transparent it can interfere with the transfer of light to the screen. For this reason, vellum is not recommended for small or high detail images.
• Exposure Unit

  o Unit Types

  ▪ Sunlight
    • FREE
    • Difficult to control
    • Although sunlight has been used to expose screens for many years, it is not a recommended method given the inexpensive options available today.

  ▪ Halogen work light
    • Inexpensive
    • Easy to use
    • Poor for high detail images
    • Faster than sun but slower than other options
      o *If you decide to use this method, remember to remove the glass lens that comes with your light, as it will almost certainly contain a UV blocking filter that will prolong exposure times.*

  ▪ Fluorescent
    • Affordable
    • Easy to use
    • Good for high detail images
    • Fluorescent units are simple to use, inexpensive and relatively fast exposing. For these reasons fluorescent units are arguably the most popular exposure unit type industry-wide.

  ▪ Single point halide
    • Pricier but still reasonable
    • Easy to use
    • Very accurate with high detail images
    • Very fast exposing
    • A must for any automatic press shop

  ▪ LED
    • LED units are still in their infancy but are quickly proving to be not only accurate but also incredibly efficient.
• **Washout Booth**

  Washout booths are only differentiated by size and material. If you are looking for affordability, composite units are very popular and are offered in many sizes. However, if you are looking for a unit that can be easily cleaned and will last for decades, a stainless steel booth may be a good investment. Regardless of which size and type you choose, a washout booth is a great tool for any shop that wants to keep things clean and dry.

• **Printing Press**

  • Press Types
    - **Table top**
      - Least expensive
      - Small footprint
      - Slower production
    - **Stand alone**
      - Affordable
      - Easy to use
      - Larger footprint
      - Faster production
      - Increased multi-color capability
    - **Automatic**
      - Most expensive
      - Largest footprint
      - Very fast production
      - Greatest multi-color capability
      - Never needs a break

• **Dryer**

  • Dryer Types
    - **Handheld**
      - Cheap
      - Inconsistent
- Slow
  - Flash dryer
    - Affordable
    - May be inconsistent depending on the environment
    - Easy to use
    - Hard on printing pallets
  - Conveyor dryer
    - Reasonably priced
    - Easy to use
    - Fast
    - Reliable
    - Adjustable for time and temperature

- Other Tools
  - Scoop coater
    - A must for coating screens with liquid emulsion
  - Squeegee
    - Offered in many sizes and styles to fit your need
  - Ink knife
    - An easy and clean way to distribute ink and clean screens
  - Drying rack
    - Screen racks are an often overlooked but very valuable tool in any shop
  - Scrub pad
    - The perfect tool for scrubbing your screens and ink tools
  - Pressure washer
    - A pressure washer is a great tool for cleaning a screen at any stage of the process
  - Laser temperature gun
    - Having the peace of mind that comes with knowing that you have properly cured your garments makes this tool worth every dime
Setting up Your Workspace

Setting up a Dark Room

When most people hear the word darkroom, they immediately imagine a small dank space void of all light. Fortunately, the darkroom needed for screen printing is not this at all and can in fact be the same space you print in if proper care is taken.

Blocking UV Light

The need for a darkroom is based upon the UV sensitive nature of the emulsion that is used to create the stencil on your screen mesh. The emulsion is exposed to high amounts of concentrated UV light during exposure and is hardened to a solid state in the process. Because UV rays are around us all of the time, it is important for us to create a UV safe environment or “darkroom” in which we can work with the emulsion prior to the exposure process.

Creating a UV safe environment is much easier and less expensive than one might think. Unlike photographic darkrooms that require total darkness, screen printing darkrooms only require that UV rays are filtered out of any light source. UV rays are filtered out when light passes through a semi-transparent colored object like a piece of film or a tinted bulb. Red and yellow are the most common colors used for the purpose of filtering UV rays but many colors are effective in achieving UV filtration. UV safe bulbs and UV blocking films are readily available and relatively inexpensive.

Note: *DO NOT USE BLACK LIGHTS AS THEY WILL ACTUALLY ENHANCE UV RAYS AND WILL EXPOSE YOUR SCREENS.*

With the inexpensive items listed above, almost any space can be turned into a darkroom sufficient for screen printing. By simply covering any windows or other openings that let a significant amount of light in with UV filtering film, the UV rays will be filtered out and will leave you with a well-lit UV safe environment in which to work. Another option is to block the light out altogether by using an opaque covering to make the room totally black. If you choose this method you will want to install a red or yellow light bulb into your room so that you will be able to see what you are doing while maintaining a UV safe environment.

There are of course more complex and expensive ways to create a darkroom and as printers grow they will often move in that direction. However, for the beginning printer the methods listed above are tried, true, and cheap. Remember that most emulsions that you will use have an exposure time of multiple minutes under intense UV exposure, so a few seconds of exposure to a low source of UV probably wont ruin or even affect your screen.
Controlling Humidity (Wet Room vs. Dry Room)

Due to space constraints, many people will include their drying and washout areas into their darkroom. While this does make things easy by eliminating the need for multiple UV safe environments, it can also present some challenges. The most obvious contradiction with washing and drying in the same room is that you are introducing moisture to an area where you are also trying to remove moisture. This will not necessarily ruin you, but may make things a little more difficult overall.

If you do decide to coat, dry, clean and washout frames in your darkroom, make sure you have the right tools going in. A dehumidifier is a great thing to have around especially if you are in an environment known to have high humidity anyway. If you do decide to purchase a dehumidifier, make sure that it pulls water out of the air and deposits it outside of your darkroom. Many small dehumidifying units have an onboard reservoir that actually holds standing water in the very area in which it is supposed to be removing it.

A drying cabinet is another great tool to consider. Drying cabinets have built in fans that allow air to move around the wet screen. This creates an ideal environment in which the screen can dry. Most drying cabinets also come with some form of filtration system as well, so dust and other particles on your screen should not be a problem.

Considering the tasks that you will be performing in your darkroom and ensuring that you have the tools to perform each task successfully is all that you will need to do to make sure your darkroom works for you. Proper workflow and project management will help you avoid conflict between tasks and should save you time and money.

Setting up Your Print Area

A few hours spent properly setting up your print area in the beginning could save you hundreds or even thousands of hours down the road. Many people getting into screen printing don’t realize just how many steps can go into the printing of a single garment. The best and most profitable printers have print areas that are designed to avoid any unnecessary steps that will add to the time needed finish each print.

