Creating the "Perfect" Colorbar

What is "Perfect"?

Each printing environment is different. Presses differ. Processes differ. Media differs. What then makes up a "perfect" colorbar? In simple terms, it is a pattern of measurable and visually inspected targets that yield useful information to assist in the quality control of a printed item. Let's take a few example situations and see how colorbars might be tailored to deliver good control data without redundancy. One definite rule - - where possible:

> The "perfect" colorbar should have a solid control target for each printing unit for each and every ink control key (offset). This should be an exact one-for-one relationship.

The preceding statement is fundamental to "perfection". It ensures that we are able to measure the solid ink density for every ink across the entire page without gaps and without redundancy. We have a one-to-one relationship between solids and keys. This relationship is press specific! For example, let's consider the following conditions:

> Press is model XYZ from vendor ABC. It is a 30-inch, four-color, offset, non-perfecting machine with 24 ink keys. The ink keys are 32 mm in width.
>
> Measurement device has a 3.5 mm aperture (this means that targets cannot be less than 3.5 mm x 3.5 mm in dimension).

If we simply divide the key width by the minimum patch size, we immediately learn that we could have 9.143 patches (approximately) per 32 mm key. An odd number!

Alternately, we might adjust patch width to yield an exact patch count: for example, 8 patches per key! If we do the math; 32 mm per key divided by 8 patches per key equals 4.375 mm per patch width - exactly. Will this yield a "perfect" colorbar?

Below is but one example of "perfection": a very simple but very useful colorbar. The bar is defined as:

• Four solids – KCMY • Four screens – KCMY 25%
• Four solids – KCMY • Four screens – KCMY 50%
• Four solids – KCMY • Four screens – KCMY 75%
• Four solids – KCMY • Three overprints – RGB & Three-quartertone gray – RGB @ 75%

Notice that each 'pair' consists of eight patches. Four of these patches are solids. The four additional patches each deliver different information about the printed sheet. Group one tells us something about the highlights, group two about the mid-tones, and group three about shadow details. The last group looks at ink trap and places a gray balance target immediately to the left of the next "repeat".

Repeat? What's a "Repeat"?

Let's draw a representation[1] of the colorbar we've verbally defined above:

If you care to count the patches you will find that we have a total of 32. This group is precisely the number of patches which will span 4 keys on our imaginary press. If this is the case, then what comes next?

Think Wallpaper!

A colorbar pattern simply steps across the press sheet.

In our example we print 32 patches and the pattern starts over again with the first patch in the series. We have one and only one solid for each of 4 printing units K, C, M, and Y. We have quartertone, mid-tone, and three-quartertone targets. Thus, we can look at highlights, mid-tones, shadow detail, print contrast, hue error, grayness, and overprints all with a VERY simple 32 patch series of targets. By repeating this pattern across the press sheet, we can accommodate any size of sheet.

The pattern (32 targets) is akin to the process of hanging wallpaper. The right-hand side of sheet #1 butts exactly against the left-hand side of sheet #2. The "flower" or "bicycle" or other image element of the first sheet blends precisely into the same (other half) element of sheet #2. This process can continue indefinitely. Thus, a simple 32 target bar becomes infinitely extensible.

