



shaping the future of optics

Optotune ELM-12-4.0-18-C

Test report

October 2025
Amir Saba, Application Engineer

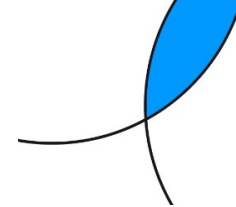
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Summary

- **Working distance (WD) range of 200mm-Inf (Shorter WD possible)**
- **Performance close to the Nyquist rate of 2.74 μ m pixel size**
 - Resolution >140 lp/mm across the field and WD tuning range
 - Resolution >170 lp/mm under certain conditions
- **FP-sensitivity: 200mm-Inf WD with only 2.1dpt**
- **Negligible field curvature and distortion**
 - Maximum 2.7% of Geometrical distortion across the field
- **Vignetting level of ~24%: reasonable for such a wide-angle lens**
- **No resolution degradation due to the gravity-coma for horizontal optical axis**
- **Very good polychromatic performance**
 - Performance very similar between white and blue backlights



ELM-12-4.0-18-C Datasheet



Lens module specifications

EL-7-20-TC-VIS-14D

Effective focal length	12.9	mm
F/# (fixed)	4.0	
Maximum sensor format	1.1	inch
Maximum image circle (Φ)	18	mm
Lifecycles (10-90% sinusoidal)	>1'000'000'000	cycles
FOV for 1.1" sensor	Diagonal	72.1 °
	Horizontal	53.6 °
	Vertical	53.6 °
Back focal length (BFL)	11.46	mm (in air)
Optical distortion	<3.7	%
Pixel size (recommended)	2.74	μm
Wavelength range	420-900	nm
Relative illumination	>72	%
Max chief ray angle	6.5	°
Working distance (WD) range ¹	200 to inf	mm
Optimal WD	500	mm
WD at 0 dpt	1000	mm
Mount	C-mount	
Filter thread	M60.5 x 0.5	
Connector type	Hirose (6 pins)	
Total track length (TTL)	94.0	mm
Dimension (Φ x L)	63.0 x 82.5	mm
Weight	306	g
Operating temperature	-20 to +65	°C
Storage temperature	-50 to +85	°C

Focus tunable lens specifications

EL-7-20-TC-VIS-14D

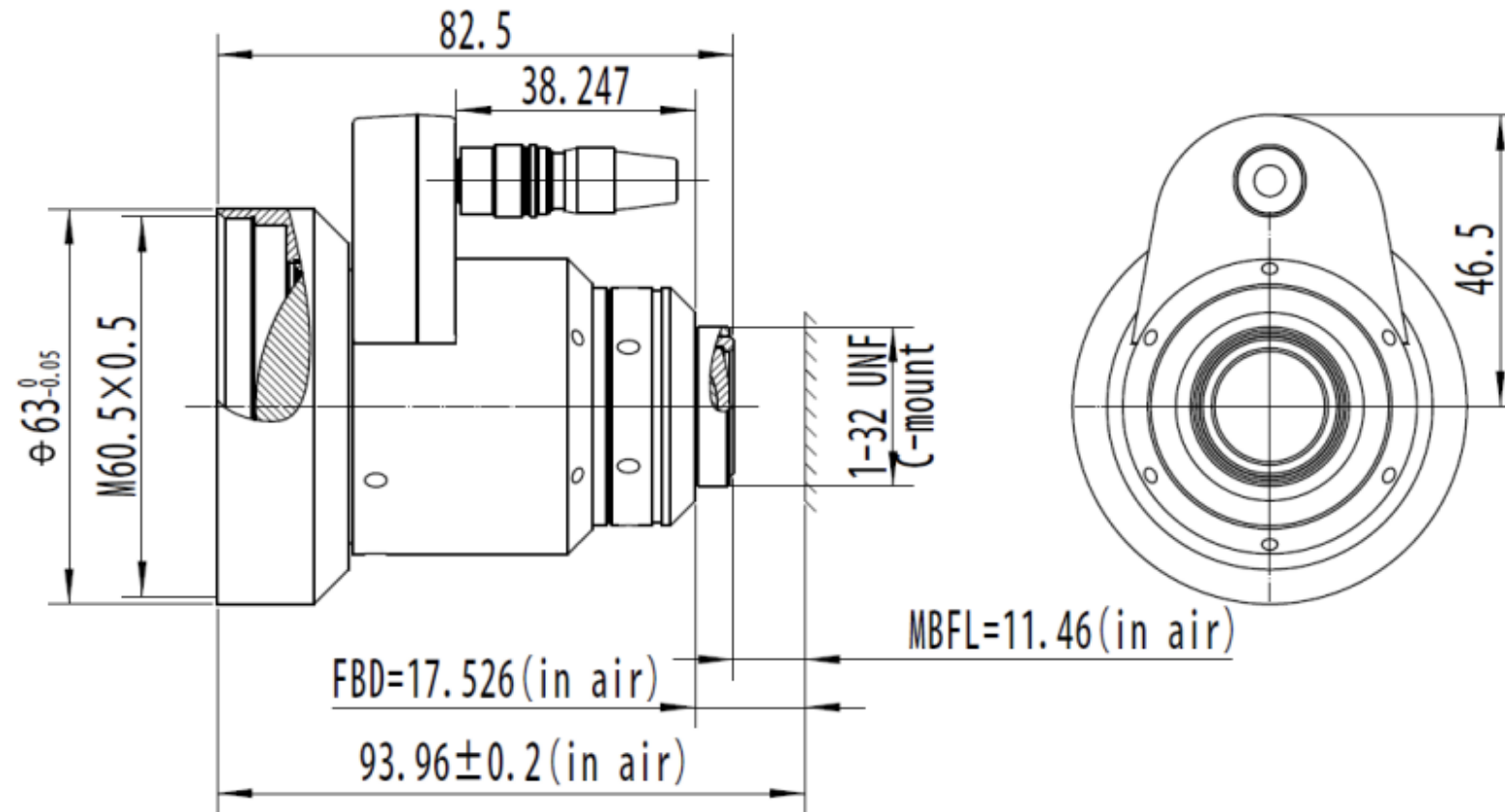
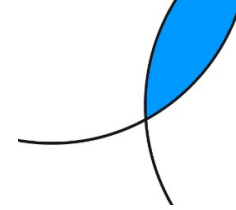
Focal power range (@25°C)	-6 to +8	dpt
Focal power range for module WD range	-0.6 to +2.0	dpt
Temperature sensor and EEPROM	Yes	
Control current (typical)	-250 to +250	mA
Max. control current	-300 to +300	mA
Motor coil resistance @ 30°C	12	Ω
Absolute maximum voltage (coil)	6	V

Electrical layout

Hirose connector (HR10G-7R-6PB)	Function	Sensor pins	
Pin 1	Control current +	-	
Pin 2	Control current -	-	
Pin 3	Ground	1-4	
Pin 4	Vcc (3.0-3.7V)	8	
Pin 5	I ² C SCL	6	
Pin 6	I ² C SDA	5	