Setting up Your Press Correctly

Although there are many different brands of presses on the market today, most are built using a single basic plan. Whether you are working on a single color press, a multicolor press, a tabletop, or a stand alone unit you will be loading a shirt, dropping a screen, and running a squeegee across it.
When setting up your press the first thing to consider is the person or people who will be using it. Manual screen printing can be a physically taxing activity and a press that is incorrectly set up will only make the task more difficult. Make sure that your press is not too high or low for the user. If you are using a tabletop press you can simply adjust this by placing the press on a more appropriate surface. On the other hand, most stand alone presses are not adjustable for height so you will need to create a raised surface for either the operator or the press to stand on if the press is not at the correct height.

The next thing to consider is the amount of room that will be needed for the operator to properly operate the press. Remember that the operator is likely going to need a number of tools, ink, garments and other products in close proximity when he or she is printing. If the aforementioned items are not close by, your printer may have to make many trips back and forth which will add time to the job. The same consideration should be given to the placement of your press in relation to your dryer. Because each garment will need to be placed on the dryer you will want to ensure that the effort required in moving the garment from the press to the dryer is minimized.

**Setting up Your Dryer Correctly**

Setting up your dryer or dryers is another key component of organizing a proper workspace. If you will be using a flash dryer to cure your shirts you will want to consider setting up a surface other than your press platen on which to perform this process. Although platens are designed to withstand the heat of a flash dryer in short bursts, they are not intended to be left under the dryer for long periods. Using a standard platen as a curing surface could cause damage to your platen and may also make it more difficult to print subsequent garments.

Conveyor dryers are a great option and drastically decrease the effort and time needed in the curing process, although they do come with their own challenges. Conveyor dryers run at very high temperatures and as such will put off a good deal of radiant heat. If possible you may want to setup your dryer with an exhaust fan that will allow you pull some of the excess heat away from the unit. You will also want to make sure that the dryer is not near an area where uncured ink is kept as the continuous exposure to heat may negatively affect the ink over time.

When setting up a conveyor or flash dryer the amount of power each will use should also be carefully considered. While many screen printers operate from their homes or other small spaces, few of them make certain the power in their location is sufficient for their needs. Both a conveyor dryer and a flash dryer should be on dedicated circuits. Failing to properly address the power needs of your equipment could cause them to operate poorly.
Additionally, if you overload circuits you could damage your electrical system or even cause a fire.

**Setting up for Proper Workflow**

One of the most important things that a printer can do when setting up his or her shop is to consider each step of the job and each item needed to complete it. In doing so he or she will be able to determine what items they will need and where the most convenient location for that item will be. By having equipment properly placed and supplies at the ready, a printer can ensure that no unnecessary time or effort is needed to complete the job.

Although it may seem like there is a great deal to consider when setting up your shop, it really is very simple. Keep in mind the entirety of the task you are going to perform and allocate for each aspect. Make sure that the people using your shop can function easily in the environment. Always assemble and connect equipment to manufacturer’s specifications. And most of all, make it a place that you will be comfortable working. Screen printing can take a lot of long hours and you don’t want to spend them in a place that makes you miserable.
Job Evaluation

As with any multifaceted task, screen printing requires that each step of the job be given careful consideration before work begins. Due to the dependency of each step upon the step that precedes and follows it, failure to complete the job evaluation phase can result in a significant loss of time and supplies. Job evaluation is also the point at which you will determine which inks, screens, emulsion, squeegees and other supplies and equipment you will need for the job. Most of all, the job evaluation stage is where you will determine the profitability of the job and whether or not it makes sense for your business. This knowledge will allow you to prepare more thoroughly and will reduce downtime.

During the job evaluation phase, one should consider any and all variables that can affect the time and expense demands of the job.

- Artwork
- Substrate
- Ink
- Print quantities
- Other (time frame, customer)

**Artwork**

**Creation or Alteration**

It is rare for a screen printer to receive artwork from a customer that is ready to be printed as a film positive. Often customers will request that you alter or create an image for them. In either case, you will need to make this determination as part of the job evaluation process so that you can account for any additional time that will be needed.

**Raster or Vector**

Depending on the image type you may need additional tools such as Rip software in order to achieve the desired look.

**Detail**

Because image detail will dictate what ink type and screen mesh you will need to use, it is important that it be given careful consideration.

**Color Count**

Some images look very simple but become much more difficult upon closer examination. Be sure to count every color when evaluating your job. Although you
may be able to consolidate colors later, having an accurate count of the colors as they appear on screen is important in your initial evaluation.

**Image Size**

Simply put, larger images require more ink. Large images can also require larger platens than you may have on hand. If you have to buy new platens or use a great deal of ink, you may want to consider raising the price of the job.

**Substrate**

**Price vs. Quality**

Most screen printers and their customers think of one thing when it comes to garments - PRICE! This is unfortunate because in fact there is much more to consider here. Though thought should also be given to price, the quality, material, and durability of any garment that you will be printing on is far more important.

The quality of the garment should be given strong consideration during the job evaluation process because your garment is after all the surface on which your print will live. A poor print surface will usually mean a poor print while a quality surface can make a subpar print appear better than it really is. Often, lower priced garments will have a loose weave with fibers that stick up off of the garment surface. When printing on lower priced garments you may have to make multiple passes or flash between colors just to achieve proper coverage. Although you may have saved the customer money on the garment, you may have cost yourself both time and money during production.

**Material**

The material that the garment is made of is also of extreme importance when evaluating any print job. Most customers do not understand the challenges that are inherent with various types of garments. Often customers will request or even provide you with a garment to print on and assume that the price would be the same as any other print. It is important that both you and your customer are aware of challenges that certain garments can present and that consideration is given to those challenges when pricing the job.

**Will it Work?**

Matching up images and substrates is a lot like matching up people - despite your best intentions sometimes it just isn’t a good match. When evaluating a print job be sure to consider how the image will look on the substrate you’ve chosen and not just how it will look on a particular color of background. You also want to keep in mind
the type of inks that you will need to complete the print properly and consider whether or not those inks are compatible with your substrate.

**Durability**

If you have done your job right, all of your prints should look clean, crisp, and bright coming off of the dryer. But how will that shirt look coming out of the dryer in the home of your customer? Many printers never consider what a shirt will look like after it has been washed, but they really should. Although the individual price of a printed garment is usually quite low, the quantity is usually high enough that your customer has spent a significant amount of money with you to have those garments printed. When garments start to shrink or fall apart in the wash, the money that your customer spent with you starts to seem like money wasted in a hurry. Although you may have had very little to do with the selection of the garments, you can believe that this will come back on you. It is a good idea to keep washed examples in your shop so that you can show customers what the garment will look like after it has been laundered. This will help guard you against returns and will often lead the customer to consider a higher quality garment.

