



Printing Nylon and Polyester Athletic Uniforms

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- *Overview*

Anyone who has ever direct printed even one athletic uniform readily admits to the challenges faced in completing the job correctly. Many printers have even resorted to thermoplastic die-cut numerals, transferring the numbers to the uniforms leaving only the team name and logo to the direct printing process. While this is an acceptable process in which to decorate the uniform it creates two extra steps—matching the ink color to the color of the die cut numeral, and then the transferring of the numeral to the uniform. If this is the process you are using now, this paper will eliminate these last two steps by demonstrating the proper techniques to direct print athletic uniforms correctly and make the challenges easier to overcome making it a profitable part of your business instead of a burden.

- *Determining Fabric Content—Is it nylon or polyester?*

Before beginning production on any athletic uniform check the fabric content of the uniform. Just recently we spoke to a customer who printed athletic gold ink on twelve navy uniforms for a youth basketball team. Guess what, eight of the uniforms had a beautiful gold printed logo and number while the remaining four had turned a hideous, greenish gold color a few days later. Upon further inspection, when both uniforms were placed side by side under a bright light and inspected closely, you could see a slight shade variation in the navy fabric between the good and bad prints. Upon further inspection, the customer discovered that the four uniforms with the greenish-gold prints were 100% polyester and the dye had migrated through the ink film and turned the athletic gold print a greenish color.

Uniform manufacturers have turned to polyester because it is an extremely durable fabric which costs less than nylon. This customer just happened to be the unlucky guy who received a shipment when the manufacturer was changing his fabric over from nylon to polyester. Having learned a lesson the hard way, this customer will be inspecting all fabric content labels from this moment forward. Also, when you read the bottom of our Technical Data Sheet where it says in bold, black letters-- **“CAUTION, always test this product for curing, adhesion, crocking, opacity, dye migration and other specific requirements before using in production”**, it would behoove you to heed this warning. You are not printing a \$2 t-shirt, you are printing a substrate which can cost between 10-\$50 or even more. Ruin just one uniform and your profit is gone!

- *Choosing the ink—Are these uniforms to be game worn or replica uniforms?*

In order to determine what ink to use you must first determine if the uniforms are to be game worn or replica jerseys. Union manufactures two specific ink series, Athletic Gloss Series (for 100% nylon) and the Polyester Series (for 100% Polyester) that are specifically formulated for game worn athletic uniforms. These inks are made with special plasticizers, pigments, fillers, resins and dye blockers to give prints the gloss, opacity, color brightness, bleed resistance and durability characteristics needed to survive the pounding of a full season as well as surviving the numerous launderings to remove grass stains and perspiration. These inks are typically more expensive than regular plastisol inks. If you think you can get away with using general purpose inks just because they are youth uniforms for the local Pop Warner football team, please think again. Because of the budget restraints of small colleges, high schools and youth sports teams, these game worn uniforms sometimes have to survive several seasons. Inks are not the place to cut corners.

If you go anywhere in public you see fans sporting the logos of their favorite teams on what looks like the real uniform of that team. Unless it is the die-hard fan that has to have the same shirt that Greg Maddux wears when he pitches for the Braves, he or she is wearing what is called a replica jersey. Replica jerseys are exact copies of the uniforms worn by professional and college sports teams including styling, trim and logo color. However, the likeness stops at the look. Generally, these jerseys are not constructed of the same materials as game worn jerseys and do not command the same price. Many of these jerseys are constructed of 100% polyester which again, makes it important to check the fabric content prior to production. Because these jerseys are only worn to the store or ball game and do not have to survive a 162 game season, a regular high opacity or low bleed plastisol (again check fabric content) that provides good coverage and easy printability can be utilized with excellent results.

- *Why do manufacturers use polyester?*

Uniform manufacturers have turned to polyester because it is not only a stronger fabric that resists fading, it is also a lesser costing material than nylon. Think of it—a more durable fabric that will last longer, hold its color longer for the end-user as well as becoming a larger profit center for you!

- *Do I need to add a catalyst to my ink?*

The most misused additive in the screen printing industry is the nylon bonding agent (catalyst) printers add to help plastisol inks bond to nylon jackets. Nylon jackets are woven and have a slick finish leaving plastisol inks nowhere to bond unless catalysts are added to glue the ink to the slick surface. Even though uniforms are made of nylon, the difference is they are a knitted nylon. To illustrate this point, take nylon uniform and hold it up to the light, what do you see? You see light coming through the different fibers that have been knitted together to form the uniform. Anytime you have a fabric where you can see the fibers the ink will surround the fibers and form a mechanical bond during the curing process without the aid of a catalyst.