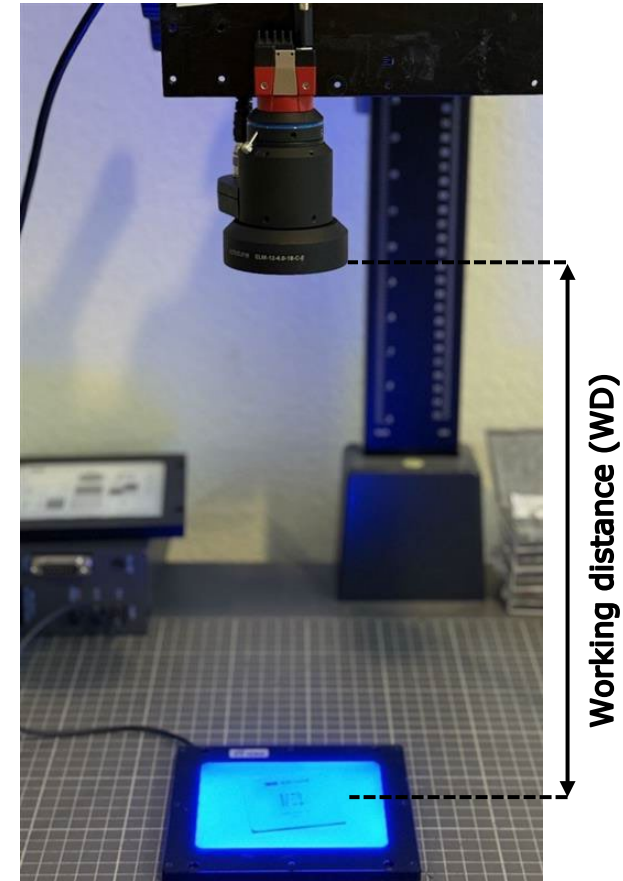
Hirose connector (HR10G-7R-6SB)	Function	Value	
Pin 1	GPIO Trigger	-	
Pin 2	Analog In	0-10V	
Pin 3	UART Tx / I ² C SCL	TTL	
Pin 4	UART Rx / I ² C SDA	TTL	
Pin 5	GND	-	
Pin 6	Vcc	5-24V	

Mechanical drawing



Test Setup

Camera:	Alvium 1800 C-2040 1.1" 4512 x 4512 px Pixel size = 2.74 μ m Nyquist rate = 182 lp/mm C-mount
Lens:	ELM-12-4.0-18-C
Tunable lens:	EL-7-20-TC-VIS-14D SN: DHAA0262
Orientation:	Vertical Optical Axis
Driver:	ECC-1C SN: CXAB1447, FW: 2.0.741648
Target:	USAF chrome target, positive
Light:	White backlight (LED1-FLS-110x110W) Blue backlight



Field of view with 1.1" sensor

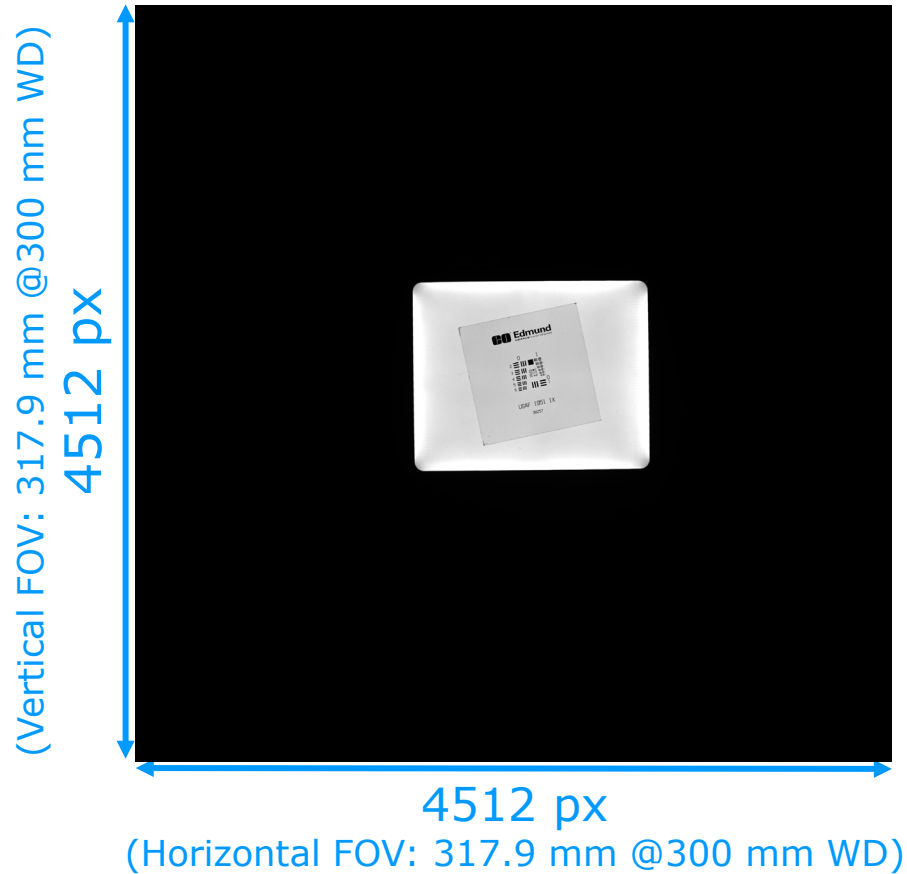
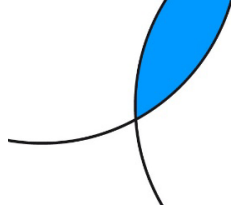
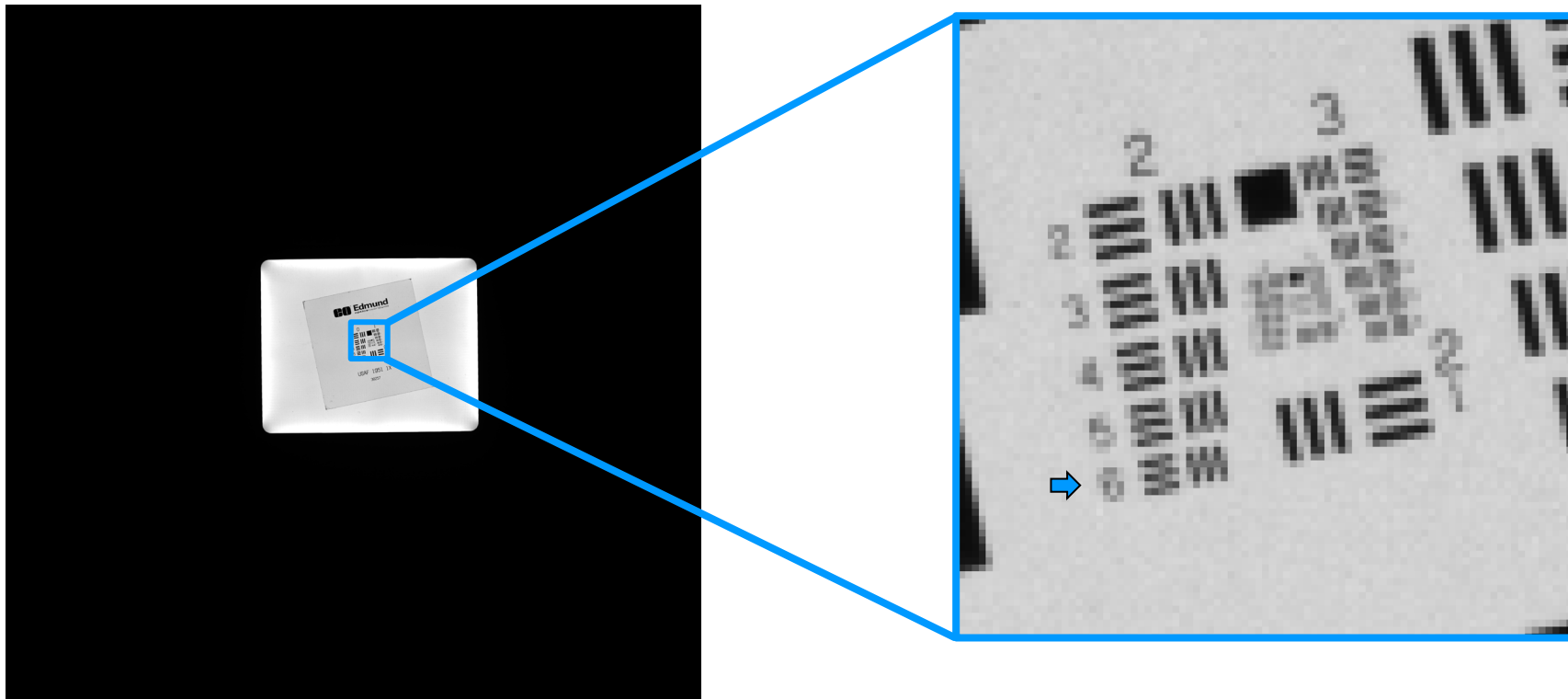