**Ink**

**Price vs. Quality**

Although it is always nice to increase your margin by mitigating your supply costs, it can also be a risky proposition. When you consider the punishment that the average printed garment will endure in its lifetime it really is amazing how long they hold up. The primary reason for this durability is quality ink. It can take chemists as long as a decade to perfect quality textile ink. And it is not only the strength that makes these inks amazing but also the fact that they can so easily be applied and cured by almost anyone, anywhere. Keep this in mind when selecting the ink that you will use, because if the chemist didn’t do the work on their end, you can be sure you will end up doing it once or maybe twice on your end.

**Will it Work?**

Much like paint, screen printing ink can come in many various forms that are designed for specific applications. When evaluating the job in front of you, consider whether the ink will adhere appropriately to the substrate you’ve chosen, whether the viscosity of the ink is compatible with the mesh count necessary for the image detail, and whether the opacity of the ink is great enough to properly cover your substrate. There are of course other variables that may need to be considered but most often if you have explored those three factors you will have identified the appropriate ink for your job.
Custom Ink Colors

From time to time you may be requested to match or create a specific color for a customer. Fortunately, ink mixing is a relatively easy process that can be done in your shop or by most reputable suppliers. Keep in mind however that if you have to purchase a mixing system or order custom ink colors from your supplier, the cost of your ink will rise considerably.

Side Note: When curing with a dryer, remember to make sure that your substrate is able to withstand the high temperatures that you will have to expose it to. If you are unsure whether your garment is able to withstand the heat, it is recommended that you test the garment prior to printing.

Quantities

Total Number of Print Strokes

When evaluating a job it is very important to consider how many times you will have to pass a squeegee across your screen to complete each garment. Customers will often look at the job as total number of garments and not total number of prints. As such they may expect a lower price than is reasonable for the job.

Total Number of Placements

Like print strokes, placements are an often overlooked aspect of a print job. If a garment has multiple print placements it will have to be loaded on the platen and removed multiple times and will also have to be dried in between each print. The additional steps caused by having multiple placements can triple the total production time of each garment. When production time goes up, cost goes up, and it is for this reason that the total number of placements should be carefully considered during the evaluation process.

Total Number of Garments

In the business of screen-printing, higher quantities usually equal higher profits. The reason for this is that setup times are the same regardless of how many garments you actually print. It is not uncommon for a customer to request a low total number of garments to be printed. The problem with small orders is that the total price that you can charge per garment may not justify the effort required to complete the job. In the end, if the profit doesn't justify the output of time you may want to decline the job.
Other variables to consider

Rush Orders

Rush orders interrupt your other work and can add cost to a job in the form of additional labor and shipping costs. Ensure that these costs are considered before quoting a final price.

Equipment and Supplies

Although many screen printing jobs can be completed using the same supplies and equipment, you may get a job from time to time that requires more than you have on hand. If you find that you have to purchase new equipment or supplies to complete a job you may want to consider adjusting your price to reflect this additional cost. Consider whether or not the equipment or supplies needed to complete your job will be useful in the future. If you find that the items you are purchasing are for one time use you may want to consider turning down the job.

New Processes

If you find yourself in a position where you have taken on a job that requires a process that is new to you, you will want to consider the options available that will help you complete the job.

You may decide that you want to attend a class or bring a trainer onsite to help you learn this new process. If you do decide to seek training it is important to consider whether or not this new skill will be of use in the future. If you don’t believe that your new skill is going to be useful to you moving forward you may want to turn down the job or consider bringing in someone that already has the needed skill to help you complete the job.

If you decide that bringing in a specialist to help you is the right way to go you will want to be sure to adjust your cost accordingly.
Example Evaluation:

This morning your best customer came in with the following image and told you that she wants it printed on 25 red polyester moisture wicking tee shirts.

The first thing that we need to determine is what process will make the most sense for us to use in recreating this image on tee shirts. In this case we are working with a spot color vector image that will most easily be printed using spot color plastisol inks. The second thing we need to know is how many ink colors we will need to recreate the image exactly as it appears. In this image it appears as though we are going to need the following colors:

1. Red
2. White
3. Black
4. Green
5. Light brown
6. Yellow
7. Grey
8. Light blue
9. Medium blue
10. Dark blue
As you will notice, this relatively simple looking job is already getting to be a handful so what we need to do next is look for a way to simplify the process. In the case of this image you may want to suggest to your customer that you consolidate some of the blues into a single shade and you can also talk about using the red color of the shirt rather than printing red ink. By eliminating and consolidating colors you can immediately take this from a 10-color to a 7-color print. It may also be a good idea in a situation like this to take a moment to explain to your customer a bit about how screen printing works. By taking time to explain, your customer will either have a better appreciation for what they will be paying for or may in fact choose to bring you an image that is less demanding.

Now that you know how many colors you will be printing it is time to pick the ink type that you will use for this job. If you recall, your customer asked for 25 red polyester moisture wicking tees. What this tells us is that we will need to use a polyester white ink with a blocking agent. The poly white will provide a base coat that will help you avoid the migration of the red dye in the shirt into your plastisol inks. With our artwork decided upon, our garments chosen and our needed inks determined we can now choose the screen mesh that will work best for this print.

For this print we do not have a great deal of detail. This means that we can use a lower screen mesh than would be necessary if there were high detail to this image. We also know that we are using a poly white and 6 other standard plastisol inks for this print. Plastisol inks are fairly viscos and will also work well with a lower mesh count screen. All of these factors together let us know that we can likely use a 110 or 156 mesh screen for this job.

Printing and curing of this job will be fairly straightforward and should not require anything out of the ordinary. At this point we can list all of our costs and come up with a price for this job.

- **Films**
  - 7
- **Screens**
  - 7
- **Flash cures**
  - 25-50
- **Full cures**
  - 25
- **Print strokes**
  - 175-200
- **Time to print**
  - 1-1.5 hours
- **Garments**
  - 25-30
- *Additional shirts should be ordered in order to account for any mistakes in the printing process or garment defects*

As you can see, taking these steps helps us gain an in depth understanding of what we will be printing and what we will need to complete the job. In the case of our example image, a printer would have to charge anywhere from $11-$15 per garment with a $70-$100 setup fee just to make this job worth doing. The customer may or may not choose to move forward at this price but at least we would be able to give them a complete breakdown explaining our quote.
Artwork

When talking about screen printing, it all starts with art. Art will dictate which screens you use, which ink you use and even which garments you print onto. Unfortunately, each step from the computer to the press is a natural degradation of the artwork quality. However, if a printer focuses on maintaining the integrity of the art from start to finish, the quality of the image on your garment can be quite remarkable.

