DARKROOM AUTOMATION
1412 Dorsh Road
Cleveland, OH 44121-3840

216.691.3954
nolindan@ix.netcom.com
http://www.darkroomautomation.com

Application Note

SPLIT GRADE PRINTING
A MEASURED APPROACH

This application note provides a practical guide to basic split grade printing without the use of test strips. The methods described are intended for users of Darkroom Automation's Precision Enlarging Meter and f-Stop Timer, but can be used with any meter and timer. The basic principles can be used with test strips in lieu of a meter.

This application note is divided into the following sections:

- The Method
- How Split Grade Really Works
  - High Contrast Prints
  - Low Contrast Prints
  - Negative contrast range and relative #5/#00 exposure
  - Split grade paper speeds
- Pros and Cons of Split Grade Printing
- The Darkroom Automation Exposure System

THE METHOD

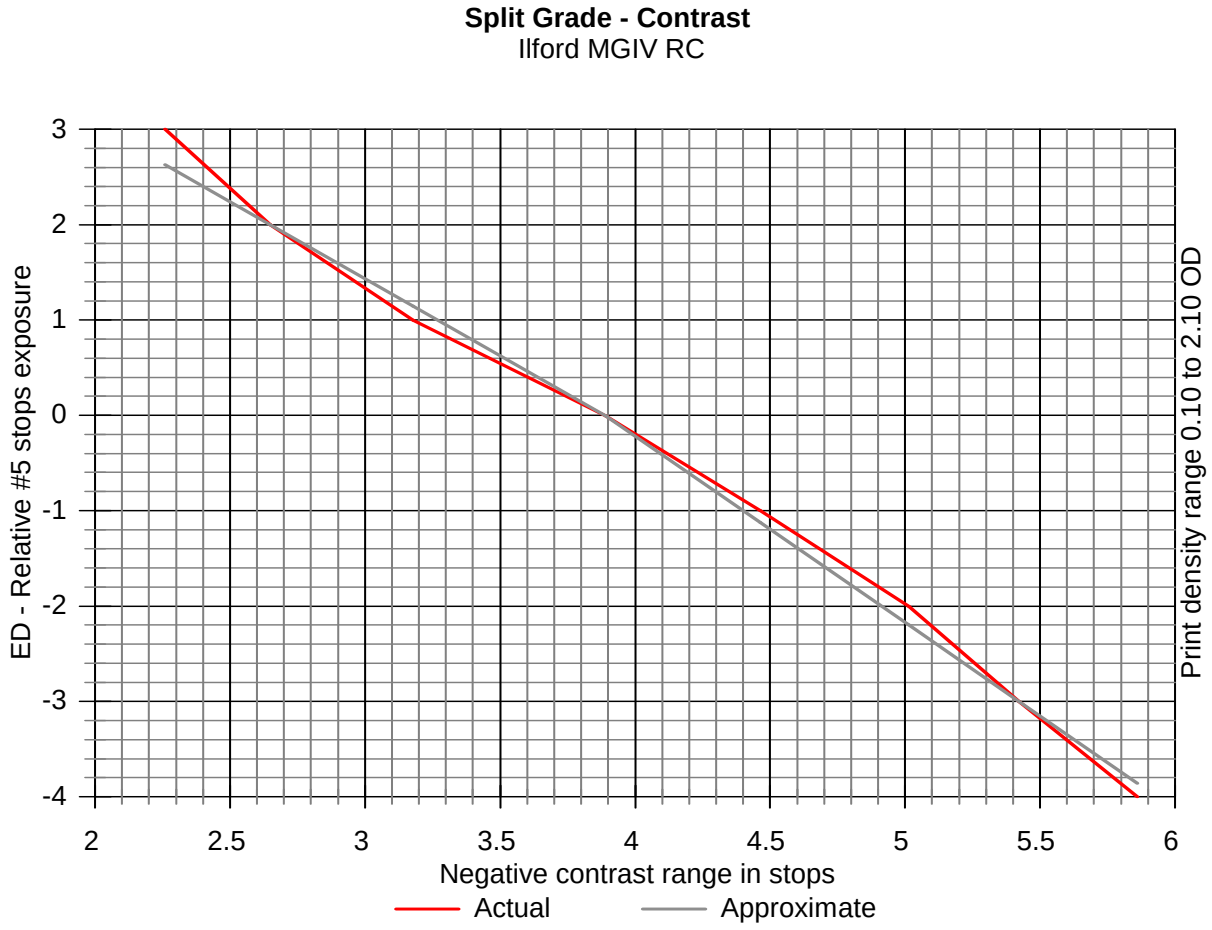
The method will work with all VC papers. The specific numbers and charts below are for Ilford MGIV RC paper. Instructions for using this method with other papers are provided later in this application note.

