

Optem® FUSION

Micro-Imaging Lens System Visible to SWIR (400-1700nm)

Covering the optical, mechanical,
and operational parameters of
FUSION system components.

Now Supports Key Visible, NIR and SWIR wavebands

8th Edition



Table of Contents

HOW TO USE THIS GUIDE

Configuring your Optem FUSION Lens System now with  compatibility..... 3

LENS SYSTEM COMPONENT OPTIONS

Optem FUSION Component Matrix.....4-5

OPTICAL PERFORMANCE CHARTS

Fixed Magnification	6-7
Fixed w/Mini Tube Magnification	8-9
Fixed Magnification w/ LWD Objectives.....	10-11
Fixed Magnification w/Mini Tube w/ LWD Objectives.....	12-13
7:1 Zoom with Lower Lens	14-15
7:1 Zoom w/Mini Tube with Lower Lens	16-17
7:1 Zoom w/ LWD Objectives.....	18-19
7:1 Zoom w/Mini Tube w/ LWD Objectives.....	20-21
12.5:1 Zoom and Fetura+ with Lower Lens.....	22-23
12.5:1 Zoom and Fetura+ w/Mini Tube with Lower Lens.....	24-25
12.5:1 Zoom and Fetura+ w/ LWD Objectives	26-27
12.5:1 Zoom and Fetura+ w/Mini Tube w/ LWD Objectives	28-29
Wide Angle Lens with Lower Lens	30-31
Fixed Zoom and 7:1 Zoom with  compatibility.....	32-33
FUSION Flexibility and Notes	34-35



How to use this guide

Optem FUSION is a modular Lens System, which can be modified to affect form, function and performance across the Visible (400-700nm), the Near Infrared (NIR – 700-1100nm), and the Short-Wave Infrared (**SWIR** – 900-1700nm) wavebands. Follow the steps outlined herein to configure an Optem FUSION Lens System to meet your specific optical, functional and physical configuration requirements. Refer to the **Optical Performance Chart** that matches your chosen Fixed-magnification or Zoom configuration (e.g., with or without Objectives, with Standard or Mini Camera Tubes). Following the flow lines in the **FUSION Component Matrix** (p. 4-5), you can identify the components you will require to configure the lens performance you desire.

1 The first step in configuring your Optem FUSION Lens System is to determine whether you require a fixed field-of-view or a zoom system and what your desired operating wavelength will be (from Visible to SWIR). If you require zoom, determine how much zoom range you require, 7:1 or 12.5:1. This decision will direct you to the correct FUSION **Optical Performance chart** (p. 06 - 33).

2 Your second choice is determining what working distance you require for your system. Specify the correct Lower Lens to best fit your working distance requirements. Working distance is the mechanical space between the bottom of the lens system and your specimen. The addition of a ringlight or right-angle module to the bottom of the system will further reduce this working distance. Using the shortest working distance will provide the best resolution for all systems. Choose longer working distances when necessary to increase your desired field-of-view. Working distances for each Lower

Lens is listed just below the Lower Lenses shown across the top of each **Optical Performance chart**. You need to know your intended camera format (chip size) to determine the field-of-view for your lens system. If you do not have a particular camera format in mind, use the numbers in the chart to help you determine the best camera chip size selection for your Optem FUSION Lens System.

3 Navigate from the top of the **Component Matrix** down to the Lower Lenses to identify the components needed to complete your FUSION Lens System. Fixed Magnification systems require the Aperture Module 35-07-20-000 for best performance. The correct aperture diameter is provided in the **Fixed Optical Performance Chart** (p. 07 - 13 and p.32).

These steps above are a general guide in configuring your Lens System. Your application may require choosing components in a different order than detailed herein. In this case, refer to the appropriate **Optical Performance chart** and identify your desired parameters (typically field-of-view at high- and low-end zoom) as it relates to your intended camera format.

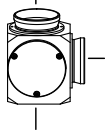
NOTE:

- Now including Optical Performance Charts for FUSION  systems (p. 32-33).
- With the Optem FUSION System, the optical magnification is the product of the magnification of the Lower Lens, Zoom dial setting (if Zoom and the magnification of the Camera Tube. This formula works even when using Qioptiq Microscope Objectives.

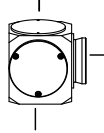
Contact your Qioptiq representative or your Qioptiq dealer for additional help determining your specific requirements.

