**Analyser/ZoneMaster Calibration Table**

Date:

Developer:

| PAP | Paper Type | Grade | 00 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 2 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 3 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 4 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 5 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 6 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 7 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 8 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |





# Analyser Pro
# ZoneMaster II
# Calibration Manual



CE

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Contents







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| 2 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 3 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 4 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 5 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 6 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 7 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |
| 8 | | Offset | | | | | | | |
| | | Contrast | | | | | | | |

6. ISO( R) contrast figures can be entered directly.
7. The table below gives starting point setting for a variety of alternative papers.

| Paper type | Grade | 00 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| Ilford MGV Deluxe Multigrade RC | Offset | -1 | -8 | -4 | -2 | -3 | -4 | -10 |
| | Contrast | 175 | 152 | 126 | 105 | 86 | 61 | 56 |
| Ilford Multigrade FB Classic | Offset | -3 | -2 | -6 | -6 | -5 | -6 | -12 |
| | Contrast | 153 | 141 | 117 | 99 | 77 | 59 | 52 |
| Ilford Multigrade IV Resin coated (standard) | Offset | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Contrast | 179 | 144 | 132 | 109 | 89 | 65 | 47 |
| Ilford Multigrade IV Fibre-based | Offset | 3 | 1 | 2 | 1 | 0 | -4 | -10 |
| | Contrast | 155 | 136 | 110 | 84 | 68 | 52 | 45 |
| Ilford MG Warmtone RC | Offset | 10 | 10 | 9 | 9 | 9 | 8 | 7 |
| | Contrast | 200 | 163 | 149 | 123 | 101 | 81 | 66 |
| Ilford MG Warmtone FB | Offset | 12 | 12 | 11 | 12 | 12 | 13 | 13 |
| | Contrast | 189 | 166 | 148 | 119 | 98 | 71 | 56 |
| Ilford Multigrade III RC | Offset | -1 | 0 | 0 | 0 | 0 | -3 | -5 |
| | Contrast | 188 | 164 | 142 | 127 | 100 | 85 | 72 |
| Ilford MG Cooltone RC | Offset | -2 | -4 | -5 | -5 | -7 | -11 | -16 |
| | Contrast | 160 | 138 | 116 | 93 | 77 | 60 | 55 |
| Ilford MG IV RC (Leitz V35 MG head ) | Offset | - | -8 | -10 | -9 | -10 | -19 | -24 |
| | Contrast | - | 180 | 157 | 123 | 100 | 75 | 51 |
| Agfa Multicontrast Premium RC | Offset | 0 | -2 | -4 | -5 | -3 | -6 | -6 |
| | Contrast | 168 | 140 | 123 | 105 | 85 | 69 | 65 |
| Agfa Multicontrast Classic FB | Offset | 1 | 1 | -1 | 0 | -1 | -11 | -13 |
| | Contrast | 176 | 148 | 127 | 105 | 88 | 76 | 66 |
| Kodak Polymax II RC (Kodak filters) | Offset | -4 | -6 | -6 | -7 | -8 | -3 | -3 |
| | Contrast | 174 | 144 | 120 | 113 | 102 | 73 | 55 |
| Kentmere Warmtone VC FB | Offset | -6 | -8 | -10 | -11 | -14 | -15 | -14 |
| | Contrast | 138 | 121 | 109 | 95 | 86 | 72 | 75 |
| Kentmere Fineprint VC FB | Offset | -5 | -6 | -8 | -8 | -13 | -18 | -24 |
| | Contrast | 139 | 121 | 108 | 89 | 83 | 72 | 76 |
| Fomatone MG Classic | Offset | 23 | 20 | 20 | 21 | 22 | 15 | 13 |
| | Contrast | 128 | 118 | 101 | 90 | 84 | 65 | 65 |
| Ilford MG IV (Ilford 500 head) | Offset | --- | -25 | -24 | -24 | -20 | -14 | -20 |
| | Contrast | --- | 177 | 136 | 119 | 100 | 73 | 48 |
| Agfa Multicontrast Premium (Ilford 500 head) | Offset | --- | -30 | -26 | -25 | -23 | -30 | -30 |
| | Contrast | --- | 147 | 114 | 98 | 86 | 67 | 51 |