To make a split-filter print, follow these steps:

1. Take a reference reading at the image's white point by holding down the meter's delta button for one second.

2. Move the meter to the black point and read the negative's contrast range in stops of illumination.

3. Using the graph below find the relative exposure difference [ED] for the #5 filter.



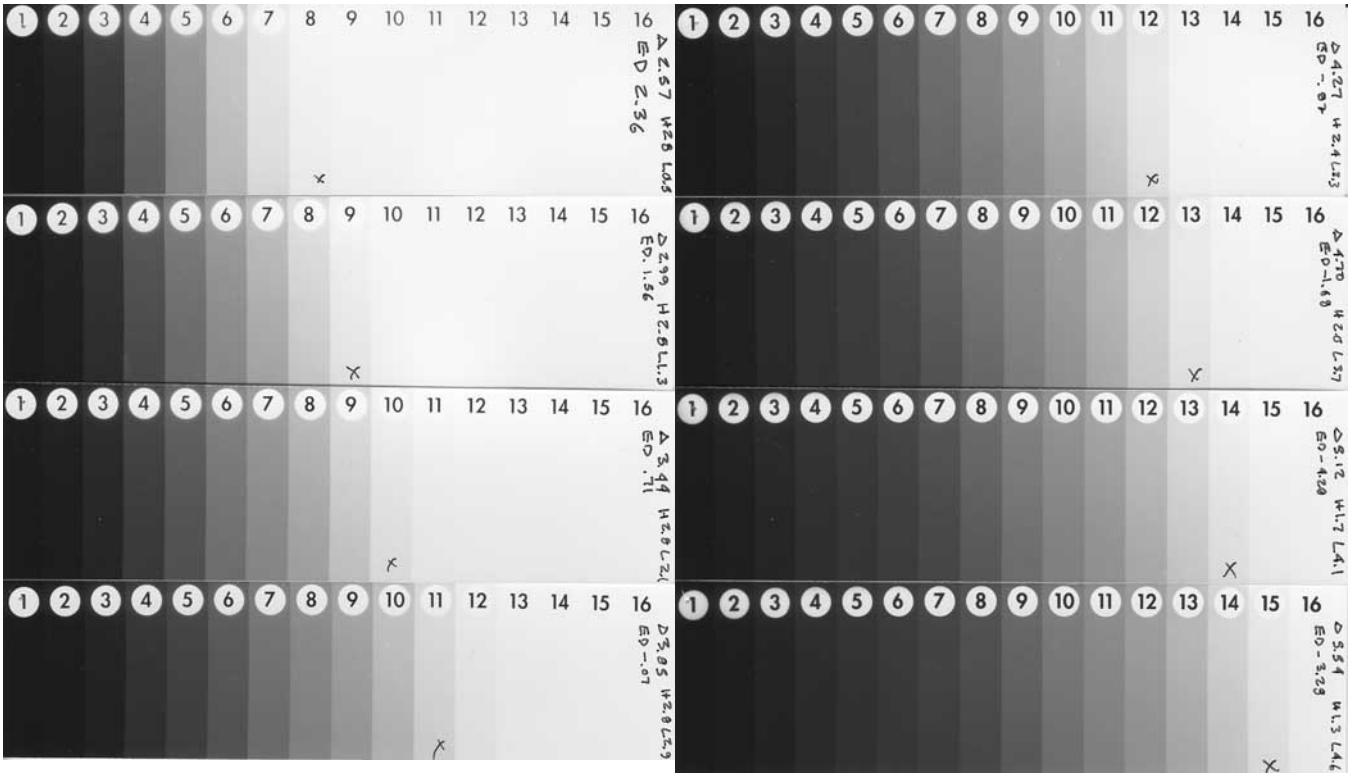
Note the approximate curve is derived from the quick paper characterization method given later in this application note.

4. <u>Low contrast negative, high contrast print</u> ED >= 0
   a. Meter the black point
   b. Set the timer to 9.1 - meter reading
   c. Make the #5 filter high contrast exposure
   d. Decrease the timer setting by the ED
   e. Make the #00 filter low contrast exposure

5. <u>High contrast negative, low contrast print</u> ED < 0
   a. Meter the white point
   b. Set the timer to 5.3 - meter reading
   c. Make the #00 filter low contrast exposure
   d. Decrease the timer setting by the |ED| (absolute value of ED)
   e. Make the #5 high contrast exposure

When making prints outside the H+3/H-4 contrast range it is best to make a test-strip print to determine the second exposure.

The illustration below shows the results of using this procedure with a step tablet. In all cases the black point was set for step #2, the white point was set for steps #8 through #15.



