American Screen Printing Association

Certified Screen Printer (CSP)
Examination Study Guide

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FOREWORD
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The American Screen Printing Association (ASPA) Certified Screen Printer (CSP) Study Guide is the recommended resource to prepare for the CSP exam. It’s primary purpose is to prepare you to successfully pass the exam and to help you gain some of the necessary knowledge for securing a job in the screen printing industry.

The ASPA CSP exam has (36) true or false and multiple choice questions. Certain questions require that you refer to a photograph. A score of 70% is required to pass the exam. We have included a few practice questions at the end of this Study Guide to acquaint you with the actual exam.

The success of each student is very important to ASPA. Therefore, we strongly encourage you to thoroughly read the CSP Study Guide prior to taking the examination.

If you feel that your knowledge of screen printing is inadequate, we encourage you to take a course in screen printing. American Screen Printing Association offers several screen printing training courses. Books on screen printing are also available at most libraries.

Questions about this Study Guide should be referred to the staff at your training facility.
Process Ink Colors
Cyan, Magenta, Yellow and Black (CMYK). A printing technique utilizing four ink colors (Cyan, Yellow, Magenta and Black) to print the entire color spectrum.

CMYK is often referred to as 4 color process printing.

Pantone Color Guide
A useful tool for matching art to ink colors is a Pantone Color Guide.

It is used by printers, artists and others in the graphics and printing industries to make accurate color identification.

The Pantone Color Guide shown to the left is one made specifically for screen printing.

What is a Screen?
A "screen" is the term used for the mesh fabric that it is attached to a wooden or metal frame and is used for the purpose of screen printing. Screen frames can rigid or retensionable.

Mesh is a fabric usually made of synthetic material that has uniform openings which allow the ink to pass through it onto the product (known as the "substrate") that you are printing.

Preparing Ink
Before beginning any print job, it important to stir the ink in the container before inking the screen.

Plastisol ink is thixotropic, a term used to describe the condition that as the ink is stirred, the lower it's viscosity becomes. Translation: the more you stir, the creamier and more fluid the ink becomes.
Halftone Printing

Screen printing photographic images require that the image be converted to halftones. There are many software applications available for that purpose.

Halftoning is the graphic technique that simulates continuous tone images with the use of dots, varying either in size, shape or spacing between them.

The size of the halftone dot used will be determined by the type of artwork that you are going to print or the substrate that you are printing on.

For example, screen printing on apparel typically involves printing halftones in a range of 35-65 LPI.

There may be occasions where you want the halftone to be very noticeable and exaggerated for a special effects look, where you may want to go down to a 25 LPI size halftone which will produce a very noticeably large dot.

If you are printing CMYK or simulated process color on apparel with a manual screen printing press, it is recommended that you print from 45-55 LPI.

If you have a high end automatic screen printing press along with a point light source exposure unit and are using professionally produced film positives you may want to consider printing as high as 65 LPI.

Higher mesh counts are used for halftone printing. Mesh counts of 162-254 are a recommended range for halftone or photographic grayscale images.

Examples of halftone screen prints on apparel

25 LPI (line per inch) halftone 55 LPI (line per inch) halftone
Squeegee Durometer

The rubber blade on the squeegee is the “business end” of the tool.

The “hardness” of the rubber is measured in units known as durometers.

A “soft” durometer squeegee has a hardness of 50. A medium is 70 durometers, and a “hard” durometer is 90.

Soft durometer squeegees like a rounded edge, 50 durometer “bullnose” squeegee is used when it is desirable to print a heavy ink deposit like for athletic jersey printing or player numbers. Hard durometer squeegees are better for printing images with fine detail, halftones, etc. They deposit less ink on the substrate and last longer than soft or medium durometers.

For most general textile printing including t-shirts, you should use either a medium (70 durometers) or triple durometer (70-90-70) squeegee.

A triple durometer squeegee has a rubber blade that consists of a hard middle layer and two softer outer layers. Triple durometer blades are more versatile.