## 1. Introduction

1. Calibration is the process of matching the characteristics of your Analyser or ZoneMaster to those of your own methods, materials and equipment. Once completed, calibration does not need to be repeated unless you change either your paper, your enlarger, or your working methods and chemicals. A full calibration will be worth the effort involved as when complete, your Analyser or ZoneMaster will be able to predict accurately the results you will get on your prints.
2. Within the remainder of this manual we will use the term “meter” when descriptions apply to both the Analyser and the ZoneMaster. If certain items are specific only to either the Analyser or the ZoneMaster, then the product name will be used.
3. Your meter will have been shipped with a calibration test kit comprising two items:

- A Stouffer 21-step Sensitivity Guide, or “Step Wedge”.
- A paper density comparison tile with two pairs of patches; a highlight reference with one patch paper-base white, the other a density of approx. 0.04 log.D, and a shadow reference with one patch maximum black (D.max), the other a density of approx. 90% of maximum.

Keep these items clean and in a safe place, and handle them with care. Replacement kits are available from RH Designs should any item be lost or damaged

## 2. Why calibration is necessary

1. Photography is a very inexact science, and while the meter has been designed so that it can be used with popular materials more or less straight out of the box, there are many factors which can affect its performance and which are outside our control. Major factors are the paper type and surface and the enlarger type and filtration. Filter factors vary between enlarger types, and the notion of contrast “grade” is very unspecific. One paper’s grade 2 may have a contrast range close to another’s grade 3 for example. We have therefore provided the meter with a comprehensive calibration system which can be used to personalise it to your requirements in terms of both exposure correction and contrast matching.
2. Put another way, exposure correction is equivalent to determining your own personal film speed and setting your camera’s ISO dial to that number instead of the film manufacturer’s recommended setting. Contrast matching is similar to refining your film development time.

## 2.1 What's involved

1. There are two separate aspects to calibration; exposure correction and contrast matching. Of these, exposure correction is the most frequently required. If, when you made your first prints, you determined the amount of exposure correction required and entered it into the meter's calibration tables then you already have a good starting point. The procedures described in this manual will help you to refine your corrections and make the meter more accurate in its predictions.
2. Because filter factors etc. can vary from grade to grade, the meter can becalibrated for both exposure and contrast at every full grade. The half grade settings are calculated from the adjacent full grades.
3. Exposure calibration involves making a test strip to determine the correct highlight exposure. You need to do this at each full grade so you will need to make seven test strips, one each for grades 00 through 5. Once you have done this, you compare the test strip to the supplied highlight density tile to determine the correction required.
4. Contrast calibration must not be attempted until you have satisfactorily completed a full exposure calibration. This is because exposure errors will affect the contrast measurement. To calibrate contrast, you need to make a test print using the supplied step wedge, and then compare the result to the supplied density tile and find the density patches which are the closest match to them. The positions of the matching density patches determine the contrast setting. Again, you will need to do this for each full grade.

## 2.2 Other calibration methods

The basic method described here can achieve good results with care. Use of a reflection densitometer will provide higher accuracy but it is not a requirement.

# 3. Before you start

1 Since calibration is best done in a single session for optimum consistency, it's as well to prepare your equipment and materials in advance and adopt a methodical approach. It is assumed in this manual that you are familiar with the basic operations of your meter such as taking measurements, making prints and test strips, etc. Keep your Instruction Manual to hand for reference if you are not.

2 Set up your meter as usual, and choose the PAP channel you want to calibrate. This is especially important if you have already entered some exposure corrections, determined either from regular printing or from a previous calibration.