The same principle holds true when printing 100% polyester athletic uniforms. If you are having problems with your designs washing off the uniforms you are either not pushing the ink far enough into the fabric so it can bond to the fibers during curing, or you are not reaching the full cure temperature of the ink. Consult the sections of this article under printing techniques and curing for more information.

- *Are there special screen making considerations?*

Because of the thicker ink deposits needed to give uniforms the athletic print look and durability you will need to alter your screen making techniques. Uniform printers typically use mesh counts in the 83-110 range depending upon the color of the fabric. We recommend that polyester uniforms, especially dark colors, be printed on 83 mesh count screens. This mesh count will give you a nice, thick athletic appearance to the design or number as well as an ink film strength that will last years of game worn use and washing providing the equipment manager or home laundry expert follows the care instructions for laundering the garment.

Since ink deposit is directly related to the emulsion thickness on the print side of the screen you may need to coat your screens an extra time on the print side (bottom). This extra coat will also increase your print sharpness. Use the following guidelines for this process:

High solids, one part emulsions (Photopolymers)- Put one coat on the print side, turn the screen over and put one coat on the squeegee side. If you not satisfied with your ink film thickness using this technique let the coated screen dry completely and put an additional coat of emulsion on the print side (bottom).

Dual cure emulsions—Put two coats on the print side, turn the screen over and put one coat on the squeegee side and let dry. Complete the process by coating the print side of the screen again.

Diazo emulsions—Same technique as dual cure emulsions except due to the lower viscosity of this type of emulsion a third coat may be necessary.

Remember, always dry your screens horizontally, print (bottom) side down. This allows gravity to pull the emulsion downward on the print side giving you the thicker coating you are trying to achieve.

- *Will I need a special press for printing uniforms?*

Uniforms are generally printed on manual presses because of their relatively short runs so any manual press on the market today will suffice. However, if you are going to do this full time you may want to look into invest in a numbering machine. A numbering press contains a short and very wide screen (approximately 20" tall by 6' wide) and contains the numbers 0-9. The screen is held in a carriage that slides back and forth depending upon the number to be printed. Registration guides on the press help line up the number in the correct position on the uniform for both single and double digit numbers.

Another method used to print numbers is with paper or plastic number stencils where the numeral has been die cut from plastic, thick parchment paper or card stock.

In this process a regular screen is coated using the coating methods described earlier. For a 6" number, the screen maker will utilize a 10" square mask cut from rubylith or some other opaque medium and place this on the screen as the image. This leaves a blank open image area approximately 1" square in size around the actual

number. The printer then places the uniform on the platen and positions the number stencil in the correct position on top of the jersey. The screen is then brought down over the number stencil, and with the numeral acting as the image prints the numeral upon the uniform. After printing, the stencil will lift with the screen. Peel the stencil from the back of the screen and repeat this process for each uniform. For larger numbers such as 8", 10" or 12" a larger mask will be needed to compensate for the additional number dimensions.

Even though paper stencils cannot be reused, there are plastic stencils available that may be cleaned and used repeatedly.

- *Is there a "Rule of Thumb" for the placement of logos and numerals on uniforms?*

There is nothing worse than to see someone wearing a uniform where one half of the number is tucked into the uniform pants or a front logo on a lady's jersey printed too low. Equally as bad are numbers that inconsistent in placement. Before discussing the guidelines for the placement of logos and numbers let's first talk about some of the caveats or things you should be aware of prior to placement.

- Beware of the number 1

The numeral one is thinner in width than any other numeral. For example, if you are printing the number 10 you must compensate and move the numeral one closer to side of the garment than if you were printing the number 20 where the two numerals are relatively identical in width.

- One inch space rule.

Always leave on inch of space between the sides seams of the garment and the numerals and logos. Also, any sporting events that are sanctioned by a governing body require that any logo or name has to have one inch of space between the logo or name and any number. This is so the number of the player can be easily identified by the referee. A violation of this rule can cause disqualification of that player or other penalties assessed to the team.

