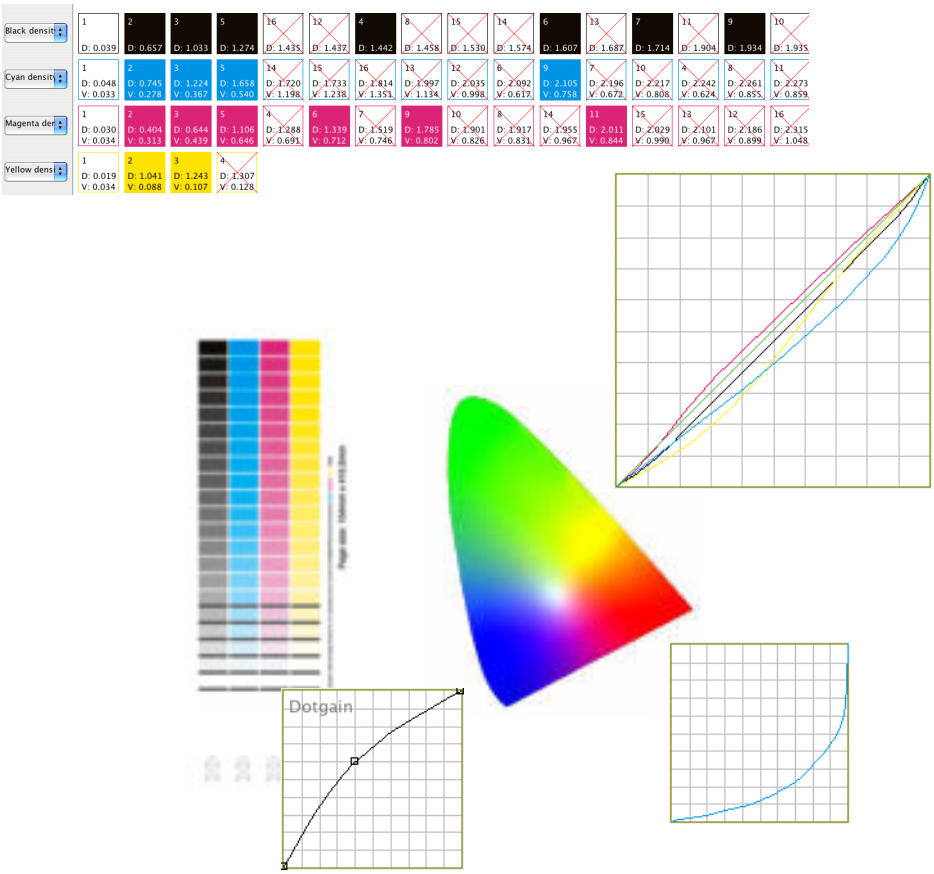
Colour Calibration Guide



Calibration User Guide V1.0

Written 13th January 2005

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Calibration Guide

Overview

Calibration takes several steps to achieve the optimum output quality available from the printer. Once initial calibration is done then maintenance is quick and easy. The principle for each printer is the same. The steps involved are as follows

- Configuring a Pagesetup
- Creation of a Paper Profile
- Apply ink limits to the Paper Profile
- Linearisation
- Creation of ICC profiles
- Applying ICC Profiles
- Minor adjustments

With this section we will work through calibrating an Epson 4000 step by step. The first section will deal with the quick and simple method which is the automatic Paper Profile creation. At the end of this section there is an experts section which details a manual approach to Paper Profile creation.

Equipment needed

Serendipity Blackmagic
Epson 4000
Suitable media loaded
Densitometer and/or Spectrophotometer.
ICC Profiling software

Before you begin make sure that the printer is running at its optimal level. Check to make sure that the heads are clean and printing correctly.

Configuring a Pagesetup

This is the first and most important step. The Paper Profile is based around the printer driver and the configuration of it. The important elements are resolution, colour space, ink type (Pigment, dye, matt etc.) and the use of light inks or not. If any of these change the Paper Profile must be re-created as the Serendipity Blackmagic server will not process any jobs where there is a mismatch between the values and Paper Profile. Other important values are printing direction and paper type. While these can be changed and the job still process through OK, you may find that the quality is not as good.

We will set the Epson 4000 up as follows

- Ink type - Pigment Black and Light Black
- Resolution - 720 x 720 dpi
- Colour Space - CMYK
- Use Light inks - Yes
- Direction - Uni Directional
- Paper Type - Premium Luster Photo Paper 250

Once you have configured your Pagesetup ready to print then we can create a Paper Profile. See other relevant sections in the manual if you are having difficulty with Pagesetup and output configuration.

Creating a Paper Profile

The aim of the Paper Profile is to better match ink and paper characteristics for a given printer. By printing a chart and measuring it we can better determine how the inks in the machine react to the paper when they are printed. Not all inks and droplet sizes produce good results and therefore we need to determine what works and what does not. The Paper Profile is generated directly from the printer driver based on the settings that you make in the Pagesetup, which is why the Pagesetup needs to be created correctly first.

As we mentioned, the chart that gets printed is generated from the printer driver. It creates a series of squares in the colour space configured, utilising all ink combinations (light and dark) and printer dot sizes (for variable dot devices). For a simple device that does not have light inks and only one dot size this would print one patch per colour space. If the colour space was CMYK then you would get a solid K, C, M and Y. In the case of the 4000 then you get a lot more, 15 in fact which is a combination of light and dark inks and 3 dot or droplet sizes. See the expert section at the end for more info and examples.

The squares are measured and then a decision is made as to which combination of dots should be turned off and which should be left on. This section takes the automatic approach and makes the decision for you based on the measurements. If you want to make your own decisions you need to read through the expert section at the end. Here is what you do.

1. Select Paper Profile in the Workbench and create a new one.

2. Choose your new configured Pagesetup and click OK.

3. Enter a name for the Paper Profile.

What you will see is a series of square patches in the colour space you have configured in your Pagesetup. The number will vary as we said depending on the

type of printer and configuration you have selected. For the Epson 4000 configured as above you will see Black, Cyan and Magenta with 16 patches and yellow with 4. The first patch for each colour is to represent the paper value for that colour.

Print Density Chart

Next you need to print the density chart to the Pagesetup that you are calibrating. Choose “Print Density Chart” from the tool bar options or by right clicking anywhere on the Paper Profile.

