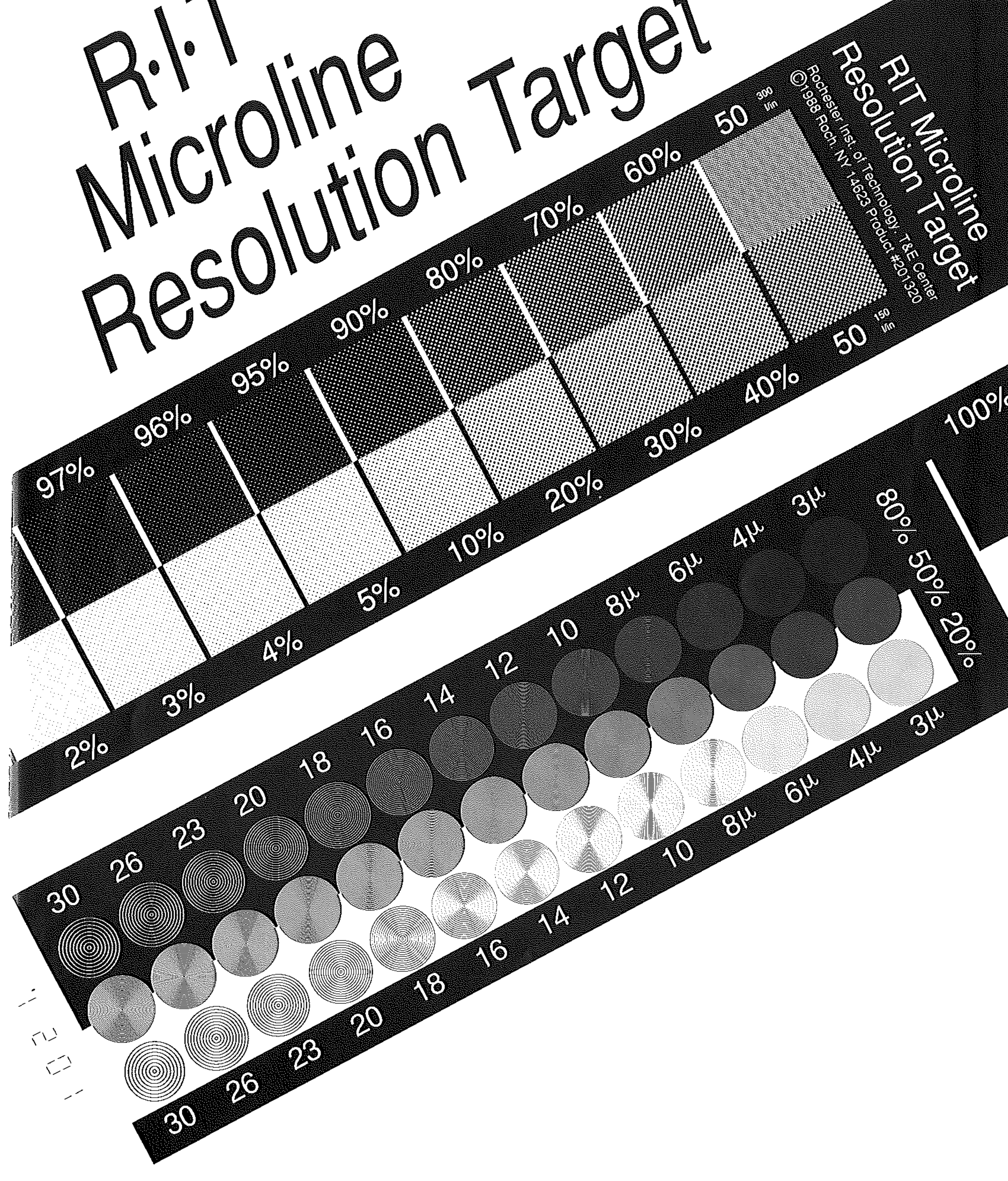
R·I·T
Microline
Resolution Target
RIT Microline
Resolution Target
Rochester Inst. of Technology, T&E Center
©1988 Roch. NY 14623 Product #201320
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RIT Microline Resolution Target