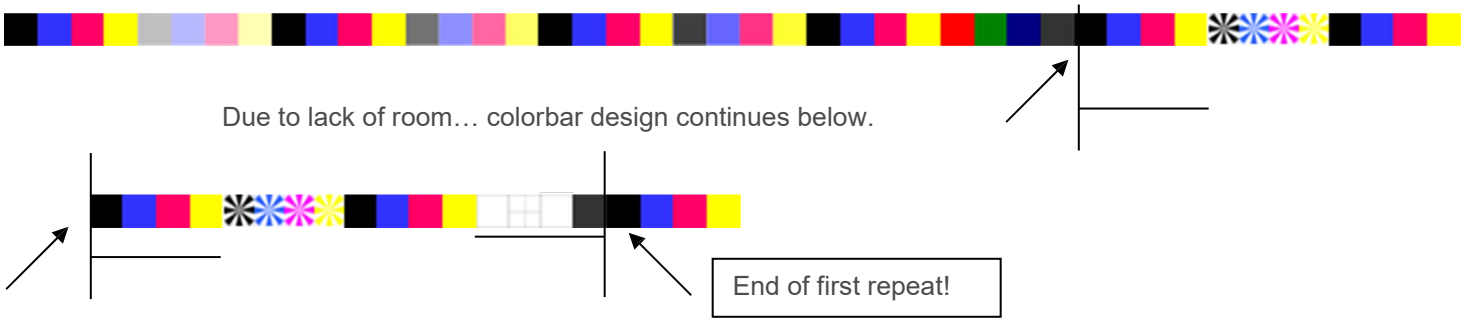
What Are We Missing, What Else Could We Add?

At least three additional items come immediately to mind:

- Slur Targets
- A blank "paper" target (needed for many densitometric calculations!)
- A register target

[1] Colorbar images are not to scale!

Paper and ink are expensive commodities. Because of this fact, colorbars should (generally) occupy the least amount of real estate possible. Anything of value that will benefit the quality control capabilities of the pressman should be squeezed into the colorbar if at all possible. Considering our relatively simple design above, how we can modify the pattern to include these 6 additional elements (remember our key width demands one solid per ink unit per key and that we can only fit 8 elements into the width of a single key!).



Remember that each key for each ink unit must have a solid target. To keep our colorbar pattern properly synchronized with the press it is necessary to have four targets between the repeating solids. While anything could be dropped into this area, it seemed reasonable to stick in a second paper and another gray (can never have too many grays!).

Our pattern has grown by 16 patches: 32 + 16 = 48. As with the shorter colorbar, this pattern can be stepped across the page to provide the pressman with complete key by key solid ink control as well as a wealth of additional printing information. This colorbar design provides:

- Solids
- ¼ tones
- Mid-tones
- ¾ tones / Print Contrast
- Overprints - RGB
- Slur targets (visual tool – not measured)
- Register target (visual tool – not measured)
- Paper
- Graybalance targets

Kick it Up a Notch – All of the above with 6-colors

Keeping in mind the primary rule that each ink unit must have a solid target for each key,

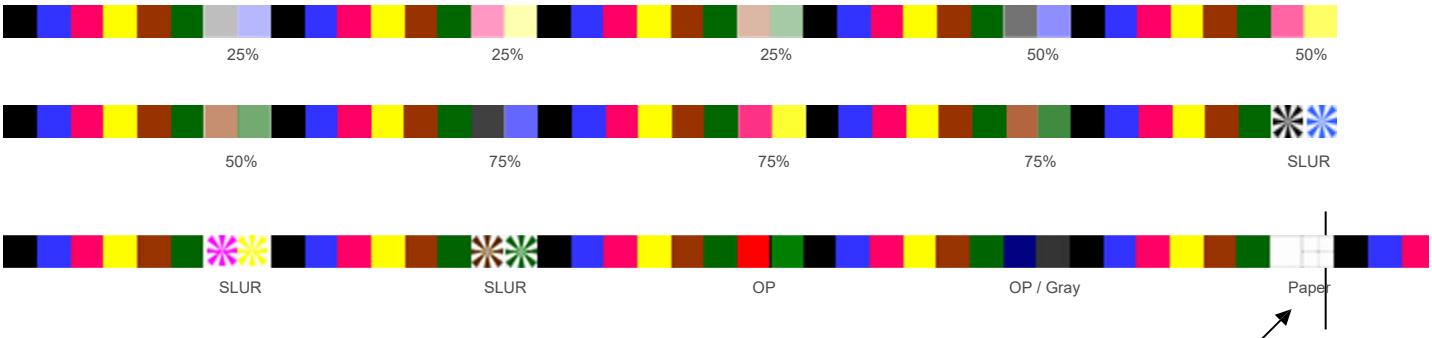
AND,

leaving the patch dimensions the same (4.375mm)

how can we design the “perfect” bar for a six color press?