Image size (2.74 μm pixel size):

- Width = 12.4 mm
- Height = 12.4 mm
- Diagonal = 17.5 mm

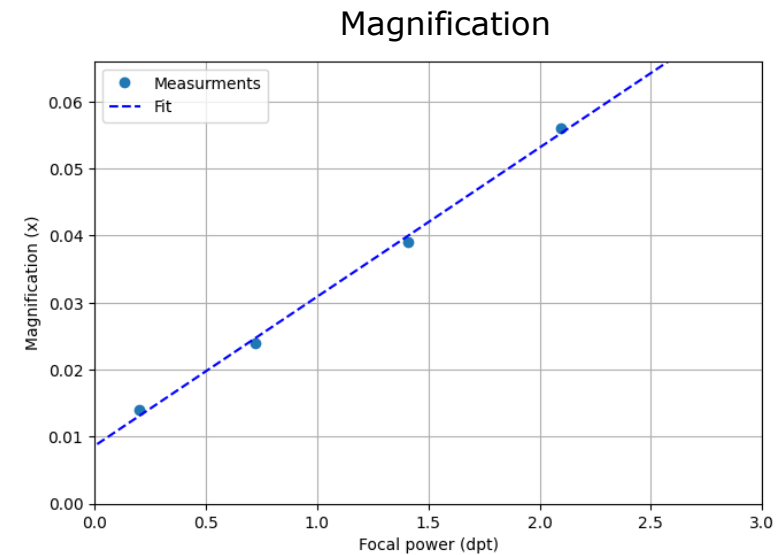
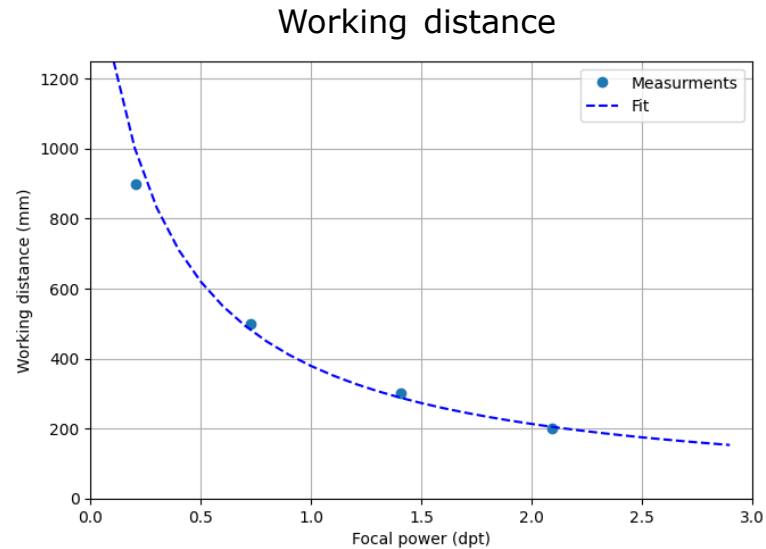
Image evaluation

- All the images are taken at Gain 0, and without gamma correction
- The intensity of illumination is controlled to adjust the histogram of the images
- After acquisition, images are zoomed in to show the resolution-limited element



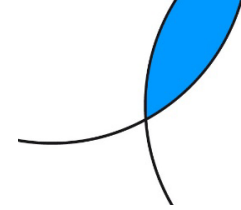
Working distance, Magnification

- Magnification and working distance of this ELM is very well aligned with an ento-centric lens



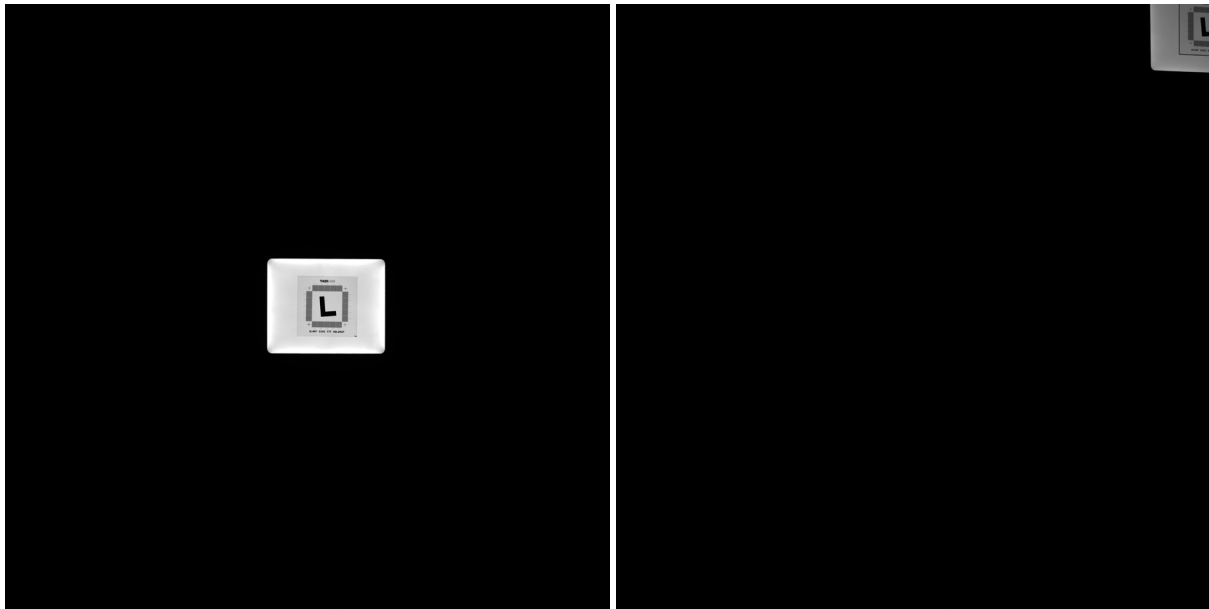
- * Measured with blue LED backlight
- * Magnification measured at the center of the image