ACCESSORIES

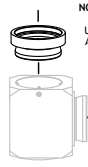
35-07-01-000
50/50 CUBE



35-07-00-000
MIRROR CUBE

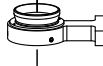


35-07-02-000
MIRROR CUBE
ADAPTER



NOTE: 35-07-11 USES 65mm WORKING DISTANCE WHEN USED BELOW LOWER LENS. USE THIS COMBINATION WHEN PLACING RIGHT ANGLE BELOW SYSTEM. REMOVE DOVETAIL TO INCREASE WORKING DISTANCE.

35-07-11-000
INLINE MOUNT



35-07-21-000
25.4MM FILTER
HOLDER



35-07-20-000
APERTURE SET



NOTE: NOT EVERY COMBINATION WILL PRESENT DESIRED RESULTS.

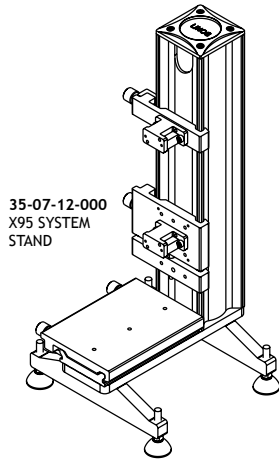
35-07-25-000
ADJUSTABLE
IRIS



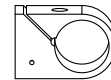
35-07-04-000
FLUORESCENCE CUBE HOLDER UPPER
(NOTE: USES ZEISS TYPE 91029 CUBE)



35-03-50-000
TUNABLE LENS FOCUS MODULE
(NOTE: ATTACH DIRECTLY ABOVE
LOWER FUNCTION MODULE ONLY)



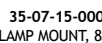
35-07-12-000
X95 SYSTEM
STAND



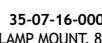
35-07-10-000
CAMERA TUBE
CLAMP



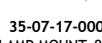
35-07-14-000
TUBE CLAMP MOUNT, 76mm dia.



35-07-15-000
TUBE CLAMP MOUNT, 82mm dia.



35-07-16-000
TUBE CLAMP MOUNT, 83mm dia.



35-07-17-000
TUBE CLAMP MOUNT, 84mm dia.

ACCESSORIES

CAMERA MOUNTS

25-60-23-000
EOS CAMERA
MOUNT



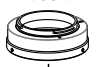
25-60-24-000
F CAMERA
MOUNT



35-08-70-000
C \ CS CAMERA
MOUNT



25-60-26-000
4/3 CAMERA
MOUNT



CAMERA TUBES

35-08-00-000
CAMERA TUBE
0.4X \ 80 FL



35-08-01-000
CAMERA TUBE
0.5X \ 100 FL



35-08-02-000
CAMERA TUBE
0.6X \ 120 FL



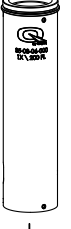
35-08-04-000
CAMERA TUBE
0.8X \ 160 FL



35-08-11-000
MINI CAMERA TUBE
0.8X \ 160 FL



35-08-06-000
CAMERA TUBE
1X \ 200 FL



ACCESSORIES

7:1 ZOOM

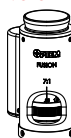
35-31-10-000
7:1 ZOOM
MANUAL



35-31-40-000
7:1 ZOOM
MANUAL
DETENT



35-31-60-000
7:1 ZOOM
STEPPER
MOTORIZED



A CONTROL

FIXED MAGNIFICATION

35-07-20-000
APERTURE
SET
REQUIRED FOR FIXED
MAGNIFICATION
SYSTEMS



LOWER FUNCTION MODULES

35-03-10-000
15mm FOCUS
MANUAL



35-07-03-000
FLUORESCENT CUBE
HOLDER LOWER



NOTE: USES ZEISS
TYPE 91029 CUBE.
USE WITH 35-01-00-000
BASIC LOWER FUNCTION
MODULE RECOMMENDED.