We have already determined that we need exactly 8 patches per ink key. So, in addition to our solids, we have space for only two additional patches before the solid sequence is repeated. Our new design might look something like the image below:

[2] Again, the colorbar image depicted in this Word document is NOT to scale.



Whew!

This colorbar is now 120 patches in length! A monster, but it follows the rules. There is a solid for every ink and every key on the press. It still has all the measured and visual control targets necessary for good process control.

Is this the "perfect", 6-color colorbar?

Reflecting on the mechanics of the printing press, the colorbar we just designed might still be improved in several ways. For example, we might want to ensure that we have register and or slur targets closer to the edges of the press sheet. It is here that these problems are most dramatic and here that the pressman needs greatest control. We might also decide that we would prefer the halftone order to be by ink unit rather than by weight (25%, 50%, 75%). If we did this then we would have 25%, 50%, 75% of ink number one then 25%, 50%, 75% of ink number two and so on.

If we are of a European mindset, we might prefer to print with other screen values. It is quite common for European colorbars to have only 40% and 80% screens. These two values do a good job of allowing the pressman to monitor gain in the near highlights and deep shadows and at the same time avoid the dot gain "jump" that occurs just as the 50% screens touch.

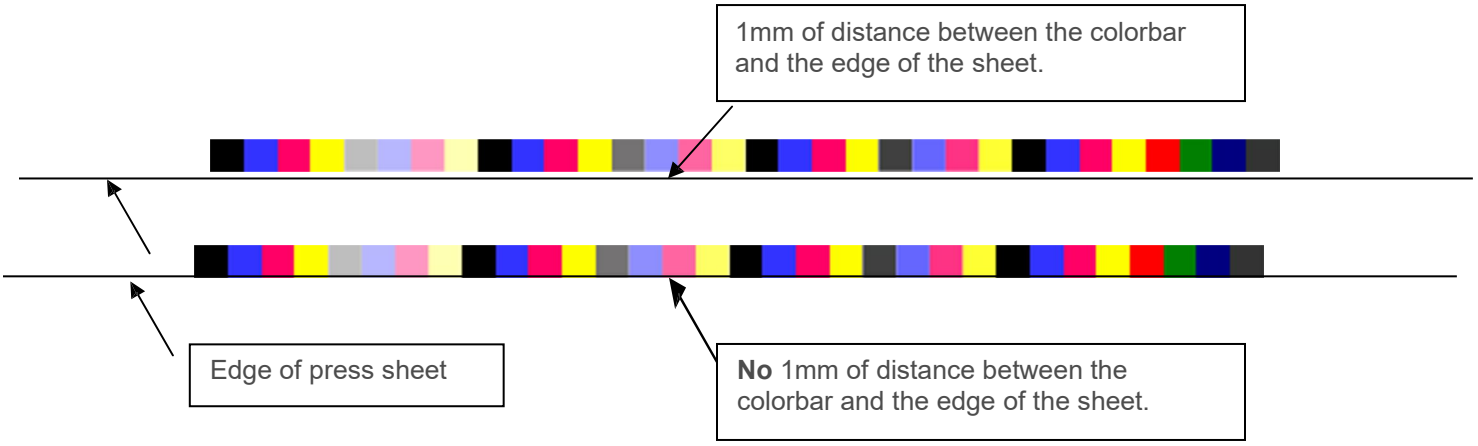
Bottom line is there is no one best way to create a colorbar. Its design is dependent on your printing conditions and the types of data that you wish to have available for process control. If you are not printing offset and do not have fixed pitch ink keys – rotogravure for example uses a single doctor blade – then the need for fixed pitch solids is eliminated.