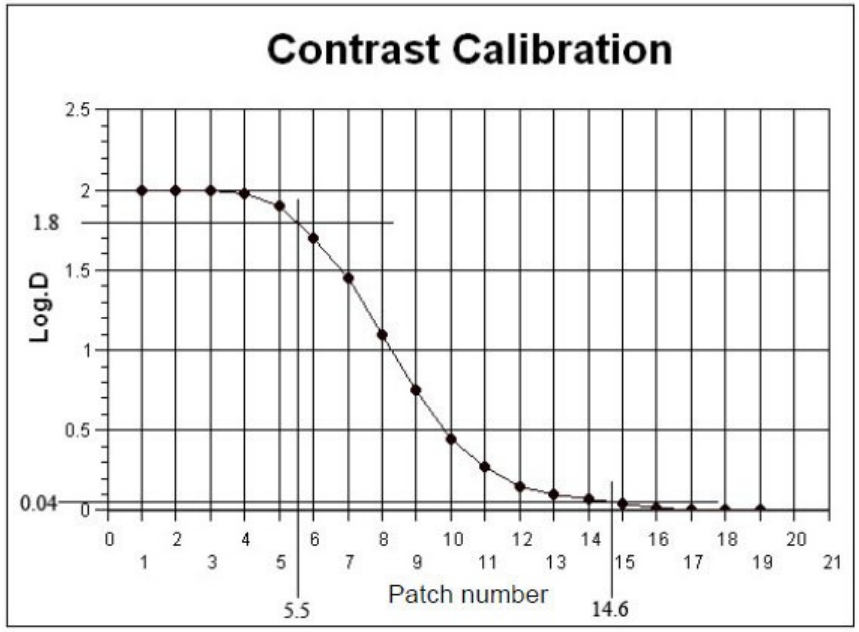

2. If you are using a colour enlarger, use the filter settings in the table below which are a fairly good match to Ilford under-lens filters. See your meter's instruction manual for more information about different enlargers.
3. If you are using a different paper, we have derived exposure correction factors and contrast values for a number of popular papers which you can enter into the meter's calibration tables. These figures should be regarded only as a starting point; you should refine them using the calibration methods described in this manual to improve accuracy. The figures assume the use of Ilford Multigrade under-lens filters except where indicated.
4. Choose your set-up from the list on p14, and enter the exposure correction (offset) and contrast values from the table into the meter's calibration tables. These figures are to be regarded only as starting points and for best results the full calibration procedure should be carried out, as actual values will depend on the characteristics of your enlarger, your working methods and materials. However if you use these starting figures it's likely that only fine tuning will be required. (The figures for Ilford Multigrade IV RC are the factory standard and are listed here only for reference purposes.)

| Grade | Durst (max 170M) | | Durst (max 130M) | | Kodak | | Leitz Focomat V35 | | Meopta | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | M | Y | M | Y | M | Y | M | Y | M |
| 00 | 115 | 0 | 120 | 0 | 162 | 0 | 135 | 6 | 105 | 0 |
| 0 | 100 | 5 | 88 | 6 | 90 | 0 | 105 | 12 | 85 | 10 |
| 0.5 | 88 | 7 | 78 | 8 | 78 | 5 | 77 | 11 | - | - |
| 1 | 75 | 10 | 64 | 12 | 68 | 10 | 67 | 17 | 60 | 20 |
| 1.5 | 65 | 15 | 53 | 17 | 49 | 23 | 52 | 28 | - | - |
| 2 | 52 | 20 | 45 | 24 | 41 | 32 | 39 | 43 | 40 | 45 |
| 2.5 | 42 | 28 | 35 | 31 | 32 | 42 | 32 | 51 | - | - |
| 3 | 34 | 45 | 24 | 42 | 23 | 56 | 23 | 62 | 20 | 60 |
| 3.5 | 27 | 60 | 17 | 53 | 15 | 75 | 14 | 79 | - | - |
| 4 | 17 | 76 | 10 | 69 | 6 | 102 | 10 | 95 | 10 | 75 |
| 4.5 | 10 | 105 | 6 | 89 | 0 | 150 | 15 | 154 | - | - |
| 5 | 0 | 170 | 0 | 130 | 0 | 200 | 0 | 200 | 0 | 200 |

5. If you have the manufacturer's ISO(P) speed rating for your paper, you can use this to determine a starting point exposure correction from the following table, based on the ISO(P) speed of Ilford Multigrade IV which is 200.

| ISO(P) | 50 | 64 | 80 | 100 | 125 | 160 | 200 | 250 | 320 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Offset | +18 | +15 | +12 | +9 | +6 | +3 | 0 | -3 | -6 | -9 | -12 |

2. During the exposure correction calibration, find the test strip which is closest to 0.04 log.D.
3. For best accuracy of contrast calibration, measure each patch of the step wedge image on the paper, and draw a graph of the densities vs patch number. This will enable you to better estimate the positions of the 0.04 log.D and 90% D.max points.
4. In this example, the D.max is 2.00 so the 90% point is 1.8, corresponding to a patch number of 5.5, and the 0.04 log.D point corresponds to a patch number of 14.6. The range is therefore 14.6 - 5.5 or 9.1. Multiply this figure by 15 to get the ISO(R) range, which is 136.
5. If your densitometer can make transmission measurements as well, you can use it to calibrate the step wedge although the accuracy of the Stouffer product is quite sufficient for meter calibration.