Screen Printing Steps

The screen printing process is performed in the following sequence of steps:

1. Create a film positive
2. Expose and washout screen
3. Print & cure substrate
4. Clean-up
5. Reclaim screen

Feel of a Print

How a screen print feels when touched.

A screen print on a shirt is commonly described as having a soft hand or rough hand.

A soft hand print is desirable as it has a smooth feel to the hand.
Flood Stroke

A flood stroke (coating the print area with ink) should be done at an angle of around 20-30 degrees.

The flood stroke is often used to “flood” large open print areas so the print stroke has an adequate layer of ink to produce a good print.

The angle is considerably more “downward” than a normal print stroke. A typical use of the flood stroke is for printing a large white underbase print where a single initial stroke will not spread the ink sufficiently across the screen. The flood stroke is used to flood the screen with ink so there is an adequate ink supply over the stencil while not forcing any ink onto the substrate.

Capillary Film

Capillary film has certain advantages over liquid emulsion. First, capillary film is easy to use. There is no mixing, spilling, or no mess to clean up.

It also produces a razor sharp stencil and exposes and washes out like a dream even if you have a less than ideal light source exposure unit.

Capillary film is also very effective in eliminating “sawtooth” images in stencils. Sawtooth can be characterized as a jagged “stair-step” appearance in the stenciled image.

Dye Migration

This is a problem that occurs when dye migrates from the fabric into the imprinted ink on a garment or other substrate.

This problem occurs with 100% polyester or 50/50 blend garments only and can be avoided by using bleed resistant inks and by taking certain precautions when printing, curing and handling the garments after curing.

You typically see this with red garments. White ink will bleed and the white print turns pinkish.
Postscript

If you plan to print halftone images (images that contain gradient tone shadings), you will need to have a printer that has Postscript capability. A Postscript printer gives you the capability to print out an image into black and white halftone dots, the settings of the halftones being determined by the computer graphics application that you are using.

Laser printers can be purchased with Postscript as an option built-in. With inkjet printers, you will need to purchase a third party application know as a Postscript RIP (raster image processor). If you plan to print halftone images, you will want to investigate Postscript capable printers.

Postscript printers are also ideal for printing vector art (which is preferable over bitmap images). Unlike bitmap images, vector art can be enlarged without degradation.

Printing on Dark Shirts

Unlike printing on white or other light colored t-shirts, printing dark colored apparel can present certain challenges. Single color printing on dark shirts is best achieved with the use of specially formulated ink known as “super opaque” to achieve the opacity of an acceptable print.

When printing on dark shirts, more often than not you will need to print the ink twice to achieve the desired opacity of the print. Printing the ink twice covers the fibers in the shirt so you do not see the color of the shirt showing through.

To achieve complete opacity of the print you would use the Print-Flash-Print technique (PFP).

To use the PFP technique, you print the ink color, flash cure to “dry” the surface of the print, then apply another print stroke. Flash curing times when using the PFP technique will vary depending on the type and color of ink that you are using. Flash curing times for white ink is typically under 10 seconds. When flash curing colored inks you may need to flash the print 20 seconds or more. Flash prints can become very hot and it may be necessary to use either a cool down station or a “chiller plate” to cool the print before applying your top coat of ink.
Burning Halftone Screens

High end exposure units that have a light integration system are the best possible light source for screen making, particularly for exposing screens that contain halftone dots.

A light integrator is an electronic component in the exposure unit that detects and controls changes in light intensity. It automatically adjusts the light output to a consistent light level despite changes in electrical power line levels and for the light intensity changes due to the aging of the light bulb.

With a light integrator, you will be assured of getting the same amount of light each time you expose a screen. When exposing images such as fine halftone dots, having a light integrator will improve the quality of your screens considerably. Without a light integrator, you will experience light scattering and the halftone dots will not resolve as sharply.

Pinholes

Prior to placing a screen in the screen printing press, you should check for pinholes. “Pinholes” are small unwanted specks that are exposed in the emulsion when the screen was being burned. To check for pinholes, hold the screen up to the light and look to see if there are any visible “white” specks present.