Many experts would also argue that Graybalance is such an essential ingredient in good printing that you should liberally scatter balance targets across the page.

Additional Rules for the Individual Scanning Systems

Rule 1------IntelliTrax1/2 Only

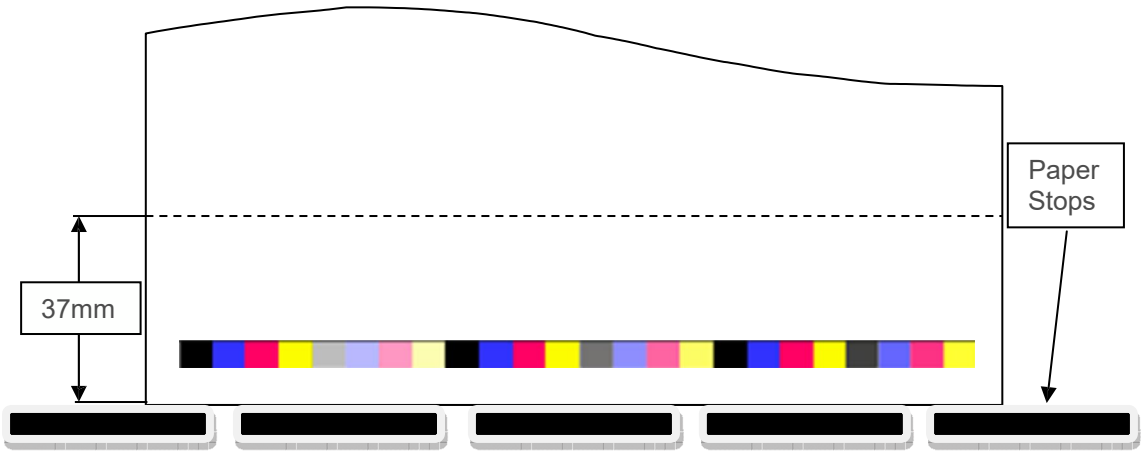
The design of the IntelliTrax “look-ahead sensor” is such that the colorbar cannot be adjacent to (or touching) either the image or the edge of the press sheet! **At least 1mm (one generous millimeter) of paper MUST surround the entire bar!**



In the preceding image, only the first colorbar will scan! The second, is too close to the edge and the sensor will not be able to auto-track the colors. Note there is a manual “Set-Y” mode but this mode defeats the unique auto-tracking, look-ahead functionality of the system.