Microlines Small Dots Halftones

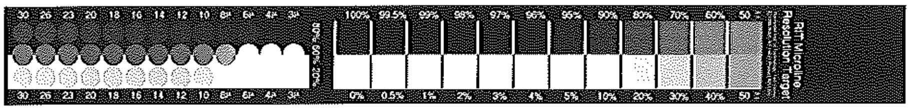

Figure 1

Introduction

The RIT Microline Resolution Target is an effective tool used for monitoring daily performance of film or plate-making. It is used to determine proper exposure, processing, tone reproduction, exposure latitude, and resolving power of both positive and negative working light sensitive systems. It helps to quickly evaluate an unknown film or plate.

The target consists of three sections: a calibrated 150 LPI (60 LPC) halftone gray scale; small highlight and shadow dots; and a section with microlines. (LPI = lines per inch, LPC = lines per centimeter).

Halftone Patches

The halftone patches match closely the nominal values, and can therefore easily be used to measure tone reproduction. The finely incremented highlight and shadow dots can be used as indicators of a possible dot loss at the extreme ends of the scale.

There are two patches with a dot area of 50%, one with a screen ruling of 300 LPI (120 LPC) and one with 150 LPI (60 LPC). They match within 0.1% dot area. A difference in darkness indicates a change in dot size. Therefore, when there is no dot gain or loss, the two patches look and measure the same. The finer halftone is twice as sensitive to dot gain or loss than the coarser one. If, for instance, the 300 LPI 50% halftone has the same darkness as the 40% 150 LPI halftone, then the midtones of the 150 LPI halftone were undercut by light by 10% dot area. With experience, a user of this target can visually estimate approximate dot gain. An exact evaluation requires a measurement.

Microlines

The width of the microlines covers a range from 3μ to 30μ. (1μ = 1 micron = 1/1000 millimeter.) For each width, there are 3 patches with concentric circular microlines. The line-to-space ratio on these three patches is such that the area covered by the patches is 20%, 50%, and 80%. (The 80% patch is a negative of the 20% patch. See Figures 2 to 4.)

Other microline targets use 10% and 90% line-to-space ratios, rather than the 20% and 80% combination of the RIT Microline Resolution Target. Experiments have shown that both versions give the same response, but the 20% and 80% combination makes it easier to visually detect the presence or absence of a given patch.

Microlines are more sensitive than halftone dots because they are finer than dots, but are easier to see because they are lines and therefore cover a larger area.

Exposure determination

When contacting a halftone image on a film or plate, we must find a compromise between a reproduction without dot gain or loss, and one without dust or film edges.

Exposure latitude is a measure of the change of exposure that is required to obtain a certain change of the dots or microlines. The more exposure latitude there is, the more the exposure is allowed to change without significant effect on the halftones. High resolution materials tend to have a larger exposure latitude than lower resolution materials.

Normally, it is not possible to reproduce all dots of an original without changing dot size at least somewhere along the scale. In theory we lose some fine highlight dots and some fine shadow dots even at optimum resolution. When using a high resolution system, the loss may be very small and of no practical consequence. This is desirable in dot-for-dot contacting. The disadvantage is that such systems are more likely to reproduce specks of dust. Lower resolution systems are more sensitive to distortions in tone reproduction and have less exposure latitude. However, this can be desirable in processes such as dry dot etching.

In practice, dot-for-dot means that the same amount of loss takes place in both the shadows and the highlights, therefore the midtones are reproduced without gain or loss. To determine the exposure for a dot-for-dot reproduction, we use a microline target and make a series of test exposures that ranges from underexposure to obvious overexposure. In theory, an exposure without dot gain or loss is reached when the 50% microline patches reproduce with the finest lines.

Underexposure favors the fine positive lines or dots because they are not undercut by excessive light. However, the fine negative lines or dots are too narrow to let enough light pass to form an image. The very fine 50% microlines will reproduce as if they were black in the original. (See Figure 2.)

Overexposure has the opposite effect. It favors the negative lines and undercuts the fine positive lines of the original. The very fine 50% microlines will reproduce as if they were clear in the original. (See Figure 4.)