Ink will pass these through these small specks and must be covered prior to printing. Pinholes can be caused by dirt, dust, and other unwanted debris that is on the exposure unit glass.

Pinholes can be controlled by cleaning the glass before each screen burning session. Pinholes can also be caused by having unwanted specks on the film positive. In addition, if you coat (or dry) your screens in dusty conditions, dust, link, and other debris can land on your screens as well.
Exposure Units and Screen Burning

An exposure unit is a device used for the purpose of making a stencil. It is the light-emitting device used to expose a image on an emulsion coated screen. It consists of a light source and some means of holding a screen in place against a film positive. Your artwork is placed on the exposure unit glass during the exposure process also known as "burning a screen."

The screen is coated with a photographic chemical solution that is sensitive to light known as emulsion. When the light hits the screen, only the area darkened by the film positives ink "develops."

The exposure process can take from just a few seconds to several minutes, depending on the type of exposure unit and the type of emulsion. Water is then applied to the screen during the "washout" process. Only the portion of the screen that contains the image "washes out," thus creating the stencil. The stencil is the "open area" of the screen.

Exposure Time

Exposure time is the time that is necessary to expose a screen to light to make a stencil. Exposure time can vary by the exposure unit and the emulsion used. Review the specification sheet provided by the emulsion and exposure unit manufacturer.

Typically, the manufacturer will include exposure times for various light sources. This will be a good starting point. The worst that can happen is the screen will be underexposed (stencil will be less durable) or overexposed (stencil will be hard to wash out). Conduct tests and adjust your time until you find the ideal exposure time.

A useful tool to have is an exposure calculator. It is a pre-printed film positive that can aid you in determining the optimum exposure time for your particular set-up. They are available at most screen printing supply vendors.

Remember, exposing a screen for too long of a period of time resulting in a screen that will be difficult or impossible wash out.
Types of Ink

It is important that you choose the right type of ink for the substrate.

Choosing the wrong ink can lead to ink adhesion problems and wear resistance issues. Below are some of the more common types of inks that you may use in screen printing.

Plastisol ink is the most popular type of ink used for printing apparel and other textiles. It does not dry in the screen and must be cured with heat in a textile dryer or with the use of a flash cure unit.

Acrylic ink is an easy to use solvent-based ink used to print many types of “plastics” including polypropylene, polyethylene and polystyrene. Decals, metals, glass, and some types of vinyl can also be printed with it.

Be aware that certain plastics (polyethylene and polypropylene) require flame treatment prior to printing for proper ink adhesion. Flame treatment can be done using a propane torch (available at most hardware stores) by briefly passing the flame over the substrate. Take care when flame treating.

Vinyl ink is a specially formulated type of solvent-based ink used for printing vinyl products such as pocket protectors, portfolios, binders, etc.

Epoxy ink is used whenever a durable imprint is required that will withstand physical abrasion and resistance to chemicals and solvents. Epoxy ink is typically used for printing glassware, metals, and other substrates where rough treatment is an issue.

UV ink is a popular type of ink for ad specialty screen printing applications. Multi-purpose UV ink is formulated for a wide variety of substrates, eliminating the need for stocking a lot of different inks.

UV inks are slow to dry in the screen and that property makes them desirable for hard goods printing.

Be aware that most UV inks have a disagreeable odor, should be used in a well ventilated area. They require drying/curing with a UV light source.
Is It Dried or Cured?

The last step in the screen printing process is the curing of the print. Plastisol ink must reach a temperature of 320 degrees to be considered “fully cured.” The best method for curing a print is to use a textile dryer. This dryer is essentially nothing more than a belt driven chamber that contains the same type of heating elements that you find in a flash cure unit.

Although it would seem natural to use the term “dried,” it would be a misnomer, as the ink film on a product may feel “dry” to the touch but not be fully cured throughout the entire ink deposit. The print surface may seem “dry” but the inner portion of the ink film may not be. A print that is not fully cured will not stand up to a washing. The ink will come off during the washing cycle as the ink was only “gelled” and not thoroughly cured.