Rule 2------IntelliTrax1/2 Only

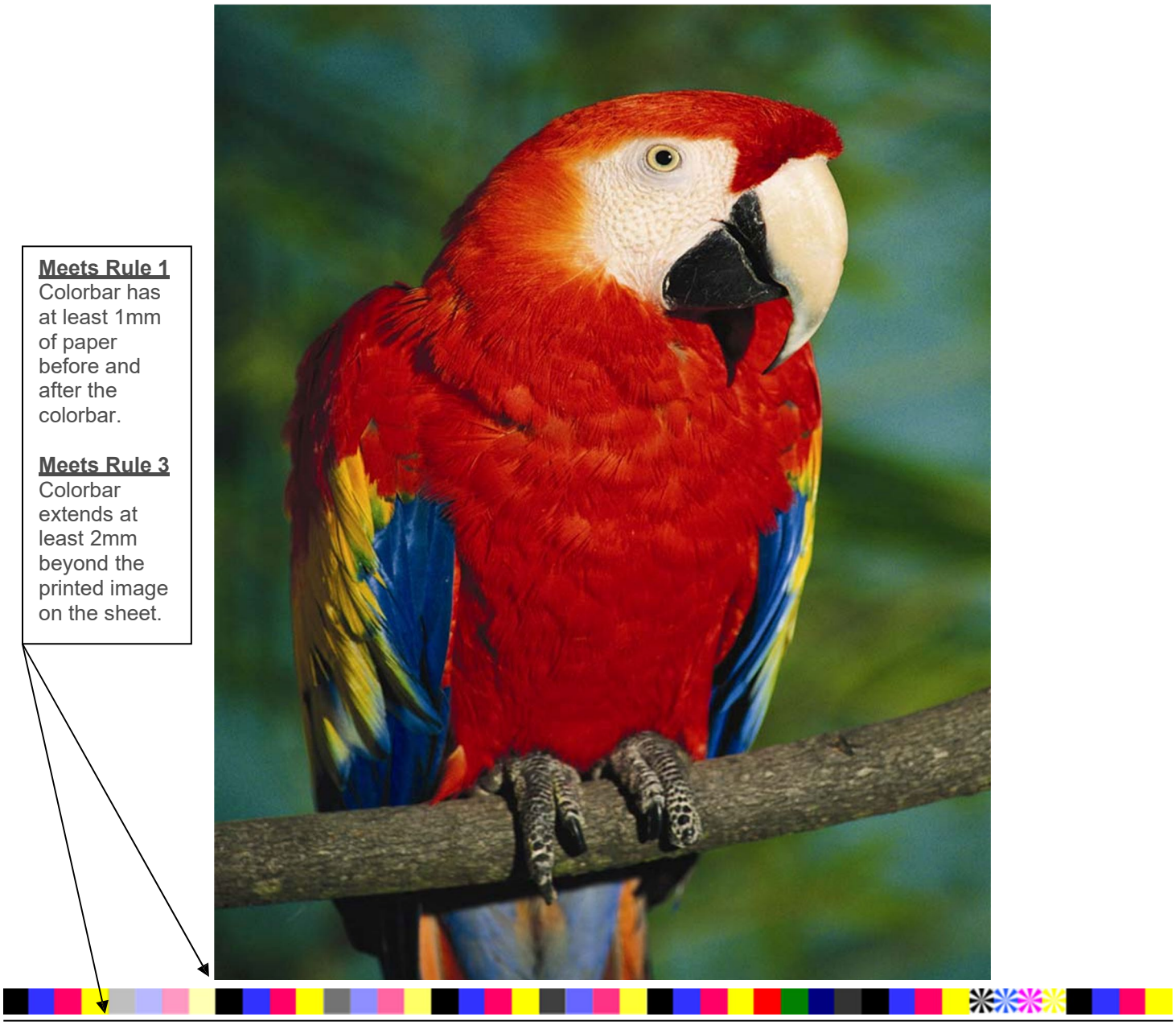
IntelliTrax requires the colorbar to be placed within the 37mm spaced between the sheet edge that is up against the paper stops and the work.



Rule 3------IntelliTrax1/2 Only

A second IntelliTrax only colorbar requirement is that the colorbar must extend at least 1mm to 2mm beyond the printed image on the sheet! This press sheet will scan fine! There is at least one millimeter of paper on all sides of the bar and the bar extends beyond the image.

