



shaping the future of optics



25 mm lens with integrated EL-16-40

Test report of Optotune ELM-25-2.8-18-C (Evetar E3406A)

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Summary of Optotune ELM-25-2.8-18-C

High resolution and medium field of view (FOV)

- Ideal for code reading (e.g. box packing), iris recognition

Working distance (WD) range from 250mm to infinity

- Ideal optical leverage of 0.61m/dpt

Resolution for 2.4um pixels (e.g. IMX183 1" or IMX304 1.1")

- In the center over the WD range: at 169-180 lp/mm (close to Nyquist limit)
- At the corners for WD 250mm-1000mm still 157-174 lp/mm

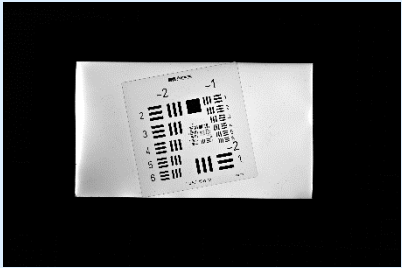
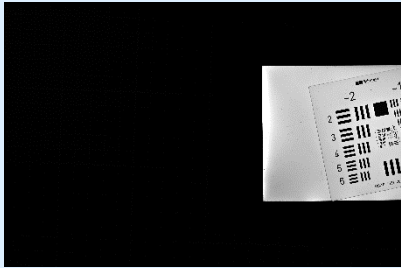
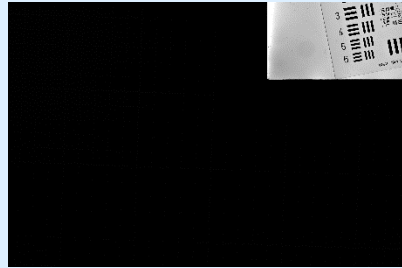
Image quality

- No vignetting up to 1.1" format
- Very low distortion
- Great polychromatic (white light) performance although better contrast was achieved with monochromatic (red) light



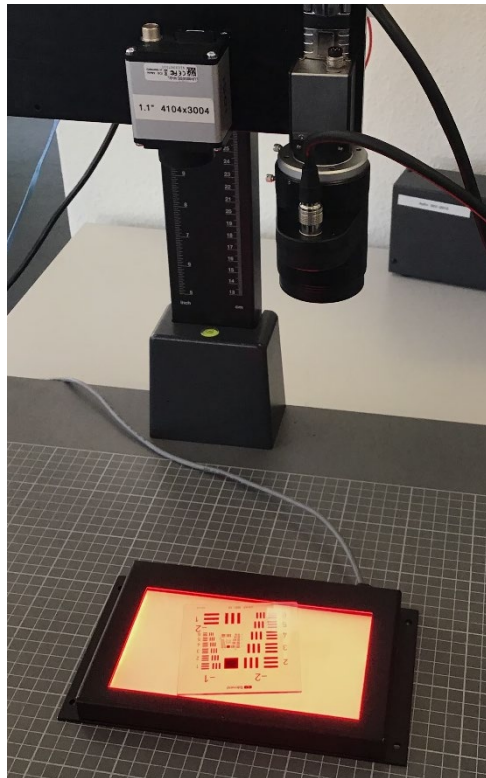
Best performance of this lens achieved with monochromatic light at F/4

- Several series of test images were acquired varying: Field positions, lighting, optical axis orientation & f-number

500mm WD	Center	Edge	Corner
USAF target position			
Optical axis vertical			
Red backlight	174*	174*	174*
White backlight	174	174	174
Optical axis horizontal			
F/2.8, white	158	141	141
F/4, white	177	177	158
F/5.6, white	177	158	158

*While the resolution with the red backlight is similar to white, the contrast achieved is higher

Test setup 1 with 1" sensor, 2.4um pixel size, red light



Camera: Baumer VCXU-201M.R, 1" CMOS,
2.4 um pixel size, 5472×3648 pixels

Lens: ELM-25-2.8.18.C
25 mm lens with integrated liquid lens
EL-16-40-TC-VIS-5D

Driver: Optotune Lens Driver 4i

Target: USAF chrome target

Light: Red background illumination

WD 970 mm, lens @ 0.45 dpt, F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

