EL-16-40-TC-VIS-5D-M42 image analysis

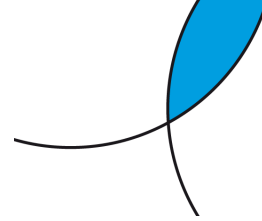## with SK Apo-Componon 4-60 and Dalsa Genie TS-M4096

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Summary

After adding the EL-16 to the optical setup:

- WD range: from 1100mm @-2dpt to 380mm @3dpt
- Distortion unchanged
- Resolution equally good
- No added vignetting
- Slight resolution loss in the corners

Note: Infinite focus is possible by using only 8mm instead of 13mm of spacers at the back.

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Glossary

- **Aperture size** is given in units written on the SK objective (ranging from 1 to 6), where S1 is the most open (F/4) and S6 the most closed aperture setting

- WD: **Working Distance**. Measured distance between image sensor and target

- EL-16: Short for EL-16-40-TC-VIS-5D-M42 in this report

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Setup

General Setup & Lighting:

~600mm WD

All images were taken using 4 LED panel illumination

Dalsa Genie TS-M4096 camera (30.7mm diagonal)

Schneider Apo-Componon 60mm objective

Setup without EL-16:

30.1mm + 13mm tube

Setup with EL-16:

13mm M42 thread tube

Lens in 30.1mm spacer configuration
Serial Number ANAA0206

Objective Base – EL-16 base distance: 8.2mm

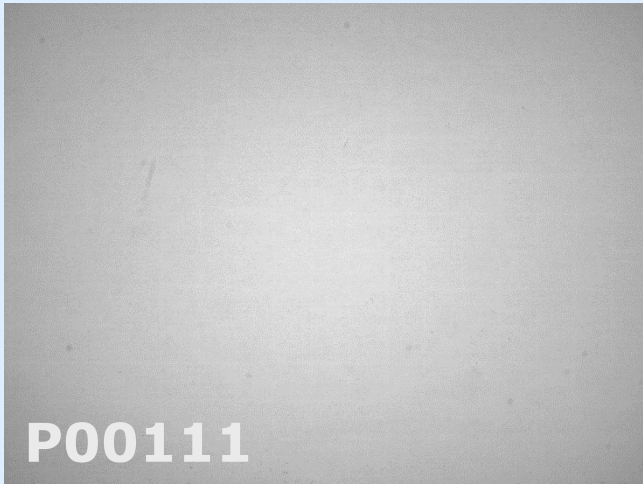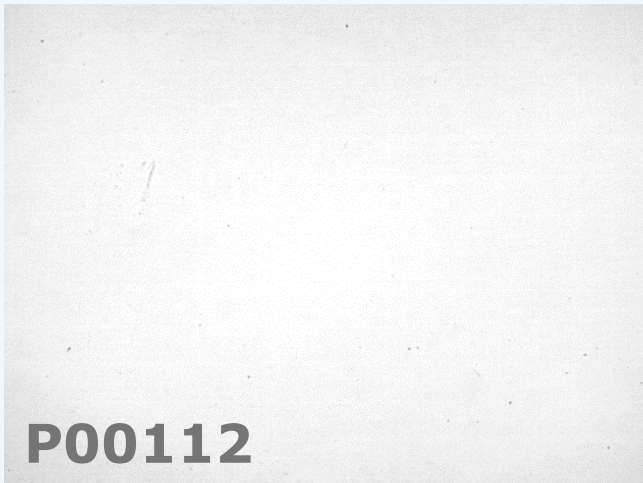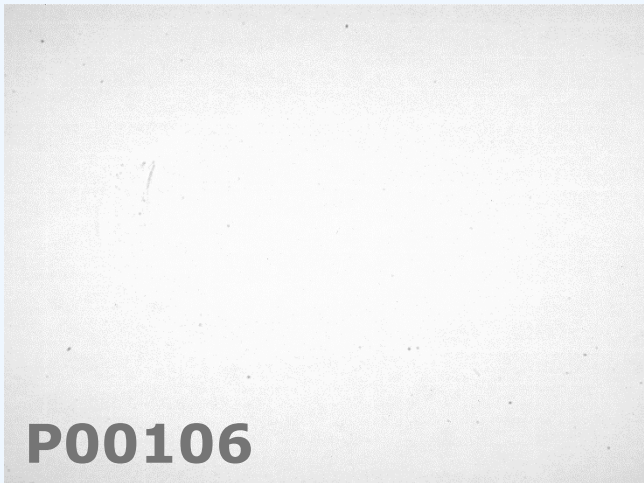13mm of spacers M42x0.1 ——