Print Types

Spot Color

Spot color printing is a method wherein each color that exists in the original image is represented by a corresponding ink color in the print. Spot color prints do not rely on the mixing of colors or halftone gradients to achieve the illusion of color. Spot color prints are the most common print type in the garment industry.

Four Color Process (CMYK)

Four color process or CMYK prints utilize semi-transparent inks that are printed one on top of the other and mix to create desired colors. The colors used for this style of printing are cyan, yellow, magenta and black. Four color process printing is popular because of the simplicity with which it allows printers to create multi-color images. Ink saturation variances and print order changes can result in inconsistent prints.

Spot Process

Spot process printing is a practice in which spot color halftones are placed near one another in order to give the illusion of a greater range of colors. Due to the fact that it can be printed in high production with vivid and consistent results, spot process is often chosen over four color process. Specifically designed software or a tremendous amount of skill in artwork software is needed to achieve this style of print.

Gradient types

Image Gradient

An image gradient is a directional change in the intensity or color in an image. In graphics software for digital image editing, the term gradient or color gradient is used for a gradual blend of color, which can be considered as an even gradation from low to high values. Another name for this is color progression.
**Halftone Gradient**

Halftone is the reprographic technique that simulates continuous tone imagery through the use of dots, varying either in size, in shape or in spacing. Halftone can also be used to refer specifically to the image that is produced by this process.

Where continuous tone imagery contains an infinite range of colors or greys, the halftone process reduces visual reproductions to an image that is printed with only one color of ink, in dots of differing size. This reproduction relies on a basic optical illusion—that these tiny halftone dots are blended into smooth tones by the human eye.

**Image types**

**Raster Graphics**

Raster graphics, or bit-mapped graphics, are digital images stored as arrays of pixels for display and modification. In raster data there are no lines, circles, or polygons, only pixels that are grouped to give the appearance of these elements. Because scanned images and photos are saved as raster graphics, it is common for customers to submit images in this format.

The most common challenge with working in raster format is resizing the graphic. Raster graphics are measured by the number of individual pixels per inch of the total graphic when the image is created. For example, if a graphic is created to have 300 pixels per inch and the graphic is 3 inches tall by 2 inches wide, the total graphic will be 6 square inches and will be made up of 1,800 pixels. If you take an image created in this way and attempt to change the overall size to 6 inches by 4 inches, you will now have a 24 square inch image area but you will still only have the same 1,800 pixels with which to cover that area. Because each pixel is intended to cover a very small area and must be stretched considerably to cover the new larger area, the overall quality of the graphic will suffer considerably.

Another challenge of working in raster format is the creation of straight lines. Because raster graphics consist of a series of small circles, it is impossible to ever truly create a straight line. For this reason, things like typed fonts and geometric images are not recommended for creation in raster format.

**Raster Graphic Software**

The most commonly used raster graphic art creation program is Adobe Photoshop. Photoshop can be purchased for download and installation, or for a monthly fee, users can access the program via the Internet. In either case, Photoshop allows users to create, edit and print raster graphic artwork.
Vector Graphics

Vector graphics use geometrical primitives such as points, lines, curves, and shapes of which are all based on mathematical expressions, to represent images. Vector graphics are comprised of groups of solid colors and do not contain gradient color shifts. Because of this, images that have a lot of shading are not recommended for use as vector graphics as they will increase the total color count of the image to an unreasonable number.

Because vector graphics are based on mathematical expressions, it is easy to resize them. When a vector graphic is resized, the program is able to use information related to the size of the graphic and simply adjust the math to account for the change. Simple resizing is a great feature if you will be creating an image for use on both the front and back of a garment. If you will be printing a 4 by 4 inch image on the front of a shirt and the same image in 12 by 12 inch size on the back, you will need only create the image once and resize it for the different placements. Conversely, if you want to create this image in raster form you would need to create the image twice to ensure that the image quality was the same for both images.

Most vector artwork programs include tools that will allow you to convert an image from raster to vector. When converting images it is important to remember that the quality of the raster image will directly affect the quality of the converted vector image. Images that are of poor quality or are too small will often become distorted during the conversion process and will require that all or part of the image be recreated.

Vector Graphic Software

There are two vector graphic software products on the market today that the vast majority of printers will use. The first product is Corel's Draw program, most commonly just called Corel Draw. Corel Draw is a simple and inexpensive software that packs in a plethora of useful tools. It is important to keep in mind however that Corel Draw is not compatible with Apple Macintosh computers. The second option for vector graphics software is Adobe Illustrator. Like Photoshop, Illustrator is available for purchase and download and is also available as an online application with a monthly subscription. Illustrator is great for people that like to use Photoshop for their raster needs because it has a similar look and feel. Another great feature of Illustrator is that it is compatible with both Mac and PC hardware. Regardless of the software you choose, you will be glad that you have a good vector program.
**Color Separation**

**Spot Color Separation**

Because spot color images do not rely on the mixing of colors or small halftones that must be placed perfectly to create an optical illusion, they are in essence separated as they are created. In order to print spot color images to film, each color in the image must be isolated and then printed as its own film. Depending upon which artwork software you work in, this process should be at least semi-automated. If you are unsure about how to separate images in your software there are videos available online that will help walk you through the process.

**Four Color Process Separation**

Like spot color images, CMYK images are fairly easy to separate using the automated features built into most artwork creation software. Your software will usually ask you to specify the form in which you want the file you are working with to be opened or created. By selecting CMYK you are essentially separating the image. At this point you need only go to the print window and select one color at a time to print to film. Again, if you are unsure about this process there are a plethora of online video tutorials that will help you out. This process will require the use of Rip software to properly create your films.

**Spot Process Separation**

Spot process separations are unlike any other type of separation that you will do. Some printers will actually separate for spot process by manually creating halftone layers during the artwork creation or editing process. This is essentially the same process that Spot Process Separation Software uses with two very big differences. Spot Process Separation Software uses a predetermined color pallet and a mathematical algorithm that is designed to read and recreate an image in its most optimum form. The color pallet contains the components to create any color while the algorithm determines which size and concentration of halftones will be used to achieve the correct shades. In addition, this software will even adjust for the color degradation inherent in screen printing and allow the user to enhance the ink saturation to adjust for it. Conversely, manual separators are limited to what they see on the screen in front of them. This is an issue because while colors may exist in the image they may be invisible to the naked eye. The shades of those colors may also be off because the average human doesn’t possess the math skills to run the equation necessary to achieve halftone accuracy. In the end, if you decide to try spot process printing, a good separation software is strongly suggested.