This will print a chart that looks the same as the one on the screen. There is no need to turn any other colour management off (if you have any on) in the Pagesetup as everything is automatically disabled. Because the job is generated internally from the print driver there is no preview of the job.

Measure the Patches

Once the job has printed allow it to stabilise for a few minutes. Depending on the printer, inks and media it may come out wet so you will need to let it dry before you measure it. If you have one of the supported on-line Spectrophotometers or Densitometers you need to connect it to the computer where the client is running. Then select the Measure patches option. This will then present you with a list of supported devices. Select the one you have from the list and click OK to continue. The Client will connect to the measurement device and display the measuring window with the first patch highlighted ready to measure. This first patch is the colour or density of the paper you are printing on. Measure each of the patches in turn until complete. The patches will highlight in turn and return to the first patch again once the last patch is read. If you need to re-measure any patch simply click on it and read it again. It then advances to the next patch after a successful read. Click OK when you have read all the patches to close the measure window and store the measurements in the Paper Profile. Then choose File/Save to save the measurements in the database.

manual entry

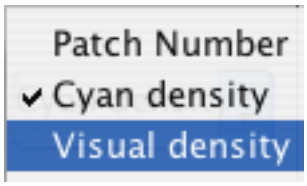
If you do not have one of the supported devices you need to measure the values for all the patches and enter them into the Paper Profile manually. To do this make sure that the sort patches option is set to patch number and click on the patch you want to enter a measurement for next to the D or V value. When you have entered the value, pressing the tab or enter key moves to the next patch for the next measurement.

D and V values

The D value is the density and the V value is the visual. When you use one of the supported on line devices both these values are automatically read and entered for all colours except for the Black. The Density (D) of a colour refers to the colour content and is the traditional method for measuring density. e.g. a Cyan has a density of 1.5D. The Visual (V) value of the colour refers to how dark the colour is. This is the same as the Black content as Black is an amount of light reflected or absorbed. Both values are measured and used to assess which dot combination works well. See the expert section at the end for more information on assessing the values.

Sifting the results

Once all the measurements have been entered you need sort the values in the appropriate order. For the Black channel select “Black Density” from the pull down menu. For the Cyan and Magenta choose “Visual Density” and for the Yellow choose “Yellow Density”. This will order the colours in the selected mode.



As a general rule if you have a device with light inks then you order those values in Visual Density (except for Black) and others in Colour Density (or real density). Then select the Sift button for each colour in turn and select an appropriate sifter from the list. For the Epson 4000 we will choose Epson with UltraChrome inks. Once you have sifted each of the colours save the Paper Profile.

Select the Paper Profile

Now that you have an initial Paper Profile you need to select it in the Pagesetup that we are calibrating so that all further prints are done using the Paper Profile we have just created. Go to the Pagesetup, select the Paper Profile and re-save the Pagesetup. Then go back to the Paper Profile ready for the next stage of calibration.

Ink Limits

The next stage in the process is to set ink limits for mixes of ink. We do this by printing a chart out that has increments of one, two, three and four inks mixed. Then for each mix you need to determine at what point the ink bleeds and limit it before it reaches that point, there by restricting the amount of ink on the paper.

Select the “Print Inklimit Chart” from the Paper Profile we are creating and choose the Pagesetup that we are calibrating. If you want to confirm that the Paper Profile is saved to the Pagesetup you can check the preview of the Pagesetup in the submit window. Alternatively choose File>Show Referrers. This will display any Pagesetup using the currently selected Paper Profile. Select OK to print the chart.

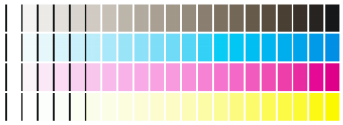
When the chart has printed it is a good idea to get the print immediately so that you can see where the inks are dry and where they are wet. For each of the four ink limits determine the point that the mix of inks produce a good neutral colour and are clearly defined. The patches should not bleed or mottle. The Colours of the two inks combined should maintain the colour that the two inks make. i.e. The magenta and yellow produces a red colour so make sure that this stays red. Some inks and papers tend to move towards orange at the upper end and this will give you problems when measuring ICC charts. Same goes for the Blue and Green. Determine the point that the colours produce good balanced results. With modern printers this is generally very easy but some of the older ones produce some strange results so the whole scale needs to be assessed. The single colours should not need to be adjusted. If they do then the Paper Profile patches probably need re-assessing. See the expert section at the end. When you have selected the values enter each limit in the inklimit section of the Paper Profile and save it. The Paper Profile is now complete.

Linearisation

Once the Paper Profile is made and saved to the Pagesetup we need to linearise the printer. This brings the printer to a neutral known state, making sure for example that a 30% cyan actually prints out at 30%. It does not grey balance the printer. That is handled in the ICC profile. The linearisation process uses a wizard to print and measure a chart to create the linearisation curve. The linearisation curve is automatically applied to the Pagesetup. When the chart is printed all other colour management except for the Paper Profile, is disabled. This way quick linearisation updates can be done without having to remember to disable ICC's, correction curve etc. You basically update the linearisation curve on a regular basis, bringing the printer back to the same point that the ICC profiles were originally applied so maintenance is quick and easy. Print a chart, measure it and apply and continue with your work.

Printing the Linearisation Chart

From the Application menu select the Lineariser. This will display two windows, the lineariser application underneath and the linearisation wizard on top. Select a Pagesetup from the list of available Pagesetups. If a curve already exists in the Pagesetup the graph will display the curve and the name of all the Pagesetups that are currently using the curve. In our example we created a new Pagesetup so there should not be any curve applied. Click next to continue. You are then presented with a list of supported densitometers and spectrophotometers and a manual option. If you have one of the instruments, select it from the list and click Print Chart. The device must be connected to the machine that the client is running on and powered on. The correct linearisation chart is then submitted to the Pagesetup for processing and printing. If the device is not connected an error will occur and no chart is printed. Click next to continue to the measuring window.



Linearisation Strip

Reading the Linearisation Chart

Depending on the device you have, the patch or strip to be measured will be highlighted. Measure each patch or strip in turn following the instructions at the bottom of the window. If you want to re-measure a patch or strip, select it again and measure it. You can only measure strips with a strip reader or patches with a spot reader.

Submitting the curve

When complete click “submit”. If the Pagesetup did not have a curve applied to it as in the example we are doing, you will be presented with a save window allowing you to enter a name for the curve and OK to save it. When you save the curve it is automatically applied and saved to your Pagesetup. If you do have a curve there then you are presented with a choice. Cancel, Create New or Overwrite. The choice you make depends on your preferred method of working.