Slanted-Edge MTF

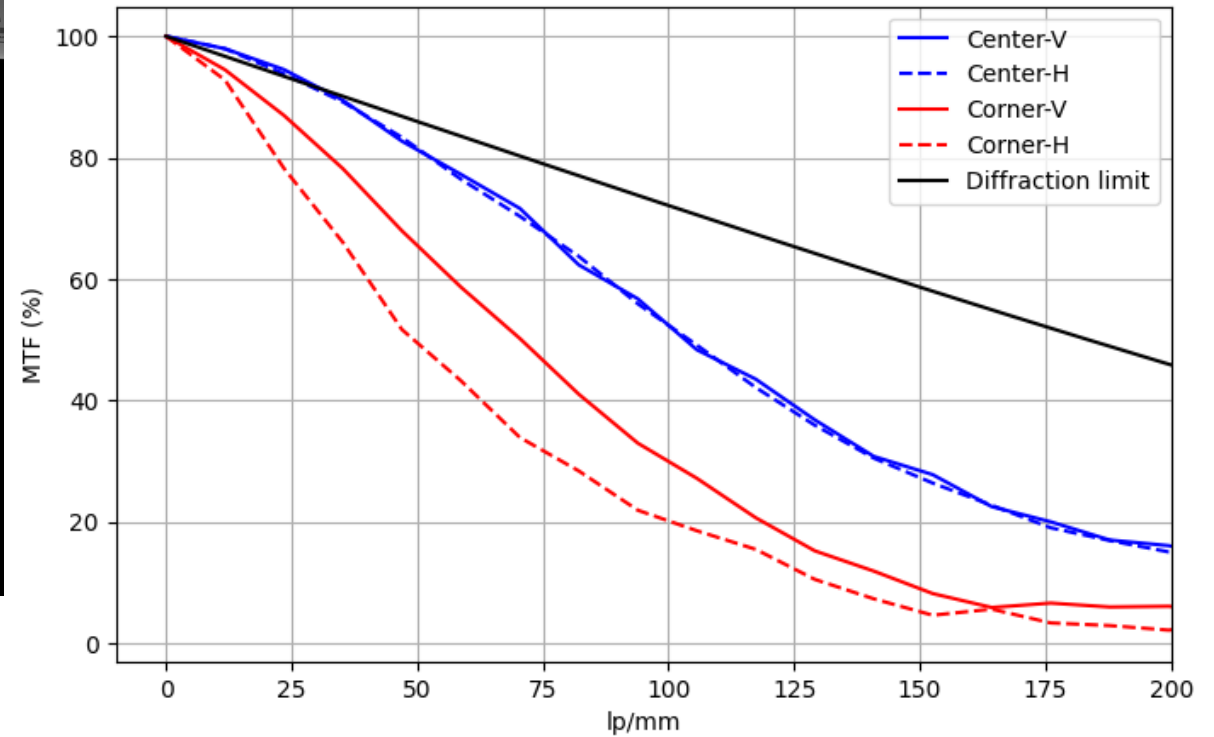


Center

Corner

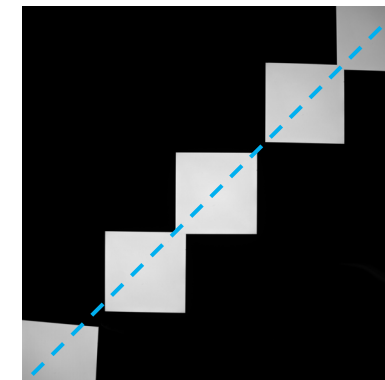
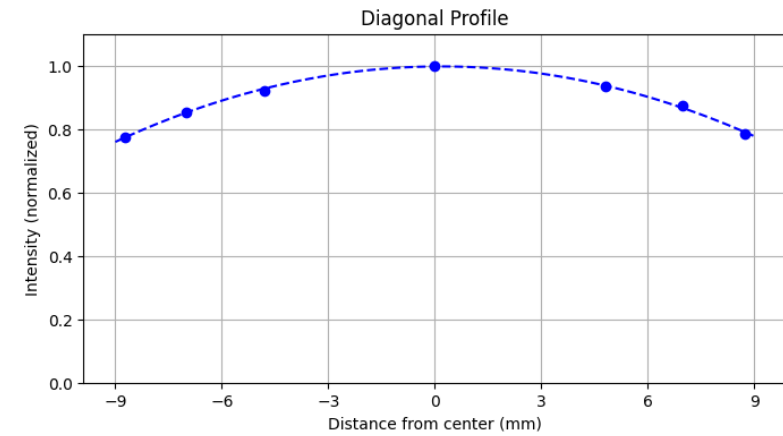
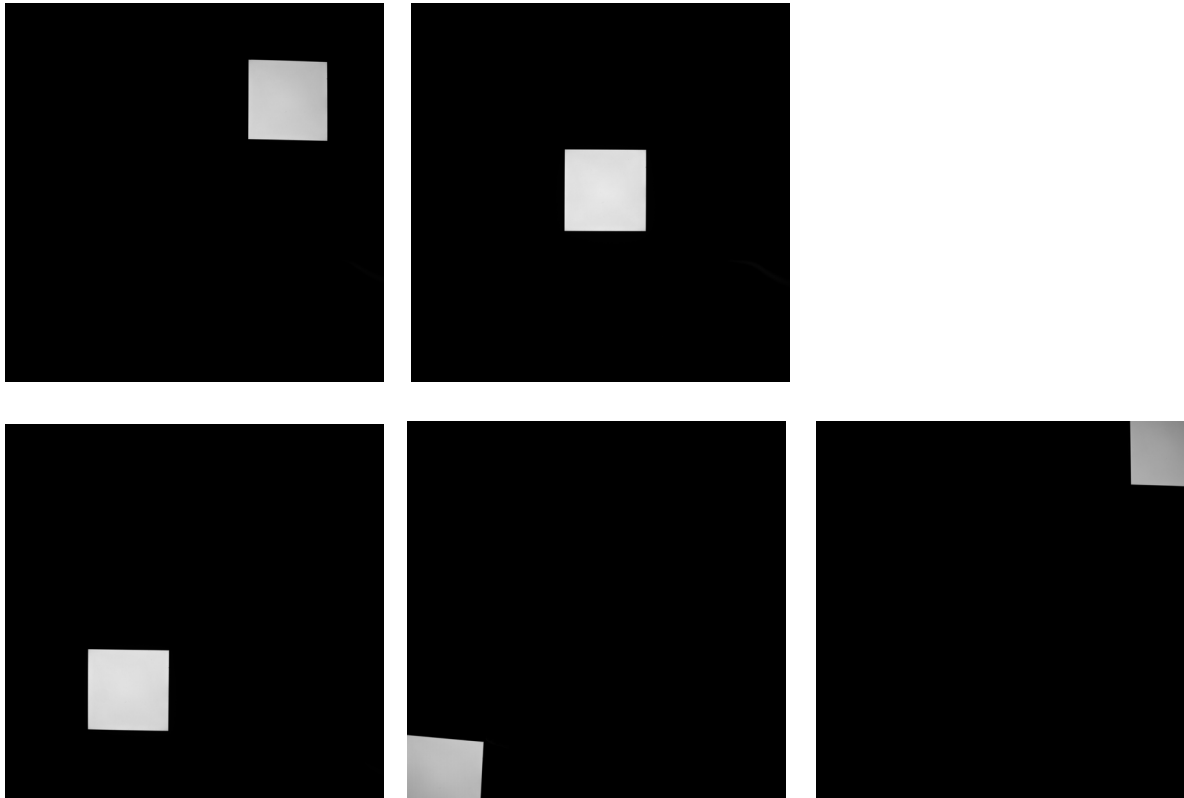