Optimum resolution is obtained at an ***intermediate exposure,*** where the 50% microlines reproduce at their best, and where the width of the just not lost lines for both the 80% and the 20% microlines is the same. At this exposure, 50% microlines that are too fine to reproduce as lines will still show a grainy or continuous tone image. *This should not be mistaken as a resolved image, but rather as another indication of optimum resolution condition* (See Figure 3). In theory, a 50% halftone will reproduce without change in dot area, although sharp corners or some very fine highlight and shadow dots may be lost due to a lack of resolving power.

At the *exposure for optimum resolution,* the 20%, 50%, and 80% microline patches all just reproduce at the same finest width. At less exposure, the 50% and 80% patches will not reproduce because there is not enough light passing through their gaps, while at overexposure, the 50% and 20% patches will not reproduce because their lines are undercut. Therefore, the 50% microline patch will reproduce at the highest resolution only for optimum exposure; it will reproduce at lesser resolutions (wider lines) for all other exposures.

Judgment of microline patches is somewhat subjective, because we are always interested in those finest microline patches that just copy, or just do not copy. By their very nature, the lines of these patches are not "healthy." We consider a patch as having copied when one half to two thirds of its lines are black enough that they would copy again. Particularly with low contrast films, there may be one or more patches where the lines are so gray that they are visible, but could not be contacted again. The grayness of the lines may be appraised with the help of a magnifier.

References with additional information on the theory and use of microlines are listed at the end of this document.

Practical Use

There are different ways to determine the desired microline response. Plate manufacturers often recommend a certain microline reading for their plates. In addition, Fogra has published tables of standardized microline responses for different printing plates[3]. However, particularly for positive plates, a simple rule of thumb, developed by UGRA, also can be used. It recommends that we first determine the required exposure for optimum resolution, and then increase exposure such that an additional 4 microns are lost on the 20% microlines. Due to this slight overexposure, "normally" processed printing plates are expected to have a dot gain of 3% to 4% in the midtones for negative working plates, and a dot loss of the same amount for positive working plates.

Step-by-step procedure to determine best exposure for an unknown film or plate.

1. *Exposure Series:* Mount an RIT Microline Resolution Target (and a continuous tone gray scale) into a mask made from a very high density material. Aluminized paper that is used by some manufacturers to package films or plates is well suited. Rubilith is probably not dense enough. Because several long exposures will be made, the density should be more than 5.0. (Use 2 layers of very black film if aluminized paper is not available.) Step off several exposures. Do not use a constant addition to get the next exposure (eg. 1, 2, 3, 4, 5, 6 units), but rather a constant multiplier (eg. 1, 1.4, 2, 2.8, 4, 5.6, 8 units). A multiplier of 1.4 is recommended. It corresponds to one step on the sensitivity guide. Span the exposure range from underexposure to obvious overexposure.

2. The ***optimum resolution*** condition is found at the sample where the density of the 50% 3µ, 4µ and 6µ patches is the same as the coarser 50% microline patches. The 3µ, 4µ or 6µ 50% patches may not be resolved as lines, but will copy as a grainy image.

Using this sample and a magnifier, inspect the finest patches of both the 20% and 80% microlines. Find the patches where half to two thirds of the lines on the patch are black enough that they could be copied again. At optimum resolution, this should happen at the same line width for both the 20% and 80% patches (see Figure 3). Optimum resolution of this system is expressed by the width in microns of these patches.

3a. ***Positive working plates:*** increase the exposure required for optimum resolution until an additional 4 microns are lost at the 20% microlines (see Figure 4). This is the standard exposure for positive plates. (Most positive working plates are diazo plates and therefore the same rule applies for all.)

At this exposure, most film edges and fine specks of dust do not copy. The midtones of a 150 LPI (60 LPC) halftone sharpen by about 3% to 4% dot area due to this slight overexposure. This is expected and considered standard procedure. If some film edges remain, then part of the exposure (not more than 30%, preferably less) can be done with diffuse light rather than the normal point light.

3b. ***Negative working plates:*** in general, the same rules apply as for positive plates. However, there is a gain of 3% to 4% in the midtones. Since there are no film edges for negative working plates, diffuse light is not used. A slight overexposure is still required to assure adequate hardening of the coating for proper plate life and elimination of dust.