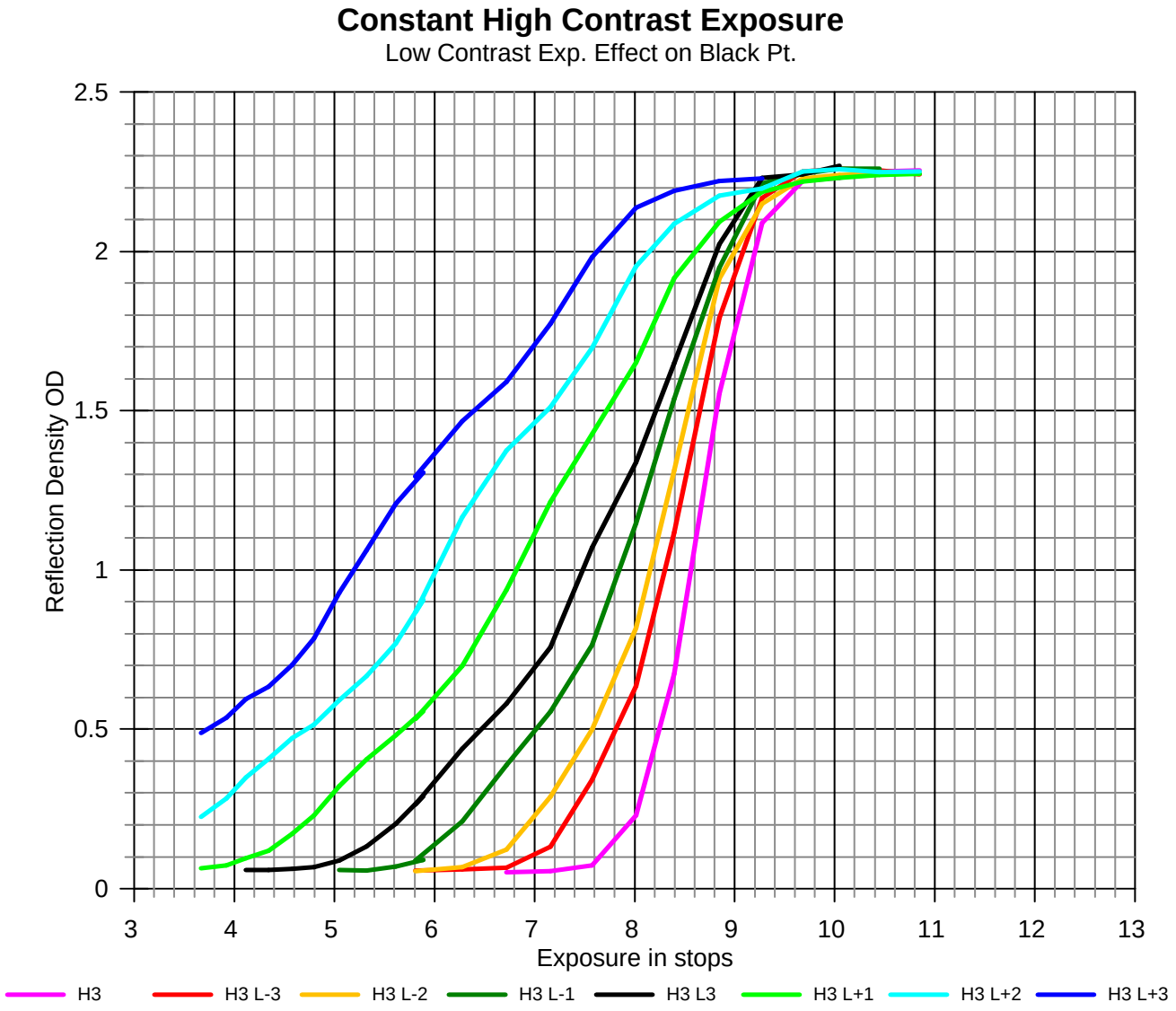
HOW SPLIT GRADE WORKS

Traditional split grade printing is based on the naive assumption that the black and white points can be controlled independently with the high and low contrast filters. This, however, is only true for prints made at close to normal contrast with roughly equal amounts of high and low contrast filtration - a grade 2 print - which beggars the point of why bother with split grade at all if it only works at one grade. Some pundits favor always making the high contrast test print first and some the other way round - followed by lot of hand waving and assurances that experience will allow the printer to modify the result of the test prints as needed - but this again negates split grade printing's promise that it will find exactly the right contrast grade for a negative and that experience is <u>not</u> required.

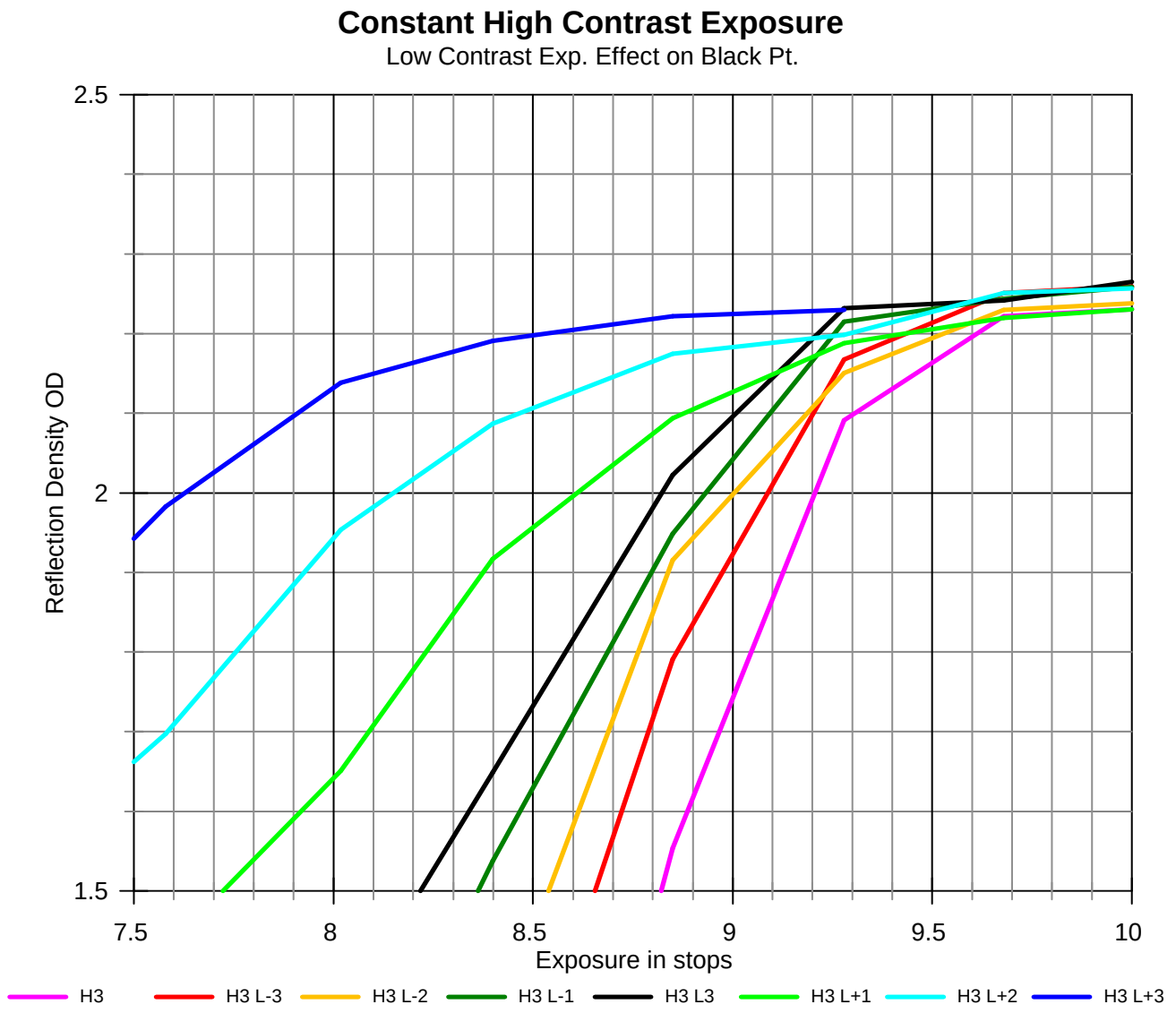
The key to making split grade printing work reliably is realizing that high and low contrast prints must be treated differently.