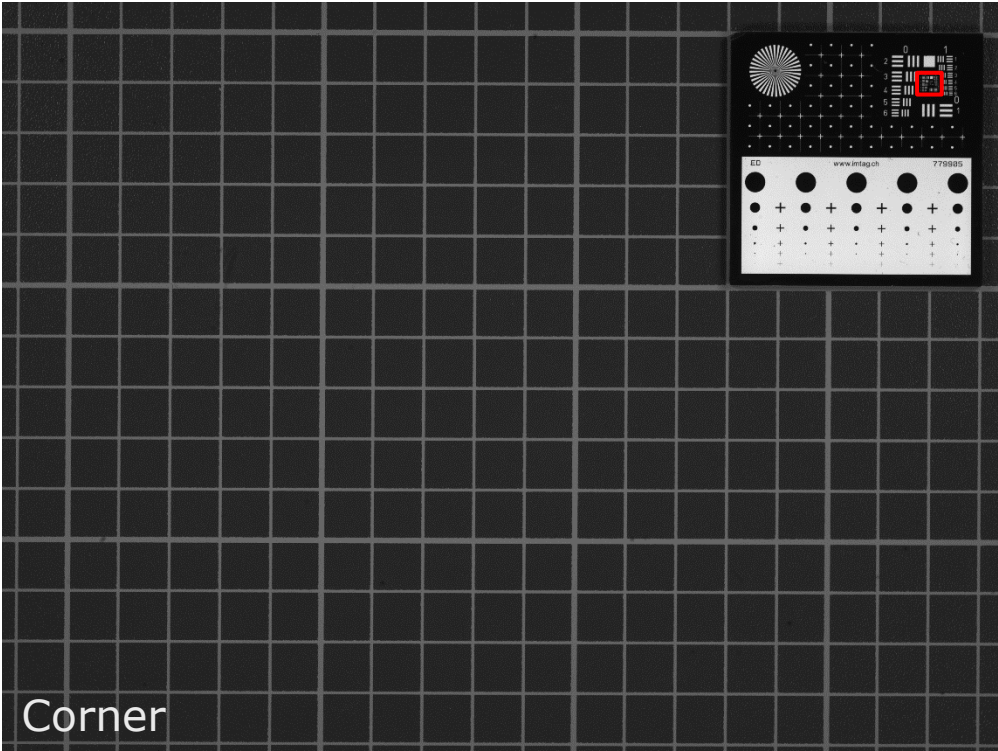EL-16-40-TC-M42 ——

8mm spacer ——

Apo-Componon ——
60mm lens

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Only slight increase in vignetting for lowest f-number