The consequences of the option you choose are as follows.

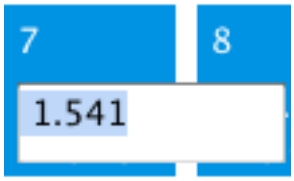
- Cancel - This does not alter the current curve in any way. The measurements that you have just taken are discarded and the wizard is dismissed. You are left with the Lineariser window showing the patches and curve for the current linearisation applied to the Pagesetup. From here you can enter values manually (see below), adjust the advanced options (see below) and save or close it.

- Create New - This creates a new curve based on the reading that you have just taken. You will be asked to enter a new name for the curve and the data will automatically be applied to the Pagesetup. The important thing to note here is that the curve will only apply to the Pagesetup you are calibrating. If you have more than one Pagesetup pointing to the same printer, say a direct output and a nested output you can end up with one Pagesetup being calibrated and the other not. i.e. one will have the old curve and this one the new curve. You must therefore remember to manually attach the new curve to any Pagesetup that currently shares the same curve (providing you want to maintain them the same).

- Overwrite - This will overwrite the current curve with the data that you have just read, therefore creating a new curve. This is a good way to keep multiple Pagesetups that point to the same printer with the same media in linearisation. However you also need to be aware that all Pagesetups that reference the curve will have the curve data updated. This may not be your aim. To find out what Pagesetups are using the curve either go back to the first part of the Linearisation wizard and check the Pagesetups that reference it. Alternatively select the curve in any section in the Workbench and select “Show referrers” from the File menu.

Manual Entry

If you do not have one of the supported on-line devices then you can still create a linearisation curve providing you can take density readings. When you are presented with the choice of devices to choose from, select Manual Entry from the list and print the chart. Then select Finish and you will go straight to the linearisation window. To enter your first value click on the square that corresponds and the number in the box will be highlighted.



. Enter the density value for that square and press “Return/enter” or “Tab” key to move to the next square. You can click to particular squares if you only have a few values to enter. Press the Esc key to de-select the number entry box. When you have entered all the values you need to select the “Submit Linearisation” option from the Lineariser menu. This will offer the same options as the automated method. i.e. if the Pagesetup does not have a curve currently then you are prompted to enter a name. If there is a curve there already then you are presented with the choices of “Cancel”, “Create New”, “Overwrite”. See above for the action meanings.

Once all the data has been measured and submitted the Pagesetup and printer should be at a neutral state. This is a state that we can get back to easily by quickly re-linearising. From here you can go on to make you ICC profiles.

ICC Profiles

With your Pagesetup linearised you are ready to create an ICC profile. The first thing to do is to make sure that there are no other colour management settings enabled, except for the Paper Profile we have just created and the Linearisation curve. If you have ICC enabled then turn it off. Make sure that there are no correction curves, dot gains etc. applied. Once done you need to select the ICC chart that you wish to print and send that through the Pagesetup we have linearised. The chart is usually offered as part of the test prints in the ICC software and come as Tiff files. You can print this by creating a drop zone, drop folder or simply using the submit button from the Application menu.

There are instances that you may have a curve applied before the ICC profiles are created. But this is rare and not recommended as a general rule. One reason is that you must always remember that the curve is applied with the ICC profile. If the profile is used without the curve then the values will be wrong. But Linearisation brings the printer to the same point each time.

Assess the chart

When the chart is first printed, examine the patches for any wet inks, smudges, head errors (blocked nozzles) or mottling. If the nozzles are blocked run a head clean and verify they are clear with a test print and then submit the chart again. If there are smudges you need to discard the chart, find the source of the

smudging and fix it before you continue. Smudges may cause faulty readings which will not yield very good results.

If the inks are coming out wet you probably need to go back and reassess your Paper Profile ink limiting. If you do make any adjustments in the 2, 3 or 4 ink limits there is no need to re-linearise as the single inks have not been affected. If the patches in the Paper Profile need to be changed then linearisation will be required as the single inks will change as well.

If you see mottling then you can normally remove this by adjusting the ink limits in the 2 or 3 ink limit level and then rendering the chart again. (Re-rendering takes the intermediate file and re-applies all the output colour management as currently set up in the Pagesetup). With some media's (particularly on some older printers) it is difficult to eliminate the mottling, so you need to reduce it as much as possible without compromising too much on the ink limits. i.e. making them too low so there is little density there.

Once you have determined that the chart is good you need to leave it to stabilise before you measure the values. This time will vary depending on the media and ink set, but quite often 30-60 minutes for good quality media with Pigment inks should be sufficient. Once the chart is ready, you need to measure it according to the profiling software's instructions, and create your ICC profile. It is beyond the scope of this document to detail the process of creating an ICC profile. Suffice to say that most ICC profiling software can produce very good profiles and very bad profiles. But they are generated based on the decisions you make and the chart that it reads. The settings will vary depending on the media you are proofing on. You should consult the relevant profiling documentation on the creation of an ICC Profile.

Placing the profile

Once you have your ICC profile created you need to copy it into the ICC Printers directory in the Serendipity Blackmagic software. These are found in the following default locations. (If you installed your software in another location other than the default then go to the installation area)

- Mac OSX
    - /Applications/Serendipity/Serendipity Blackmagic/lib/icc/printers
- Windows
    - C:\Program Files\Serendipity\Serendipity Blackmagic\lib\icc\printers
- Linux
    - $HOME/Serendipity Blackmagic/lib/icc/printers

Simply copy the ICC profile that you have just created for the printer into one of the folders above. Then go to the Workbench in the Client and choose the Pagesetup that we are calibrating. Find the ICC profile section and choose your newly created ICC profile for the output Profile. This is only half of the ICC profiling solution. Before we can enable the ICC profiling you need a Match profile.

Match Profile

The Match profile or Input profile is also very important. This usually has a greater bearing on the final output quality than the Printer profile. You can have the best printer profile but if the Match profile is rubbish then the system will match rubbish. Therefore a very good match profile is essential for colour calibration. The match profile is a fingerprint of the device that you want to represent on your proof. This should be your press as this is the final product that the customer will get. Therefore your proof should show accurately what the press is capable of and the end result of each job. The process of creating a Press (Match) profile is the same as running a normal print job. The IT8 chart should be passed through your RIP, films or plates created and the job run on the press on a common stock. Leave the chart to stabilise and measure it in the same way as you did for the Printer profile. Again, consult the Profiling Software documentation for details on creating a good profile. The most important thing when creating a Press profile is to make sure that everything is running to optimum performance. The Film and Plate setters are calibrated correctly and the Press is running evenly. This can take some time to adjust but the efforts put in should result in a good quality profile.