HIGH CONTRAST PRINTS

Only for high contrast prints (low contrast negatives) will the high contrast black-point exposure be independent of the low contrast exposure. This is shown in the HD curves below where the



high contrast exposure is held constant and low contrast exposures are made at lesser, equal and greater exposures. The #5 high contrast filter exposure was fixed at 3 stops (8 seconds). The #00 low contrast exposures varied from 3 stops less (H3 L-3 - #5 high contrast exposure of 8 seconds, #00 low contrast 1 second) to three stops more (H3 L+3 - #5 high contrast exposure of 8 seconds, #0 low contrast exposure of 64 seconds). The H3 curve is for exposure with the #5 high contrast filter alone. The H3 L3 curve shows the results of equal exposures.

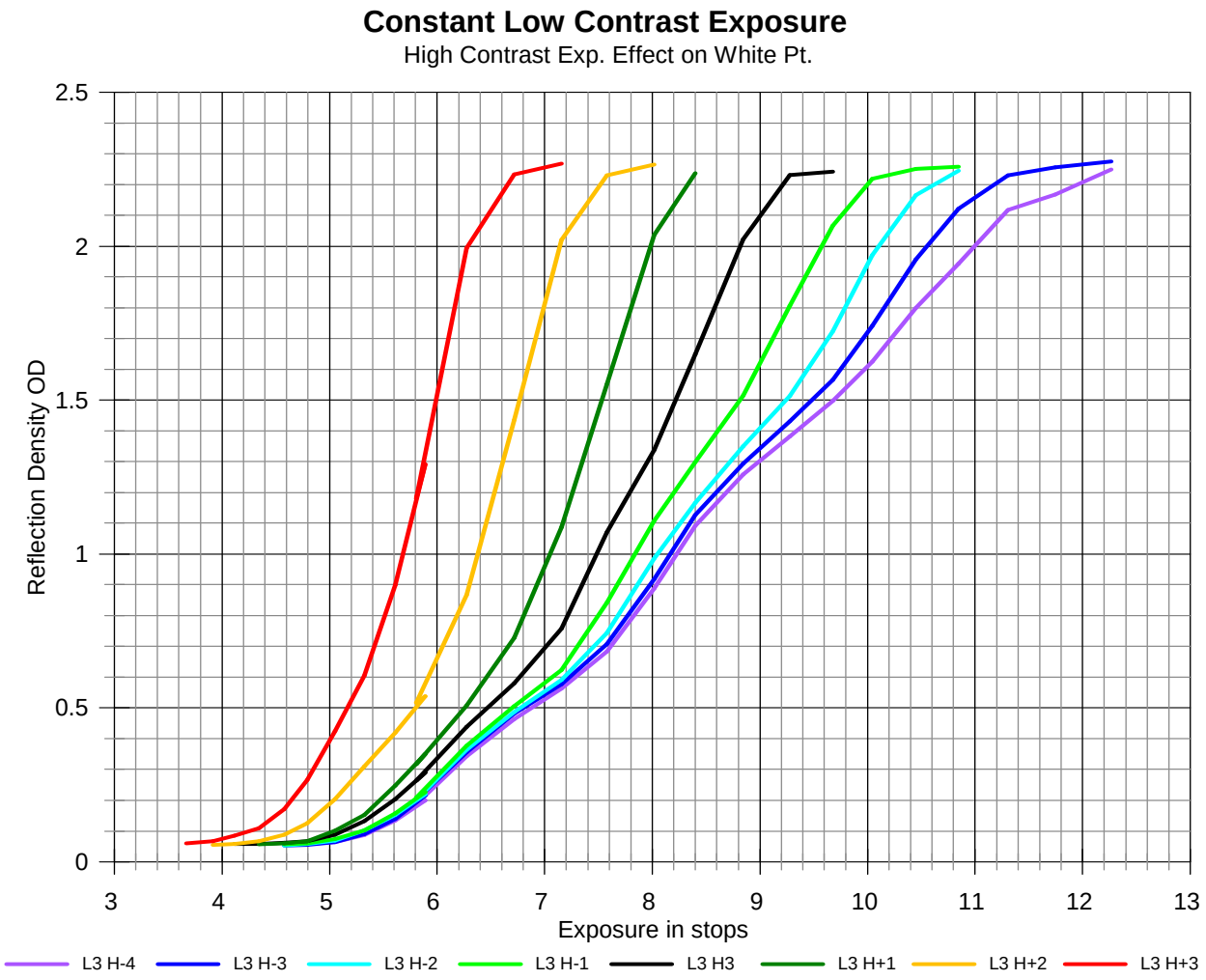


In the expanded view, above, note that the normal (black H3 L3) through high contrast (red H3 L-3) curves all cross the 2.1 density line within 0.2 stops of each other. The low contrast exposure has little effect on the black-point exposure for high contrast prints.