	Without EL-16	With EL-16
S1	P00111	P00105
S3.5	P00112	P00106

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Complete resolution test scene with EL-16
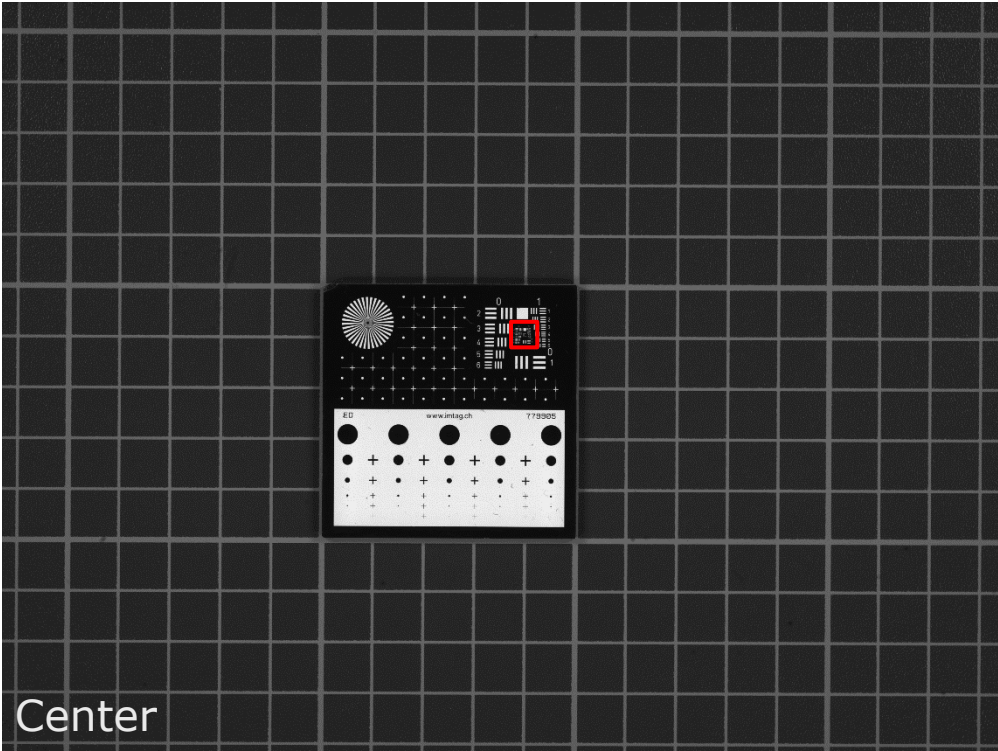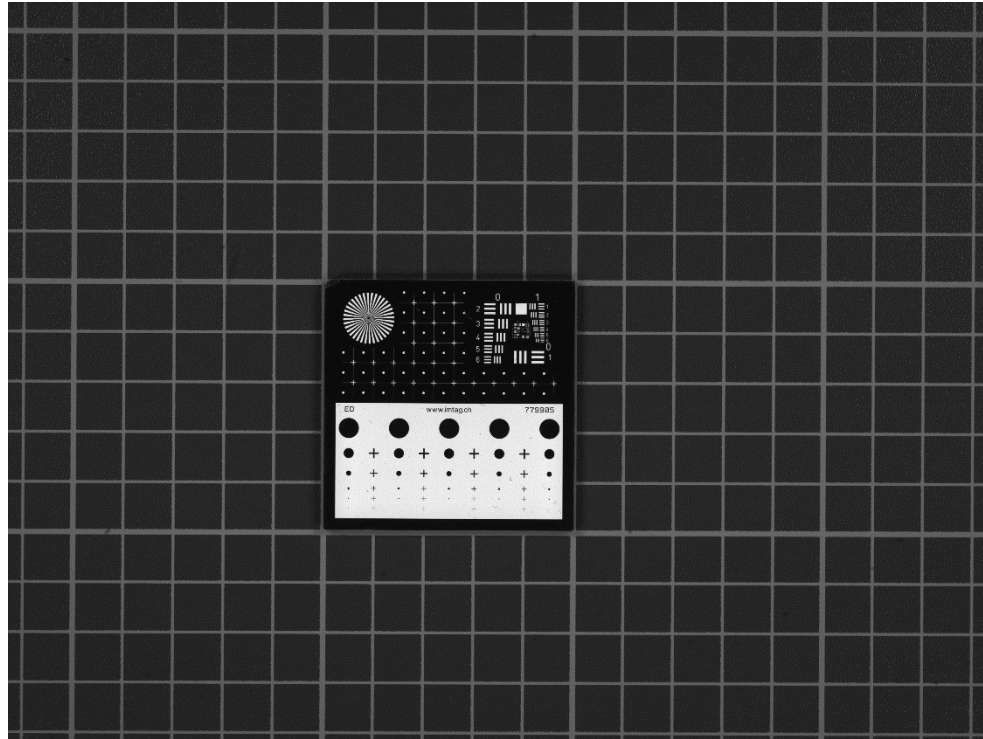