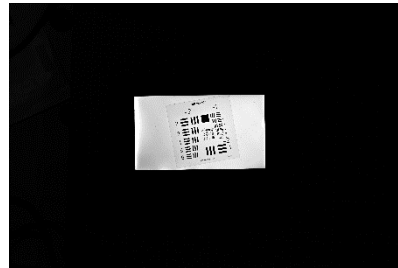
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μm

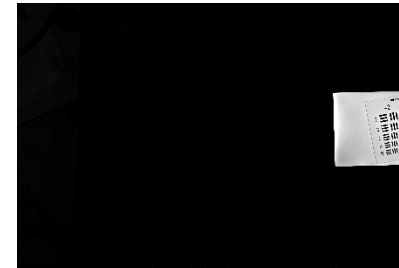
Light

Red background illumination

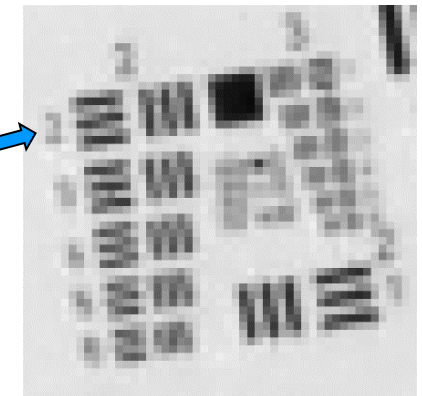
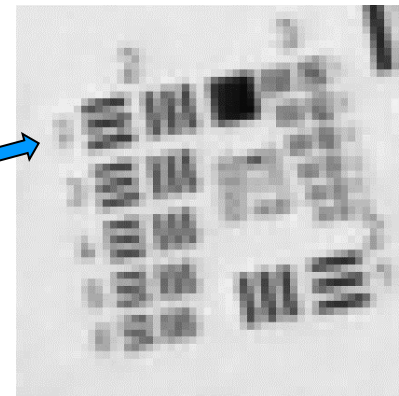
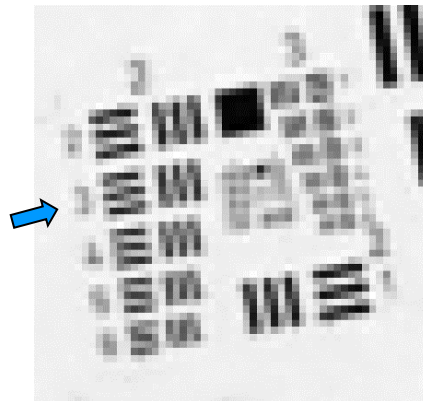
Center



Edge



Corner



USAF element:	2/3	2/2	2/2
Line width (μm):	99.21	111.36	111.36
Lp/mm (object):	5	4	4
Magnification:	0.028	0.027	0.027
Lp/mm (image):	180	167	167

WD 500 mm, lens @ 1.27 dpt, F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

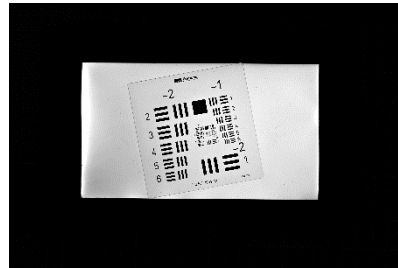
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