*Images taken with the blue LED at WD 500mm



Relative illumination

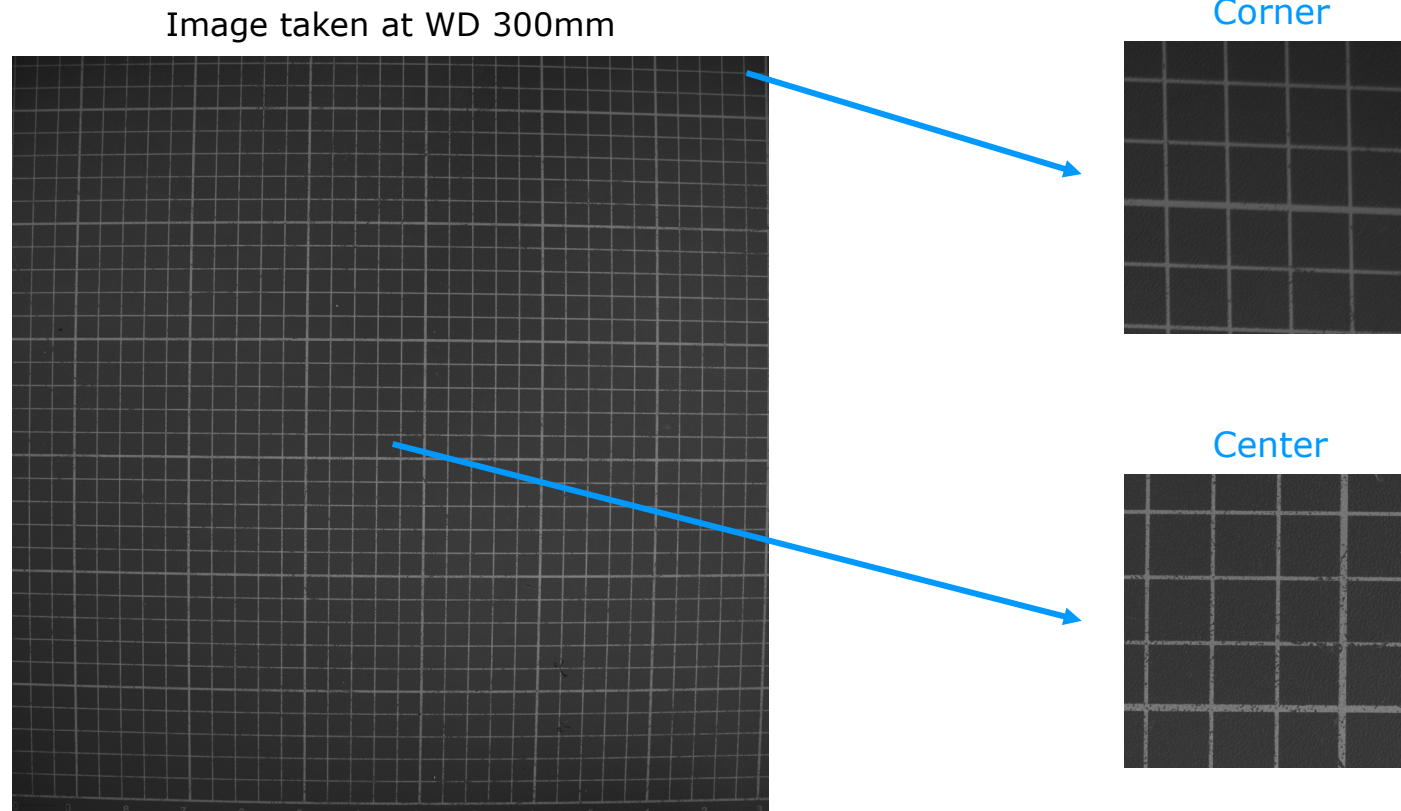
- Due to the wide-angle FOV, we did image stitching for multiple measurements with a uniform LED
- Vignetting of this ELM is 0.40EV (24%) for 1.1" sensor
- There is a negligible dependence to the focal power/WD for the vignetting



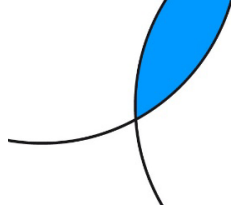
*Images taken at WD 500mm

Distortion and field curvature

- We see some distortion and slight value of field curvature
- Geometrical distortion value: **2.7%**



WD 900 mm: +0.20dpt, Blue light Performance is close to Nyquist limit



Camera

Sensor size = 4512 x 4512 px

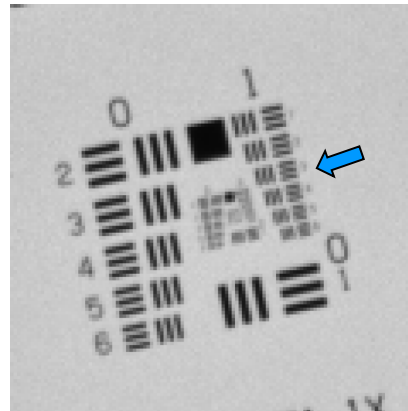
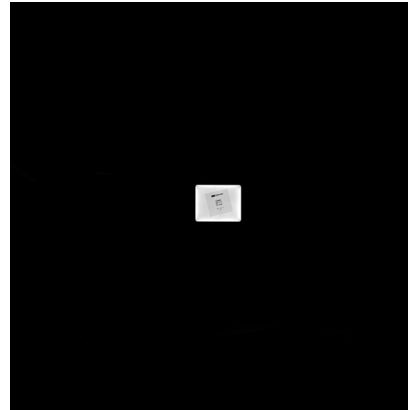
Pixel size = 2.74 μm