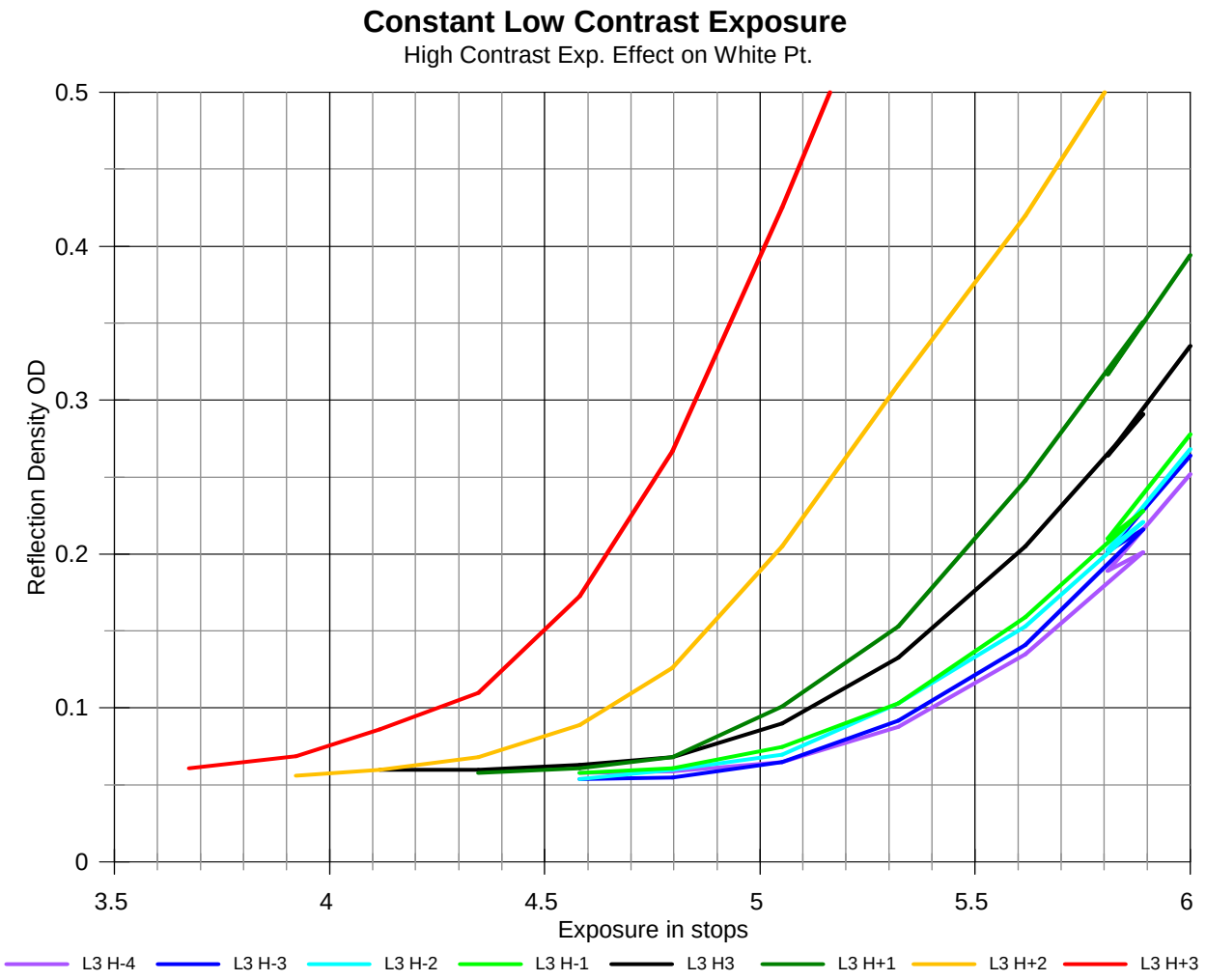
For traditional two test strip split grade printing this means the black point should be found first for high contrast prints. When the black point is determined then a second test strip, exposed first with the found #5 exposure, should be made to find the #0 filter exposure at the white point.

LOW CONTRAST PRINTS

The H-D curves below show what happens if the low contrast exposure is held constant and the high contrast exposure is varied.



In the expanded view of the toe region, below, note that the point where the curves cross the 0.1 density point, you can see the low contrast curves (L3 H-4 through L3 H-1) are clustered close to each other. For low contrast exposures the high contrast exposure has no effect on the white point in the print.