Once you have the Match profile you need to copy it into the system as you did for the printer profile. This just needs to be copied into the match folder. The locations are as follows

- Mac OSX
    - /Applications/Serendipity/Serendipity Blackmagic/lib/icc/match
- Windows
    - C:\Program Files\Serendipity\Serendipity Blackmagic\lib\icc\match
- Linux

- $HOME/Serendipity Blackmagic/lib/icc/match

Once you have placed the input profile into the match folder you need to select that in the Pagesetup that we are calibrating. Once you have selected the Match profile you need to turn on the “Use ICC Always” option and select the rendering intent. See the Rendering Intent section of the manual for information on each choice. For most pre-press applications the best one to choose is Relative Colorimetric. Save the Pagesetup with the new settings and you are now ready to send a job and check for colour. It is also recommended that you create an archive of your newly calibrated Pagesetup so that you have a working copy on hand. If you have multiple Pagesetups sending to the same device and media then you need to enable the ICC in each and select the ICC profiles, linearisations and Paper Profiles. If you run different media in the printer then you probably need to create new Paper Profile, linearisation and ICC for the printer. But because the press is the same then the match profile can still be used.

Tuning calibration

Some times there are requirements to make small adjustments to the colour. There are a number of tools available for this. Here is an indication on what is available and when you might use them.

Correction LUT

This would be used if you felt that one of the process colours needed adjusting. There is one curve for each and it can be manipulated as desired. Say you find that the proofs are a little too warm in the three quarter tones and you need to drop out some of the magenta. You can create a new curve, select the magenta curve and make your adjustments as required in the troubled area. See GradationEditor for information on how to create and alter Gradation Curves.

Dot Gain

When adjusting the calibration with the Dot gain curve you use it when you need to affect the overall view of the job. This is because the there one curve for Process colours and one for specials. If for example the proof is coming out too dark then you can apply a Dot Gain curve to lighten the output. See the Dot Gain section for more information on creating and altering Dot Gain curves.

Tweak Set

An ICC Tweak Set can be applied to alter specific colours. A Tweak Set can only be used when the incoming data is unscreened. If you can identify a particular colour that needs adjusting then that colour can be selected and changed to match the required output. For the Tweak Set to work the Use ICC always must be selected and the ICC profiles and rendering intent used in the Pagesetup must match the ones used when creating the Tweak Set. See the ICC Tweak Set for more information on creating and adjusting colours with a Tweak Set.

RGB Workflows

If your data coming in is RGB based then you need to create an Input or Match profile for the RGB device you need to match. This profile will be used when ever the data needs to be converted from RGB to CMYK for output, whether or not the “Always Use ICC” is enabled or not. The device can a scanner, camera or Monitor. The rules for creating a match profile are the same. The RGB profile needs to be placed in following locations.

- Mac OSX
  - /Applications/Serendipity/Serendipity Blackmagic/lib/icc/monitors
- Windows
  - C:\Program Files\Serendipity\Serendipity Blackmagic\lib\icc\monitors
- Linux
  - $HOME/Serendipity Blackmagic/lib/icc/monitors

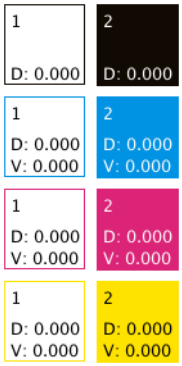
Expert section - Manual dot selection of Paper Profile

This section is aimed at the expert that wants to make their own decisions on which dots to use for the Paper Profile and which ones not to. It will take you through the process of assessing the patches and choosing the correct patches, followed by a real scenario. You still need to go through the initial process of creating a Pagesetup, creating a new Paper Profile and printing the density chart out. Please refer the above section for this as it does not change.

As we have discussed the Paper Profile is designed to match ink and paper characteristics for a given printer with a given configuration. If certain parameters change then the Paper Profile will more than likely need to be recreated. This means calibrating again from the beginning as the Paper Profile is the basis of all calibrations.

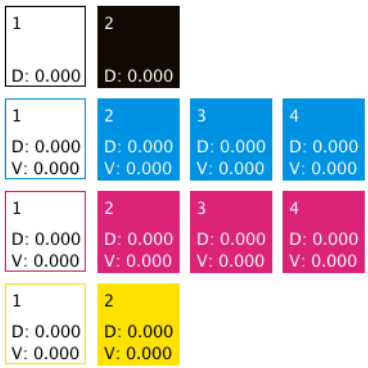
The Printers

Printers vary greatly as does the ink and media. With newer printers we have light inks and variable dot. With older printers you may just get the basic CMYK. Therefore the patches that you print and read will vary depending on the device. With the older printers the Paper Profile is very basic. A CMYK non variable dot device such as a HP1050 has just one patch (plus the paper density) and as this is either on or off any value can be used



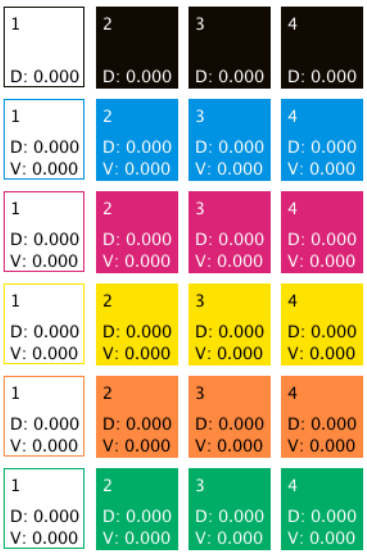
Paper Profile for HP 1050

As you begin to add light inks to printers then the dot selection becomes more important.



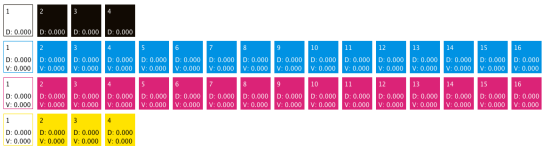
Paper Profile for Epson 9000

Or you can have variable dot.