Beware of any extremely long name where it must be arched in order to fit on the back of the uniform. The one inch rule we talked about of above applies to the whole name and not just the center of the name. The numeral must have one inch of space from every part of the name or logo.

Some uniforms today are very form-fitting and fashionable where the side trims on the uniforms taper in at the shoulders and sides. This is especially true on the new style volleyball uniforms and track and field. Adjust your logo size and numbers to accommodate the one inch spacing from the sides that taper.

- Beware of the runt!

When you are contemplating what size numbers will look the best on your uniforms always use the smallest uniform size as your guide. The same number that looks good on the back of the Extra Large uniform may fill up the entire back of a small uniform and look completely out of place.

- How do I choose the size of my numbers and logos?

This is very subjective and in this day and age just about anything goes. Athletic uniforms have become a fashionable part of society and are being driven by World Cup Soccer, NCAA sports and professional sports teams. Remember our conversation about the runt and strive to maintain consistency in placement and sizes of logos and numbers on each garment.

Placement of Numbers—Guidelines for Football

Front Placement Without Logo

- Numbers—Top of number generally located 2" below neck trim.
- Allow minimum 1" space between outside edge of number and sleeve seam.

Front Logo Placement With Name

- Team Name—2-3" team name place top of name 1" below neck trim.
- Number—print top of number 1" below team name.
- Size of number—If using 3" team name you will have to use a smaller number. If using the popular style that is fashionable in today's NCAA and NFL of a one inch team name you can use a larger number.

- Number sizes are traditionally 2" smaller in height on front than back even though we have seen some numbers the same size on both front and back.

Back Names & Number Placement

- Names are placed above seam on the yoke of the uniform.
- Numbers are placed 2" from bottom of yoke seam with or without names.
- Number sizes are normally two inches larger on back than front.

Basketball

Front Logo Placement Without Logo

- Number size is traditionally 4-6" in height.
- 2-3" Logo-Place 1" below v-neck, 2" below scoop and 3" below crew.
- Numbers under design-Place 1" below design.
- Allow minimum 1" space between edge of design and sleeve seam.
- Beware of curved designs with the number 5! These can throw off the one inch space rule if you are not careful.

Back Placement

- Normally 8" but occasionally 6" on smaller sized uniforms.
- Names start 3 ½" down from bottom of neck trim.
- Place number 1" below design.
- Allow minimum 1" space between edge of name and sleeve seam.
- Without names-Women 6-6½" below neck seam
- Men 7-7 ½" down below neck seam.

Baseball with Placket (Two button jerseys)

Front Logo Placement With Numbers

- Place center of team name 1 1/2" below placket.
- Numbers-normally 4" in size placed one inch below team name and 4 ½" to the right of the horizontal center of garment.
- Allow minimum 1" space between edge of design and sleeve seam.

Baseball Crew Neck

Front Placement with logo only and with logo and number.

- Logo only—normally 3" in height depending upon length and placed 3 ½" below collar.
- Numbers-normally 4" placed 4½" from horizontal center of garment.
- Numbers-normally 4" in size placed one inch below team name and 4 ½" to the right of the horizontal center of garment.
- Allow minimum 1" space between edge of design and sleeve seam.

Back Logo Placement

- Normally 6"-8" numbers.
- Place number 5" below collar without name.
- With name- Place name 3 ½"-4" below collar and place number 1" below design.
- . Allow minimum 1" space between edge of design and sleeve seam.

Soccer

Front Placement

- Number only—4"-6" numbers. Place number 2" down from "v" on V-neck. And 4" down from collar on crew.
- Logo and number—Place logo 1" down on V-neck or 3" down on crew and place number 1" below logo

Back Placement

- Normally 6"-8" numbers in height but have seen as large as 10" numbers without names.
- Without name—5" down from neck seam.
- Straight name-Place top of name 3½" down from collar with 1" space between bottom of name and top of number.
- Curved Name-Place top of letter that is at the lowest point of the curve 3 ½" down from collar and make sure number is placed with 1" spacing from all points of the name.

- Beware of lengthy names.

Volleyball

Front Placement

- Normally 4" numbers on front.
- Place number 5" down from center of shoulder.
- Center number between neck seam and shoulder seam.
- Beware of tapering.
- Design-Place 1" below number and at least 1"-1 ½" below any placket.
- Without placket logo should be 4" down from collar.

