PROCESSING GUIDE

# MAPPING YOUR CONVEYOR DRYER

## Tips for profiling your conveyor dryer

AVIENT

## INTRODUCTION

This guide will discuss how to profile, or calibrate, a conveyor dryer for curing screen printed inks on garments. Profiling your dryer is necessary to ensure the proper temperature heat curve and dwell are achieved.

## HIGHLIGHTS

- Plastisol and water-based inks need a specific amount of heat and time to ensure the print does not release from the fabric when washed.
- Plastisol is thermoplastic and only cures if set to the correct temperature for the correct amount of time.
- Water-based ink dries in the conveyor dryer and may need more time to cure, depending on the size of the print and how humid the shop environment is.
- "Dwell" refers to the time a garment remains in the drying chamber at cure temperature.
- There are three common tools to check the temperature when screen printing: temperature strips, an infrared laser, and an Atkins thermal probe. However, temperature strips can have limitations, and infrared laser guns are often inaccurate. Fortunately, an Atkins probe is typically more accurate and reliable in most applications.

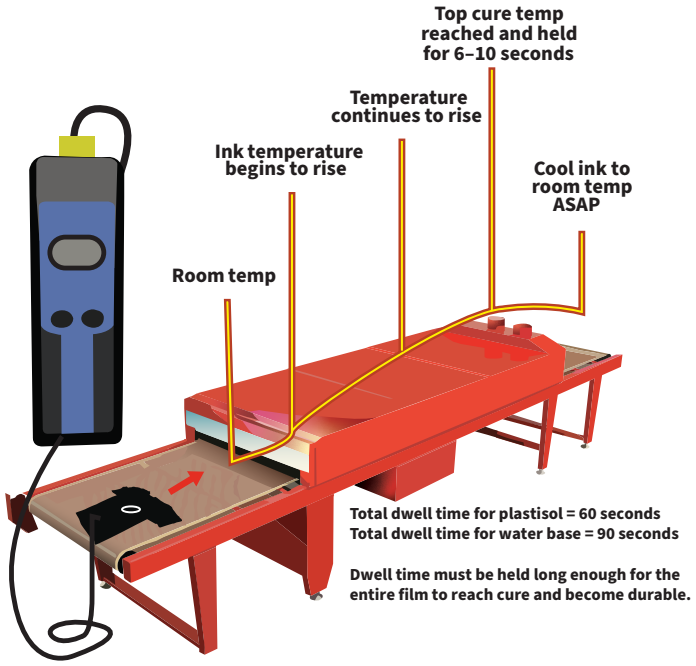
## CONVEYOR DRYER PROFILING

Using heat to set or dry a print is more complex than simply setting the dryer at a designated cure temperature and sending shirts down the conveyor belt. To successfully set a print, the conveyor dryer must be calibrated to the correct cure temperature, dwell, and adequate cure time.

Setting the temperature on the dryer's controller does not necessarily mean the machine is accurately hitting that temperature. In some cases, only a certain area within the dryer is holding the desired temperature. In contrast, other areas could be colder or warmer due to the location of the temperature probe within the dryer.


**The 320°F indicated on the dryer does not mean the ink is reaching 320°F. Instead, this signifies that the location within the dryer where the built-in probe is located is reaching 320°F.**

Dwell time is the amount of time the printed garment spends inside the "tunnel" of the dryer. This is not the same as the amount of time the printed garment spends on the belt, only the amount of time from when the garment enters the tunnel and exits fully. A dwell time of 60 seconds for plastisol inks and 90 seconds or more for water-based and reflective inks is typical.