35-01-00-000
BASIC

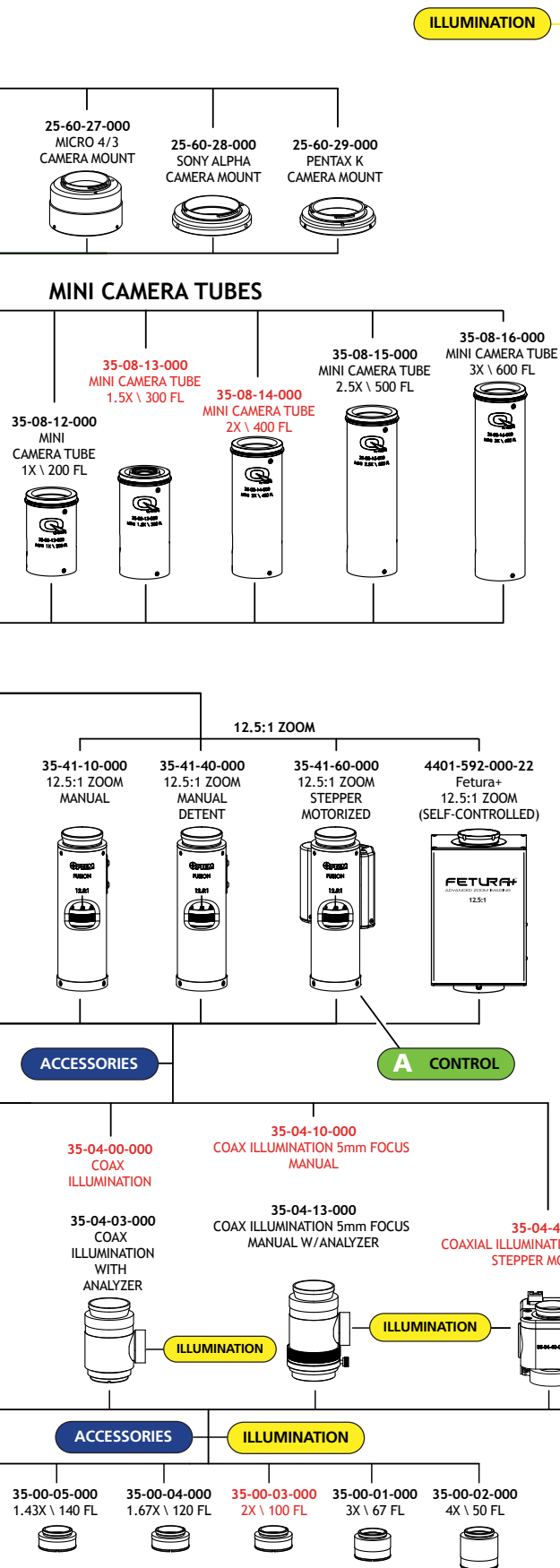


ILLUMINATION

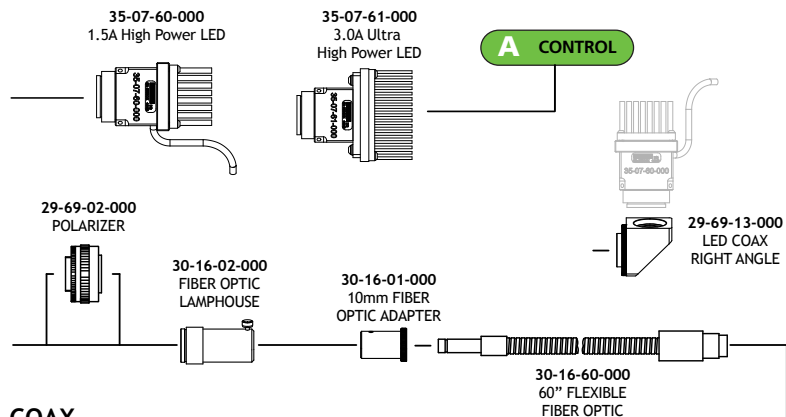
NOTE:

- Products listed in **RED TYPE** Indicate **SWIR** version available.
- For ordering purposes, **VISIBLE** components are identified by a "35" prefix, while **SWIR** components use a "45" e.g. 35-XX-XX-XXX VISIBLE, and 45-YY-YY-YYY SWIR
- All "35-XX" modules are compatible with one another; and all "45-YY" modules are compatible with one another.
- Using "35-XX" and "45-YY" modules with one another is not recommended.
- Non-optics mounts/modules are cross-compatible between VISIBLE and **SWIR**

