datacolor

Customer Support

Sample Preparation Guide
In Building Colorant Sets
For Datacolor's Match Pigment

I Overview

This guide will instruct you in creating an accurate colorant database for use with the Datacolor MATCH PIGMENT Plastics Software. The resulting files provides the system with the information necessary to match and correct colors in your product. The samples made to characterize your colorants will be referred to as "primaries."

Datacolor MATCH PIGMENT Plastics software is capable of matching colors by measuring the reflectance of opaque, translucent, and transparent samples or by measuring the transmittance of optically clear samples.

II What is needed to start

The quality of the results obtained from your system is dependent upon the quality of the data derived from your primaries.

The system cannot produce results that are more accurate than the data your primaries provide.

Each primary described in your database must be representative of the materials you are actually using in your finished products. Work with a standardized lot of each of your colorants.

Use of a clean analytical balance with at least two-place accuracy is recommended for weighing. Colorant/resin mixes should be of a size large enough ensure accuracy.

Select one technician to do the sample preparation in order to remove the variability which differences in laboratory technique can create. This technician will quickly become familiar with preparation procedures.

Review procedures within your laboratory and production environment. Installation of a color control system will frequently point out existing variations that have been ignored in the past.

Choose the resin/base used in the majority of color matches for the products you manufacture. Successfully building a file in this resin will give you the quickest maximum use of your system, as well as give you the knowledge and experience necessary to build any additional files you may require.

If the product line you are characterizing normally contains additives (stabilizers, clarifiers, fillers, etc.), be sure your primaries contain them at their normal levels.

For many of our system users, the choice of process equipment is fixed by what is available and in normal use. However, if lab formulations are the major activity, the primaries should be produced on the equipment used for lab formulation. If production adjustments are the major goal, then process samples on the equipment that gives the best correlation to production output.

Sample surface should be as consistent as possible throughout the primaries.

The first two types of colorant sets this guide presents are the two-constant relative (opaque) and two-constant absolute (translucent) colorant sets. The differentiation here is measured in Contrast Ratio or CR. It is calculated by measuring a sample over a contrasting background, such as a white and black or black and aluminum drawdown card. A sample's CIE Y tristimulus value is calculated for its measurement over the black background and also for its measurement over the white or aluminum background. Then the Y over black is divided by the Y over white or aluminum and multiplied by 100. A CR at or near 100 is considered opaque; less than that is considered translucent.

Important: If you are measuring your samples over a white and a black background, it may be prudent to use a material between the sample and the white and the black background to remove the air between them. Light would otherwise be refracted, scattered and lost at that interface and yield inaccurate higher Contrast Ratios. For plastic samples, you can use mineral oil, petrolatum, even water is more desireable than air.

An opaque set has limitations in what it can do for you. It cannot predict loading into the base to achieve opacity or a level of translucency nor can it predict the effect of varying film thickness on color and opacity. A translucent set can do these things.

You must have the densities for each material used in sample preparation!

The optical constants calculated in the software (the Kubelka Munk absorption coefficient K and scattering coefficient S) are determined by volume concentration. Without the materials exact densities, you will be introducing error into the calculation of the optical data.

If you work with a variety of material forms (dry pigments, pastes, liquids), you can enter the density information in a variety of modes: Kg/L, mg/ml, Lbs/Gal, etc. Packed powder density may be unreliable; the most accurate would be specific gravity (Kg/L or mg/ml).

III What samples to make for an opaque set

These guidelines apply whether you use dry/pure colorants, or extended materials (pastes, dispersions, flushes, etc.) that you purchase or make yourself.

White colorant - Prepare a sample using your main white colorant (e.g., TiO_2). The sample will be a masstone, i.e., 100% of the colorant in the sample will be that particular white colorant.

The sample should have a white colorant loading that represents the upper limit for this white in this base based on what you know to be a prudent loading for this product. That is, you do not want to load more white into the base than you know to be capable of producing a good product. It is expected here that the combination of loading and film thickness will make the sample opaque (CR at or near 100).

Black colorant - You are asked to prepare five (5) samples to characterize this colorant.

5% black and 95% white
10% black and 90% white
30% black and 70% white
50% black and 50% white
100% black

The white used in these mixes should be the same white colorant used in the preceding step.

The loadings of the black-and-white mixes and the loading of the masstone sample in the resin system need not be constant as long as the combination of loading and film thickness produces an opaque sample.