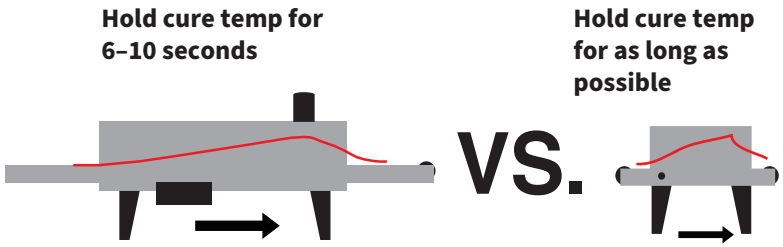

## SETTING CONVEYOR BELT SPEED

Although there are many different styles of conveyor dryers in the screen printing industry, operating the belt speed of a machine is fairly standard. Look for a speed adjustment knob that increases the belt speed as it is turned clockwise. On some machines, there may be numbers indicating the speed of the belt in feet or meters per minute. You do not need to obsess over these numbers, as they may be arbitrary.

To establish the speed, place a rag or waste garment on the belt and time how long it takes to travel through the tunnel. Start a stopwatch as soon as the garment is completely in the tunnel, and stop your timer when the garment has fully exited from the tunnel. If your speed is

above or below the dwell time desired (usually around 60 seconds), repeat this test and adjust the speed until you achieve the proper dwell.

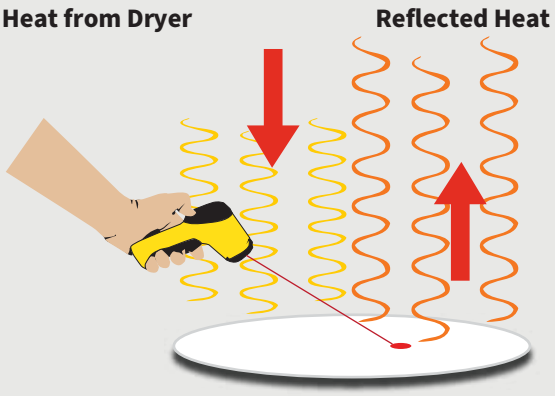
On smaller hobby dryers, it may not be possible to achieve a full 60 or 90-second dwell without damaging the garment. Aim for 45 seconds of dwell time with as much time spent at the cure temperature as possible. These dryers are not sufficient for water-based inks but can work well with simple silicone prints.




## CALIBRATING CONVEYOR DRYER TEMPERATURE

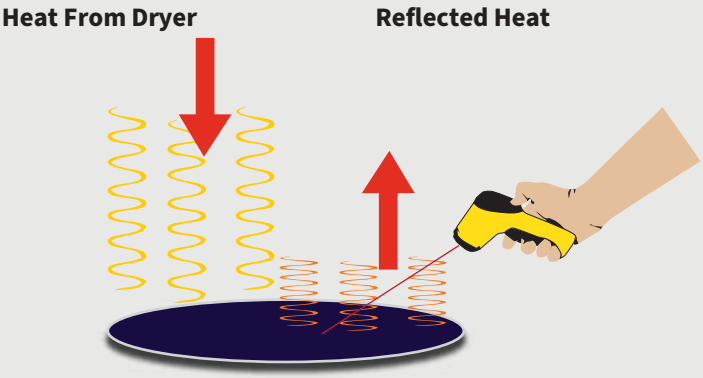
There are three common tools to check the temperature when screen printing: temperature strips, an infrared laser, and an Atkins thermal probe. An Atkins AquaTuff thermal probe with a "donut probe" attachment is the preferred tool for verifying cure. However, the Atkins probe is the most expensive option, so it is common for printers to use an infrared laser temperature probe or temperature strips.

Infrared laser temperature probes are very inaccurate because they only measure the reflected temperature of a print. This reading can vary widely depending on how reflective your ink color is. Light colors will often read hotter, and darker colors will often read cooler than their actual temperatures. Since the readings can be inaccurate, the laser temperature probe should only be used to approximate the location in the dryer where the garment reached its highest temperatures. Affixing a heat strip on the inside of the garment below the ink deposit will provide an accurate maximum temperature reading of the heat that penetrated the ink deposit, but will not provide insight into the duration of time the temperature was held. Using a laser probe with heat strips should provide an idea of how long the print was at the proper cure temperature.