There are negative working plates that have an extremely wide exposure latitude. Therefore, a very large increase in exposure is required to lose the additional 4 microns. For such a plate, a continuous tone gray scale should be used to control exposure, and less than 4µ should be lost[2]. Consult the manufacturer's recommendations. Too much exposure can cause haloes.

3c. ***Films*** may be made with less overexposure than plates. At the exposure for optimum resolution, we are close to a dot-for-dot contact. However, dust can become a problem.

For a film to be good for dry dot etching, the dots must change size with overexposure without a fog appearing between them.

Sensitivity Guide

For some applications it may be desirable to attach a continuous tone gray scale, such as a Stouffer Wedge[4] or a Kodak Control Scale T-14[5] to the Microline Resolution Target. At optimum resolution, a continuous tone patch with a density of 0.30 will reproduce again with a density of about 0.30 (or slightly higher).

Discrepancies between theory and practice

It was found that some films react exactly as the theory predicts. At optimum resolution, most films show a midtone dot area change of less than 1%, and a solid density of more than 3.0. For most films, when exposure is increased beyond the optimum resolution point, such that an additional 4μ are lost, the dot area of the midtones changed by 2% to 4% dot area. The relationship between microline response and dot gain is different for each light sensitive system.There are a few systems that exhibit unusual behavior, particularly if they are prone to edge effects.

It does not take much to change dot area of a midtone by one percent dot area. The difference in side length between a square 50% and 51% dot of a 150 LPI (60 LPC) halftone is 1.2 microns (2 wavelengths of green light!). To be able to control dot diameter to one micron is a pretty high tech achievement.

Specifications

Size:	9/16 x 5 in. (14 x 127 mm.)
Thickness:	0.004 in. (0.1 mm.)
Material:	Photographic silver halide film.
Halftones:	150 LPI (60 LPC): 21 patches from 0.5% to 99.5% 300 LPI (120 LPC): one patch at 50%
Dot shape:	The 0.5% to 5% and 95% to 99.5% dots are round, while the other dots have an elliptical dot shape.
Microlines:	3 μ to 30μ. For each line width there are three patches at 20%, 50%, and 80% area.

References:

1. Sigg, Franz, "A Few Things About Microlines That Most People Do Not Know," TAGA 1988, pp 428-449

2. Fisch, R. S. and Cavin, R. D., "Resolution as an Exposure Determinant for Negative-Acting Presensitized Plates," SPSE Journal of Imaging Technology, Vol. 13, No. 5, Oct. 1987, pp 159-163

3. FOGRA, Praxis Report No. 30, 1984, FOGRA, Streitfeldstrasse 19, PO Box 800469, D-8000 München 80, Germany. This report is in English and may also be available from the RIT T&E Center Order Dept.

4. 21 Step Sensitivity Guide, Part No. T2115, Stouffer Graphic Arts Equipment Co., South Bend, IN 46617

5. Kodak Control Scale, T-14, Publication No. Q-55

5X Photographic simulation of a positive working system

(For a negative working system, the image would be a negative of this one)