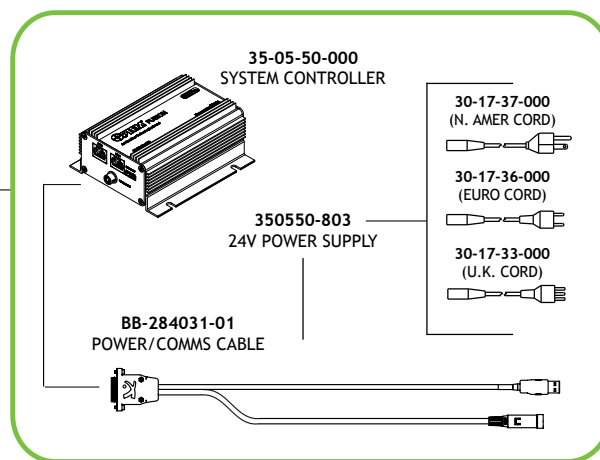
Product Matrix



LIGHTING ACCESSORIES



A CONTROL



LWD OBJECTIVES

28-21-02-001 2X M PLAN APO

28-21-05-001 5X M PLAN APO

28-21-10-000 10X M PLAN APO

28-21-11-001 20X M PLAN APO

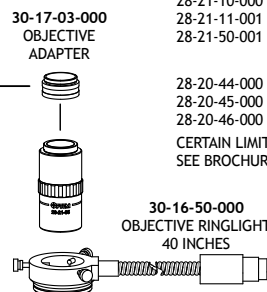
28-21-50-001 50X M PLAN APO

28-20-44-000 5X HI-RES

28-20-45-000 10X HI-RES

28-20-46-000 20X HI-RES

CERTAIN LIMITATIONS APPLY WITH HI-RES OBJECTIVES. SEE BROCHURE FOR DETAILS.



Optical Performance - Fixed Magnification with Lower

Chart 1A

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm			0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm			0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm			1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm			
Max FOV Dia.		100			80			60			40			
Max Coax FOV Dia.		13			13			14			12			
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6 5mm Stop	FOV (mm)	NA	0.0050			0.0063			0.0083			0.013		
		Res (lp/mm)	15			19			25			38		
		Mag	0.16			0.20			0.27			0.40		
		DOF (mm)	23			15			8.2			3.6		
	Cam Format	1/3"	23	x	30	18	x	24	14	x	18	9.0	x	12
		1/2"	30	x	40	24	x	32	18	x	24	12	x	16
		2/3"	41	x	55	33	x	44	25	x	33	17	x	22
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12 5mm Stop	FOV (mm)	NA	0.0050			0.0063			0.0083			0.013		
		Res (lp/mm)	15			19			25			38		
		Mag	0.20			0.25			0.33			0.50		
		DOF (mm)	23			15			8.2			3.6		
	Cam Format	1/3"	18	x	24	14	x	19	11	x	14	7.2	x	9.6
		1/2"	24	x	32	19	x	26	14	x	19	9.6	x	13
		2/3"	33	x	44	26	x	35	20	x	26	13	x	18
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4 8mm Stop	FOV (mm)	NA	0.0080			0.010			0.013			0.020		
		Res (lp/mm)	24			30			40			60		
		Mag	0.24			0.30			0.40			0.60		
		DOF (mm)	8.9			5.7			3.2			1.4		
	Cam Format	1/3"	15	x	20	12	x	16	9.0	x	12	6.0	x	8.0
		1/2"	20	x	27	16	x	21	12	x	16	8.0	x	11
		2/3"	28	x	37	22	x	29	17	x	22	11	x	15
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2 12mm Stop	FOV (mm)	NA	0.012			0.015			0.020			0.030		
		Res (lp/mm)	36			45			60			90		
		Mag	0.32			0.40			0.53			0.80		
		DOF (mm)	3.9			2.5			1.4			0.63		
	Cam Format	1/3"	11	x	15	9.0	x	12	6.8	x	9.0	4.5	x	6.0
		1/2"	15	x	20	12	x	16	9.0	x	12	6.0	x	8.0
		2/3"	21	x	28	17	x	22	12	x	17	8.3	x	11
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24 18mm Stop	FOV (mm)	NA	0.018			0.023			0.030			0.045		
		Res (lp/mm)	54			68			90			135		
		Mag	0.40			0.50			0.67			1.0		
		DOF (mm)	1.8			1.1			0.63			0.28		
	Cam Format	1/3"	9.0	x	12	7.2	x	9.6	5.4	x	7.2	3.6	x	4.8
		1/2"	12	x	16	9.6	x	13	7.2	x	9.6	4.8	x	6.4
		2/3"	17	x	22	13	x	18	9.9	x	13	6.6	x	8.8