**Temperature Read Out: 320°F**

**Actual Ink Temperature: 285°F**




**Temperature Read Out: 290°F**

**Actual Ink Temperature: 310°F**

## CALIBRATING CONVEYOR DRYER TEMPERATURE USING AN ATKINS THERMAL PROBE

An Atkins thermal probe can cost a few hundred dollars, which can discourage many printers from owning one. However, the spoilage savings from properly curing your prints should offset this cost very quickly.

**Calibrating a conveyor dryer with an Atkins thermal probe requires:**

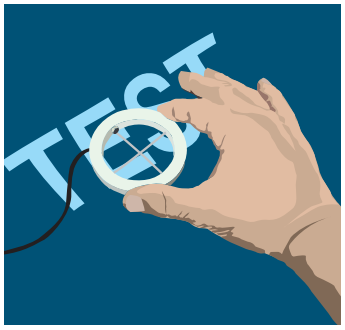
- Atkins AquaTuff Unit
- Atkins “donut” thermal probe
- Test garments for printing
- Test garments that have not been through the dryer in the previous 24 hours

For measuring purposes, affix a piece of colored tape at one-foot or meter intervals along the probe cord, starting from the probe and going all the way back to the plug.

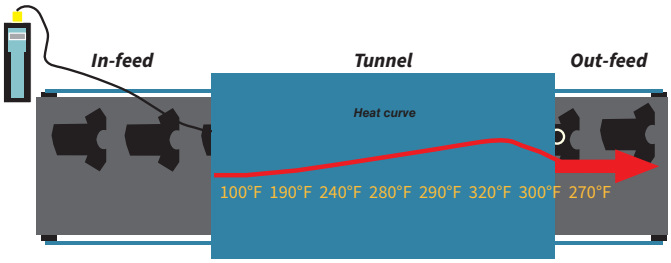
**Then, follow these steps:**

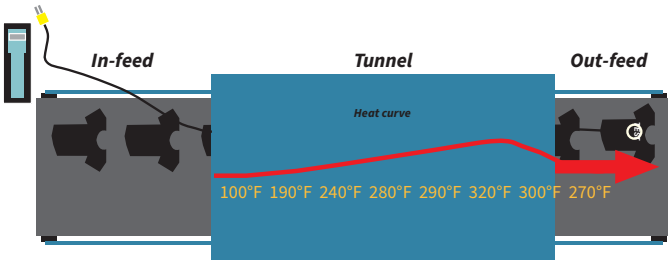
1. Print a test garment with the ink you wish to profile, noting the ink’s recommended cure temperature.
2. In order to simulate the conditions of a print run, pre-load the dryer belt with 3–5 garments that have not been through a dryer in the past 24 hours. These garments are meant to enter the dryer tunnel where the humidity trapped in the garment will evaporate, cooling the tunnel.

   *Testing without pre-loading the dryer belt can cause temperatures during the actual print runs to be lower than the necessary cure temperature. Pre-loading the dryer allows for the humidity to evaporate from the garments and proper cure temperature to be reached during the actual print run.*
3. Turn on the Atkins unit and plug in the wire that leads to the donut probe. Place your test print on the belt with the cross-wires of the donut probe pressed **into** the test ink deposit.




4. Making sure the cord to the donut probe does not tangle while traveling down the belt, watch the temperature read-out on the Atkins unit. Look for a gradual heat curve increasing and finally reaching the holding cure temperature for 6–10 seconds while in the final third or quarter of the heat tunnel.




5. Once the donut probe has exited the heat tunnel, disconnect the probe cord from the unit and collect it from the out-feed of the dryer. Allow the probe to cool to room temperature before using it again. When you are ready to print again, do not use the same garments for pre-loading as they have dried and will need 24 hours to regain humidity. You may use the same test garment for test printing with a pre-load garment next to it to simulate the humidity that would normally be present in the test print garment.