## 7. Starting Point calibration settings for alternative papers and/ or equipment

1. The meter's basic calibration suits Ilford Multigrade IV Resin-Coated variable contrast paper, used with a standard diffusion-type halogen-illuminated enlarger and Ilford under-lens filters. This is the most popular configuration here in the UK, and if you use it you should get good results "out of the box".




3 Gather together the following:

- The Stouffer Sensitivity Guide (step wedge) and the density comparison tile that came with this manual.
- Some sheets of the paper you want to calibrate. Usually 2 or 3 10x8 sheets will be sufficient. Cut test strips approximately 5" x 1" (125mm x 25mm). You will need seven strips for the exposure tests and another seven for the contrast tests. (If you have a test-strip easel then obviously cut the strips to fit that!)
- Print developer and fixer, freshly mixed at the dilution and temperature you normally use for printing.

## 4. Determining Exposure Corrections

### 4.1 Making the exposure test strip

1. Remove any negative from your enlarger; the tests are made using a blank exposure.
2. Raise your enlarger's head to the top of the column and close the lens down to its minimum aperture.
3. Set the meter's step size to 1/4 stop.
4. Remove all filters, take a measurement from the centre of the baseboard and check the exposure time on the meter's display. If it is between approximately 10 and 20 seconds then all is well and you can proceed to the next section. If it is longer than 20 seconds or so, open the lens aperture, press the ✗ button on the meter, and try again - repeat until the exposure time is within range. If it is between 5 and 10 seconds and the lens is already at minimum aperture and the enlarger head at the top of the column, then you can proceed but accuracy will be reduced because of the short incremental test strip exposures. If the indicated exposure time is less than 5 seconds, use separate test strips mode rather than the usual incremental mode.
   - If you have trouble achieving a long enough exposure time, you can use a neutral density filter to reduce the light level. This can simply be a piece of unexposed processed film leader. Alternatively if you're using a colour enlarger, dial in equal amounts of cyan, magenta and yellow ▲ ▽ filtration.
5. For the entire remainder of the process, do not touch the meter's or buttons, or the ✗ button!
6. Set the meter to the grade to be calibrated. Set the enlarger filters to that same grade, and make the test strip.

## 4.2 Examine the test strip

1. Process, wash and dry your test strip and inspect it. Compare the exposures on the test strip to the highlight density reference tile and find the exposure that most closely matches the darker of the two patches on the tile. If you have a reflection densitometer, choose the exposure that is closest to a density of 0.04 log.D. In the example diagram below, the target density is one step more exposure than the centre strip; that means that the meter is underexposing by one step.


- If the test strip is completely blank (under exposed), increase the exposure time by one stop and try again. If this results in a useable test strip, mark the paper "+1 stop" and continue to step 2. If it is still too light, increase by another stop, and repeat if required.
- If the test strip is too dark and there is no exposure matching the reference tile (likely if you are using a cold light enlarger), reduce the exposure by one stop and try again. If this results in a useable test strip, mark the paper "stop" and continue to step 2. If the strip is still too dark, reduce by another stop, and repeat if required.
- *If you are using a colour or variable contrast enlarger*, you will usuallyneed to correct the exposure at grades 4 and 5 because standard above-lens and below-lens filters require an exposure increase at these grades. This increase is built into the meter's basic calibration. Before you make the grade 4 test strip, reduce the exposure setting by one full stop (i.e. for a step size of 1/4 press ∇ four times). Leave the exposure setting the same for grade 5 as well.

2 Note the number of steps the exposure that matches the reference tile is offset from the centre (if any). In Table 1, look down the "Test Strip Offset" column to find this offset number, and read the figure in the column corresponding to the 1/4 stop step size we're using. This is the exposure correction factor for the current grade. Mark the test strip with the grade and the correction factor.