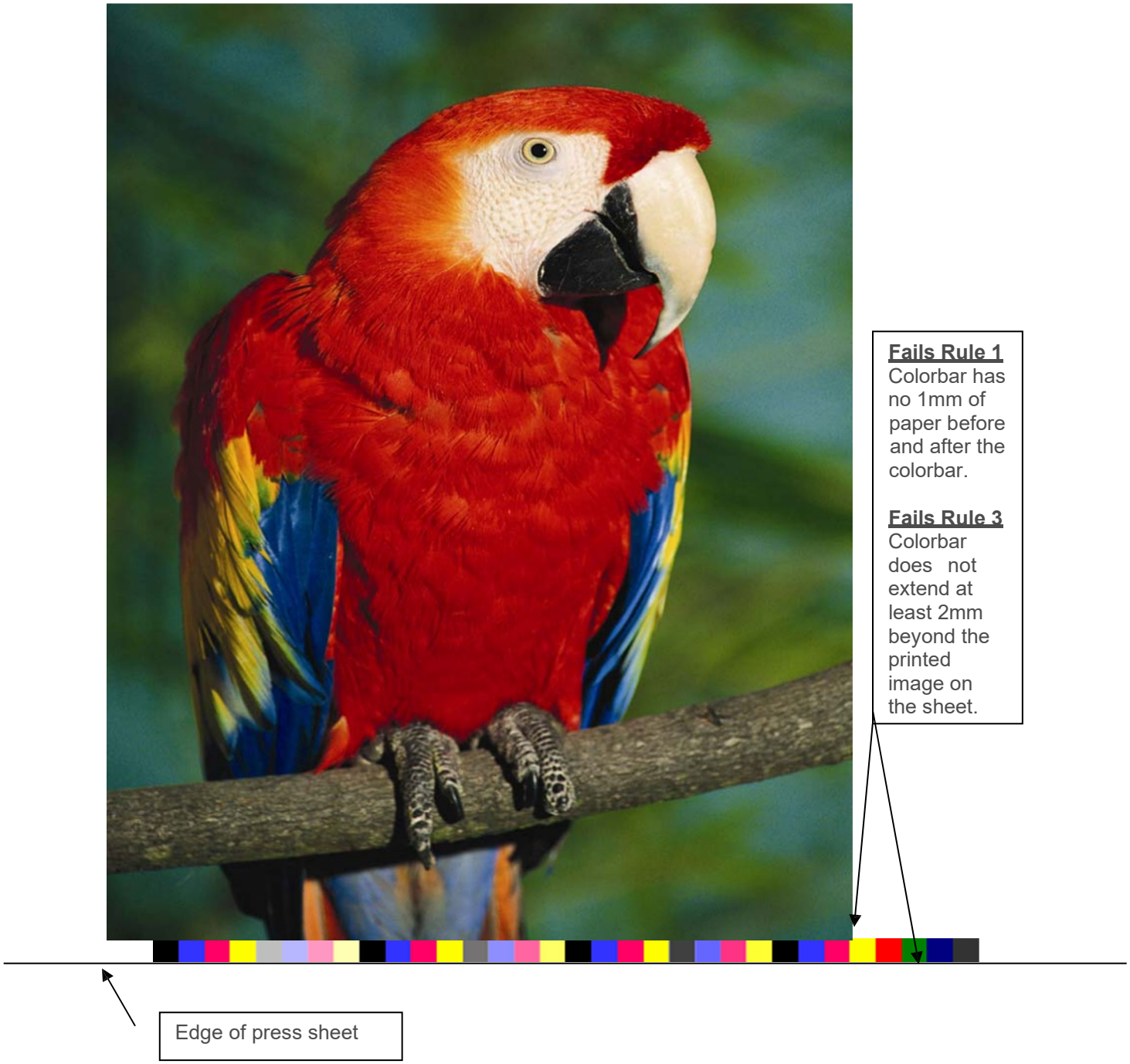
LAYOUT IMAGE #1: THE CORRECT IMPLEMENTATION OF THE COLORBAR



Note: In reality, the colorbar need only extend beyond the image at the edge of the page which is adjacent to the scanning dock. As the head leaves the station, it MUST see the colorbar as the first item on the page else it is not able to synchronize in the "Y" direction.

This layout breaks all the rules! The image extends beyond the colorbar. The colorbar is adjacent (touches) to both the image and the edge of the page. While this might able to be scanned, it requires that the system be placed into a manual mode. Clearly this is not desirable. It does not make efficient use of the technology.

