# Statistical Distribution of DeltaE

A recent technical presentation (1) suggested that the deltaE distribution of printed samples is represented by the three-dimensional chi-squared function. This approach uses the average standard deviation (s-avg) of L*, a* and b* as a single parameter to characterize the probability distribution. The quantity "deltaE/s-avg" when squared follows the chi-squared distribution. This provides a convenient estimate of the distribution of deltaE which is more realistic than the use of gaussian statistics.

Evaluation of a large number of samples of the Kodak Q60 transmission and reflection targets showed that the deltaE characteristics of individual samples compared to the batch mean followed this same statistic. We have therefore chosen to use the chi-squared statistics to characterize the within-batch variability of the individual patches of Kodak Q60 targets and are reporting the value, identified above as s-avg, as STDEV_DE in the Kodak Q-60 batch average data files.

For reference, the chi-squared distribution indicates the following relationship between s-avg and probability.

| deltaE | Probability |
|---|---|
| 1 x s-avg | 0.211 |
| 2 x s-avg | 0.749 |
| 3 x s-avg | 0.973 |
| 3.35 x s-avg | 0.990 |

Typical values for s-avg, on individual patches in recent production runs of the Q60 targets,are about 0.5. A value of 0.5 means that 99% of the targets will be within a deltaE of 1.7 of the batch average value.

It is interesting to note that the ANSI and ISO standards specify a tolerance of 2 delta E for measured targets. Based on the above statistics, and the current Kodak batch manufacturing tolerances, the Kodak batch average data generally meets the tolerances specified (at a 99% probability level) in the standards for calibrated targets.

(1) Appraisal of Production Run Fluctuations from Color Measurements in the Image, Friedrich K. Dolezalek, FOGRA, Munich, Germany, TAGA Proceedings 1994