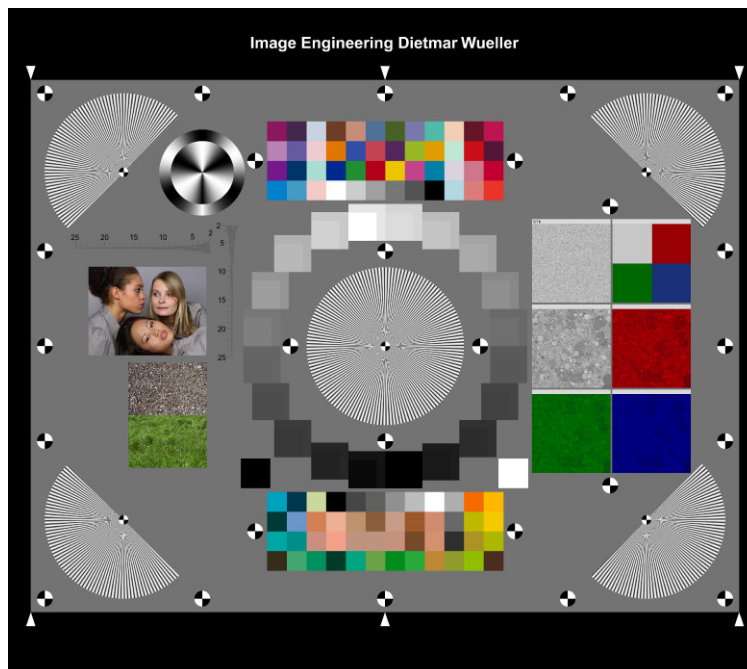




# FORTY TWO

## REFLECTANCE



With the new Test Chart "Forty Two" (TE42) Image Engineering is a serious multi-functional contender for testing digital cameras and lenses: With one single chart OECF (Opto Electronic Conversion Function), dynamic range, resolution, shading, distortion, lateral chromatic aberration, color reproduction and texture loss can be measured according to ISO standards and analysed with the corresponding software (iQ-Analyzer, until version 4 called IE-Analyzer ).

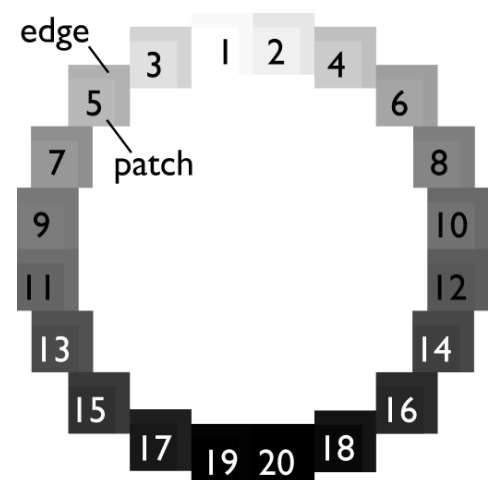
The chart consists of several components.



## OECF

The circular gray scale, arranged around the central Siemens star, is used to determine the opto electronic conversion function (OECF). It describes how the digital camera transfers luminances into digital values. The patches are analyzed for all three color channels red, green and blue in color images. There are three significant characteristic values derived from the OECF: SNR (relation between signal and noise), Visual Noise (takes into account that the visual perception of noise can be different for observers compared to a mere SNR approach) and Dynamic Range (contrast in a scene reproduced by the digital camera). The black and white patch below the circle are the minimum and maximum printable densities.

Patch	Density patch		Density edge	
	reference	actual	reference	actual
1	0.06		0.09	
2	0.12		0.15	
3	0.18		0.22	
4	0.26		0.30	
5	0.33		0.37	
6	0.41		0.45	
7	0.48		0.53	
8	0.59		0.64	
9	0.68		0.73	
10	0.77		0.84	
11	0.88		0.82	
12	1.00		0.93	
13	1.15		1.07	
14	1.29		1.21	
15	1.45		1.36	
16	1.64		1.52	
17	1.90		1.76	
18	2.17		2.00	
19	2.50		2.29	
20	> 3.00		> 3.00	
Background	0.75			





**COLOR**

The color patches above and below the OECF patches base on the X-Rite ColorChecker SG and are used for evaluation of color reproduction. The patches are converted into color coordinates in the CIE L\*a\*b\* color space (represents the color reception of the human visual system). From these values the color distance Delta E is calculated that describes the color reproduction quality. Reference values:



	L	a	b
A1	34	57	-12
A2	66	30	-16
A3	32	57	-44
A4	54	-16	-50
A5	65	-32	-26
A6	19	-35	-5
A7	65	-44	-11
A8	18	3	19

	L	a	b
B1	22	23	-20
B2	45	21	-38
B3	21	0	-39
B4	65	-17	-29
B5	20	-21	-23
B6	65	-4	-32
B7	55	-52	-9
B8	65	-43	22

	L	a	b
C1	90	-1	-5
C2	90	15	3
C3	90	-20	2
C4	90	13	9
C5	91	-12	32
C6	67	34	42
C7	70	24	22
C8	55	-58	17

	L	a	b
D1	34	23	31
D2	66	41	83
D3	21	26	-64
D4	99	1	3
D5	0	1	-2
D6	83	22	28
D7	80	33	29
D8	22	-30	9

	L	a	b
E1	69	23	25
E2	38	16	-53
E3	56	-50	46
E4	88	1	3
E5	32	0	1
E6	69	15	31
E7	70	17	21
E8	65	-48	12

	L	a	b
F1	50	-4	-24
F2	52	58	26
F3	39	72	49
F4	71	2	3
F5	43	1	2
F6	47	19	32
F7	70	17	21
F8	66	-32	47

	L	a	b
G1	41	-18	37
G2	25	35	-28
G3	87	4	99
G4	54	0	2
G5	65	0	2
G6	73	16	21
G7	70	20	23
G8	55	-54	52

	L	a	b
H1	56	11	-26
H2	27	-27	72
H3	53	62	-12
H4	38	1	1
H5	82	1	3
H6	49	28	24
H7	39	20	34
H8	66	-55	49

	L	a	b
I1	75	-3	2
I2	76	21	86
I3	51	-33	-32
I4	0	1	-2
I5	99	1	3
I6	70	27	31
I7	72	25	33
I8	65	19	57

	L	a	b
J1	91	11	21
J2	95	-18	10
J3	92	6	-2
J4	91	-11	-5
J5	76	1	3
J6	47	0	2
J7	20	1	1
J8	67	-16	60

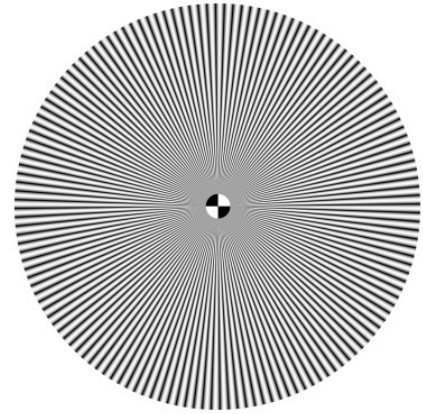
	L	a	b
K1	22	43	15
K2	47	75	59
K3	65	39	7
K4	68	41	22
K5	67	55	86
K6	80	-10	91
K7	67	3	64
K8	77	-31	83

	L	a	b
L1	45	71	16
L2	19	38	-7
L3	44	75	40
L4	57	74	59
L5	85	15	93
L6	89	7	106
L7	77	-16	87
L8	22	16	23



## RESOLUTION

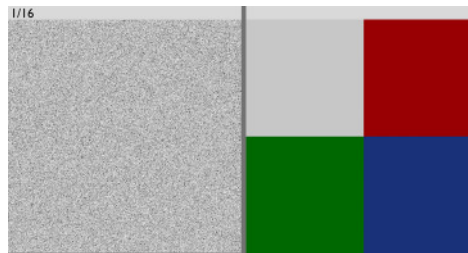
Resolution is measured in the center and the image corners using sinusoidal Siemens stars. There are 5 stars, one in the center and four half stars in the corners of the target. The stars are divided into segments and the resolution is measured for each of them. There are eight segments for the center star and three for the corner stars. Finally the mean value of the segments for each star and, additionally for the corners, the mean value of all four stars get reported.



## NOISE

For evaluation of camera noise and the reproduction of details (sometimes referred to as texture) the six noise and “dead leaves” patches are used.

White noise (sigma = 1/16)

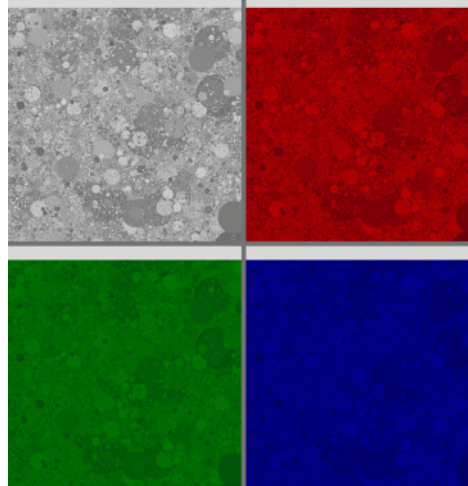


The gray patch (density 0.25) is used for calculation of the noise corrected “Dead Leaves” power spectrum

“Dead Leaves”

The structure is made of circles in all sizes and gray levels. A fourier transform of an image of this structure taken with a camera provides the power spectrum that the camera is able to reproduce.

The red, green and blue “Dead Leaves” structures are used to evaluate the resolution depending on the color.



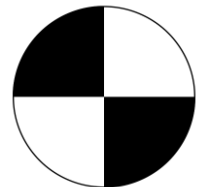


### **SHADING**

Shading describes the loss of light from the center of an image to the corner and is measured on the gray background.

### **DISTORTION**

Distortion is an geometrical aberration caused by the lens that causes a variation in the scale with the image height. Original straight lines look curved. Distortion is measured by using the marks. This structure is also used to determine the lateral chromatic aberration. A scale factor depending on the wavelength of the light that results in color fringes around high contrast structures in the corners of an image.



### **VISUAL APPRAISAL**

Several elements are used for a visual appraisal of reproduction of details, structures, skin tones and breaks in the digitalization process.