2. With the lens stopped down and with a blank negative in the enlarger, take a meter reading for the appropriate grade to be calibrated, and increase the suggested exposure time until the LED on the shadow end of the bar-graph lights up.
3. Make a test strip **with 1/3rd or 1/6th stop step-size** at this exposure time and with the appropriate paper/ grade/ filter setting.
4. Examine the test strip and decide on the position (with respect to the middle strip) on the test strip where the tone matches the reference tone on the black reference tile provided. If it is in the middle, then no adjustment is required.
5. If the middle strip is too *light* then the contrast range needs to be *increased*. Similarly, if the middle strip is too *dark* then the contrast range needs to be *decreased*.
6. In the example below, the matching black tone is two steps darker than the middle. That means that the ISO(R) number for the grade being adjusted requires increasing by 2 steps.


7. There are 30 ISO(R) units per full stop of contrast, so if 1/6th stop steps were used to make the test strip, alter the contrast setting by 5 units per step. If 1/3rd stops were used, alter the contrast by 10 units per step.
8. To enter the contrast adjustments into the calibration tables, see the instructions in section 5.3.

## 6. Using a Densitometer

1. If you have a densitometer you can use it to get higher accuracy. The important density values are 0.04 log.D for the highlight reference, and 90% of maximum for the shadows. Zero your densitometer on an unexposed and processed piece of paper so get the paper base reference. Now measure the density of maximum black, for example an area outside the image of the step wedge which will have been exposed to maximum density. To get your shadow reference density, multiply this figure by 0.9. For example, if you paper has a maximum black density of 2.00, your target shadow density is 1.80 (2.00 x 0.9).

## 5.3 Entering the Contrast Values into the meter's calibration table

To store the contrast values that you just determined into the meter, proceed as follows

1. Press and hold ✧ for one second until "CAL" appears in the display.
2. Release the ✧ button. The displays shows in sequence the current PAP number, then "off", then "o 00". (Note - if you have previously entered an exposure correction then the time display will show that correction instead of 00.)
3. If you are using an Analyser, press ✹

   If you are using a ZoneMaster press 🕑

   The display shows "cont" and then "o 179". (Note - if you have previously entered a contrast figure the time display will show that figure instead of 179.)
4. Using the ▲ and ▽ buttons, change the time display so that it shows the contrast value for grade o.
5. Press ◁▶ to advance to grade 0. Using the ▲ and ▽ buttons, change the time display so that it shows the contrast value for grade 0.
6. Press ◁▶ to advance to grade 1 and enter the factor for grade 1. Continue until you have reached grade 5 and entered its contrast value factor.
7. If you are using an Analyser, press ✹

   If you are using a ZoneMaster, press 🕑

   The meter will revert to normal mode, and the display will show "PAP1", then the default step size, then "2 15.0"
8. Your contrast values are now stored. Note - the default PAP channel is now selected (normally PAP1); if you entered factors for a different PAP channel you will need to select that again before testing the results.

## 5.4 Refining the Contrast Calibration

For more accurate contrast calibration, the figures derived using the procedure in 5.2 and 5.3 can be refined using the test-strip procedure described below. This procedure is not a necessity but is described here for users who want the highest accuracy of calibration.

1. Before attempting to calibrate the contrast values you must have determined all the exposure corrections and entered them into the meter's calibration tables as described in the foregoing sections. If you do not do this, the contrast calibration will be ***wrong***!




If you're confused about whether the required correction is negative or positive, remember that if the test strip is too dark the required correction is negative, and if it's too light, the correction is positive.

| Table 1 | | Test Strip Step Size | | | | |
|---|---|---|---|---|---|---|
| | | 1/12 | 1/6 | 1/4 | 1/3 | 1/2 |
| Test Strip Offset Lighter <> Darker | -3 | -3 | -6 | -9 | -12 | -18 |
| | -2 | -2 | -4 | -6 | -8 | -12 |
| | -1 | -1 | -2 | -3 | -4 | -6 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | +1 | +1 | +2 | +3 | +4 | +6 |
| | +2 | +2 | +4 | +6 | +8 | +12 |
| | +3 | +3 | +6 | +9 | +12 | +18 |

3 If you needed to adjust the exposure to get a useable test strip, change the correction factors as follows.

- If the paper is marked "+1 stop", add 12 to the correction factor to get the new factor. If you needed 2 stops, add 24, and so on - each full stop requires a correction of +12.
- If the paper is marked "stop", subtract 12 from the correction factor to get the new factor. If you needed -2 stops, subtract 24, and so on - each full stop requires a correction of -12.