Paper Profile for Roland FJ600 - CMYKOG - No Light Inks

Then with variable dot and light inks the combinations are greater and the selection more complicated.



Paper Profile for Epson 10000

The tables below shows the full combination of dots with and without light inks with variable dots.

	Inks					
	Light Inks			Heavy Inks		
Patch no	Dot Size					
	small	med	large	small	med	large
1	✘	✘	✘	✘	✘	✘
2	✔	✘	✘	✘	✘	✘
3	✘	✔	✘	✘	✘	✘
4	✘	✘	✔	✘	✘	✘
5	✘	✘	✘	✔	✘	✘
6	✔	✘	✘	✔	✘	✘
7	✘	✔	✘	✔	✘	✘
8	✘	✘	✔	✔	✘	✘
9	✘	✘	✘	✘	✔	✘
10	✔	✘	✘	✘	✔	✘
11	✘	✔	✘	✘	✔	✘
12	✘	✘	✔	✘	✔	✘
13	✘	✘	✘	✘	✘	✔
14	✔	✘	✘	✘	✘	✔
15	✘	✔	✘	✘	✘	✔
16	✘	✘	✔	✘	✘	✔

light inks, heavy inks and variable dot

	Inks		
Patch no	Dot Size		
	small	med	large
1	✘	✘	✘
2	✔	✘	✘
3	✘	✔	✘
4	✘	✘	✔

	Inks	
Patch no	large light	large heavy
1	✘	✘
2	✔	✘
3	✘	✔
4	✔	✔

light inks and heavy inks

Measuring the patches

After you have printed the density chart, let it dry and stabilise for a short time. Once done you need to measure the patches. There are two methods you can use to read the data into the Paper Profile. Firstly is to use one of the supported on line devices which measures and saves the relevant data direct into the system and this method is recommended. Secondly is to read the density of the patches with another device and manually enter the data via the keyboard. If you are going to input the data manually you need to measure two values for every colour apart from Black. These are the real density and the visual density of each colour and are indicated by D (real) and V (visual) on the interface. Basically the real density is the value of the colour. e.g. the Cyan value of the cyan patch and this is the traditional value we associate with density. The visual density is how light or dark the value is and represented as the black content of the colour. The reason we take both these values will become more apparent when we assess the actual values, but you will notice that sometimes patches that increase in a real density will not always increase in a visual density. Once you have measured all of the patches you need to save the values so that we can begin choosing the patches.

Choosing the patches

There are a few steps to consider when selecting the patches.

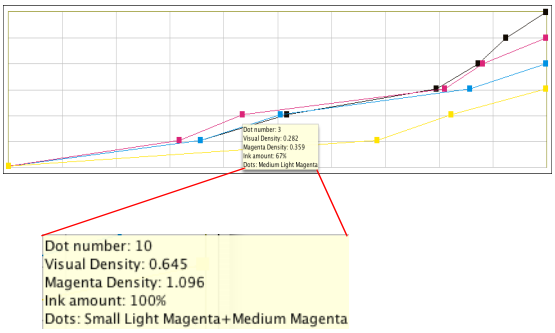
Assessing the print

The first thing to do is assess the print. Look for patches that are bleeding, or mottling. Mottling can occur where inks dry at different rates and are not laid down evenly. Sometimes due to the light ink and dark ink not mixing and one drying quicker preventing the other from drying properly. Look for inks that tend to change colour. i.e. some inks in the cyan and magenta tend to shift away from cyan and magenta changing to look more blue and ruby coloured respectively. Once you have identified certain patches that should not be used you can look to turn them off.

You may find it easier initially to sort the patches by Patch number (when saved the patches are sorted in one of the density orders). Then click in the patch's upper half to turn the dots off that you have visually assessed to be poor. Once done sort the patches by either colour (real) density or visual density. As a general rule you sort patches in visual density where light inks are used. i.e. cyan and magenta, and sort the others as real density.

Evaluating the densities

Once you have eliminated visually poor patches you need to look at the density values that you measured for those patches that are still on. The patches represent a vignette of the colour and therefore must increase as evenly as possible. Taking each colour in turn you need to assess the densities for the sort mode you are in. i.e. if you have sorted visually then assess the visual values first. Make sure that the values of adjacent patches are not too close in value. If they are you get a hump or band in the colour. Generally they should not be any closer than 0.05. If there are two patches side by side that are closer, then you need to turn one of them off. As they have similar densities, keep the one that uses less ink. This can be determined in a couple of ways. The tables above show the dot combinations which you can use as a guide. You can also get the values from the patches or graph points by hovering the mouse over the dots that you need to choose. This will display a tool tip telling you the amount of ink coverage that patch has.



Once you have chosen the values for one sort mode, check the other. i.e. if you have selected the dots for the visual density, change the sort to real density and check for the same criteria. Also, as you change the sort order make sure that none of the patches that are still on switch places with one another. This usually proves to be problematic and you should turn one of them off. Again choose the one that uses more ink to disable. Repeat this for each colour in turn until you are satisfied that your dot selection is good.

TIP

As a general rule we find that the patches 4, 8, 12 and 16 are not very good (where light inks are used), and in particular the Cyan and Magenta. These will often mottle anyway or

be very close to an adjacent value. Therefore most times these points will be eliminated by the other processes but if you get problems this is one point to look at.

When turning points off you need to make sure that the last point on has sufficient (real) density required. If not then the proofs will not yield very good results.

The Graph

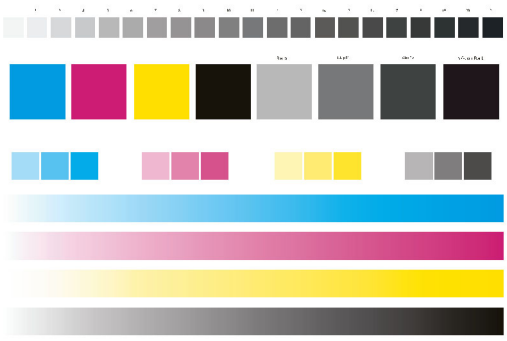
The graph is used as visual indication of how the values are used. Moving the mouse over a point will display a tool tip giving information about the patch. It will tell you the dot combination and the ink coverage. The horizontal scale is set in 10% increments. This can be used if you see a problem at a particular point, say 75%. You can see which patch/patches are causing the problems. Each patch is “on” at the point displayed by the graph. They turn on before the patch and switch off after the patch. The point that this happens depends upon the distance of the previous and next patches. They fully merge with the adjacent patches mid way between them.