Back Placement

- Normally 6"-8" numbers.
- Numbers only-place number 4 ½" down from collar.
- Name and number-Place name 3" down from collar with 1" space between name and top of number.

Shorts

- Numbers are generally 3-4"
- Edge of print should be 2 ½" from vertical seam (side seam) and 1 ½-2" from bottom seam. This should enable the number to be easily seen across the center of the leg instead of the inside of outside.

• Are there any special printing considerations when printing athletic uniforms?

Special consideration should be taken when printing light colors versus dark colors, mesh fabrics versus solid fabrics and polyester fabrics.

One color numbers or logos should be double hit to ensure good coverage and accurate reproduction of the color. With a medium (70 durometer) squeegee make sure the first stroke pushes the ink down into the fabric (not through the fabric). This will give the ink a sufficient area to wrap around and adhere itself to the fibers and form a strong mechanical bond. The second stroke should be made so the ink is cleaned from the screen and lay on top of the first coat. Good athletic printers have developed a technique so the second coat lies on top of the first coat and does not push the first coat further into the fabric.

Two color numbers and logos should not only be double stroked but also flash cured between colors particularly on dark garments. Flash curing between colors will ensure that each color has the same finished look and also help increase opacity. The artwork for uniforms is generally "trapped" which means part of the second color overlaps or touches the first color to ensure proper registration. Follow the same guidelines as printing one color numbers or logos except flash cure between the first and second colors. If a white or other light colored ink is to be printed as the outline or on top of the darker color ink, an athletic ink with a non-migrating pigment must be utilized for the first color. Non-migrating pigments will not migrate up though the light color causing a shift in the lighter color of the top print.

For polyester uniforms a low bleed ink must be used on all colors except white or light colors and a print/flash/print technique should be used to form a good ink film thickness that will reproduce the color, resist bleeding and give the number or logo good durability. Also, when printing "dazzle cloth" make sure the first coat of ink is pushed well into the garment in order to insure a good bonding of the ink to the fibers during the curing process. We have seen prints that are completely cured degrade because the ink was not pushed down into the garment where it could wrap around and adhere properly.

An extra, extra special consideration has to be taken when printing micro-mesh (small holes), mesh jerseys (regular size holes) or "porthole mesh" (large holes) uniforms. Because of these holes, the ink will go onto the printing platen and will transfer onto the next uniform. If you do not want to clean the platens after every print, simply spray the platen lightly with a repositionable adhesive, place a sheet of card stock or newsprint large enough to cover the image area of the number or logo, spray the card stock or newsprint with adhesive, and then place the mesh jersey on the platen and print. Some printers will even flash the image before removing the garment to ensure it does not accidentally drag through any of the wet ink that has been left on the platen. Discard the card stock or newsprint after each print and replace. Even though this may sound like a major pain it is much more productive than cleaning your platen after each print.

Good athletic uniform printers have taken many years to perfect their printing techniques. Upon asking most uniform manufacturers will provide at a minimal cost sample pieces of material in order for your printers to practice and perfect their printing techniques prior to producing a job. Maybe Curt Warner can handle the pressure of throwing the winning touchdown pass at the end of a game but don't put the same pressure on an inexperienced printer by having him print a \$25 jersey without some training.

- *Are there special curing considerations for athletic uniform prints?*

This is the single, most important parameter involved in successfully printing 100% polyester fabrics. You must learn how to control your heat. The print needs just enough heat to reach the full cure temperature but not enough heat to cause the polyesters dyes in the garment to start moving and trying to come up through the ink film and discoloring it. You can use the greatest inks and have the best printing techniques but if you do not learn to control the control the temperature that that fabric temperature reaches you are going to have problems.

There are three things that have to happen in order to properly cure a plastisol ink. You first have to rid the garment of any moisture content. This applies to 100% cotton or any cotton blends because synthetic fabrics such as polyester do not absorb moisture. Second, you must bring the fabric up to temperature and last the ink film has to reach the proper cure temperature.

Union Ink's Polyester Series cures when the entire ink film reaches 300° F. Even though these temperatures are the same as recommended for inks printed on tee shirts, extra caution must be taken. Because of the thicker ink deposits required for the athletic look and durability coupled with the different thicknesses of the uniform material you may need to increase the heat, slow down your belt or do both to reach 300° F throughout the entire ink film.