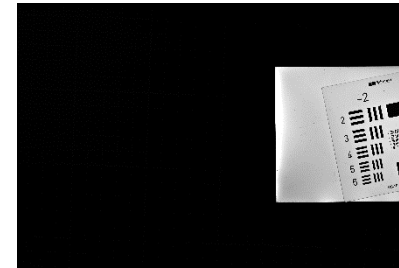
Light

Red background illumination

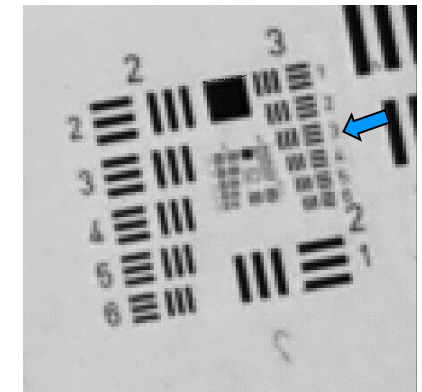
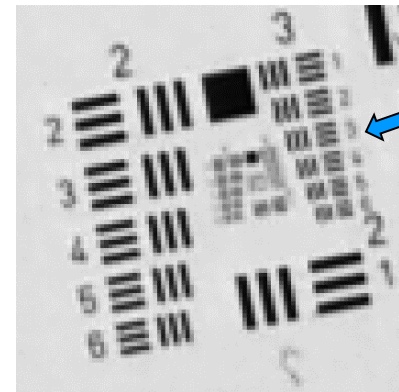
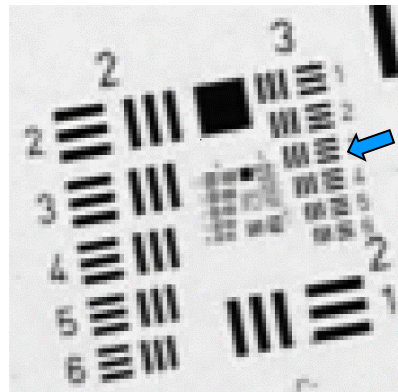
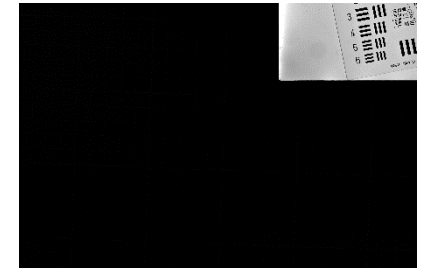
Center



Edge



Corner



USAF element:	3/2	3/2	3/2
Line width (μ m):	55.68	55.68	55.68
Lp/mm (object):	9	9	9
Magnification:	0.052	0.052	0.052
Lp/mm (image):	174	174	174

WD 250 mm, lens @ 2.69 dpt, F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

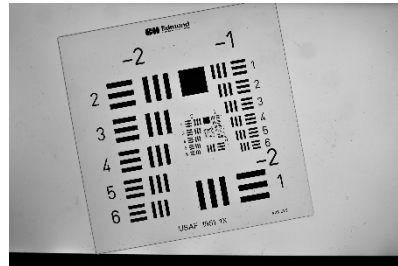
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

Light

Red background illumination

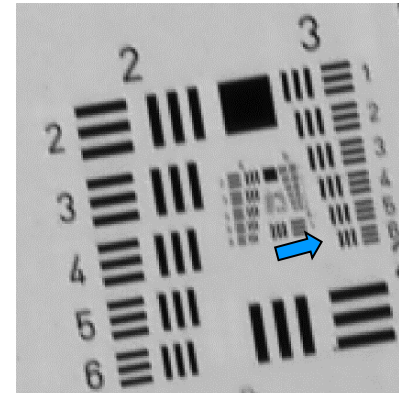
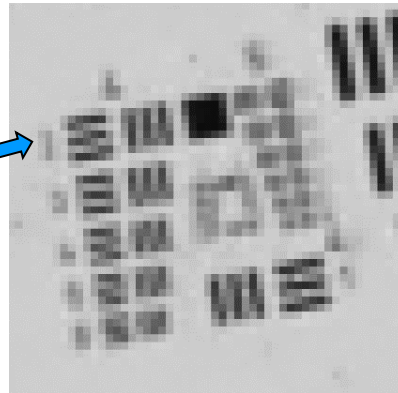
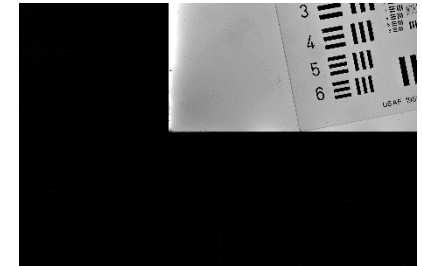
Center



Edge



Corner



USAF element: 4/1
 Line width (μ m): 31.25
 Lp/mm (object): 16
 Magnification: 0.095
Lp/mm (image): 169

3/6
 35.08
 14
 0.095
150

3/6
 35.08
 14
 0.091
157

Test setup 2 with 1" sensor, 2.4um pixel size, white light



Working distance (WD)

Camera: Baumer VCXU-201M.R, 1" CMOS,
2.4 um pixel size, 5472×3648 pixels

Lens: ELM-25-2.8.18.C
25 mm lens with integrated liquid lens
EL-16-40-TC-VIS-5D

Driver: Optotune Lens Driver 4i

Target: USAF chrome target

Light: White background illumination

WD 970 mm, lens @ 0.45 dpt, F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