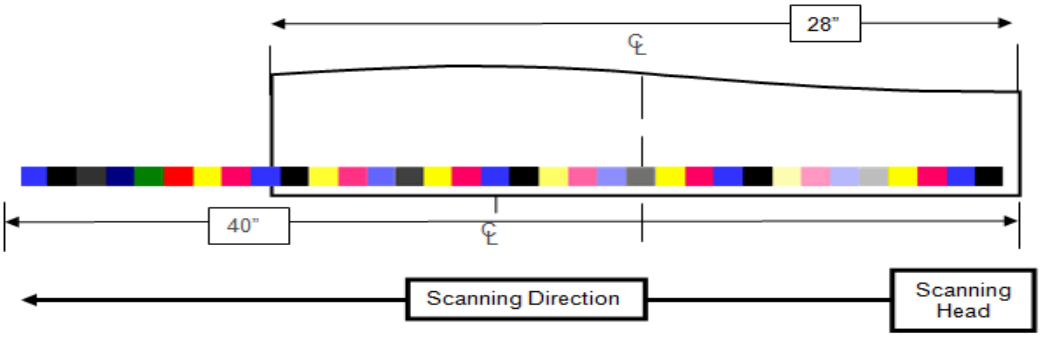
LAYOUT IMAGE #2: THE INCORRECT IMPLEMENTATION OF THE COLORBAR



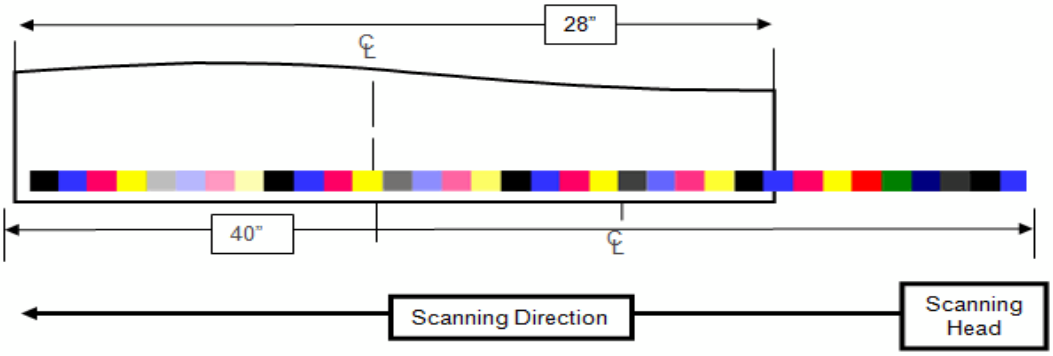
Rule 4------IntelliTrax1/2, EasyTrax, and eXact Auto-Scan

There are three and ONLY three permissible ways to strip the colorbar:

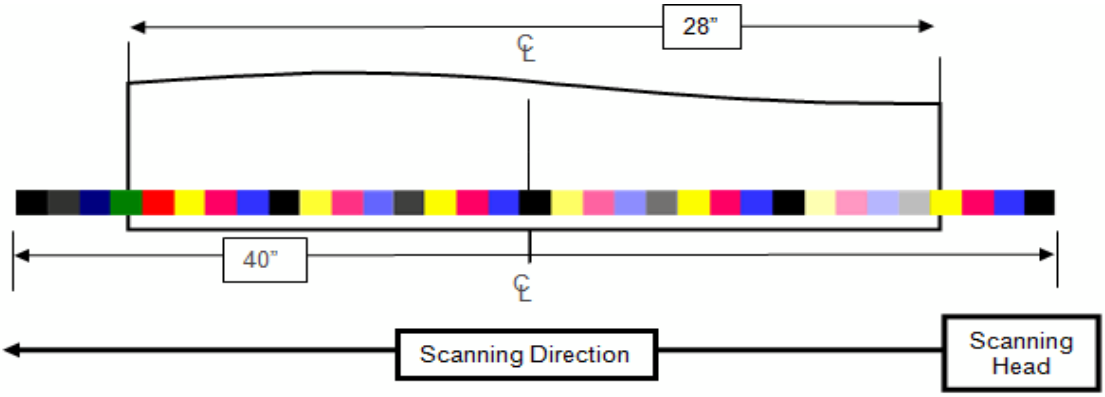
1. **Left Aligned:** First patch ALWAYS pinned to the station edge of the sheet
    - If FIRST patch is a solid from ink unit number 1, then this patch MUST always be the first patch that the scanner sees as it moves away from the station!