**Raster Image Processing (Rip) Software**

Raster image processing software or Rip software, as it is otherwise known, analyzes images and identifies gradient shifts in color intensity and tone. When a
gradient is identified, the software automatically converts that portion of the image and tells the printer to produce a series halftones on the film. Raster image processing software is a helpful tool for any print shop but is absolutely a must if you want to print photographic or spot process images. While it is possible to manually create halftone images it is nearly impossible ensure manually that the size and concentration of those halftones will accurately recreate the nuances of your image.

Some Rip software also contains an ink management feature that allows the user to convert their color printer to an all black ink system for greater image opacity on film. While the creation of halftones is the primary function of Rip software, the all black conversion feature may in fact be the more important and useful function. Regardless of the type of image you will be printing, the opacity of the film is going to be of the utmost importance. When the image on the film is not clean and opaque light is allowed to travel through and around the image during the exposure process. This can cause issues with edge definition, loss of detail or may even cause your screen to expose behind the image, in which case you would have to start over. Inadequate film opacity is one of the leading causes for problems for new printers but is easily avoided by integrating the proper tools into your workflow.

*Note: Not all printers are compatible with Rip software so it is a good idea to consult the software developer for your particular Rip prior to purchasing a printer.
Film Output

The term film output refers to the printing of an opaque positive image to a transparent or semi-transparent substrate. Most often films are printed using either inkjet or laser jet printers. Most transparent films are designated for one style of printer or the other and will have an emulsion layer that allows for the adhesion of the ink or toner. Semi-transparent films such as velum work with laser jet printers but may require an opacity enhancer such as toner aide in order for the image to appear opaque.

Film Types

Inkjet

Inkjet film is a transparent polyester substrate onto which either dye or pigment inks can be printed. Inkjet film is coated with a nano or micro porous coating that is designed to absorb the ink quickly and prevent image bleed. This coating is designed to adhere to a specific ink type, which means that you should know if you are using pigment or dye ink prior to purchasing your film. Because the nano porous coating allows the ink to absorb quickly it will appear and even feel dry almost instantly. Although the film will appear to be dry, it is important to remember that appropriate time should be given if you wish for the ink to permanently bond to the film. Films that are not allowed to dry may be damaged during the exposure process and will have to be reproduced for later use.

Inkjet film is often referred to as “waterproof film” although this moniker could not possibly be less appropriate. Inkjet film is actually hyper-absorbent and is designed to immediately hold any liquid it comes in contact with. Because of this you will want to be sure that your films and anything they come in contact with are completely dry before putting them to use. Printing your films 12-24 hours prior to using them and letting them dry in a semi-arid environment is all that you will need to do to ensure quality.

Laser

Laser film is a transparent polyester substrate that has been coated with an emulsion layer that is receptive to the toner deposited by laser printers and is resistant to the heat needed to adhere the toner to the film. Laser film is popular among printers because it is economical and fast to produce. The drawback of using laser film is that the process is not designed for high opacity printing. This can lead to films that do not properly block UV light and result in poor screen exposure. Products such as toner aide can be used to liquefy the toner and create better coverage although they will add additional cost and may cause damage to the film in the form of spotting or image distortion. Toner aide is also highly toxic and should not be inhaled.
Velum

Like laser film, velum is designed for use with laser printers. Velum is the cheapest of the three film types and is somewhat popular for that reason. Common issues with velum include shrinking, wrinkling, undercutting and adhesion of the velum to emulsion during the exposure process. While toner aid does seem to work better with velum than it does with laser film, keep in mind that you are still working with a highly toxic product and it is still possible that you may experience image distortion.

How Films are Created

Printed Films

Inkjet

Inkjet printers such as those made by Epson use a mechanical piezo technology of precise electrical pulses that cause the ink reservoir wall in the head to compress, projecting ink through the nozzle. This process takes place at room temperature and does not utilize heat as a means of ink propulsion.

Bubble Jet

Other inkjet manufacturers like Cannon and HP use an entirely different process to propel ink from the print head. This process is commonly referred to as bubble jet printing. Bubble jet printers use a thermal device within the ink cartridge to heat the ink to a very high temperature for less than one second. The heating of the ink produces a bubble in the ink and propels it from the print head.

Laser Jet

Laser printers are aptly named because they do in fact use a laser to control the printed image. The laser does not actually burn or deposit the image to the substrate but rather positively charges a roller inside the printer that will then attract and deposit the toner onto the substrate. Once the toner has been deposited onto the substrate, a pair of heated ceramic rollers will heat the toner and permanently affix it to the substrate. Opacity and clarity are compromised with laser printing because the image is deposited onto the substrate using a dry media rather than a liquid media.

Hand-Drawn Films

Although not as popular as they once were, hand-drawn films are still a viable form of film output. Special pens containing high opacity ink are most often used to create the images on hand-drawn films. Many printers that work in the fashion or art
worlds are fond of this style of film because it makes the print feel more organic and accentuates the subtle nuances of the print. Unfortunately halftone and multicolor prints are nearly impossible with hand-drawn films.
Screen Preparation

Screen Choice

During the job evaluation phase you should have identified the screen or screens that will work best for your job. Before you begin preparing your screen it is a good idea to ensure that no changes have been made and that your screen is still appropriate for the job.

Degreasing and Drying

Degreasing a screen is one of the most important and easy steps that you can take in preparing your screen for printing. Simply scrub your screens using a quality screen degreasing agent and a scrub brush and you are done. Remember to let your screens dry in a clean environment where dust and other particles will not be able to gather upon it. DO NOT use compressed air to dry your screens. Compressed air is very tempting because it will dry your screen in a hurry but it will also introduce any oils or moisture in your airlines onto the screen and could cause issues in the coating process.

Emulsion Choice

As with your screen choice, your emulsion choice should have been made during the evaluation process. Again, in this step you are simply verifying that nothing has changed and that your emulsion choice is still appropriate for the print your doing.

Coating and Drying

Once your screen has been degreased and dried you will be ready to coat it with emulsion. There are two types of emulsion, liquid emulsion and capillary film.