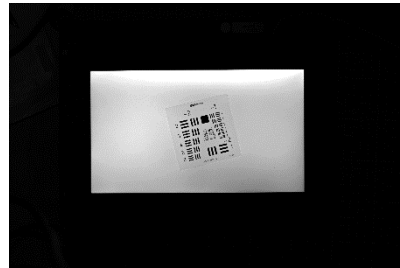
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

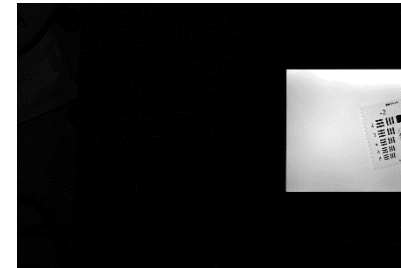
Light

White background illumination

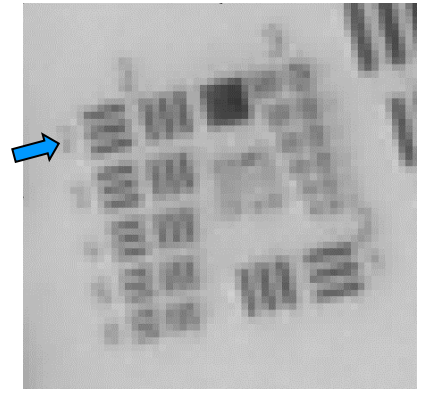
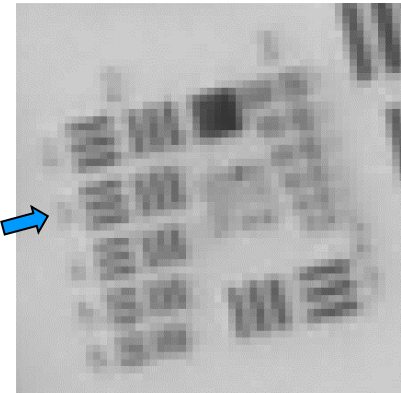
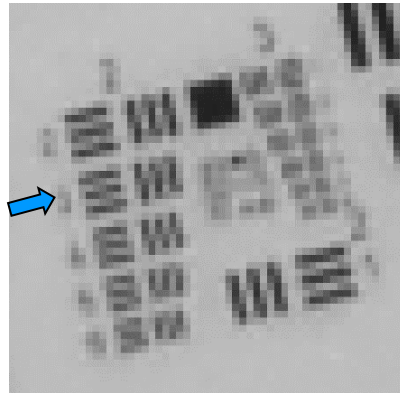
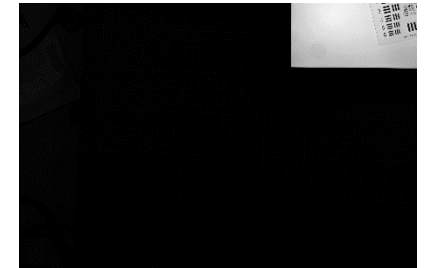
Center



Edge



Corner



USAF element:	2/3	2/3	2/2
Line width (μ m):	99.21	99.21	111.36
Lp/mm (object):	5	5	4
Magnification:	0.028	0.027	0.027
Lp/mm (image):	180	187	167

WD 500 mm lens @ 1.22 dpt, F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