There are several methods that can be used to help with the determination of full cure. Temperature strips or temperature “tapes” are little strips of specially made paper that have temperature readings printed on them that will indicate the temperature as the garment is being run through the dryer or flash cure unit.

A heat gun also known by it’s technical name (non contact pyrometer) is a useful device for checking the temperature of the print as it is coming off the dryer belt or when being flashed.

Stretching the print on the shirt to see if it cracks has a limited value for checking for curing of the print. The idea behind this test is if the print “cracks” during stretching it is most likely under cured.

The only guaranteed way to determine if your prints are curing properly is to do a “wash test.”

It’s a good habit to periodically wash a test shirt to see if your belt dryer is working as expected. It’s also a good idea to wash test a shirt for any “high value” order, large quantity orders, or if the order is for any type of garment or product that you may have concerns for curing issues, e.g.: metallic, glitter inks, etc.
Dehazing a Screen

As screens go through the cycle of printing, cleaning, and reclamation over and over again, “ghost” images will begin to appear on the screen mesh. These “ghosts” are actually dried ink that was never removed completely when the screen was cleaned. Eventually, the “ghost images” will become so apparent that they must be removed.

The process of removing these ghost images to make the screens completely clean again is known as “dehazing”.

Mixing Reclaiming Powder

The solution for screen reclaiming can be bought in pre-mixed containers. But since most reclaimation solutions contain a mixture of water and the chemical sodium metaperiodate, it is much more cost effective to buy sodium metaperiodate in powder form and mix it with water yourself.

Mixing the solution is very easy. You only need a tablespoon for measurement and any type of gallon container.

Sodium metaperiodate is the key ingredient, along with water that is used in most screen reclaiming solutions.

Toxicity and MSDS

Toxicity is the degree to which something is able to produce illness or damage to an organ.

Always follow the manufacturer's instructions and/or MSDS (Material Safety Data Sheet) regarding the use and handling of all screen printing chemicals. We also recommend that you wear rubber gloves, protective eye wear and a disposable dust mask or respirator when handling, mixing, and applying screen cleaning and reclaiming chemicals.

Material Safety Data Sheets are supplied by the manufacturer indicating the composition, substance, health and safety data of the product.
Moiré Patterns

Moiré is the visual effect of radiating curves created by superimposing two regular patterns. For example, a moiré pattern can result from overlapping two halftone screens of different angles, dot spacing, dot size and the weave of the fabric.

Moiré patterns are the undesirable result of rescreening an image with a different halftone screen or with the same halftone screen on an angle different from the original. Moiré patterns create a “herringbone” appearance and make the printed image visibly distracting.

Eliminating moiré can be as simple as choosing a different brand of shirt or as complicated as outputting the art at different halftone angles and reburning the screens.

Grayscale Images

To be able to screen print photographic or grayscale images, an image must be converted into what is known as “halftones”. A halftone image consists of many small dots that make up the grayscale portion of that image. The angle, pressure, and speed at which you pull the squeegee will effect how a halftone dot is printed on the substrate.

Use as little pressure as possible to clear the ink from the screen and print at a regular and deliberate speed at a normal squeegee angle.

You want to try to print “like you are a machine” with consistent, repeatable strokes of the same angle, pressure and speed. Automatic screen printing machines always produce a better result than a manual printer and your goal is to try to “emulate an automatic press” in your printing technique.

Higher mesh counts are used for halftone printing. Mesh of 162-254 are a good choice for halftone or grayscale images.
Print Registration for Multi Color Printing

When printing multiple colors of ink on the same substrate, registration marks (crosshair targets) are placed on each film positive for each ink color of the artwork. These marks should overlap exactly when each individual screen is made. This overlapping is how different ink colors or screens are registered. When the screens are lined up on the printing press, each screen for each ink color must line up in perfect alignment to produce a good print.

An out of registration print will produce a blurry image where the colors do not line up as desired. Above is an example of an out of registration print. Notice that the registration marks do not line up exactly on top of each other as they should. Once registration is achieved, the marks should be taped over.

Off-Contact

Off-contact is the gap between the bottom of the screen and the platen. In the screen printing process, the screen is filled with ink and the squeegee is pulled across the screen pushing the ink through the stencil to produce a printed image.