Nyquist limit = 182 lp/mm

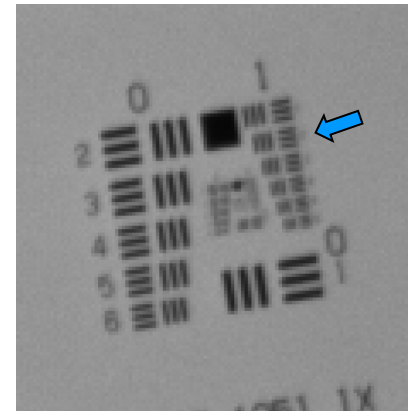
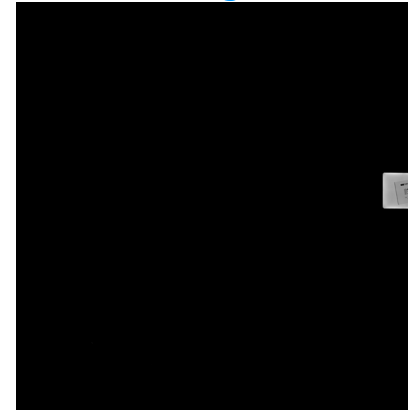
Light

Blue background illumination

Center



Edge



Corner

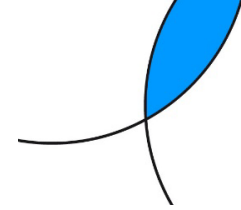


USAF element:	1/3
Line width (μm):	198.43
Lp/mm (object):	3
Magnification:	0.014
Lp/mm (image):	180

USAF element:	1/2
Line width (μm):	222.72
Lp/mm (object):	2
Magnification:	0.013
Lp/mm (image):	173

USAF element:	1/1
Line width (μm):	250
Lp/mm (object):	2
Magnification:	0.013
Lp/mm (image):	154

WD 500 mm: +0.73dpt, Blue light Performance is close to Nyquist limit



Camera

Sensor size = 4512 x 4512 px

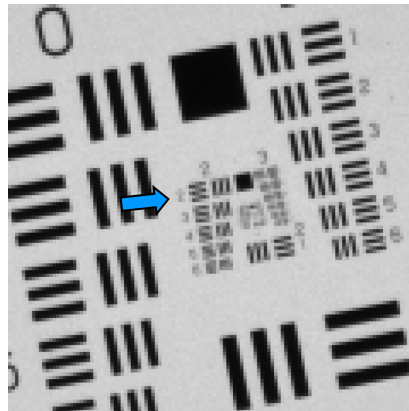
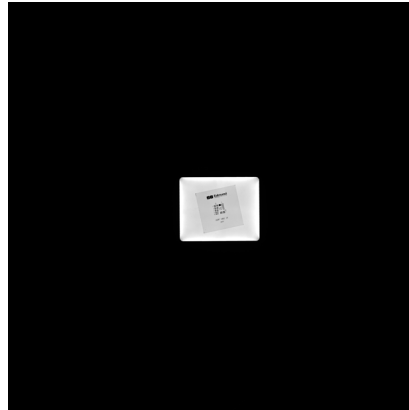
Pixel size = 2.74 μm

Nyquist limit = 182 lp/mm

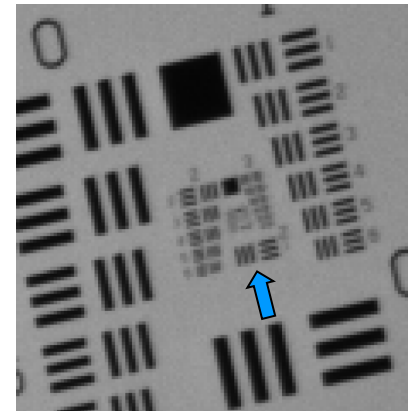
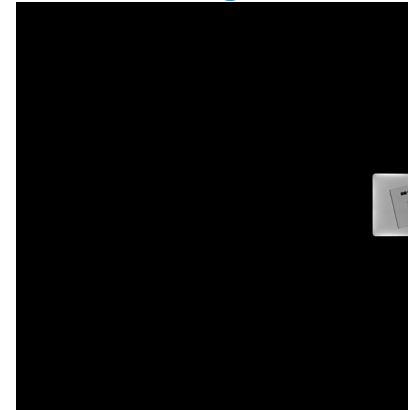
Light

Blue background illumination

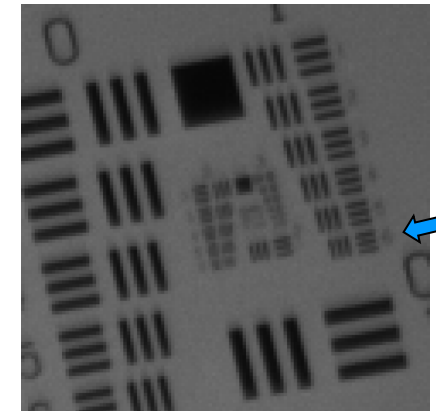
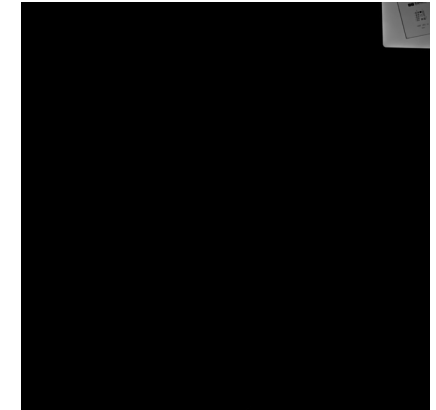
Center



Edge

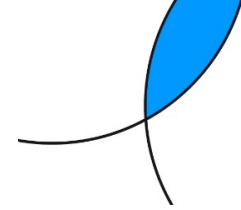


Corner



USAF element:	2/2	2/1	1/6
Line width (μm):	111.36	125	140.31
Lp/mm (object):	4	4	4
Magnification:	0.024	0.023	0.022
Lp/mm (image):	187	174	162