Underexposure | Optimum Resolution at 6 microns | Overexposure, additional 4μ

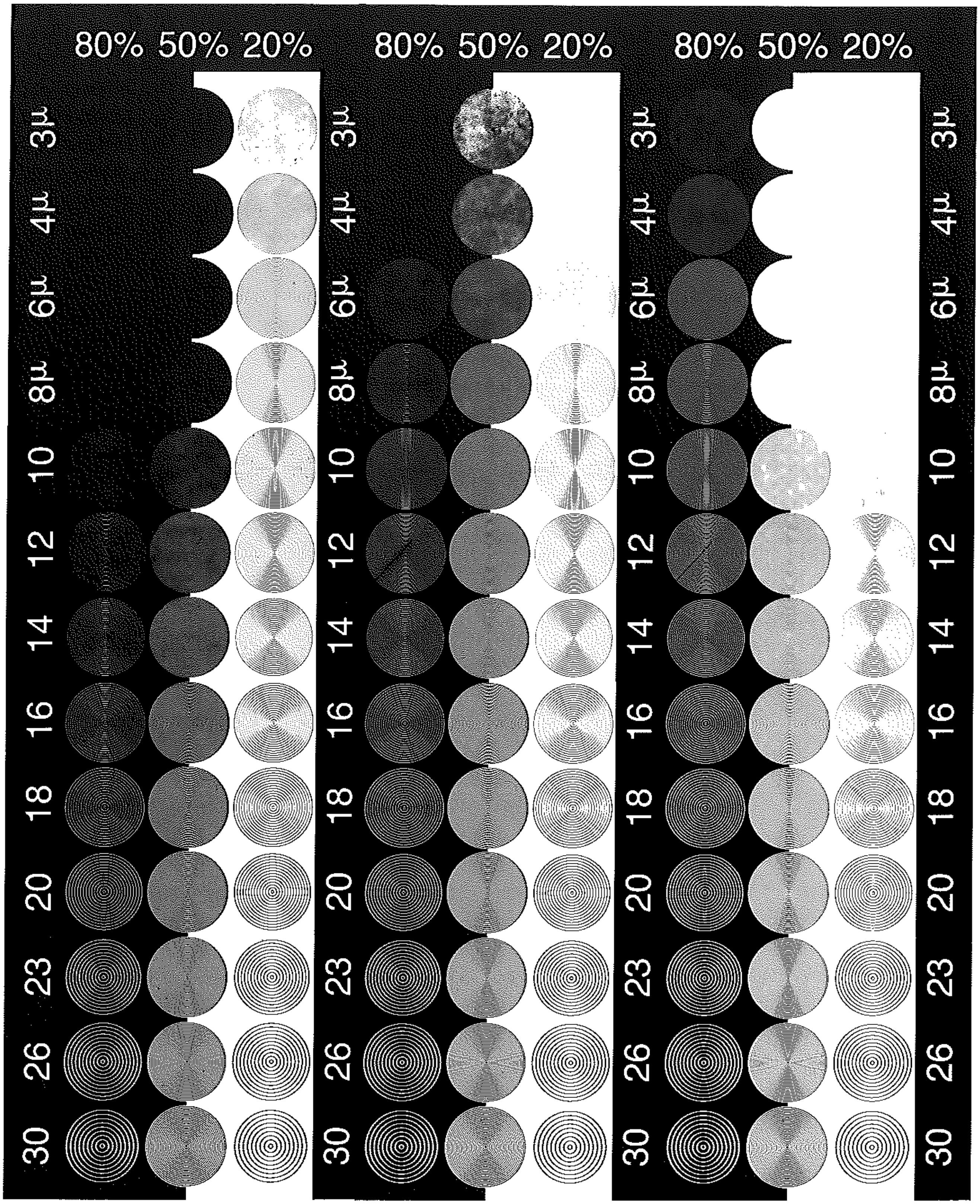

Figure 2 | Figure 3 | Figure 4

Representative Measurements on RIT Microline Resolution Target

Dot area measurements			Microline measurements			Microline measurements		
Nominal Values of Halftones % area	Film meas. %	Diff. Film Aim %	Microline Aim Value	Film µ Black 20 Black 50 Clear 80	Diff. Film Aim µ	Microline Aim Value	Film µ Black 20 Black 50 Clear 80	Diff. Film Aim µ
99.5%	99.4	-0.1	20%	3.0	0.0	20%	15.9	-0.1
99%	99.0	0.0	3µ 50%	3.0	0.0	16µ 50%	16.1	0.1
98%	98.0	0.0	80%	2.2	-0.8	80%	16.0	0.0
97%	97.0	0.0	20%	3.8	-0.2	20%	18.0	0.0
96%	96.1	0.1	4µ 50%	4.3	0.3	18µ 50%	18.0	0.0
95%	95.0	-0.0	80%	3.7	-0.3	80%	17.7	-0.3
90%	90.1	0.1	20%	5.9	-0.1	20%	20.6	0.6
80%	80.1	0.1	6µ 50%	6.2	0.2	20µ 50%	20.5	0.5
70%	69.8	-0.2	80%	5.8	-0.2	80%	19.6	-0.4
60%	60.2	0.2	20%	8.0	0.0	20%	22.5	-0.5
300L 50%	49.9	-0.1	8µ 50%	8.1	0.1	23µ 50%	22.5	-0.5
150L 50%	49.8	-0.2	80%	7.3	-0.7	80%	23.6	0.6
40%	39.9	-0.1	20%	9.8	-0.2	20%	26.2	0.2
30%	29.8	-0.2	10µ 50%	10.1	0.1	26µ 50%	25.4	-0.6
20%	19.8	-0.2	80%	9.9	-0.1	80%	26.0	0.0
10%	10.0	0.0	20%	11.9	-0.1	20%	30.3	0.3
5%	5.3	0.3	12µ 50%	12.0	0.0	30µ 50%	30.3	0.3
4%	4.0	0.0	80%	11.5	-0.5	80%	29.5	-0.5
3%	3.2	0.2	20%	14.2	0.2	Dot areas measured on custom photometric dot area meter. Microlines measured on calibrated microscope.		
2%	2.0	0.0	14µ 50%	14.3	0.3			
1%	1.1	0.1	80%	13.1	-0.9			
0.5%	0.5	0.0						