Center

Corner

The red rectangles mark the crop areas of the following images

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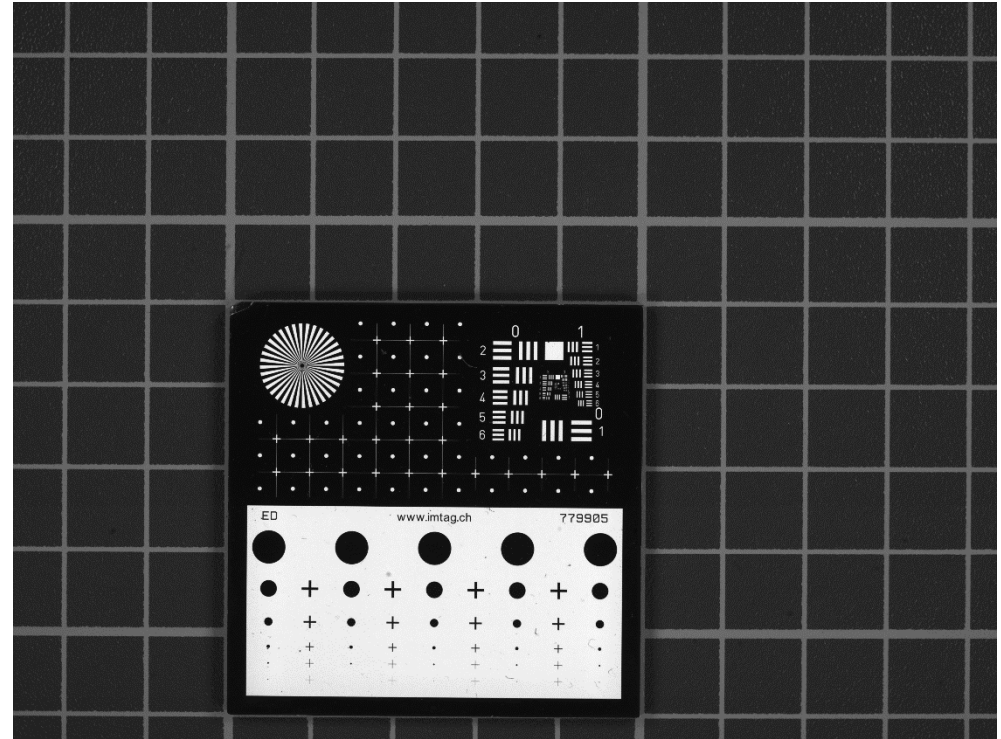# Resolution with EL-16: Equally good in the center, slight drop in the corners

	Without EL-16	With EL-16 @ 0dpt
Center	P00113	P00107
Corner	P00114	P00108

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Long WD: WD change of 230mm with lens tuning from 0 to 3 dpt

P00107

EL-16 @ 0dpt
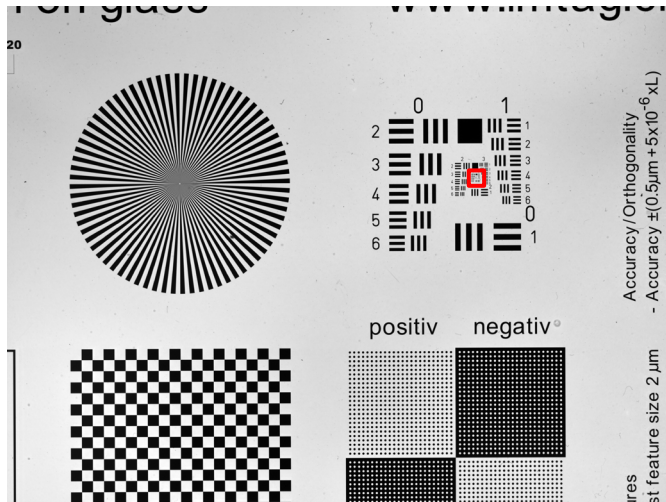
WD: 610mm

HFOV: 195mm

Mag: 0.15X

P00109

EL-16 @ 3dpt
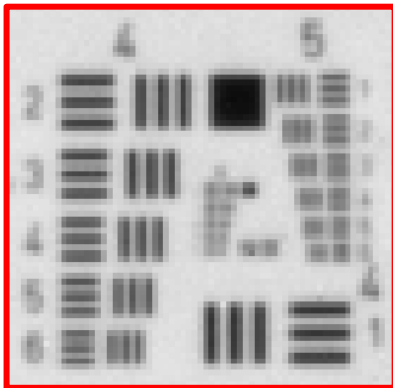
WD: 380mm

HFOV: 110mm

Mag: 0.22X

Note: Infinite focus is possible by using only 8mm instead of 13mm of spacers at the back.