4. Repeat this process for each full grade. There is no need to take a new measurement for each grade provided you have not touched the meter's exposure or clear controls, and you have not altered the lens aperture or enlarger head height.
5. When you have finished this process you should have seven test strips, each marked with a grade and a correction factor.

## 4.3 Entering the exposure correction factors into the meter's calibration table

To store the exposure correction factors you just determined in the meter, proceed as follows:

1. Press and ✧ hold for one second until "CAL" appears in the display.

2. Release the ✧ button. The displays shows in sequence the current PAP number, then "off", then "o 00".

*Note - if you have previously entered an exposure correction then the time display will show the current correction instead of 00, and you should add this figure to the new factor to get the total correction factor required.*

3. Using the ▲ and ▽ buttons, change the time display so that it shows the correction factor for grade o.
4. Press ◁ ▶ to advance to grade 0. Using the ▲ and ▽ buttons, change the time display so that it shows the correction factor for grade 0.
5. Press ◁ ▶ to advance to grade 1 and enter the factor for grade1 Continue until you have reached grade 5 and entered its exposure correction factor.
6. If you are using an Analyser, press ✹
   If you are using a ZoneMaster, press 🕑
7. The display shows "cont" and then "o 179". (Note, if you have previously entered a contrast figure the time display will show that figure instead of 179.) If you have contrast figures that you want to enter, you can do that now - proceed to section 5.3.4.
8. Press the same button again. The meter will revert to normal mode, and the display will show "PAP1", then the default step size, then "2 15.0"
9. Your exposure correction factors are now stored. Note - the default PAP channel is now selected (normally PAP1); if you entered factors for a different PAP channel you will need to select it again.

## 4.4 Refining the accuracy of the exposure correction factors

1. For maximum accuracy you can repeat the process using a smaller step size. This is especially useful at the hard grades 4 and 5 where a small difference in exposure can result in a large change of density on the test strip. We recommend using a step size of 1/12th for grades 4 and 5, 1/6th for grades 2 and 3, and 1/4 for the softest grades 00, 0 and 1.
2. When you read the correction factors from Table 1, remember to choose the column corresponding to the step size you used to make the test strip!

# 5. Determining Contrast Values

1. To calibrate the contrast range you will need to make a test contact print from the calibration step wedge (shown right) supplied with your meter, for each full contrast grade, and then find the strips on each test print which most closely match the reference densities on the paper density test tile.




## 5.1 Making the Test Print


1. Cut a piece of the paper to be calibrated into pieces approximately 4 x 2 inches (100 x 50mm). A single sheet of 10x8 paper cut into 8 will be fine. You can of course use larger pieces for convenience if you prefer.
2. With no negative in your enlarger's negative carrier, place one of these pieces on the easel and place the step wedge on top of it. For best results place a piece of clear glass over the wedge and paper to keep them in close contact.
3. Set your lens to the aperture you normally use to make a print. Adjust the enlarger's grade setting to the grade you are calibrating (it's usually convenient to start at grade 00 and work up to grade 5) and set the exposure time to 15 seconds.
4. Expose the paper.
5. Process and dry your test print using your usual technique.
6. Repeat for each grade.

## 5.2 Examine the Test Print

1. Check that the test print shows a complete range of tones from black to white. If it does not show a true white, close the lens by one stop (or decrease the exposure time) and try again. Similarly, if it does not show a true black, open the lens one stop (or increase the exposure time) and try again.
2. Compare the exposures on the test print to the shadow density reference tile and find the dark tone that most closely matches the lighter of the two patches on the tile. Note the number of the matching strip.
3. Now find the pale tone that most closely matches the darker of the two patches on the highlight density reference tile. Note the number of the matching strip.
4. Find the paper contrast as follows:

- Subtract the figure determined in step 2 from that determined in step 3.
- Multiply this figure by 15 to determine the ISO(R) contrast value. (Each step of the wedge represents a change of half a stop. There are 30 ISO(R) units per stop, hence each step represents 15 ISO(R) units.)

5. For greater accuracy, if the required density lies between two steps you can refine the figures in steps 2 and 3 by estimating the correct value. For example, if the highlight density lies midway between steps 15 and 16, use a figure of 15.5, and so on.