The graph displays all of the process colours. You can turn the display on and off by checking the tick box below the graph for each colour. This is only a visual display and has no affect on the output.

If the graph does not display for any particular colour (and the checkbox is on) then the points you have selected are poor. If you try to use the Paper Profile in this state the server will error any job processed. The error displayed is “Inconsistent data in Paper Profile, some pixels are lighter or the same density. Please fix and try again”. You will need to re-assess your selection and make some adjustments.

Printing a vignette

After you have made your selection you need to print a chart out and make sure that the dot selection works well on a vignette. Make sure that the sort order is correct and saved. Make sure that the correct Paper Profile is selected in the Pagesetup and that no other colour management is enabled and print a chart with a vignette of each colour. You can download a test chart (shown below) from the Serendipity Software ftp site at ftp://ftp.serendipity-software.com.au/pub/downloads/GrayBalance-Vignette



Grey Balance Vignette Chart

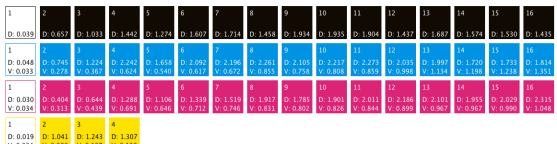
Make sure that the vignette is nice and smooth. If you see an area where there is a sharp transition or a hump in the vignette you need to go back to re-assess your selection. Estimate the area where the anomaly is and then use the graph to determine which patch or patches are the problem. Change the ones that you select, save and re-render the vignette chart. Sometimes you may find that changing the sort mode, say from Visual to Real will fix the problem. This simply moves the points that the dots are turned on and off. Slight problems will most likely be hidden by the linearisation and ICC profiles. Once you are happy that the values are correct you can continue with the calibration process.

Practical Example

In this last section for the Paper Profile we will work through a real example. Taking each decision in turn, explaining the reasons for the choices made and showing the results.

We will profile the Epson 4000 at 1440dpi by 720dpi using Premium luster 250 paper with light inks (pigment) and photo black.

The Pagesetup was configured and saved and the Paper Profile density chart printed. This was measured using an Xrite DTP 34 and the results are shown below.



Paper Profile sorted by patch number for Epson 4000 at 1440 x 720 dpi

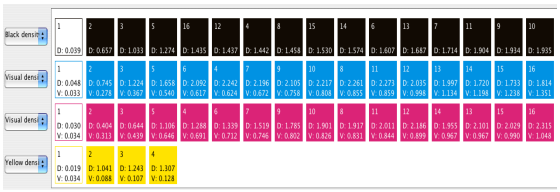
The Table below shows the density values of the patches as read. You will see the values that violate the rules and need to be fixed.

Table 1: Starting Densities

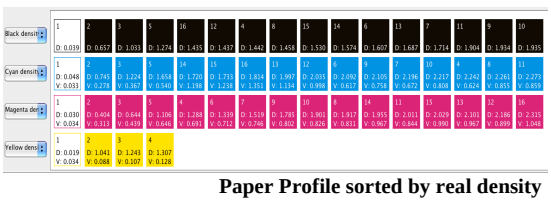
Patch No.	Black	Cyan		Magenta		Yellow	
	Rd	Rd	Vd	Rd	Vd	Rd	Vd
1	0.039	0.048	0.033	0.03	0.034	0.019	0.034
2	0.657	0.745	0.278	0.404	0.313	1.041	0.088
3	1.033	1.224	0.367	0.644	0.439	1.243	0.107
4	1.442	2.242	0.624	1.288	0.691	1.307	0.128
5	1.274	1.658	0.54	1.106	0.646		
6	1.607	2.092	0.617	1.339	0.712		
7	1.714	2.196	0.672	1.519	0.746		
8	1.458	2.261	0.855	1.917	0.831		
9	1.934	2.105	0.758	1.785	0.802		
10	1.935	2.217	0.808	1.901	0.826		
11	1.904	2.273	0.859	2.011	0.844		
12	1.437	2.035	0.998	2.186	0.899		
13	1.687	1.997	1.134	2.101	0.967		
14	1.574	1.72	1.198	1.955	0.967		
15	1.53	1.733	1.238	2.029	0.99		
16	1.435	1.814	1.351	2.315	1.048		

Rd = Real Density Vd = Visual Density

From the values you will see that the patches will vary depending on the order that we sort them. For example the highest patch of Cyan when sorted visually is patch 16 at 1.351D. However after sorting the patches by real density patch 16 drops to the 7th position and the top patch is 11with a real density of 2.273D (patch 16 has a real density of 1.814 D)

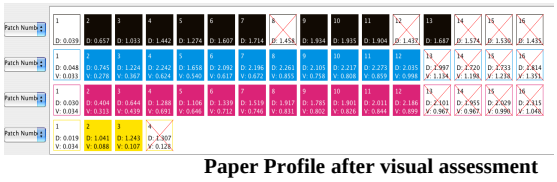


Paper Profile sorted by visual density



Paper Profile sorted by real density

The first thing that we do is assess the print for poor patches. From the print done we can see in the black that some patches have printed with a matt finish. These can be eliminated and so 8, 12, 14, 15 and 16 are turned off. In the Cyan and Magenta we see patches 13, 14 15 and 16 print very blue and ruby respectively. As we need Cyan and Magenta colours we can eliminate these patches. Like wise the last yellow patch (4) prints very yellow and has a thin boarder around the patch indicating that it has not dried evenly. So we can eliminate this patch. So from this stage we end up with the following.



Paper Profile after visual assessment

The next stage is to sort the patches and assess them again. We chose to first sort them by visual density. So again starting at the Black we check the values of the patches and eliminate those according to the rules specified earlier. From the remaining patches we see that patch 13 (1.687D) and patch 7 (1.714D) are close. So we have to choose one of these patches to turn off. By hovering the mouse over the patches we can see that patch 13 will lay down 100% ink coverage being a large heavy ink dot. Patch 7 will also lay down 100% ink (this is a medium light and small heavy). As they have the same effective ink coverage we have to decide via other means which one should be turned off. I chose 13 based on two reasons. Firstly the fact that 13 does not print very well in Cyan and Magenta and it can be assumed that the Black will perform similarly (Black hides some visual artefacts visible in other colours). Secondly that the patch before (6) is made up of a small light and small heavy. By leaving 7 on there is only one ink transition change i.e. that of small light ink changing to medium heavy ink. If we decided to leave the 13 on, then it is a big transition (all ink dot sizes change).