Liquid emulsion is spread onto the screen mesh with a tool called a scoop coater. Scoop coaters come in a variety of sizes and have two coating edges, one for thick coats and one for thin. The decision to use one edge or the other will be based upon the thickness of the stencil you will need for your print.

Capillary film on the other hand, is applied to the screen mesh by placing the film onto the moistened screen mesh and using a squeegee to smooth it against the surface of the mesh. As with liquid emulsion you will want to let the screen and emulsion dry before use.

Stencil Thickness

The type of ink you are using and the need to apply more or less ink with each print stroke will usually determine stencil thickness. For example, light colored inks that
are being printed onto dark garments, such as white ink on a black garment, will require a thicker stencil. This thick stencil will allow more ink to be deposited with each print stroke, thus allowing for better coverage. Conversely, inks that absorb rather than cover (as in the case of water-based ink), require a very thin stencil to achieve a quality print. Specialty additives and inks may also require some adjustment to stencil thickness. It is a good idea to obtain the manufacturer’s specifications for stencil thickness if you want to ensure that your stencil is correct for your ink type.

**Handling a Coated Screen**

Once you have coated a screen it is important that it be placed in a proper environment to dry. Screens coated with liquid emulsion should be placed print-side down and no portion of the wet emulsion should be in contact with any surface. Because you are still dealing with unexposed emulsion your drying rack will need to be in a UV safe environment. You will also want to ensure that the humidity in the room is conducive to the drying process. If the moisture content in the air is greater than that in the screen, there is little to no hope of evaporation and you will thus be left with a terminally wet screen. Finally, you will want to make certain that dust and other particulates are not able to fall into the wet emulsion as these could cause a defect in the print clarity when you go to press.
Pre-Registration and Exposure

Pre-Registration

The term pre-registration refers to the practice of aligning film positives to coated screens prior to exposure. Pre-registration is important because it allows the printer to mitigate the amount of adjustment he or she will have to make to the screen on press. Although some presses do have adjustments that make registration on a press fairly easy, most are limited to a couple of inches of movement in any direction. Whether your press is equipped with registration adjustments or not, pre-registration is a good practice to follow.

Templates and Tools

Pre-registration templates are a fast and inexpensive method that some printers use to pre-register films. By placing the clear template on a UV safe inspection table, the printer is able to align both the film and frame to the same location each time. This is a very effective method of pre-registering but is dependent on a UV safe inspection table for success. If a UV safe inspection table is not in your budget or simply won’t fit in your workspace, you need not worry because there are other options.

A simple T-square, like those used for carpentry, works great as a pre-registration tool. The printer can simply line up the square on the frame and then either draw lines with a pencil or just place the film using the edge of the square as a guide. While this method is less exact than a template it should allow the printer to achieve enough registration that he or she will not have to make significant adjustments on press.

Exposure

A coated screen is exposed anytime that UV light is introduced to the environment in which the screen is exists. Exposure units are designed to enhance and control UV light waves so that the screen is burned quickly and accurately. Although it is possible to expose a screen using any source of UV light, it is strongly recommended that printers use some sort of professional exposure equipment in order to ensure a clean and accurate stencil.

Exposure Times

Depending on the emulsion that you have chosen and the light source that you are using for exposure, burn times can range from a matter of seconds to many minutes. Most emulsion manufacturers should be able to provide you with approximate exposure times for the emulsion and light source you are using. However, other factors such as humidity and temperature can cause a need to raise or lower
exposure times. Fortunately there are simple tests that can be performed to determine the exact exposure time that is appropriate for your circumstances.

**Step Wedge Test**

A step wedge test is a method of exposure wherein multiple exposure times are recorded onto a single screen in an effort to determine the best exposure time for current conditions. To perform a step wedge test, the following steps must be followed:

1. Place a film positive onto a coated screen.
2. Determine the manufacturer’s recommended exposure time based on the emulsion and light source you will be using.
3. Determine the increments of time with which you will be exposing your screen. For fast burning emulsions you will use small increments (5-10 seconds), for slower burning emulsions you will use 30-60 second increments.
4. Draw lines at the top and bottom of your screen indicating how many separate burn times you will use.
5. Expose the entire frame for two increments less than the manufacturer’s recommended exposure time. For example, if you have chosen 15 second increments and the manufacturer’s suggested exposure time is 4 minutes, then you will start at 3 minutes and 30 seconds.
6. Next, cover the first section of your screen with an opaque sheet so that the light can no longer expose that section.
7. Expose the screen again for the increment of time you have decided upon.
8. Continue steps 6 and 7 until the entire screen is exposed.
9. Once the entire screen is exposed and rinsed you will most likely find that one section of the screen looks better than the rest. This section indicates the best exposure time for your conditions.
   a. *This test should be performed quarterly or anytime that you change a product or piece of equipment related to your exposure process.

**Exposure Calculator**

Exposure calculators are film positives that have been printed with a series of images designed to help printers determine exposure time. Most exposure calculators employ a series of halftone filters that filter the UV light in an effort to gauge the performance of the chosen light source with the chosen emulsion. Printers need to have a general idea of what their exposure time should be before using an exposure calculator and should follow the instructions that come with the calculator to ensure success. Some calculators will also include information to help determine whether or not the mesh that is being used will support different levels of halftone.
information. This is a valuable tool for anyone that will be working with process or photographic prints.

Washout and Drying

Washing Out an Exposed Frame

Washing out a frame after exposure is not as simple as just running water over it. While the emulsion has been hardened during the exposure process it is still a water-based product and is susceptible to damage if oversaturated. Because all emulsions are slightly different, it is a good idea to find out what the manufacturer of your chosen emulsion recommends with regard to washout. One should also keep in mind that although the emulsion has already been exposed, it is still UV sensitive and should be treated as such. Many people will washout their frames in a UV safe environment so as to avoid any exposure that could negatively affect the quality of their stencil. While post burn exposure is something to be concerned about, if you do decide to washout screens in your darkroom it is important to remember that you are introducing moisture into an area that we have established earlier is also an area in which we will be drying screens. Depending on the amount of water pressure that you use, you may also stir up particulates that could fall into any drying frames that you may have lying around.

Drying an Exposed Frame

If your screen has been properly exposed and rinsed this part should be a breeze. On sunny days you can dry your screens outdoors and the sunlight will actually help to harden the emulsion as it dries. If it is not so nice out you can dry your screens in any area of the shop that you have room.