When the screen is lowered onto the substrate, you must have a slight gap between the screen mesh and the substrate, otherwise the ink will most likely smear onto the substrate. Moreover, without off-contact, you will experience difficulty lifting the screen from the substrate because the screen/ink may stick to it causing further problems.

Printing with off-contact eliminates those problems by keeping the screen just slightly above the substrate. Once the squeegee is pulled across the mesh, off-contact immediately lifts the screen mesh away from the substrate as the squeegee is moved across the stencil, resulting in a good print.

If you have a printing press with an “off-contact” adjustment, it is a simple matter to set it precisely at the height that you want. Just turn the knob and watch the screen raise or lower. You can “feel” the amount of off-contact by pressing your fingers down on the mesh.
Post Exposing a Screen

After the screen has completely dried, you may want to post expose it. The purpose of post exposing a screen is to harden the stencil. This will make the stencil more durable for long print runs or if you intend to keep the screen for a long period of time without reclaiming it.

To post expose a screen, simply place it on the exposure unit and expose it several minutes.

How Many Strokes?

The short answer is—use as few as possible. Ideally, use only one stroke. But in the real world, that is often not possible, particularly in the world of manual printing. If you are flash printing dark shirts, one stroke is not possible, nor is it possible for certain print jobs where flood stroking is necessary and where one stroke just doesn't produce an acceptable print. To minimize dot gain when printing halftones, (an undesirable condition in which halftone dots enlarge in size), the ideal is one good print stroke. The rule to live by is this: Use as few print strokes as will produce an “acceptable” print. What is an “acceptable” print? A print that you are reasonably certain will not give a customer a reason to complain.

Tension Meter

A requirement of using retentionable frame screens is that you must have a tension meter (shown at left) to adjust the mesh tension ("tightness") of the mesh on the frame. Mesh tension is measured in units called "newtons."

A tension meter is a delicate instrument that you must take care with. Rough handling of it can easily knock it out of calibration and you must send it out to a lab for recalibration if that should happen. A tension meter that is handled carefully and stored properly will last a lifetime.
Ventilation and Safety Considerations

Most of the non textile products that you may print will require the use of solvent based inks. Solvent-based inks are both flammable and have a characteristic odor. It is imperative that you do your printing and use these inks in an area that has adequate ventilation. You must also observe all fire safety precautions.

Be aware that the fumes involved with the use of these inks and cleaners needed to clean up after the job can be very strong. Always take the proper safety and ventilation precautions that are necessary.

Be safe! Always read the MSDS (Material Safety Data Sheet) for all screen printing inks and chemicals. Informational sheets supplied by the manufacturer indicating the composition of substance and health and safety data of the product.

Pad Printing

Pad printing is a process that utilizes a silicone pad, an image that is burned on a plate (also know as a cliche) and specially formulated solvent based inks.

The process works like this, the silicone pad picks up a very thin ink deposit from the imaged plate and transfers it to the substrate.

Pad printing is the standard method of printing many irregularly shaped objects including pens and many plastic items.

Some items (like golf balls) cannot be printed by screen printing and are best printed by pad printing.

Pad printers are available as both manual and fully automated machines.
American Screen Printing Association, Inc.
Certified Screen Printer Examination

Student Name: ____________________________________________
Student Identification Number: ________________________________
Examination Date: __________________________________________
ASPA Control Number: BDX 86

Instructions:
Fill in the dot to the left of the correct answer.

See sample question below.

What is the state capital of California?
○ (a.) Los Angeles
○ (b.) Sacramento
○ (c.) San Francisco

1. What is wrong with the print shown below?

○ (a.) Nothing
○ (b.) It is out of registration
○ (c.) Improper ink colors used

2. A vector line art image is preferred over a bitmap line image because:
○ (a.) Vector images are easier to create
○ (b.) The image can be enlarged without degradation
○ (c.) Bitmap images usually produce a smaller file size

3. "Flash" curing is the ideal way to fully cure an imprint.
○ (a.) True ○ (b.) False