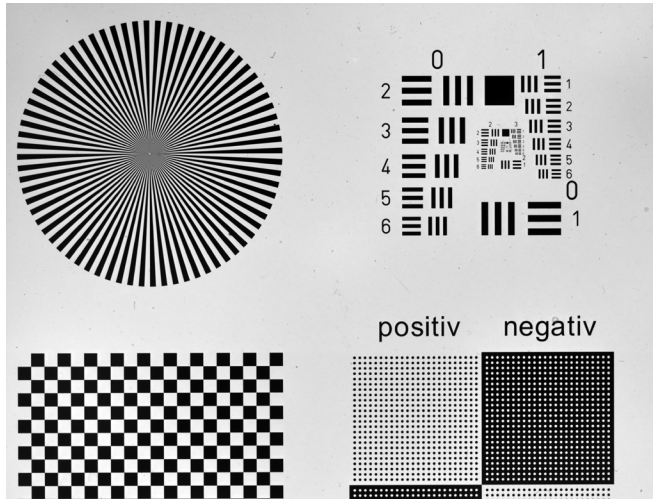Conditions: 13mm of spacers between EL-16-40-TC and camera, top illumination with 4 LED panels
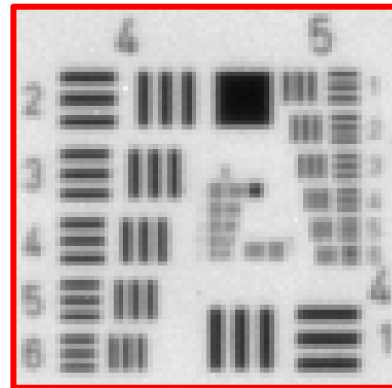
Resolution close to pixel limit

EL-16 @ -2dpt
WD: 319mm (sensor), 206mm (lens)

HFOV: 61mm (0.40X)

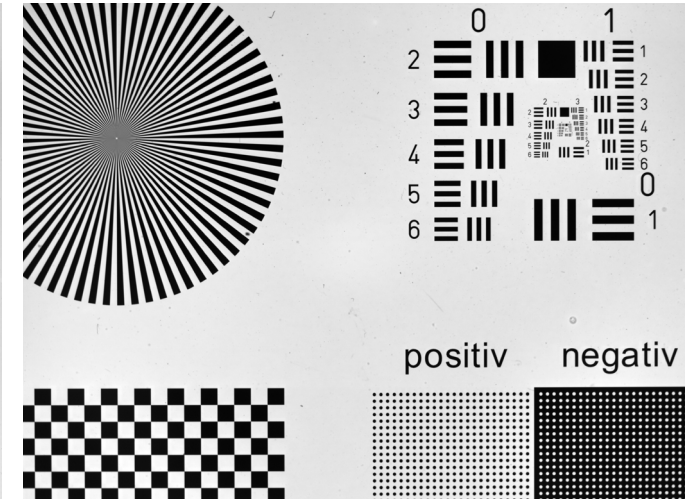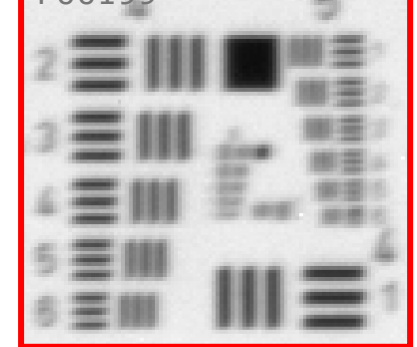### EL-16 @ 0dpt
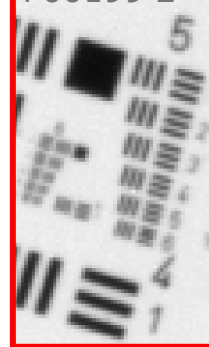WD: 271mm (sensor), 159mm (lens)

HFOV: 50mm (0.49X)