Note: *Slightly underexposed screens may have trace amounts of emulsion in the water after rinsing. If this water is allowed to dry in the image area of your frame it may cause clogging and hinder your ability to print with this frame. To avoid this you can use compressed air to ensure that the image area is clear and then lay the frame flat so that water is not able to run into the image area. You can also use newspaper or a paper towel to absorb excess water on the frame.*
Job Preparation and Printing

Job Preparation

Nothing will frustrate and cost a printer during production quite like lack of preparation. Print production is an art that requires a rhythm and flow so that the printer can be both efficient and accurate. Production is where profit is made or lost and most often it is preparation that dictates which a printer will experience.

Job Cart

Whether you use an actual cart, a card table, or just the box your shirts came in, it is important to put together any and all items that you are going to need before you start production.

Items you will want to have ready include but are not limited to:

- Films
- Shirts
- Adhesive
- Ink
- Ink knives
- Screen opener
- Press wash
- Tape
- Pellons
- Rags
- Squeegee

The goal is to ensure that you have what you need while printing so you won’t have to stop to find it.

Pallets

Although some people think that the only consideration when it come to pallets is whether or not your print will fit on it, there is much more to consider. Just because your print can be done with a pallet doesn't mean it should be done with a pallet. Remember that loading and unloading your garment is not only important to the accuracy of the image placement but also makes up a significant portion of the total movement a printer will make during the course of production. If a printer can reduce the time and effort needed to load and unload their garment they may be able to reduce their workload considerably.

Pallets are offered in a variety of sizes, shapes, and materials. Some pallets, like jacket and koozie pallets, are designed to work with specific substrates. Other
pallets are designed to help with prints on legs, sleeves, pockets or other unique placements. Pallets are most often made of wood or aluminum but also come in composite and other materials. If printing were a dance, your pallet would be your dance floor so make sure it’s right or you might break your leg.

**Pallet Adhesive**

Pallet adhesive is integral to the success of any print. In order for a printer to achieve proper ink coverage on his or her garment, multiple passes may need to be made during the printing process. If for any reason the garment should move between prints the image will come out distorted and the garment will have to be discarded. There are multiple types of adhesives designed to work with specific garments or in specific printing scenarios.

**Pallet Tape**

Pallet tape is a thick masking tape product that is used to cover the pallet prior to printing. By guarding the pallet from the damage of heat and adhesives, pallet tape will help a printer extend the life of their printing pallets. Pallet tape is sold in large rolls and is very economical when compared to the cost of replacing costly pallets.

**Press Adjustments**

Screen printing presses are for the most part very basic machines. There are however a few basic adjustments that should be made before you begin production.

**Off contact**

Off contact refers to the distance between the screen and the substrate when the screen is in the down position. When the squeegee travels across the screen the screen mesh is stretched downward until it makes contact with the substrate and the ink is deposited. After the ink is deposited onto the substrate, the mesh should snap back to its original position leaving a clean crisp image on the substrate and allowing the screen to be raised without damaging the image. If the off contact is not correct, the mesh will not be allowed to properly snap back into place and could damage the print when the screen is raised.

**Tilt**

The tilt adjustment is used to ensure the off contact adjustment is consistent from the front of the print to the back. In some cases the tilt will be used to allow for slightly less off contact in areas where the printer is unable to achieve firm print pressure.
Registration

Registration is used to align each image to the pallet and/or the other image elements that will be printed on the garment. If pre-registration was performed during the exposure process, the work required to register on press should be minimal. Often printers will affix a film to the pallet on which they will be printing and use that as a template for registering the screens. This method works well but will still require a test print to ensure accuracy. Regardless of which method is chosen, proper registration will ensure that your print is placed correctly and in line with other image elements.

Printing Techniques

Those that are new to screen printing often think that the physical act of printing a garment is going to be complex or difficult. The truth is that printing is really very simple with a little direction. The key to good printing is making sure that the angle of your squeegee is appropriate for the amount of ink you are trying to deposit and the finish you are looking to achieve. A tall angle will deposit a thin layer of ink with a very clean finish whereas a low angle will deposit a thick layer creamy ink. Once you have the angle figured out, you simply need to ensure that you are able to generate the appropriate amount of pressure needed to clear the ink from the screen.

Push Printing vs. Pull Printing

Push printing and pull printing are exactly what they sound like and the choice to push or pull is totally up to the person printing. While there are some squeegees that are designed for one style or the other, most often the choice is based upon the printer’s ability to generate the needed force. Because pull printing is more taxing on the arm muscles, it is often avoided by those with low arm strength or those printing large orders.

Flooding

Flooding takes place when the squeegee is pulled across the screen with enough force to fill the open mesh areas with ink, but not so much force that the ink passes through the screen and onto the substrate. By flooding a screen the printer is ensuring that the entire image is going to appear on the substrate during the printing process. If a screen is properly flooded the printer only needs to separate the ink on the upper portion of the screen from that on the bottom during the printing process to achieve a clean and vivid print.
Curing

Whether you will be printing with plastisol ink, water-based ink, solvent ink or something else all together, it's a pretty safe bet to say that you will need to cure it. Some inks cure with direct heat, some cure with heated air, and some simply cure as they dry in the open air of your shop. When we use the word cure in regard to screen printing what we are talking about is the process by which the ink becomes permanently bonded to the substrate. In the U.S., the majority of garment printers use either plastisol or water-based inks. Although these two ink types are very different, the processes used to cure them are similar enough that the average printer can work with both without the need for multiple pieces of curing equipment.

Dryer Types

Hand Dryer

Hand dryers have been popular with beginners for years because they are inexpensive and small enough for even the most modest workspace. While it is possible to cure both plastisol and water-based inks with a hand dryer, there are some serious downsides to curing this way. The primary issue with hand dryers is that the heat that comes from them is highly concentrated to a small area on your garment. This concentration creates a two-part problem. First, when a high amount of heat is concentrated on a garment there is a high likelihood that the garment will burn or distort in that area. Second, by concentrating the heat, you are only curing a one small area at a time and as such are setting yourself up to have uncured areas in your image. In the end, if a hand dryer is all you have and you are comfortable with the risk, it will do the trick. However, if you are simply looking for a place to skimp, your dryer should not be the place.

Flash Dryer

Flash dryers are great pieces of equipment and incredibly effective if used properly. The intended use of a flash dryer is to cure only the surface of the ink. This is done so that the ink will not transfer and may receive more ink on top of it. However, many printers have used their flash dryer as a tool to cure the entire print. Most flash dryers consist of a base (which may or may not have casters - get one with casters!), an adjustable stand, and a rectangular case containing the heating element. There are three types of heating element used in most flash units on the market today.

