

## Film Spectral Density Curve Comparisons

by Paul Verizzo

I've started getting intrigued with "Spectral Density Curves" for films. Is this topic the missing "secret" for film behavior? Is it the background for the H&D curves that we spend so much time looking at and deriving - inadequately informed - conclusions? Is this the criteria why some films seem so wonderful and others suck?

I've looked up the published info on a wide range of films. Unfortunately, the majority are only available within a PDF file, although some Kodak films have their own GIF's.

In the meantime, here are my observations. Manufacturers provide their spectral info in different formats, within PDF's, separate GIF's, separate HTML's. I've provided a link for all products. "Nm" is nanometers: 350 is UV, 400 is blue, 500 is green, and 600 is orange into red. Oversimplified, but good enough. In my narratives, I am starting at the left, short wavelength UV/blue and moving to the right long wavelength red.

**Kodak Plus-X, Plus-X movie 5231:** Virtually UV resistant, a sharp cutoff 400nm. Most sensitivity in blue, then plummets by two stops into green, then increases a stop into red. Shuts off at 660nm.

[http://www.kodak.com/global/en/professional/support/techPubs/f4018/f009\\_0431ac.gif](http://www.kodak.com/global/en/professional/support/techPubs/f4018/f009_0431ac.gif)

Movie stock 5231, pretty much the same as the still film. Available GIF button at bottom of page:

<http://motion.kodak.com/US/en/motion/Products/Production/Black And White Films/5231/tech5231.htm>

**Kodak Tri-X:** Similar to Plus-X, except much more sensitive in the blue/ultra violet with a wide, relatively flat sensitivity there. A one stop drop into green, and then back up into red. Starts dropping at 625nm and is pretty much gone by 650. Is this blue sensitivity part of "the Tri-X look?" [http://www.kodak.com/global/en/professional/support/techPubs/f4017/f009\\_0506ac.gif](http://www.kodak.com/global/en/professional/support/techPubs/f4017/f009_0506ac.gif)

**Kodak T-Max 100:** Also similar to the old T-Max 400 formulation. At 400nm, the start point that Kodak provides, the sensitivity is coming off of something very strong in the UV region. It's flat from 500 to 625, then drops outta sight by 675. Not particularly wide sensitivity. Like Ilford Pan F below, maybe some of that legendarily high disappointment and hard to work with.

<http://www.kodak.com/global/en/professional/support/techPubs/f4016/f4016.pdf?id=0.2.26.14.17.16.14&lc=en>

**Kodak T-Max 400**, new formulation "TMY-2": Pretty much flat from 350 (UV) to 475, then rising moderately to 575, dropping fast after 625. Probably the flattest of the Kodak family. The datasheet also points out that the decreased blue sensitivity more closely matches the human eye. I would say "decreased blue sensitivity" is relative to most other Kodak offerings, not other manufacturer's films. (Which raises the question why green isn't more dominant, that's what our eye sees the easiest. That's why Cool White Fluorescents give us the most effective lumens per watt.)

<http://www.kodak.com/global/en/professional/support/techPubs/f4043/f4043.pdf?id=0.2.26.14.17.14.18&lc=en>

**Kodak T-Max P3200:** Chart doesn't show below 425nm, but it looks likely that there is quite a bit of sensitivity in the shorter wavelengths. Fairly flat to 640nm, then drops fast - the opposite of where you think you would want a fast film to be. Compare to Ilford Delta P3200, below.  
<http://www.kodak.com/global/en/professional/support/techPubs/f4016/f4016.pdf?id=0.2.26.14.17.24.14&lc=en>

**Kodak BW400CN:** No UV sensitivity. Strong blue, slight dip to green, then increases into orange-red, then shuts off by 650nm.  
[http://www.kodak.com/global/en/professional/support/techPubs/f4036/f009\\_0575ac.gif](http://www.kodak.com/global/en/professional/support/techPubs/f4036/f009_0575ac.gif)

**Ilford Pan F:** Hits its stride at 425nm, then very squiggly to 600nm where it drops like a rock. Very narrow. Might explain some of the traditional disappointment with Pan F. (Your mileage may vary.)  
<http://www.ilfordphoto.com/Webfiles/2006216115811391.pdf>

**Ilford Delta 100/400:** Very flat but rising across the visible spectrum from 400nm to 675, a slight dip in the green. <http://www.ilfordphoto.com/Webfiles/20061301938422338.pdf>

**Ilford Delta P3200:** Like its slower cousins, nice and flat. Red sensitivity, which I think would be important in a film for street shooting, goes out flat to 675nm, done by 700nm.  
<http://www.ilfordphoto.com/Webfiles/200613019405339.pdf>

**Ilford FP/HP:** Starts kicking in at 400nm and keeps rising to 625, then plummets. Smooth.  
<http://www.ilfordphoto.com/Webfiles/2007321132461251.pdf>