2. **Right Aligned:** First patch ALWAYS pinned to the non-station edge of the sheet
    - If the LAST patch is a solid from ink unit number 5, then this patch MUST always be the very last patch that the scanner sees as it completes its outward movement!



3. **Centered Aligned:** Colorbar designed to be a patch-for-patch image large enough to accommodate precisely the largest sheet that can be printed on the press.
    - Colorbar always imaged to align with the center of the press sheet - - exactly the same number of patches falling off to the left and the right if smaller than max press sheet size is printed.



Rule 5------eXact Auto-Scan, eXact Scan Only

There are a few rules that must be adhered to when creating colorbars for eXact Auto-Scan or the eXact Scan software:

1. Recommend full patches, quarter patches are supported, but half patches are not supported
2. Six empty ink keys in a row max
3. Does not support single color jobs
4. No registration marks in the colorbar
5. No circle or irregular patches in the colorbar
6. All patches must be the same size in width
7. Limited support for slur targets

“Fine” slur targets are the best because they generate consistent measurement data across the patch.

“Coarse” slur targets (like the example below) can be tough because of the inconsistent data generated as the aperture moves across the patch. The coarseness and direction of the pattern is really what makes the difference.

Examples:

Good: No issues because the horizontal movement of the head does not create edge transitions.

Bad: The same pattern turned 90 degrees can be an issue because the horizontal movement creates transitions.

Both of these slur targets are OK because the lines are too fine to create transitions regardless of direction.

Useful to Know – Minimum Colorbar Dimensions

Aperture Size / Filtration	Min Target WIDTH (mm) (In Scan Direction)	Min Target HEIGHT (mm) (Colorbar Height)
IntelliTrax: 1.2mm x 2.75mm - Small Aperture	3.0	2.0
IntelliTrax: 2.3mm x 2.75mm - Standard Aperture	3.0	3.2
IntelliTrax: 3.2mm x 3.2mm - Standard / Polarized	3.5	3.5
IntelliTrax2: 1.2mm x 2.75mm - Small Aperture	3.0	2.0
IntelliTrax2: 2.3mm x 2.75mm - Standard Aperture	3.0	3.0
IntelliTrax2: 2.3mm x 2.75mm - Polarized	3.0	3.0
EasyTrax: 3.0mm x 3.0mm - Standard Aperture	3.8	4.0
eXact Auto-Scan: 1.5mm - Small Aperture	3.0	3.0
eXact Auto-Scan: 2.0mm - Standard Aperture	3.0	3.5
eXact Scan: 1.5mm - Small Aperture	3.0	3.0
eXact Scan: 2.0mm - Standard Aperture	3.0	4.0

Colorbar Registration!

The IntelliTrax system demands both good X and Y colorbar registration. In the X direction (along the measurement path), the image for each ink unit must be properly positioned within 5% of the minimum patch width. If for example you are operating a standard aperture head, then the horizontal slop (gaps or overlap) cannot exceed 5% of 3.0 mm - 0.15 mm.

There are similar demands for the Y dimension. See the table below for details.

Aperture Size / Filtration	Maximum Horizontal Error	Maximum Vertical Error
IntelliTrax: Small Aperture	0.15	0.50
IntelliTrax: Standard Aperture	0.15	0.75
IntelliTrax: Standard / Polarized	0.18	0.70
IntelliTrax2: Small Aperture	0.15	0.50
IntelliTrax2: Standard Aperture	0.15	0.75
IntelliTrax2: Standard / Polarized	0.18	0.70
EasyTrax: Standard Aperture	0.18	0.40
eXact Auto-Scan: Small Aperture	0.18	0.40
eXact Auto-Scan: Standard Aperture	0.18	0.40
eXact Scan: Small Aperture	0.18	0.40
eXact Scan: Standard Aperture	0.18	0.40