Element Types

S-Coil Electric Elements
If you have ever looked inside of an electric oven then you have seen an s-coil electric heating element. These elements are popular because they are inexpensive and are able to reach relatively high temperatures fairly quickly. Unfortunately, because these elements were designed for use inside of controlled environments like ovens, they present issues when used in an open environment like a print shop. The primary issue with s-coil elements is that the heat they put off is very inconsistent. While some areas of the dryer may produce heat well in excess of what is needed to cure the ink, other areas may not even get hot enough to make the ink dry to the touch. Most reputable manufacturers have gone away from these elements but they are still being produced and should be avoided if possible.

**Infrared Elements**

Infrared elements are the most widely used elements in the industry today. These elements are popular because they produce high amounts of even heat across the entire surface of the flash. The only real downside to using a flash with an infrared element is that the element is always on and running when you have it plugged in or turned on. This means that the area around the flash can get quite warm and also means that your power bill is going to take a hit. All in all, an infrared flash is a great way to go.

**Quartz Elements**

Simply put, quartz elements are top of the heap. These elements are able to turn on and generate tremendous amounts of even heat in just a matter of seconds. After curing, the heating element turns off and power is conserved until heat is needed again. Quartz flash dryers are not cheap by any means but if you compare their cost to the cost of electricity you may find that a little money spent up front will save you a bundle down the road.

There are many upgrades available to almost all flash dryers as well. These upgrades include automatic rotation devices, forced air fans for curing water-based and other air-dry inks, and foot switches for hands-free control. It is important to remember however that a flash dryer is NOT intended to be a final cure device and should not be used as one if you can avoid it.

**Conveyor Dryer**

To some a conveyor dryer might just look like a giant flash dryer with a box around it and essentially that is exactly what it is, although upon closer inspection it is a bit more complex. Conveyor dryers are designed to create the perfect environment in which ink will cure. Though the heating elements may be similar to those used in
flash dryers, it is the oven portion of the conveyor dryer that makes the two truly different. By controlling the temperature surrounding the entire garment, the oven ensures that the ink is hit on all sides with enough heat to cure it. Unlike a flash dryer which heats the garment from the top down while the garment sits on a flat surface, a conveyor dryer heats the garment on all sides while the garment rides on a mesh belt through which the heat can pass.

Conveyor dryers come in a variety of sizes and can even have double belts inside that travel in opposite directions. In addition to coil and infrared elements some manufacturers also offer conveyor dryers with gas heating elements. Conveyor dryers are one of the more significant investments that a printer will make in terms of equipment for their shop and though it may be tempting to try and avoid the cost you can rest assured that you will pay for it in time and lost garments if you do.

**Times and Temperatures**

The amount of time and the temperature at which you will cure your ink will vary based on the ink type and the manufacturer. When you purchase new ink it is always a good idea to ask your supplier and/or the manufacturer to give you a suggested cure temp and time. Though some ink may seem similar to others you have used before, it is important to remember that even the slightest variance can cause the ink not to cure and will result in a loss of that image when the garment is laundered.

The garment itself can also dictate the curing time and temperature that you will be able to use. While garments made of natural fibers like cotton are very sturdy and hold up well to the high heat needed to cure, man-made fibers like polyester and nylon are much more sensitive to heat and must be treated with greater care. Again, your best resource for information about the curing parameters for your garment may be the supplier and/or manufacturer. In many cases you may find that it is not the curing temperature that is the problem but rather the speed with which the garment reaches that temperature and the time for which it stays at that temperature.

**Testing**

Regardless of the type of dryer you choose, the ink you use, or the garment type, you should always wash-test your prints. By simply ordering one extra garment and using it to wash-test, you will be able to ensure that you have done everything correctly and that your customer will be happy with their garments. Printers ship under-cured or uncured shirts every day and in many cases it costs them thousands of dollars to replace the damaged garments. If you can avoid this for the cost of a little detergent and 30 minutes in your washing machine, do it.
Clean-Up

Clean-Up Checklist

Clean-up is not an area that most screen printing classes, videos, or text books spend much, if any time on. This is a mistake because it is clean up that sets the stage for your next job. Cleaning not only allows you to ensure that your shop is always ready for whatever you need to do but can also help you avoid costly losses from damaged equipment and supplies. The following checklist will help you ensure that nothing is missed:

1. Make sure all of the ink is out of your screens and back in the bucket
   a. This will help you avoid ink drying on your screens and will also save you money in wasted ink
2. Clean your squeegees
   a. Squeegees can hold a lot of ink and if they sit for a while it will dry and be wasted
3. Remove excess adhesive from your press
   a. Adhesive is great for holding shirts but no good for keeping presses clean and in good working order
4. Put lids on open product and return it to its proper storage area
   a. Paying for product that gets spilled or just evaporates into thin air is just plain silly
5. Clean your tools and return them to their home
   a. You don’t want to waste time looking for them later only to find that they are filthy when you do
6. Clean ink from the image area of screens you will be keeping on hand
   a. The great thing about exposed screens is that you can use them over and over each time your customer needs more shirts. However, if ink is allowed to sit in the image area, the screen can become irreparably clogged
7. Reclaim and de-haze screens that you are done with
   a. Although ink haze is more of an annoyance than a real problem it is an annoyance that can be avoided by acting quickly to reclaim and de-haze your screens
8. Make sure everything that gets HOT is turned off
   a. Beyond the simple power savings, this step may keep you from damaging your equipment or even burning your shop down

There are a host of great tools and chemistry products to help you with each step of the clean-up process. Keep in mind that just as with the rest of the screen printing process, the right tool makes all the difference. The reality for most printers is that they are trying to make money through screen printing. Keeping a clean shop is one of the easiest ways to ensure that they do.
Section Eleven: Summary

Screen printing can be a lot of fun and is a great means of artistic expression for those who choose to use it that way, but screen printing is also a job and like any other job it is always better when it’s done correctly. It is our hope that this course will set you in the right direction for whatever path you take with screen printing. Just as printers rely on the success of their customers, suppliers rely upon the success of their customers. We know that the best thing we can do is work hard to make you the best at what you do.

If you feel like you haven’t learned how to screen print in this class, don’t feel bad because no one has. The goal of this class is to provide you with the information that you need so that you are able to learn to screen print. We are committed to being your partner in that process and it is a commitment we take seriously. As you progress you can take comfort in the knowledge that we are always here to help you with questions, concerns, purchases or anything else you should face.

Thank you for giving us the opportunity to work with you and to be your partner in business.

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