A cure time of 6–10 seconds should cure your entire ink film. Special considerations for thicker inks and garments may need to be observed to ensure a thorough cure. Low bleed and polyester inks will be most effective when the ink deposit cools as quickly as possible after adequate cure. Do not box garments that are still warm. Warm stacked garments are not yet stable, so placing them in a box creates an opportunity for ghosting, dye migration, and prints adhering to each other.

After completing the first dryer calibration and successfully reaching and holding your cure temperature for the required dwell, repeat this process on different weights and blends of your most commonly used garments.

Document and post the speed and machine temperature settings that give you the desired cure for each of your most commonly printed garments and blends near or on the dryer. For example, you may have a different heat setting or speed for cotton, 50/50, tri-blends, 100% polyester, nylon, and hooded sweatshirts.

Large, high-output plants probe each dryer daily up to 3 times per shift and record these fluctuations in order to understand weather-related production area temperature shifts and other production area-related influences.

## CALIBRATING A CONVEYOR DRYER TEMPERATURE USING A LASER PROBE AND TEMPERATURE STRIPS

If an Atkins thermal probe is unavailable, another method of profiling your dryer is using a laser temperature probe and temperature strips.

An infrared laser temperature probe only measures the amount of heat reflected to its sensor. This means that a more reflective ink color like white, yellow, or a metallic will reflect away more heat than is reaching the print. This can result in an inaccurate, higher temperature reading. A darker color ink like black or navy does not reflect as much heat away and can result in an inaccurate, lower temperature reading that can result in over-cure. Infrared and quartz dryers use light wave heat to cure ink, making them more likely to reflect off light-colored or reflective inks.

## REMEMBER, SIMPLY REACHING YOUR CURE TEMPERATURE DOES NOT MEAN YOU HAVE REACHED CURE.

**Think about curing ink similarly to cooking. When cooking a turkey, simply reaching 350°F does not mean the turkey is cooked—the turkey then requires 13 minutes per pound at 350°F in order to cook all the way through the mass of the turkey. Curing ink is a heat and time process.**

**When curing water-based inks, you are drying the ink. Think of your water-based print like a pizza; the pizza cooks from the outside perimeter inward. It takes time to dry the entire "pizza." If you pull the pizza from the oven too soon, you will likely have an uncooked center.**

Since the laser probe can be inaccurate, it is typically only used to establish an idea of where the heat curve is in relation to the printed garment's location in the dryer tunnel. The adhesive temperature strips are used to discover what the highest reached temperature is.

**Calibrating a conveyor dryer with a laser probe and temperature strips require:**

- Laser temperature probe
- Self-adhesive temperature strips
- Test garment for printing
- Test garments that have not been through the dryer in the previous 24 hours
- Second person to record temperature readings

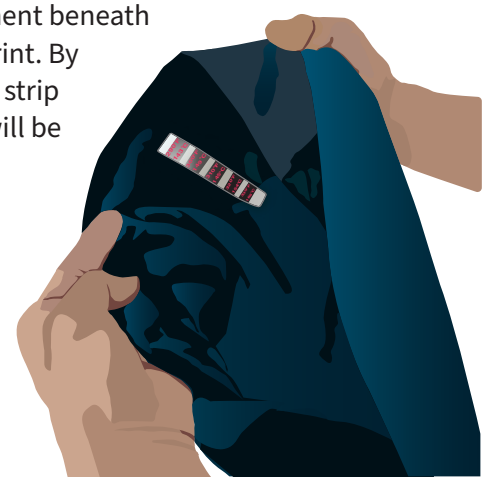
For measuring purposes, use a string or cord that you mark every foot or meter that is about 4 feet longer than your dryer tunnel. Follow the below steps:


1. Using the steps described in setting conveyor belt speed, adjust speed to meet dwell requirements.
2. Print a test garment with the ink you wish to profile, noting the ink's cure temperature.
3. In order to simulate the conditions of a print run, pre-load the dryer belt with 3-5 garments that have not been through a dryer in the past 24 hours. These garments are meant to enter the dryer tunnel where the humidity trapped in the garment will evaporate, cooling the tunnel.