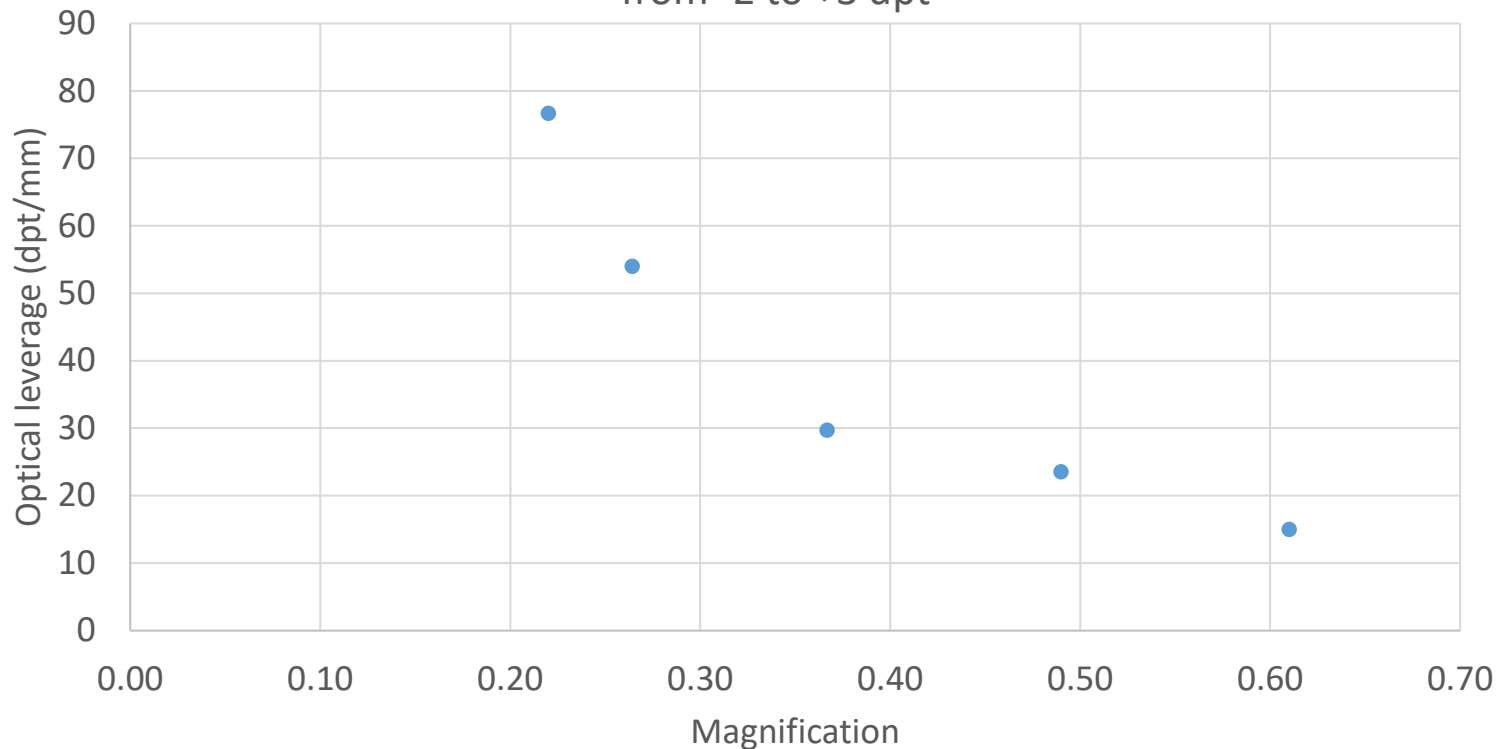### EL-16 @ 3dpt
WD: 226mm (sensor), 114 (lens)

HFOV: 40mm (0.61X)

Conditions: 35mm of spacers between EL-16-40-TC and camera, back light illumination

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Optical leverage: change of WD in mm per diopter change on the lens

Apo Componon 60mm with EL-16-40-TC in back lens configuration
from -2 to +3 dpt

Example 1: at a magnification of 0.25x, a 60mm high object can be scanned with 1 dpt change of the lens

Example 2: at a magnification of 0.5x at 0dpt, the WD can be increased by ~40mm or decreased by ~60mm over the whole tuning range of the EL-16-40 (-2 to +3 dpt)

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Image Matrix

	With EL-16-40-TC	Without EL-16-40-TC
Vignetting S3.5	P00106	P00112
Vignetting S1	P00105	P00111
Resolution Center S3.5, WD 610mm	P00107	P00113
Resolution Corner S3.5, WD 610mm	P00108	P00114
Macro at WD 319mm (-2 dpt), S3.5	P00198	
Macro at WD 271mm (0 dpt), S3.5	P00199	
Macro at WD 226mm (3 dpt), S3.5	P00200	

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