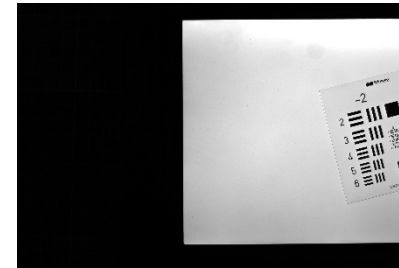
Light

White background illumination

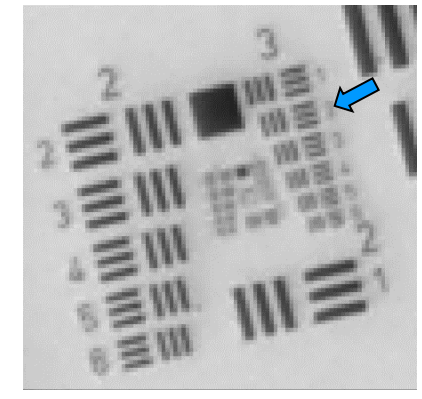
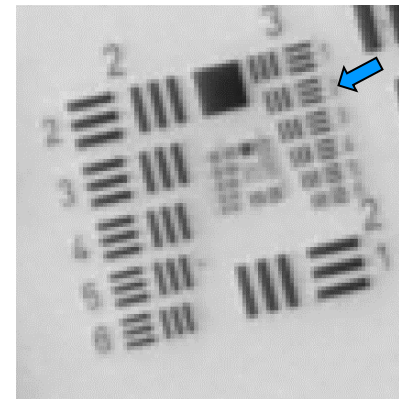
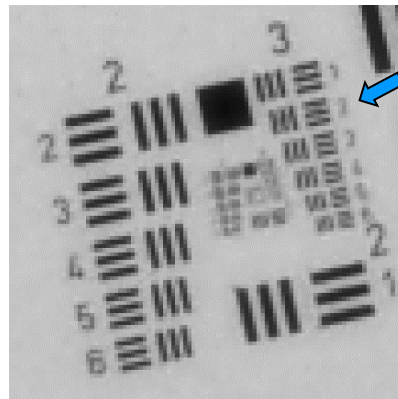
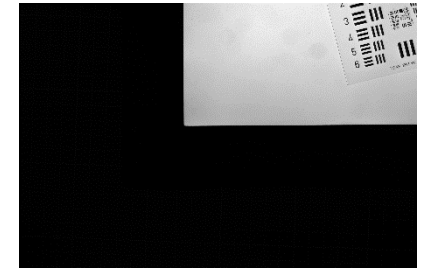
Center



Edge



Corner



USAF element:	3/2	3/2	3/2
Line width (μ m):	55.68	55.68	55.68
Lp/mm (object):	9	9	9
Magnification:	0.052	0.052	0.052
Lp/mm (image):	174	174	174

WD 250 mm lens @ 2.69 dpt , F/2.8

Resolution close to Nyquist limit

Camera

Sensor size = 5472×3648 pixels

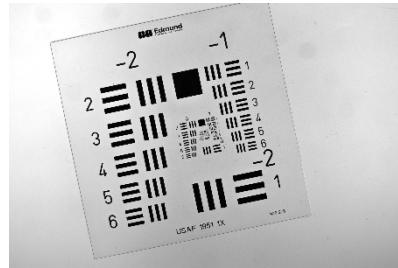
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

Light

White background illumination

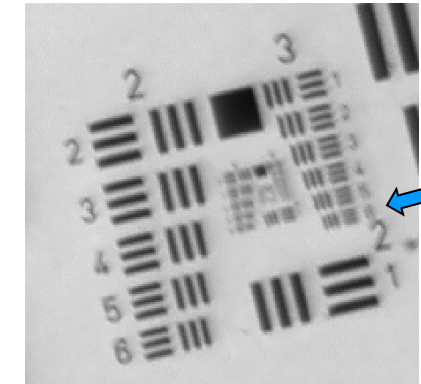
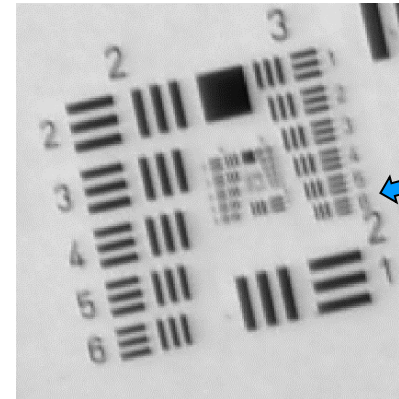
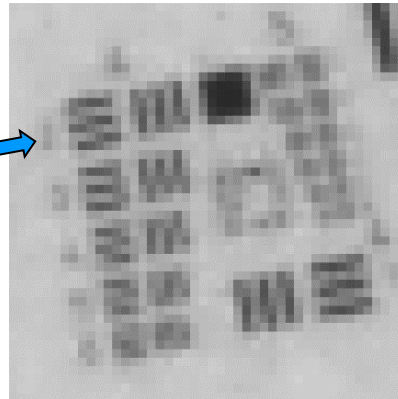
Center



Edge



Corner



USAF element: 4/2
 Line width (μ m): 27.84
 Lp/mm (object): 18
 Magnification: 0.095
Lp/mm (image): 189

3/6
 35.08
 14
 0.091
157

3/6
 35.08
 14
 0.091
157

WD 500 mm, lens @ 1.22 dpt, F/2.8

Optical axis horizontal, gravity coma visible

Camera

Sensor size = 5472×3648 pixels

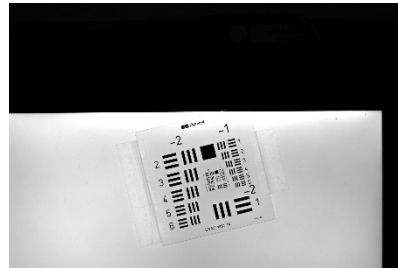
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