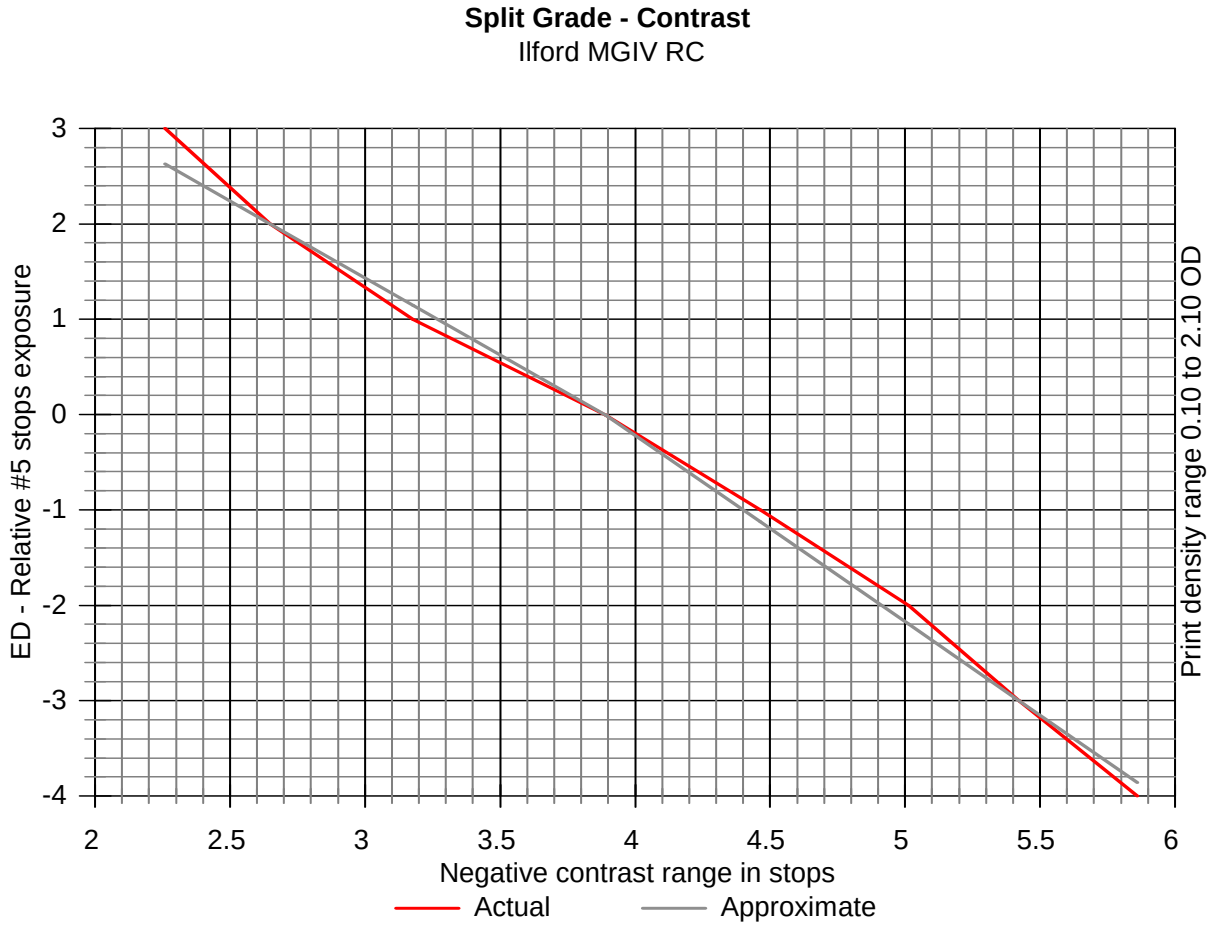


For traditional two test strip split grade printing the order is now reversed: the #0 filter white point exposure is found first and then the #5 filter black point exposure.

NEGATIVE CONTRAST RANGE AND RELATIVE #5/#00 EXPOSURE

Negative contrast and the right #5/#00 exposure ratio can be matched quite easily. Negative contrast is measured with an enlarging meter rather than a densitometer - this allows measuring small spots on the negative and also takes into account Callier effects and flare. Knowing the negative contrast (measured in stops) one can find an HD curve that has the same spread on the horizontal axis at the 0.1 and 2.1 density points. As an example, if we look at the black H3L3 (equal exposure) curves we find the white point is 5.1 stops of exposure and the black point is 9.0 stops of exposure. Thus a negative that has a 3.9 stop range from blacks to whites will print with equal #5 and #00 exposures.