**Ilford XP2:** Slightly wider than the conventional Ilford films, 400nm to 625, rising slightly with a slight dip in green. <http://www.ilfordphoto.com/Webfiles/20061301945161573.pdf>

**Ilford SFX 200:** The curve shows both a typical standard film and for SFX. SFX is incredibly flat from 400 to 725nm, then drops off to nothing by 750nm. You get an extra 100nm!  
<http://www.ilfordphoto.com/Webfiles/2007651134552223.pdf>

**Fuji Acros 100:** Sensitive below 400, a dip in the green 500, increases again in orange-red, then signs off at 625nm.  
<http://www.fujifilmusa.com/shared/bin/NeopanAcros100.pdf>

**Fuji Neopan 400:** Essentially flat to 640nm then drops like a rock.  
<http://www.fujifilmusa.com/shared/bin/Neopan400.pdf>

**Fuji Neopan 1600:** Strong blue, dipping like a Kodak product into green, then stronger again in the orange and red, dying at 650nm. Interesting, Fuji provides an EI, not ISO, for this film, yet does not call it a P type. Hmmmm..... Think ducks.  
<http://www.fujifilmusa.com/shared/bin/Neopan1600.pdf>

**Fomapan:** This family of 100, 200, and 400 ISO is pretty much the same and very unique. All start out weak but rising at 400nm and continue upward until 650-670nm, then plummet. All done by 700nm.

Fomapan 100: [http://www.foma.cz/Upload/foma/prilohy/F\\_pan\\_100\\_en.pdf](http://www.foma.cz/Upload/foma/prilohy/F_pan_100_en.pdf)

Fomapan 200: [http://www.foma.cz/Upload/foma/prilohy/F\\_pan\\_200\\_en.pdf](http://www.foma.cz/Upload/foma/prilohy/F_pan_200_en.pdf)

Fomapan 400: [http://www.foma.cz/Upload/foma/prilohy/F\\_pan\\_400\\_en.pdf](http://www.foma.cz/Upload/foma/prilohy/F_pan_400_en.pdf)

Since I presume that the technologies for shifting sensitivities by dyes is old technology, it's interesting that the different companies have such differing philosophies. At least, I presume that's part of the explanation.

### **Filters**

After studying these curves it becomes obvious that general filter factors are just that, general. Which is another way of saying "Often wrong." There are many different spectral sensitivities that coupled with a given filter will yield differing, real world filter factors. Conclusion: Use the FF that the film manufacturer provides.

The curves also show that for outdoor work, and for most but not all of the films, a *good* UV filter is a must. Especially true for Tri-X! See comments and charts for your film.

Living for many years in Colorado, UV haze was a perpetual problem with both digital and color film. I did very little B&W then. A Tiffen Haze 2 filter really works! And it should, at \$25 for a 49mm at B&H Photo. You can find some excellent test information here: <http://photo.net/equipment/filters/> The long story short is that those cheapo UV filters don't do anything worth noting. A color warming filter is much more effective. But if you want sharp UV cutoff, it's the Tiffen Haze 1 or 2.

### **General Observations and Conclusions**

1. Manufacturer's seem to each have a different philosophy in spectral sensitivity that spreads across a number of products.

Kodak: High UV sensitivity (except for Plus-X), a dip in the green, the climbing higher in the red.

Ilford: Very flat curves with gentle drops on both sides.

Foma: That weird weak in the blue to strong red and far red.

Fuji: Curves more similar to the Kodak family although not as pronounced.

2. Some derived thoughts:

A. I would pick the Ilford P3200 over the Kodak for its better far red sensitivity in doing night shooting. I would also give the nod to XP2 Super over the Kodak offering, regardless of color masks and other factors.

B. You don't need a UV filter with Plus-X! But you sure do with Tri-X.

C. . Fomapan 400 might well be the best choice for conventional grain tungsten lit night lighting over even the P3200 films (which, after all, are really only 800 ISO.) Since Foma does not specify the X axis log exposure scale, I can't compare to the venerable Tri-X. And a great price to boot! The new T-Max 400 would also be a great choice, especially if you are after finer grain and increased sharpness. Kodak even suggests shooting at 800 without a change in processing time.

D. Several of the most notoriously difficult to work with films have very short effective spectral distributions. I'm thinking Pan F, T-Max 100 and the old 400. The new T-Max 400 is raved about, and not just for better RMS granularity and sharpness. I'm guessing that a lot of the pats on the back are due to the wider spectral sensitivity.

E. Similarly, some of the most notoriously easy to work with films have a wide spectral sensitivity. It might not all be in the H&D curves! I'm thinking Plus-X and Tri-X and the Ilford conventional grain offerings.

F. Is part of the Tri-X legendary "look" due to it's strong UV sensitivity? It would tend to lighten blues and violets.

G. Although different, the curves for the still version of Plus-X and the movie version are close enough to be called the same. Hey, 100 feet of short ends for \$18?