Note:
Match Pigment has the capacity to use more than 5 primaries for the black and other colorants as well. Since these primaries are most commonly being prepared for our users' training course, we will limit the number of primaries here to 5 for the black and for each of the remaining 4 colorants. If you are preparing the database for use outside of the course, you may want to make a more extensive set of perhaps 10 primaries. The additional primaries would be to better cover the range of colorant plus white possibilities.

Other colorants –

To characterize the following colorants, let's say **yellow, red, green and blue**, you will make six (6) samples for each. Use the yellow, red, green and blue colorants that are most often employed in your color matching.

Your primary samples for each colorant will include five (5) mixes with the white colorant and one (1) mix with the black colorant previously used in this guide.

Your four colorant-and-white mixes should be prepared in this manner:

5% colorant and 95% white
10% colorant and 90% white
30% colorant and 70% white
50% colorant and 50% white
70% colorant and 30% white

Your colorant-and-black mix should be prepared in this manner:

99% colorant and 1% black

Once again, the loadings of these primary samples can be varied based on what you know to be prudent for each colorant mix, as long as the resulting sample is opaque (CR at or near 100).

Colorant blends to test the data

You will want to also prepare some blended colorant samples for testing the resulting data. They too should be made at the same time as the above primaries and include only those colorants you've created primaries for. These blends can then be used to run matches to test for the accuracy of predictions.

A:	Yellow	20	B.	Yellow	21
	Red	20		Red	22
	Blue	5		Blue	4
	White	55		White	53
C.	Black	10	D.	Black	9
	Yellow	30		Yellow	34
	Red	40		Red	38
	White	20		White	19
E.	Red	3	F.	Red	3
	Yellow	12		Yellow	15
	Green	25		Green	22
	Whtie	60		White	60

G: Repeat sample D once more from scratch. G and D will be a test of the repeatability of your preparation procedures and process.

The above formulas give proportions of the the colorants in each formula, and do not include the colorant loadings into the resin. The colorant loadings for these samples should be in line with the colorant loadings used to prepare your colorant primary samples as described in the preceding section.

IV What samples to make for a translucent set

These will all be measured on a contrasting background (a black and white contrast card). It is desireable that all these samples have measurable contrast ratios which make them less than opaque, preferably less than 96. If in the range of colorant loadings used to make these samples the contrast ratio of a sample exceeds that, try to produce that sample with a smaller thickness to get the contrast ratio down to the desired level.

Resin or Base

You will need one sample of the resin/base on the contrast background at the normal film thickness. It should contain all the normally present additives except colorant.

Caibrating White Colorant

You will need 4 samples of the white colorant in the resin/base. The highest level of loading is one sample. Just as described in the opaque set, if there is a level of loading where any higher would make a bad product, do not go into that bad product range. The other 3 samples should be spread from that level to the lowest level you believe to made accurately and still show the presence of the white in the resin/base. A reminder here: if the samples' contrast ratios are at or near 100, please try to lower that contrast ratio by having a thinner section of the sample to be measured. A sample in a step chip may be useful for this.

Black Colorant

You will need 9 samples to characterize your black colorant. 4 will be masstones prepared along the same guidelines as the white preceeding this description. You will also need 5 samples of this black colorant mixed with the white. The proportions of black to white can be the same as those described in the opaque set:

5% black/95% white
10% black/90% white
30% black/70% white
50% black/50% white
70% black/30% white

Please note here what should differentiate these from the one prepared for the opaque set will be you will want them to not to be totally opaque. Achieve that through loading and/or film thickness.

Other Colorants

You will make 11 samples: 4 masstones, 5 mixes with the master white, and 2 mixes with calibrating black. For the masstones and for the mixes with white, you can follow the same guidelines as those used for the calibrating black primaries in the preceding section. For the two primaries of colorant mixed with calibrating black for each colorant, the proportions should be

99% colorant/ 1% calibrating black
97% colorant/ 3% calibrating black

Colorant blends to test the data

You will want to also prepare some blended colorant samples for testing the resulting data. They too should be made at the same time as the above primaries and include only those colorants you've created primaries for. These blends can then be used to run matches to test for the accuracy of predictions.