   *Testing without pre-loading the dryer belt can cause temperatures during the actual print runs to be lower than the necessary cure temperature. Pre-loading the dryer allows for the humidity to evaporate from the garments and proper cure temperature to be reached during the actual print run.*

**"Pre-load" your dryer belt with garments that have not been dried in the dryer yet in orderto re-create a "production load" to account for humidity trapped in garments**

4. Affix a temperature test strip to the inside of the garment beneath your test print. By placing the strip here, you will be able to determine how much heat penetrated all the way through the ink film.



5. If you chose to use a measuring cord as described earlier, tape that next to your print so that the cord does not cross over the test print area or over the area that the temperature strip is affixed to.
6. It is helpful to have another person collect the readings and record them on the Dryer Heat History grid at the end of this guide. After pre-loading the dryer belt with 4–5 garments that have not been through the dryer yet, place your test print on the belt. It is helpful to place a couple more pre-loaded garments on the belt after the test print.
7. Pick a spot on the print to focus the laser on and follow the test print with the laser through the dryer. Every 5 seconds, call out the temperature for another person to record in the Dryer Heat History grid (found on the last page of this guide).
8. Note the highest temperatures and how many seconds the maximum temperatures lasts. Ideally, you want to see the top of your temperature curve plateau for a few seconds before cooling down as the garment reaches the end of, or exits the dryer tunnel. This plateau should hold for at least 6 seconds and up to 10 seconds if your dryer is long enough.
9. Check the temperature strip for the highest temperature achieved. If the temperature is too low and your dwell time is 60 seconds for a full-size dryer or 45 seconds for a hobby-size dryer, then raise the temperature setting and perform the test again.
10. Use the temperature curve established from your laser probe readings to understand where you hit your highest temperatures. Remember that these readings are not 100% accurate, but are used to observe how quickly the test garment achieves the desired temperature and dwell. Compare the highest temperature recorded by the temperature strip to the highest temperature read on your laser temp gun and note the difference. This temperature difference will give you a rough idea of how to estimate the actual temperature the ink deposit is reaching on future tests. Keep in mind that the accuracy of this estimation changes with ink color, garment color, and shop humidity.
11. When you are reaching your cure temperature and holding it for 6–10 seconds, allow your test garment to cool down to room temperature and perform a stretch test. You should see at least 50% stretch before seeing any breakage in the ink. Now cut the print in half and wash and dry one of the halves. Compare the unwashed print to the washed print. If your ink film is durable, you should not see any fading, cracking, flaking, or discoloration.

## LASER PROBE USES

Although laser probes have typically been used incorrectly in screen printing shops, they can be beneficial when checking pallet temperature, finding the hot spots in your dryer, and checking garment temperature before packing.