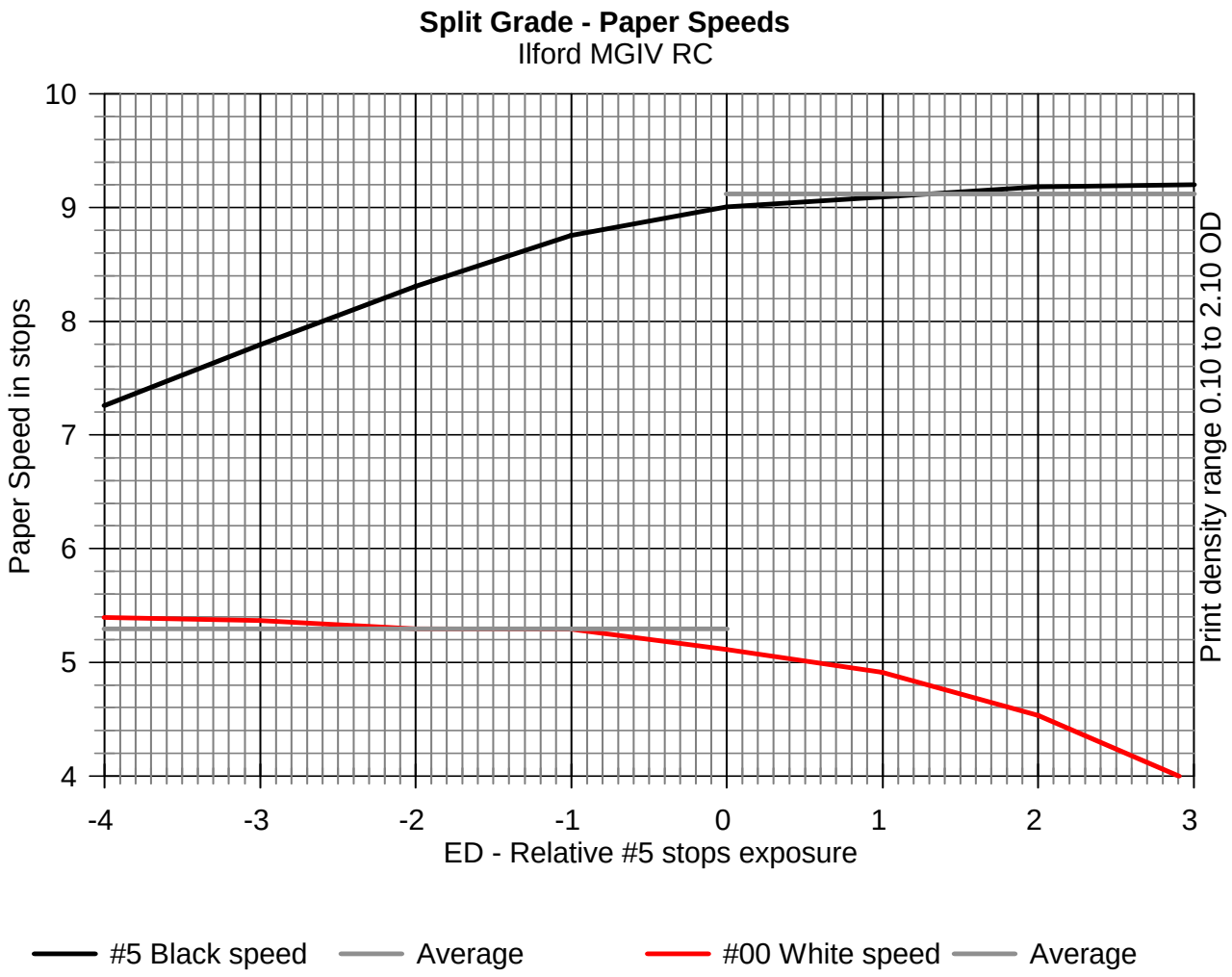
If we plot the contrast range and the relative #5 exposure for the curve families above we obtain the curve below.



The curve is almost, but not quite, a straight line. The deviation from the straight line may be significant in some cases. An error of 0.2 stops is about 1/2 a Zone for normal contrast prints and almost a full zone for high contrast prints.

SPLIT GRADE PAPER SPEEDS

If we plot the black point speed and the white point speed as a function of the relative #5/#00 exposure we get the graph below:



We can see that the black point speed is relatively constant for high contrast prints and the white point speed holds constant for low contrast prints. However, note that errors can be up to 0.2 stops. When making prints at the extremes of the contrast range it can be a good idea to add 0.1 or so of exposure to the dominant filter.

The most accurate results will be obtained by using the actual black and white point speeds, but for most purposes the average values will work well enough.

CHARACTERIZING A NEW PAPER

The use of a 31-step transmission density tablet is almost mandatory.

Make 3 test exposures of the test tablet: “H-3” with a #5 exposure that is three stops less than the #00 exposure; “H+0” with equal exposures; and “H+2” one with a #5 exposure that is two stops greater.

Find the 0.1 and 2.1 points in each test print and measure the light intensity for those steps with the enlarging meter. From these you find the paper speeds and contrast range:

White point paper speed, averaging H-3 & H+0:	Add the #00 time in stops to the meter reading for the step that produced 0.1 density
Black point paper speed, averaging H+0 and H+2:	Add the #5 time in stops to the meter reading for the step that produced 2.1 density
Contrast / relative #5 exposure chart:	Take the difference in meter readings for the 0.1 and 2.1 density steps for the three prints - these are the negative contrasts for the H-3, H+0 and H+2 splits. Plot the contrast range Vs the relative #5 exposure as straight lines through the points.

If the paper is well behaved, and matches the contrast filters, then the normal print should have the same white point as the low contrast print and the same black point as the high contrast print.

AS AN EXAMPLE

A test was done using MGIV RC Warm-Tone developed in D-72. The following results were obtained from the step-tablet prints:

H-3 low contrast print:

0.1 density	6.65 stops of exposure	= white point speed
2.1	12.88 stops	
Contrast range	6.23 stops	