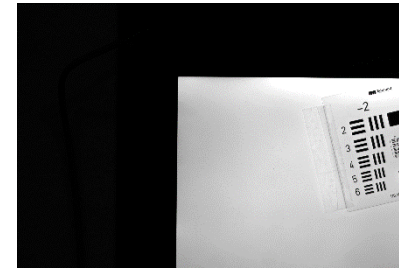
Light

White background illumination

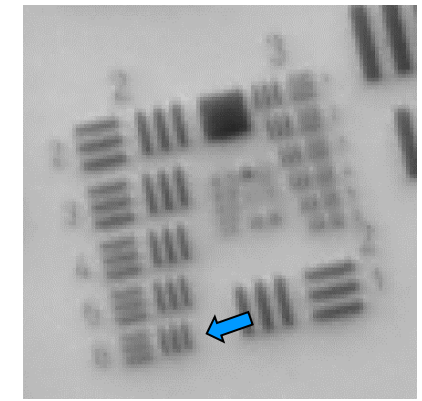
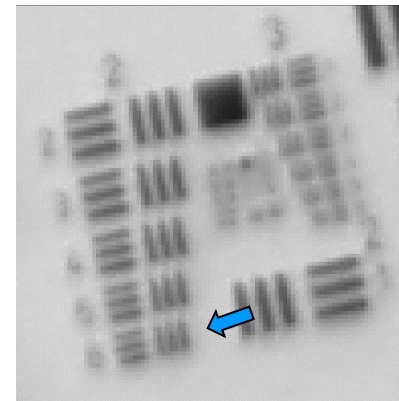
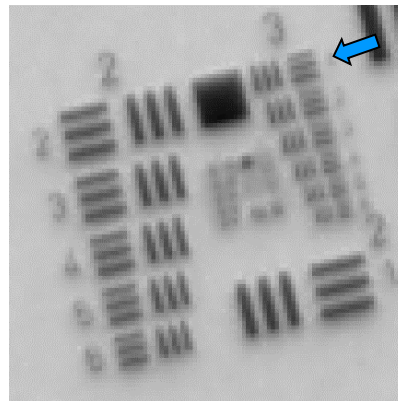
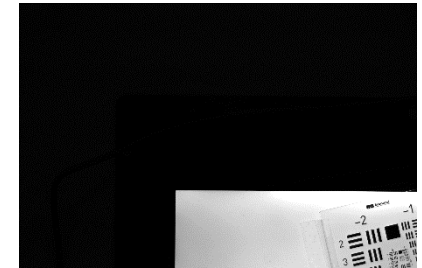
Center



Edge



Corner



USAF element:	3/1	2/6	2/6
Line width (μ m):	62.5	70.15	70.15
Lp/mm (object):	8	7	7
Magnification:	0.051	0.051	0.051
Lp/mm (image):	158	141	141