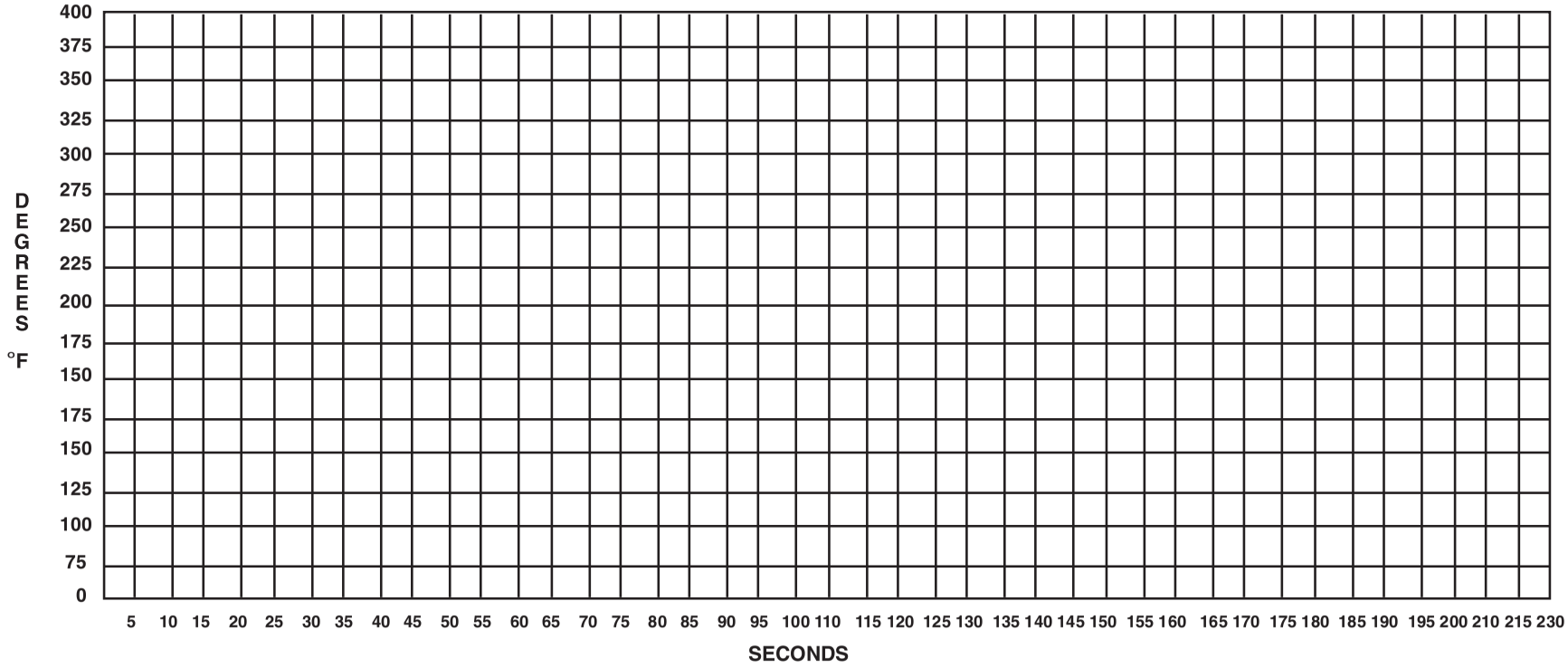
- **Checking pallet temperature** – If pallets become too hot, they can begin to cure ink in the screens they come to rest under. The laser temperature probe is the ideal instrument to measure pallet heat. For plastisol and water-based inks, the pallet temperature should be less than 140°F to prevent ink drying in the screen, build-up, and lift.
- **Finding the hot spots in your dryer** – While following an object through the dryer with a laser temperature probe will not give accurate heat readings, it can give us an idea of where the object reaches its highest temperature in the heat chamber. Once located, verify with a temperature strip adhered to the underside of the print.
- **Checking garment temperature before packing** It is common for stacks of garments that have been through the dryer to accumulate heat. This can be problematic because polyester garments are not dye-stable until they have cooled to room temperature. Never place stacks of hot polyester or polyester blend garments in boxes or bags while they are warm. Use the laser probe to check the temperature of the heat released from the garments.

If the garments are below 85°F, they are safe to pack. If the garments are not allowed time to cool, the polyester blends can release dye into your ink deposit up to 72 hours after printing. For these same reasons, you should not allow dark polyester garments to fall into a catch box at the end of your dryer. Have a “catcher” in place to pick up the garments from the conveyor belt and manually cool the garments if needed. If the garments retain heat, make multiple stacks so that you allow garments to cool before placing the next hot garment on that stack.

Be mindful that there are several limitations when using a laser temperature probe. A laser temperature probe should not be used when reading moving objects, on quartz and infrared panels, or to obtain readings other than “reflected heat.”

**For additional support, contact Avient Specialty Inks at 866-737-2066 or www.avientspecialtyinks.com/contact-us**

# DRYER HEAT HISTORY

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**DRYER SETTINGS**

BELT SPEED _____ HEATING CHAMBER _____

INFRA RED _____ FLASH TEMP _____

FORCED AIR _____ PLATEN TEMP _____

DRYER LENGTH _____

DATE _____ TIME _____