WD 300 mm: +1.41dpt, Blue light Performance is close to Nyquist limit



Camera

Sensor size = 4512 x 4512 px

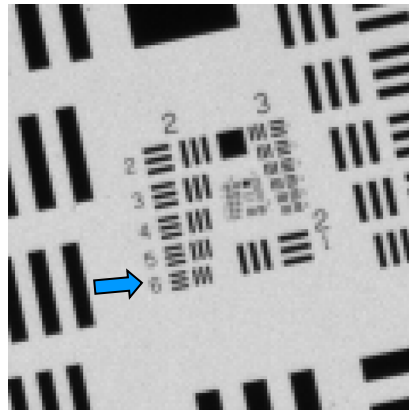
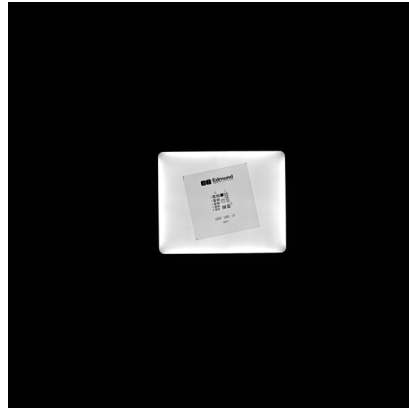
Pixel size = 2.74 μm

Nyquist limit = 182 lp/mm

Light

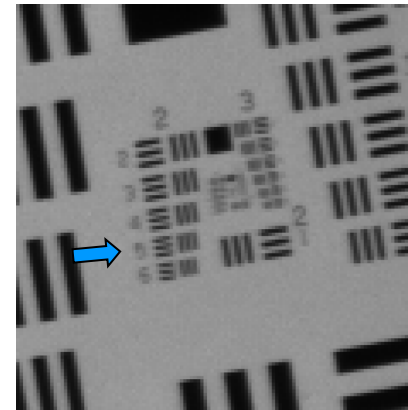
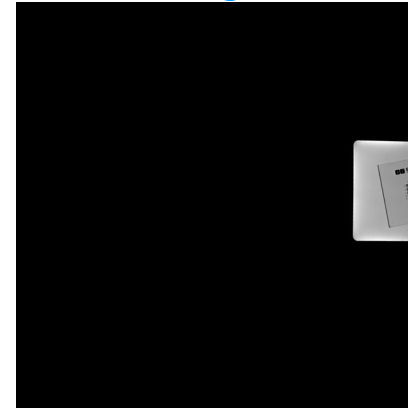
Blue background illumination

Center



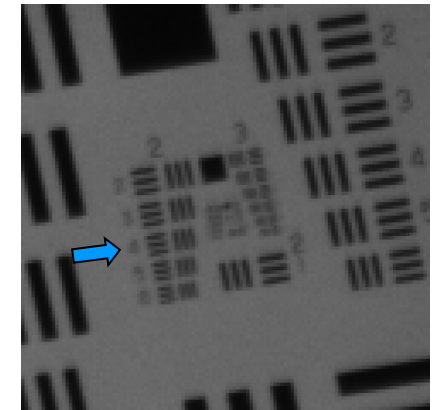
USAF element:	2/6
Line width (μm):	70.15
Lp/mm (object):	7
Magnification:	0.039
Lp/mm (image):	182

Edge



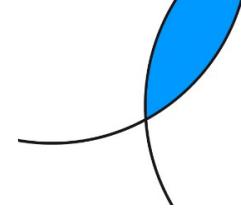
USAF element:	2/5
Line width (μm):	78.75
Lp/mm (object):	6
Magnification:	0.037
Lp/mm (image):	172

Corner



USAF element:	2/4
Line width (μm):	88.39
Lp/mm (object):	6
Magnification:	0.036
Lp/mm (image):	157

WD 200 mm: 2.17dpt, Blue light Performance is close to Nyquist limit



Camera

Sensor size = 4512 x 4512 px

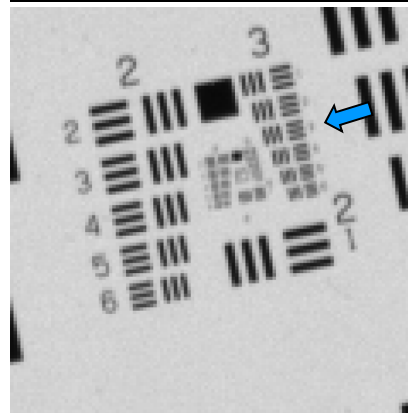
Pixel size = 2.74 μm

Nyquist limit = 182 lp/mm

Light

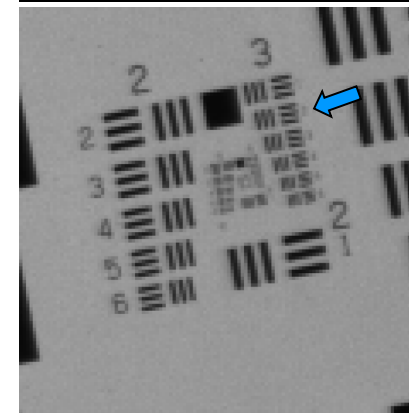
Blue background illumination

Center



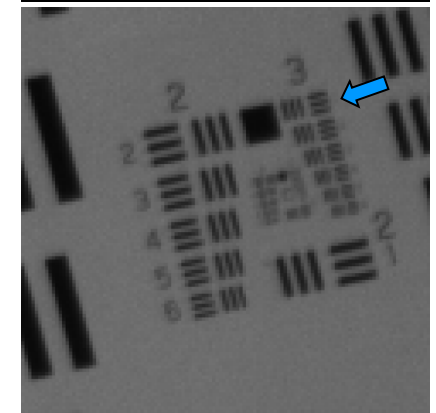
USAF element:	3/3
Line width (μm):	49.61
Lp/mm (object):	10
Magnification:	0.056
Lp/mm (image):	182

Edge



USAF element:	3/2
Line width (μm):	55.68
Lp/mm (object):	9
Magnification:	0.052
Lp/mm (image):	173

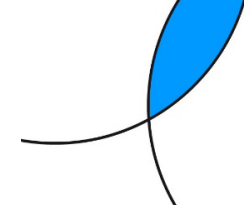
Corner



USAF element:	3/1
Line width (μm):	62.5
Lp/mm (object):	8
Magnification:	0.051
Lp/mm (image):	156