WD 500 mm, lens @ 1.22 dpt, F/4.0

Optical axis horizontal: no more gravity coma

Camera

Sensor size = 5472×3648 pixels

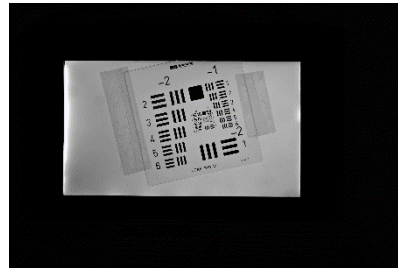
Nyquist limit = 208 lp/mm

Pixel size = 2.4 μm

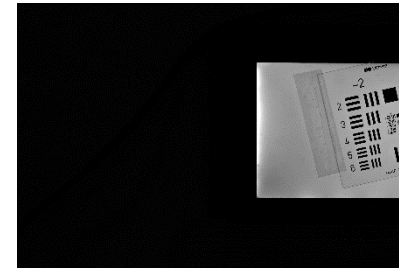
Light

White background illumination

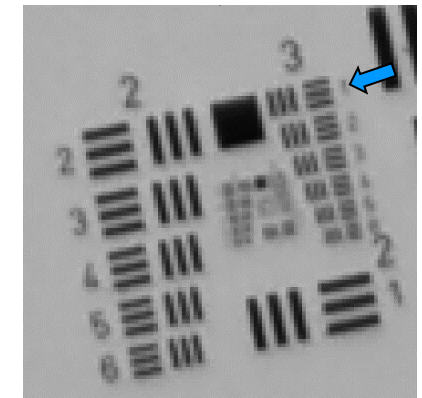
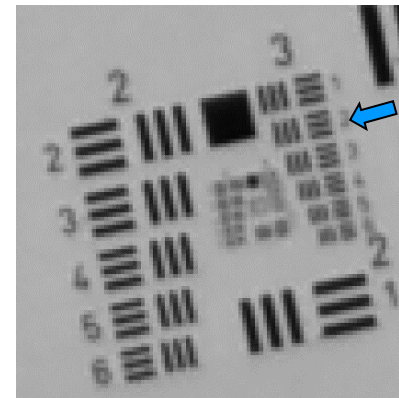
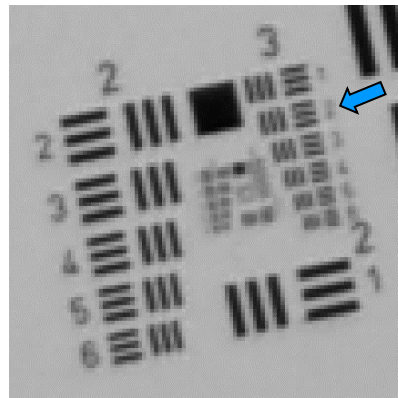
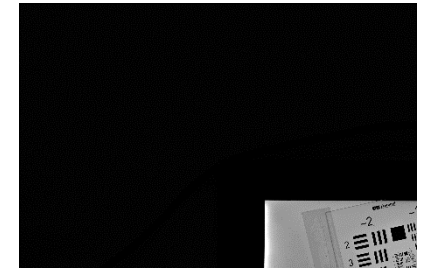
Center



Edge



Corner



USAF element:	3/2	3/2	3/1
Line width (μm):	55.68	55.68	62.5
Lp/mm (object):	9	9	8
Magnification:	0.051	0.051	0.051
Lp/mm (image):	177	177	158

WD 500 mm, lens @ 1.22 dpt, F/5.6

Optical axis horizontal, no gravity coma, but diffraction limit reached off-center

Camera

Sensor size = 5472×3648 pixels

Nyquist limit = 208 lp/mm

Pixel size = 2.4 μ m

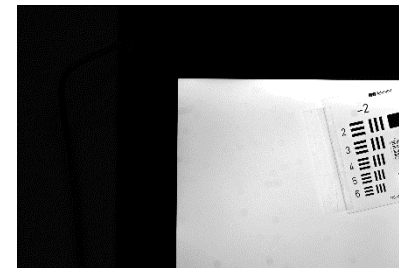
Light

White background illumination

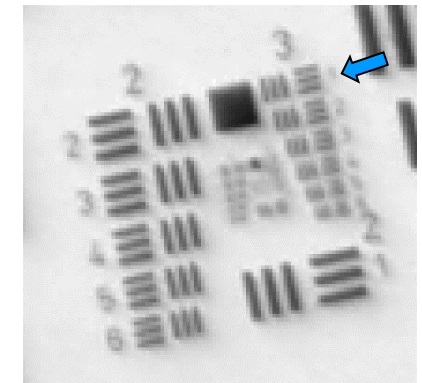
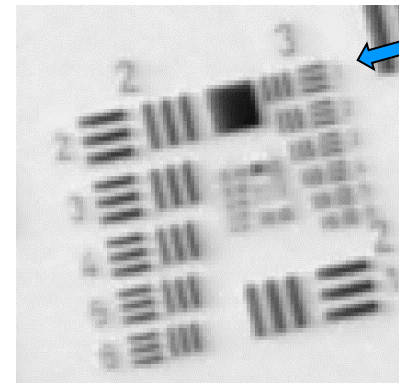
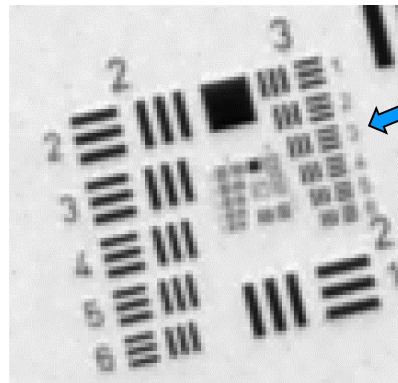
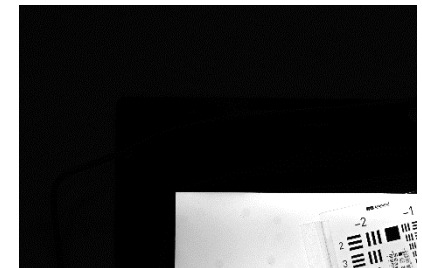
Center