Plotting of Graphs

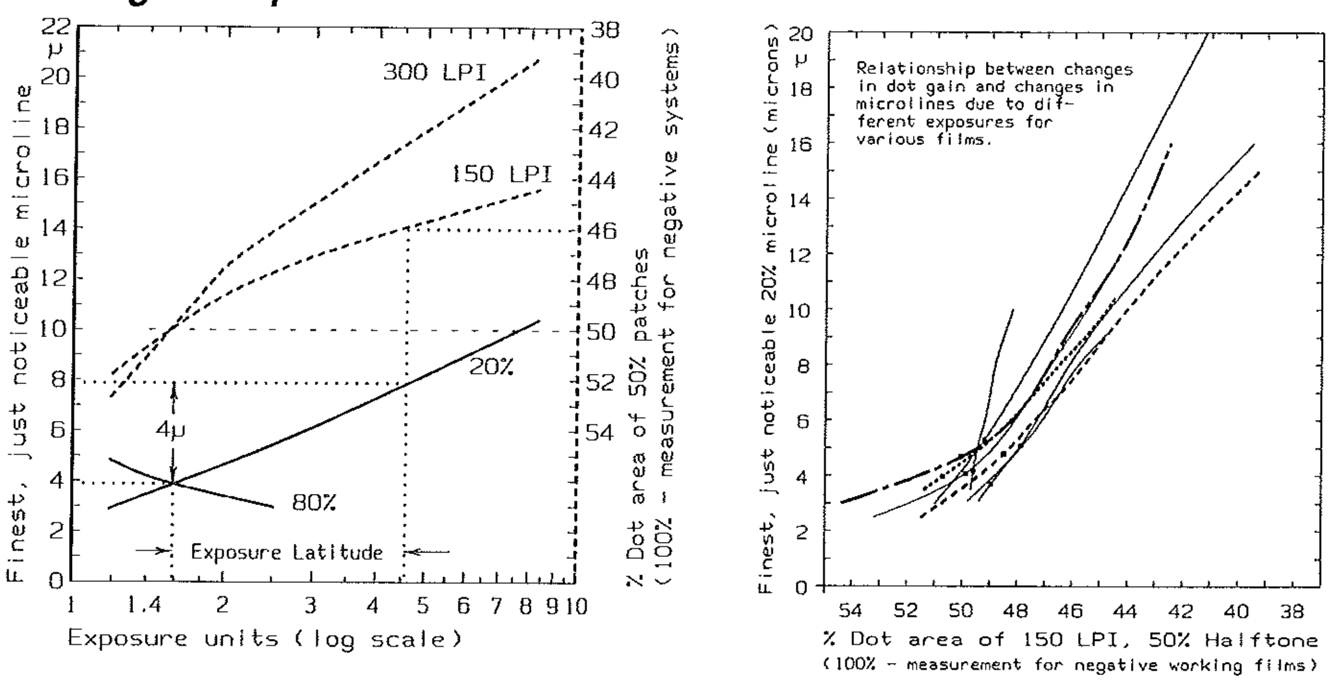

Figure 5 Example of graphs that can be plotted from the microline resolution target.