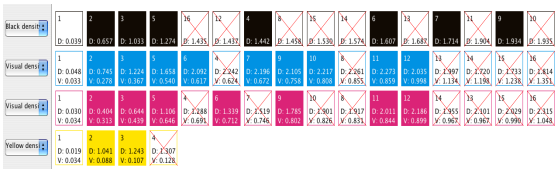
The transition of patches sometimes has an effect in the overall smoothness of the output but not always. It can be one factor used to determine those dots to keep and those to discard.

Patch 11 is close to patch 9 so patch 11 is turned off as this will lay more ink down than patch 9 but both yield similar densities. Patch 10 is eliminated for the same reason.

In Cyan we see that patch 4 and patch 8 have adjacent patches that are close (visual density). We chose to eliminate both 4 and 8 even though the adjacent values have the same ink coverage. We choose it based on transition of dot sizes and based on experience.

We know that 4, 8 12 and 16 are generally not very good. If we know this and there are no other factors to separate the patches then it is the only factor that can be used to decide.

Likewise with the magenta we have the same problem with 4 and 8 and these are turned off. But we also have problems with 6 and 7, and 9, 10 and 11. Using the ink coverage rule we can turn off patches 7 and 10. So the Paper Profile now looks like this.



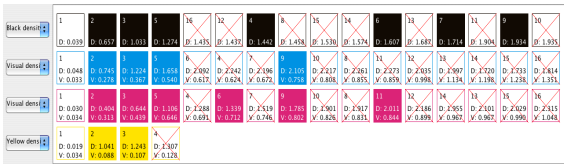
Paper Profile sorted by visual density after patch elimination

The next stage is to change the sort mode to real density and again check the density values for patches that are close. As you change the sort also check to see if any patches re-order themselves. And finally make sure that the last patch of each colour has sufficient density to achieve your match criteria.

So for this calibration obviously black does not change as there is only one density value. For Cyan we notice two things. First is that patches 7 and 9 switch depending on the sort order. This also happens with Patches 11 and 12. This can cause us some problems so we need to eliminate one of each of them. Based on the ink coverage rule we choose to keep 9 and 11, and eliminate 7 and 12. We also know that 12 can cause us some problems which is an additional factor in our decision. The next thing we notice with Cyan is that patches 6 and 9 are close in density (and patch 11 is not far off either). Because patch 6 and 9 place the same ink down you have to use other factors to determine the best one to keep. 6 has a smoother dot transition from patch 5, but I chose to turn off patch 6 (based on visual value and assessment) and patch 11 and retain patch 9. We do not need patch 11 as the density is far in excess of that needed for pre-press and patch 11 places more ink than patch 9. So I kept patch 9 as this has a darker appearance (visual density) than patch 6 and it is the last patch. Either would probably yield similar results.

With Magenta the only patch that may cause concern is patch 12. It is close to patch 11 in both real and visual and as we know that 12 can cause some problems (although less so in Magenta) we do not need 12 to achieve a maximum density so we can also eliminate this.

Now that we have assessed the patches visually and the values using both visual density and real density, we are ready to run a vignette test print to see how smooth the resultant patches are. Before we submit the job, change the sort from real to visual for both Cyan and Magenta as this generally produces better results. Then save the Paper Profile. The result is shown below.



Paper Profile sorted by visual density before printing first vignette

Then make sure that you select the Paper Profile in the Pagesetup and save before you run the test. Print the vignette and have a look to see how smooth it is. From the print run with this Paper Profile selected I found that Cyan, Magenta and Yellow were all fairly smooth. But the black had some sharp transitions at the top end. This was around the 80% area. So I had to look at the values of the patches to try to eliminate the transition. One thing to note is that when you turn a dot off, the other dots will move positions to accommodate the change. I tried changing some of the dots at the upper end. For example, turning 9 off and 10 on. This had no noticeable effect. Buy turning dot 7 off it had a small effect but the transition was still quite severe. Each time you make a change you need to save the Paper Profile and run the job again to see if the change has had the desired effect. Eventually I tried turning off dot 4, which as we know can cause problems. The result was a smooth black vignette. The final Paper Profile used is shown below.

The final Paper Profile used

You will see that there are not many dots actually used. This is a by product of higher resolutions. The essential thing is to get the right combination so that you can create good ICC profiles and get accurate colour matching. After this we now ink limit, linearise and create ICC profiles as detailed earlier in the guide.

Summary

So we now have a nice Paper Profile which we can use to calibrate the system. As you will have realised after reading this last section and after having a go yourself, there is no definite set rule. The Sift button is the best of

everything to produce good Paper Profiles. But when creating one manually there are many factors involved in making your decisions. The decisions I made are based on experience gained during a lot of testing. It is not the definitive guide or the only way to choose the patches. You may well get the same end results with different patches. This is a guide to help you understand the process involved and give (as much as possible) the experience gained during development so you can make your own decisions.

The most important thing to understand is that good calibration starts with a good Paper Profile. Because everything else comes from this and if the ink types, dot sizes and paper combinations are not producing very good results at this early stage it will not be helping as we create ICC profiles.

Lineariser - Expert Section

The lineariser is a fairly basic application with very little in the way of expert sections. Its main function is to create a curve for a particular device and apply it to a Pagesetup. The curve is applied on top of the Paper Profile and designed to make the printer linear.Therefore for a given printer and paper Paper Profile you can always return to the linear state from where the ICC profiles are created. It is for this reason that a wizard is used for the first stage to assist guiding you though a standard linearisation. There is an advanced section in the main Lineariser window. This is explained below.