Edge



Corner

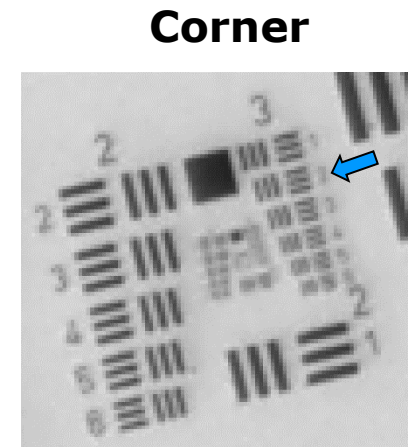
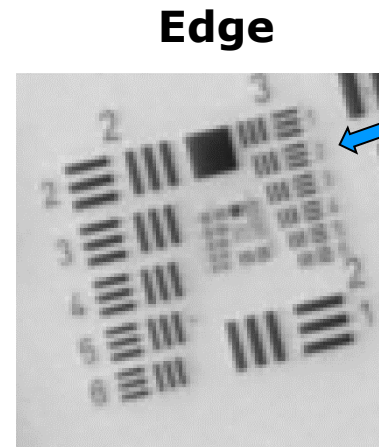
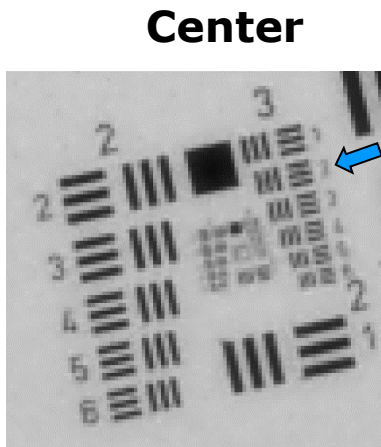


USAF element:	3/2	3/1	3/1
Line width (μ m):	55.68	62.5	62.5
Lp/mm (object):	9	8	8
Magnification:	0.051	0.051	0.051
Lp/mm (image):	177	158	158

Monochromatic performance is better (WD 500, lens @1.22dpt, F/4)

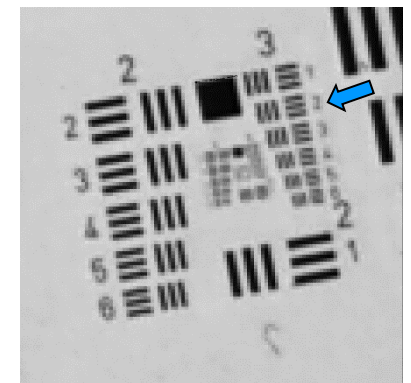
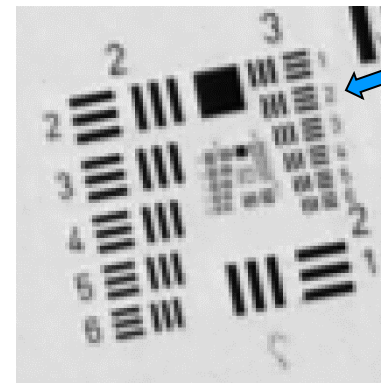
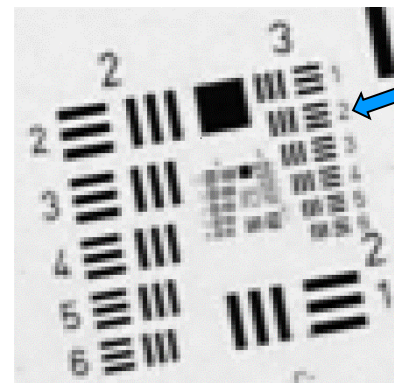
White backlight

+ Similar resolution



Red backlight

+ Higher contrast



USAF element (white): 3/2
Lp/mm (image, white): 174

3/2
174

3/2
174

USAF element (red): 3/2

3/2

3/2