Polychromatic performance: White LED vs. Blue LED

WD 500mm, +0.73dpt



Camera

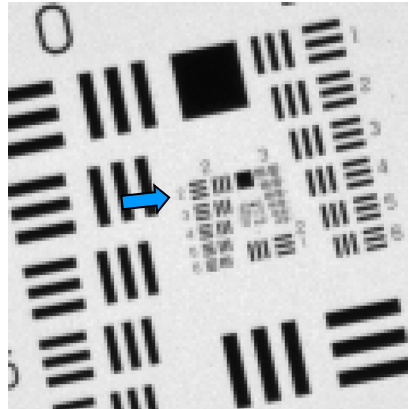
Sensor size = 4512 x 4512 px

Pixel size = 2.74 μm

Nyquist limit = 182 lp/mm

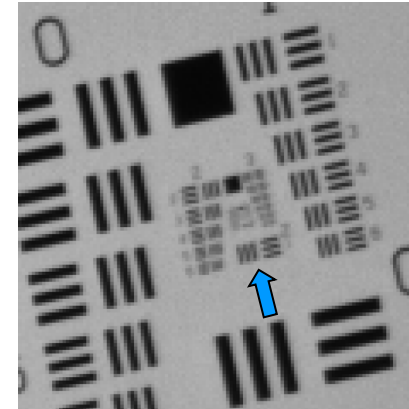
Blue

Center



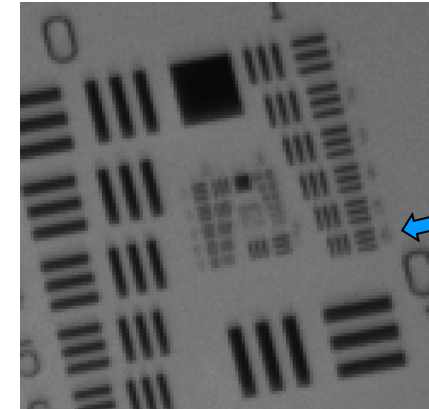
187 LP/mm

Edge



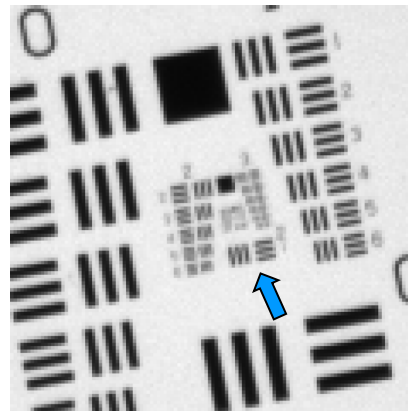
174 LP/mm

Corner

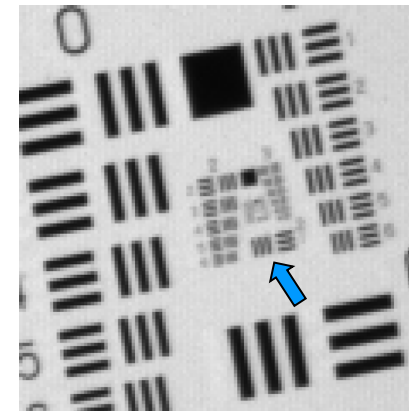


162 LP/mm

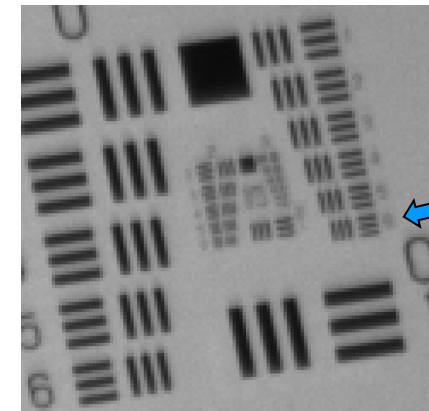
White



167 LP/mm



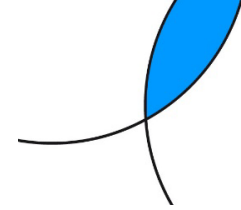
167 LP/mm



155 LP/mm

Vertical vs. Horizontal optical axis

WD 500mm, +0.73dpt, White LED



Camera

Sensor size = 4512 x 4512 px

Pixel size = 2.74 μm

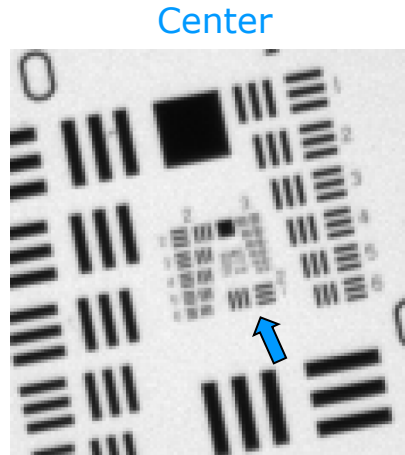
Nyquist limit = 182 lp/mm

Light

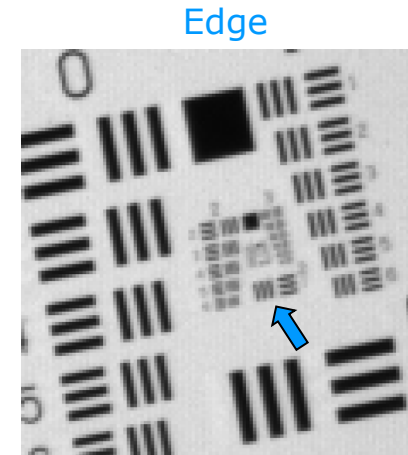
White background illumination

EL-7-20 Gravity coma: 0.05λ

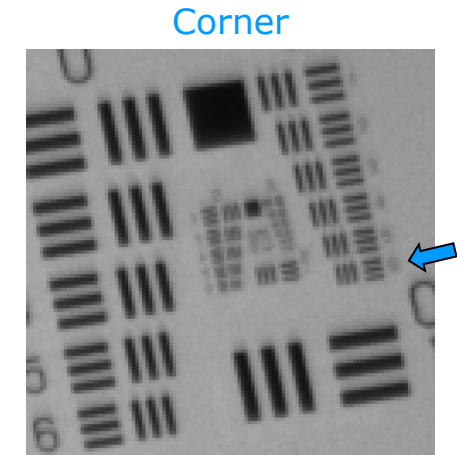
Vertical OA



167 LP/mm

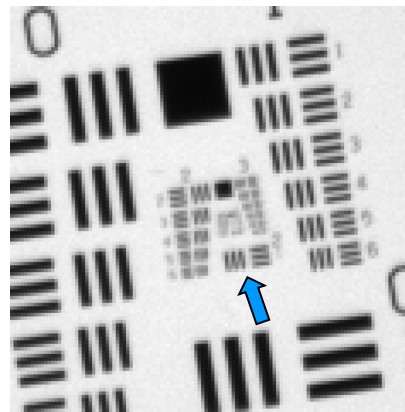


167 LP/mm

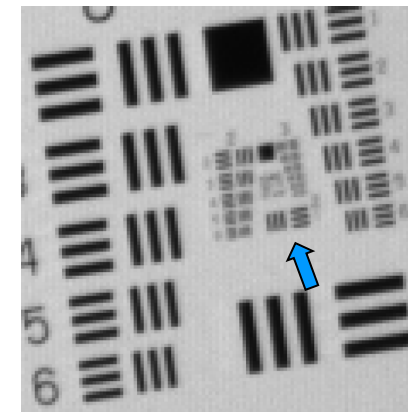


155 LP/mm

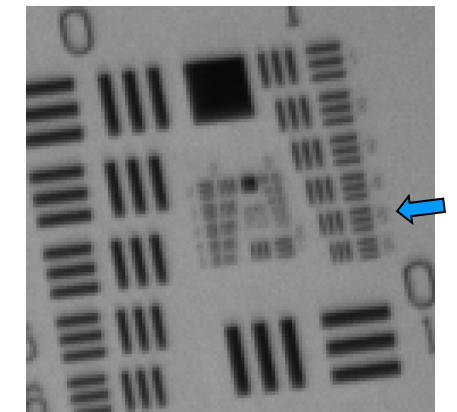
Horizontal OA



167 LP/mm



167 LP/mm



144 LP/mm