A good analogy is heating two different sized houses during winter. If one house is 1500 square feet (regular tee shirt material and print) and the second house is 3000 square feet (athletic uniform material and print), and your goal is to bring each house to a comfortable living climate from 0 degrees, it will take a longer time to bring the 3000 square foot house to a comfortable temperature providing both houses are using like heating systems. The same holds true for athletic prints--thicker fabric and ink film thickness, more; thinner fabric and thinner ink film thickness--less.

Undercuring results in poor wash fastness and can cause dye migration on polyester uniforms. We recommend that printers monitor their dryer temperatures several times daily. This is important when printing uniforms, especially polyester as over heating the fabric can cause just as large a dye migration problem as undercuring the ink.

Each color shade of a 100% polyester garment has what is called a "set point". The set point is the temperature that the manufacturer of the fabric has cured the dye in order to maintain his color shade. Some colors with the lowest set points are reds, cardinals, maroons, and dark greens which explains why these particular colors are a major headache in which to keep a white ink white. Colors with higher set points tend to be royal blue, blacks and kelly greens. Polyester dyes are very unstable and start moving and looking for a place to go somewhere over 300° F depending upon the particular set point of the fabric. Even though the dye blockers put in inks do a good job of keeping the dyes from penetrating through the ink film at 300°-320°, you substantially limit this ability at temperatures above 330° F. One major uniform manufacturer recommends checking the fabric temperature to ensure it does not go above 330° F. Because polyester dyes are unstable and overheating is such a problem, printers should test their curing temperatures so any 100% polyester garment cures the first time through the dryer. Remember, these inks are called low-bleed--not no-bleed.

One often overlooked parameter during curing is the flash cure unit. When you first start your print run set the unit for both height and time by measuring the time it takes for the ink film to reach 240°-250° F. After you have reached this temperature carefully touch the print to check if it is surface cured. If none of the ink transfers to your finger you are surfaced cured and thus able to put the next coat on top of the first coat. Do not be alarmed if none of the ink transfers to your finger and the print still feels tacky. This is called after-flash tack. Because of the plasticizers, resins and other special ingredients used to create the gloss level, opacity, durability and other athletic characteristics of the ink it may feel tacky. Let the ink cool for a few seconds till the tack dissipates and then print the top coat of ink. If you are using a printing with more than one pallet print all the bottom colors first and then go back and print each top color.

However, if you only have one pallet, or if you are only utilizing one pallet on a multi-station machine, you will have to adjust the temperature, height and dwell time of your flash-cure unit. As you progress through your print run the pallet will retain heat and continuously increase with each print. Because of this, the fabric temperature will also increase and by the time you have printed your second coat and put the garment through the dryer you will risk pushing the fabric temperature above the set point of the dye and increasing your chances of dye migration. For anyone who remains skeptical of this theory try this—print a garment, place it under the flash-cure unit, monitor the temperature and the number of seconds it takes reach 240°-250° F. Next, place an empty pallet under the flash-cure unit and heat it up for 10-12 seconds. Put another garment on this platen, print, place under the flash cure and monitor the amount of time it takes to reach 240°-250° F. You will be amazed at how much faster the second print reaches the flash temperature.

A relatively easy to use and inexpensive measuring device is a small non-contact thermometer that looks like a weapon from an early science fiction movie. It has a laser pointer to indicate the exact spot where the temperature sensor reads and when the laser is positioned on the ink film or fabric gives a very accurate reading of the temperature at that particular spot and time of the curing process. These thermometers started out in the \$900 range but lately smaller versions have been selling in the \$89-\$159 range. Save just one job and the unit has more than paid for itself! Also, remember that measuring with one of these thermometers is just a guideline. The definitive test for cure is still by putting it through several wash cycles. Follow the care instructions for the garment that have been included on the care tag sewn inside the garment and was a minimum of five times. If you see no degradation of the team name or number you are achieving a full cure.

- *Conclusion*

Athletic uniforms may not be the easiest substrates to print but they do not have to be a major difficulty either. By following a few, simple guidelines in order to develop the proper printing techniques, understanding fabric content, ink film thickness and curing parameters you can easily make the team that plays like a winner look like a winner while also developing a profitable niche in your marketplace at the same time.

- *Disclaimer*

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- *For More Information*

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