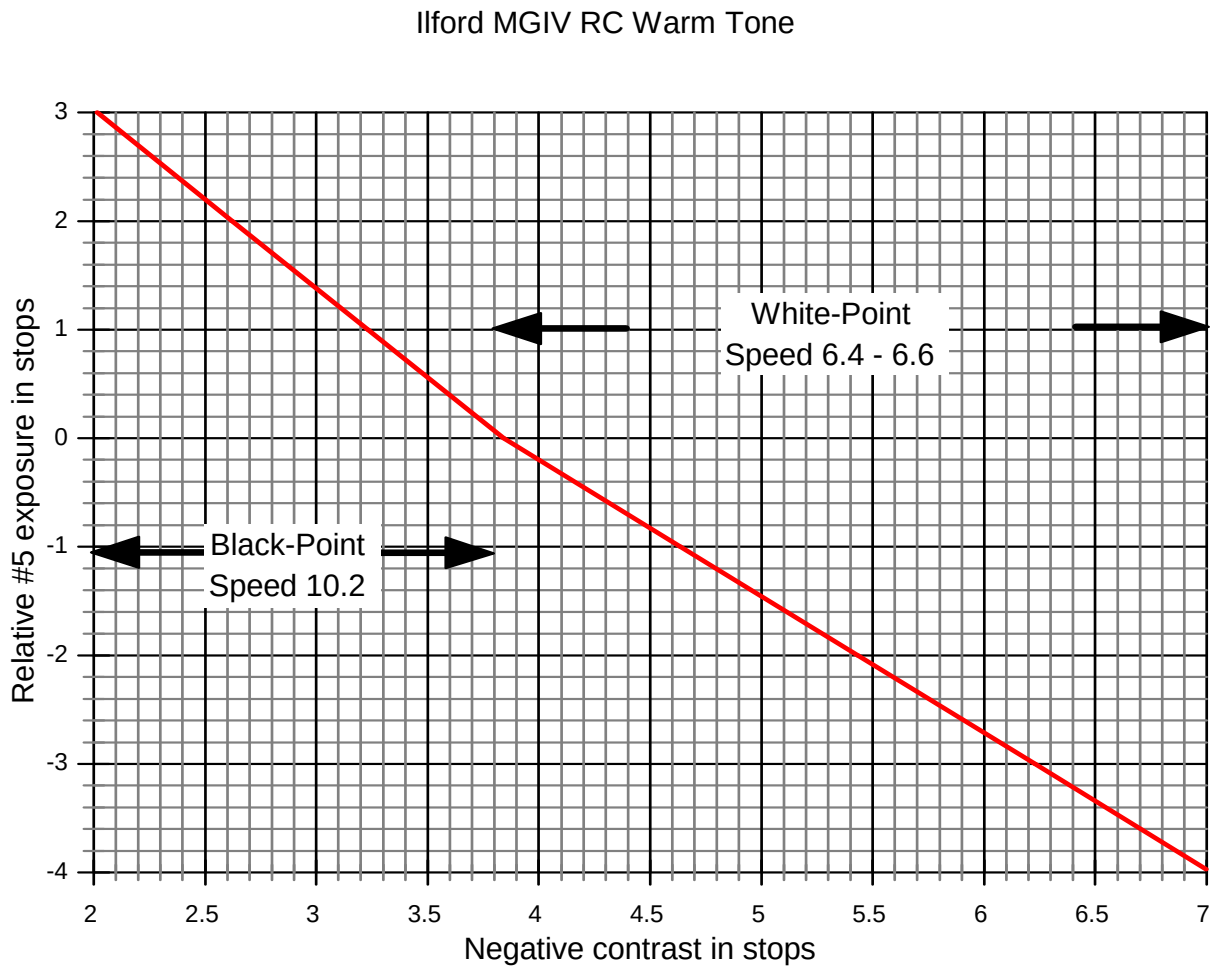
H+0 average contrast print:

0.1 density	6.38 stops of exposure	= white point speed
2.1 density	10.22	= black point speed
Contrast range	3.84 stops	

H+2 high contrast print

0.1 density	7.62 stops of exposure	
	10.25 stops	= black point speed
Contrast range	2.63 stops	

The resulting contrast Vs. relative exposure chart is shown below:



PROS AND CONS OF SPLIT GRADE PRINTING:

Split grade printing is not the do-all end-all method. It has it's uses and is but one tool among many.

PROS

Quickly makes a workmanlike print
Can be done with test strips to determine contrast, no meter required
Naturally allows burning and dodging with contrast extremes
Works with VC and color heads without any need for calibrating filtration settings
Can produce in-between paper grades

CONS

Only works with prints with pure whites/highlights and blacks
Gives prints with a drug-store look when done by-the-book, all prints have the same contrast
No direct control over the midtones where the visual interest lies
Burning and dodging midtones can be problematic
Still requires a method to sort high and low contrast negatives
Error prone if one forgets to switch filtration
Takes longer

THE DARKROOM AUTOMATION EXPOSURE SYSTEM

This application note makes use of Darkroom Automation's Exposure System. This system works entirely in stops, and is similar to the EV system used for exposing film. It is the system used in Darkroom Automation's f-Stop Timers and Precision Enlarging Meter.

Time is measured in stops with the following relationship:

0.0 stops 1.0 seconds
1.0 stops 2.0 seconds
2.0 stops 4.0 seconds
...
3.1 stops 8.6 seconds
3.2 stops 9.2 seconds
...

Light is measured in stops, with 10.0 stops being approximately the amount of light required to produce maximum black on Ilford MGIV #2 RC paper in 0.0 stops of time (1 second).

Adding stops of time to stops of light produces stops of exposure. Maximum black - an exposure of 10.0 stops - can be produced by any combination of meter reading and timer setting that adds to 10.0.

If a paper's HD graph is plotted so the horizontal axis is in absolute stops of exposure, using the system above, the horizontal axis gives the 'paper speed' - the required exposure - to produce any density or grey tone on the vertical axis. A paper has an infinite number of speeds - one for each of the infinite number of shades of grey that the paper is capable of producing. Darkroom Automation publishes charts of paper speeds for the standard Zone System tones.