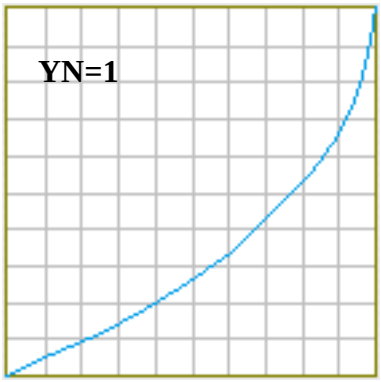
Yule Nielsen Number

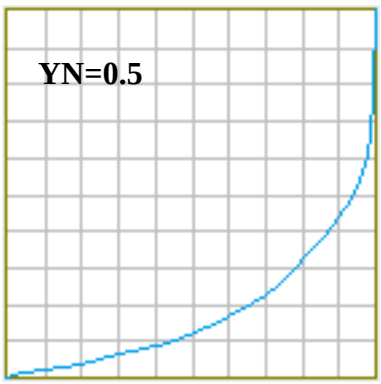
As described in the lineariser section of the manual the Yule Nielsen (YN) number is essentially a fudge factor applied to the standard Murray-Davis formula used when calculating dot percentage area from density.

The value is used to compensate for various media types as some react different to others in the way a dot will spread on a particular media and thus affect the dot percentage value. It can sometimes be helpful to change the YN number and some manufacturers will quote a YN number for a given media, but this is rare. The YN formula used for calculating the dot percentage is as follows.

$$\text{Dot \%} = \frac{1 - 10^{\frac{-\text{dot}}{\text{YN}}}}{1 - 10^{\frac{-\text{solid}}{\text{YN}}}} \times 100\%$$

Where dot is the value of the density of the value you are measuring and solid the density of the solid patch. Therefore a Yule Nielsen value of 1 has no effect on the dot percentage area. A value other than 1 will compensate for the dot spread on the media. If the YN is greater than 1 then the dot % decreases and if the YN is less than one the dot% increases. This can be seen from the graph on the lineariser.





Remember that the curves display the compensation. Therefore if the YN number is less than 1, the dot percentage calculated is increased and so the curve that we apply will go down. The reverse is true for the a YN number greater than 1.

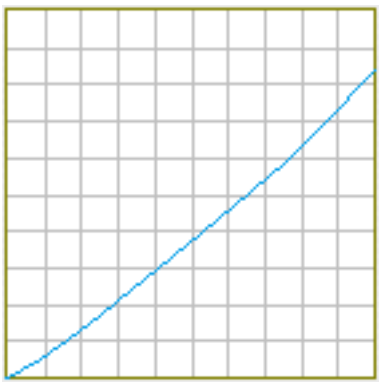
For most of the testing that was done during the development stage the value of 2 (which is the default

setting) seemed to work well. However we also noted that on occasions better results were obtainable by setting different values for each process colour.

Because you create ICC profiles after linearisation, then any value entered will be used for printing the ICC chart and will therefore effect the output. This means that when the ICC profiles are applied the same YN number must always be used in the linearisation to obtain correct results.

Maximum Densities Override

The only other section in the linearisation is the maximum density override. This allows you to cap the top end density to any value less than the maximum value read. If you enter a value less than the highest value measured then you will see the curve change. The top end will move down and the rest of the curve will adjust to compensate for the new end position. This means that values in the middle will change as well.



curve with Max density override set to 1.4D - Max measured = 1.7D

Pros and Cons

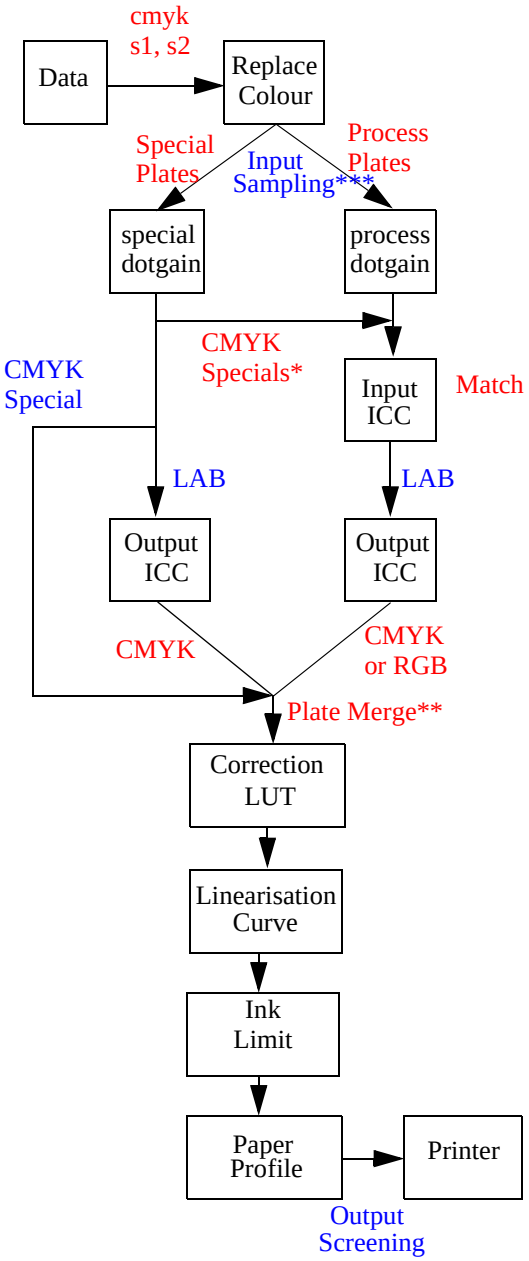
There are various arguments for and against setting a maximum density override. In general the match ICC profile would set the maximum density values so there should be no need to set them here. However some users have found it an advantage to set the values to the target densities that you require for the final proof output, and doing so have achieved very good results. Reducing the density of the output that is used to print the ICC chart will affect the gamut. However, as the gamut of a press is generally smaller than that of a proofing device this may not have any noticeable effects.

Any value entered in the maximum density override will be used when printing the chart out to create the ICC profile and therefore must always be present when using that profile. This must also be remembered when creating new linearisation curves.

It can sometimes be desirable to drop the top end densities of the output prior to ICC creation. Sometimes there is a need to boost the values after ICC is applied. But really this should only be used as a last resort and is not desirable as a general rule. If the top end densities drop then the ICC profiles are generally to blame and therefore should be corrected. As mentioned earlier it is the Match profile that has the biggest bearing on the output and that sets the output top end densities.

Colour Management diagram

Below is a diagram that shows the flow of data thought the various stages of colour management.



* CMYK Specials - This is the path of CMYK specials if the option “apply colour correction to CMYK specials” is enabled in the system settings.
** Plate Merge - Also at this point the opaque, overprint, knockout and individual colour dot gain curves are applied.
*** Input Sampling - This is where the sample method is applied and the preserve screen functions etc.

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