A:	Yellow	20	B.	Yellow	21
	Red	20		Red	22
	Blue	5		Blue	4
	White	55		White	53
C.	Black	10	D.	Black	9
	Yellow	30		Yellow	34
	Red	40		Red	38
	White	20		White	19
E.	Red	3	F.	Red	3
	Yellow	12		Yellow	15
	Green	25		Green	22
	Whtie	60		White	60

G: Repeat sample D once more from scratch. G and D will be a test of the repeatability of your preparation procedures and process.

The above formulas give proportions of the the colorants in each formula, and do not include the colorant loadings into the resin. The colorant loadings for these samples should be in line with the colorant loadings used to prepare your colorant primary samples as described in the preceding section.

Final note:

For both the opaque and translucent sets, the number of samples that you are being asked to prepare are necessarily the optimum number. The method of calculating optical data can be enhanced by more samples per colorant. The number of samples dictated here are considered a minimum to obtain adequate results. After this trial and its accompanying training, it may be advantegeous to add more primary samples.

V. What to make for transparent systems

Colorants - You will make five (5) samples to characterize each of the following colorants: yellow, red, green, and blue. Use yellow, red, green, and blue colorants that are most often employed in your color matching.

For each colorant make one sample at the minimum concentration you can precisely prepare.

For each colorant make one sample at the maximum concentration you would use for that particular colorant in that particular resin and process.

The remaining three concentrations for each colorant should be well spaced between that colorant's minimum and maximum concentration. For example, if the minimum and maximum concentrations for a red were 0.01 and 3.00 respectively, the remaining eight concentrations could be:

Minimum (0.10) 0.50 1.50 2.50 (3.00) Maximum

Note:

Match Pigment has the capacity to use as many as 10 primary samples to characterize a colorant. Since this guide is most commonly used by people preparing for our users' training course, we limit the number of primaries to 5 for all but one of the colorants.

Pick only one of the colorants (yellow, red, green or blue) and using the same guidelines as above, prepare 10 concentrations spaced from the minimum to the maximum concentration.
If you are preparing a database outside of the course, you may follow this procedure for all your colorants.

Resin - You will need to make a sample of your resin processed by your coloring procedure in the absence of colorant but with any additives normally present in this product (clarifiers, etc.).

Colorant mixes - In order to test the colorant data from your primary samples and to able to learn to use the formulation and correction programs, it is necessary that you prepare samples of colorants mixed in the following proportions:

A.	Yellow	40.0	B.	Green	30.0
	Red	40.0		Red	20.0
	Blue	20.0		Blue	50.0
C.	Yellow	30.0	D.	Yellow	20.0
	Green	40.0		Green	20.0
	Blue	30.0		Red	60.0

E. & F. Repeat sample A. twice more from scratch. These samples will be used to test the reproducibility of your preparation procedure and your process.

The actual loadings (or concentrations) of these colorant mixes into your resin system is left up to you to choose. Only samples A., E. and F. should be identical in loading.

*** * IMPORTANT * ***

Be sure to make and bring these samples to the users' course. They are a necessary part of the instruction and a gauge of any difficulty that may arise particular to your operations.

WORKSHEET FOR TRANSPARENT PRIMARIES

Colorant Name:

% Colorant: (If colorant is paste, dispersion, flush. etc.)

D e n s i t y: (Specific Gravity, lbs./gal, gr./cc)

C o s t :

Enter actual weight and thickness of each primary

	Primary 1	**Primary 2**	**Primary 3**
Colorant :			
*** R e s i n :**			
Thickness :			

	Primary 4	**Primary 5**
Colorant :		
*** R e s i n :**		
Thickness :		

*** Weight of resin should include weights of added processes aids, etc.**

VI. SAMPLE PREPARATION GUIDE

APPLICATIONS USING NO WHITE OR FIXED LEVELS OF WHITE AND MEASURING SAMPLES IN REFLECTANCE

In the production of plastic products where white colorants such as TiO2 are either not used at all or incorporated at a fixed level and the product is measured in reflectance because it is not optically clear, the sections I, II, and IV in the sample preparation guide should be followed. This would apply to such products as synthetic fibers and vinyl siding.

The resin used in primary samples should then contain that proper fixed level of white. For example, synthetic fiber might contain 0% TiO2 or perhaps 0.1% incorporated as a delusterant. In vinyl siding, the TiO2 might be held at a 10% loading.

These primary samples are then used to build a file which Datacolor's plastics software calls the "Transparent Reflectance" option.

If you have any questions regarding sample preparation, please call your application specialist.