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

Lenses

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm	1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm	1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm	2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm	3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm	4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm
32	28	24	20	15	10
12	13	14	15	15	10
0.016	0.018	0.021	0.025	0.037	0.050
47	54	63	75	112	150
0.50	0.57	0.67	0.80	1.2	1.6
2.3	1.8	1.3	0.91	0.40	0.23
7.2 x 9.6	6.3 x 8.4	5.4 x 7.2	4.5 x 6.0	3.0 x 4.0	2.3 x 3.0
9.6 x 13	8.4 x 11	7.2 x 9.6	6.0 x 8.0	4.0 x 5.3	3.0 x 4.0
13 x 18	12 x 15	9.9 x 13	8.3 x 11	5.5 x 7.3	4.1 x 5.5
0.016	0.018	0.021	0.025	0.037	0.050
47	54	63	75	112	150
0.63	0.71	0.83	1.0	1.5	2.0
2.3	1.8	1.3	0.91	0.40	0.23
5.8 x 7.7	5.0 x 6.7	4.3 x 5.8	3.6 x 4.8	2.4 x 3.2	1.8 x 2.4
7.7 x 10	6.7 x 9.0	5.8 x 7.7	4.8 x 6.4	3.2 x 4.3	2.4 x 3.2
11 x 14	9.2 x 12	7.9 x 11	6.6 x 8.8	4.4 x 5.9	3.3 x 4.4
0.025	0.029	0.033	0.040	0.060	0.080
75	86	100	120	180	240
0.75	0.86	1.0	1.2	1.8	2.4
0.91	0.69	0.51	0.35	0.16	0.089
4.8 x 6.4	4.2 x 5.6	3.6 x 4.8	3.0 x 4.0	2.0 x 2.7	1.5 x 2.0
6.4 x 8.5	5.6 x 7.5	4.8 x 6.4	4.0 x 5.3	2.7 x 3.6	2.0 x 2.7
8.8 x 12	7.7 x 10	6.6 x 8.8	5.5 x 7.3	3.7 x 4.9	2.8 x 3.7
0.038	0.043	0.050	0.060	0.090	0.12
113	129	150	180	270	360
1.0	1.1	1.3	1.6	2.4	3.2
0.40	0.31	0.23	0.16	0.070	0.039
3.6 x 4.8	3.2 x 4.2	2.7 x 3.6	2.3 x 3.0	1.5 x 2.0	1.1 x 1.5
4.8 x 6.4	4.2 x 5.6	3.6 x 4.8	3.0 x 4.0	2.0 x 2.7	1.5 x 2.0
6.6 x 8.8	5.8 x 7.7	5.0 x 6.6	4.1 x 5.5	2.8 x 3.7	2.1 x 2.8
0.056	0.064	0.075	0.090	0.13	0.18
169	193	225	270	405	540
1.25	1.43	1.67	2.0	3.0	4.0
0.18	0.14	0.10	0.070	0.031	0.018
2.9 x 3.8	2.5 x 3.4	2.2 x 2.9	1.8 x 2.4	1.2 x 1.6	0.90 x 1.2
3.8 x 5.1	3.4 x 4.5	2.9 x 3.8	2.4 x 3.2	1.6 x 2.1	1.2 x 1.6
5.3 x 7.0	4.6 x 6.2	4.0 x 5.3	3.3 x 4.4	2.2 x 2.9	1.7 x 2.2

Optical Performance - Fixed Magnification with Lower

Chart 1B

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm			0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm			0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm			1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm			
Max FOV Dia.		100			80			60			40			
Max Coax FOV Dia.		13			13			14			12			
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36 12mm Stop	FOV (mm) Cam Format	NA	0.012			0.015			0.020			0.030		
		Res (lp/mm)	36			45			60			90		
		Mag	0.60			0.75			1.0			1.5		
		DOF (mm)	3.9			2.5			1.4			0.63		
		2/3"	11	x	15	8.8	x	12	6.6	x	8.8	4.4	x	5.9
		1"	16	x	21	13	x	17	9.6	x	13	6.4	x	8.5
		4/3"	23	x	30	18	x	24	14	x	18	9.0	x	12
		APS-C	28	x	42	22	x	33	17	x	25	11	x	17
2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44 18mm Stop	FOV (mm) Cam Format	NA	0.018			0.023			0.030			0.045		
		Res (lp/mm)	54			68			90			135		
		Mag	0.80			1.0			1.3			2.0		
		DOF (mm)	1.8			1.1			0.63			0.28		
		2/3"	8.3	x	11	6.6	x	8.8	5.0	x	6.6	3.3	x	4.4
		1"	12	x	16	9.6	x	13	7.2	x	9.6	4.8	x	6.4
		4/3"	17	x	23	14	x	18	10	x	14	6.8	x	9.0
		APS-C	21	x	31	17	x	25	13	x	19	8.4	x	13
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44 18mm Stop	FOV (mm) Cam Format	NA	0.018			0.023			0.030			0.045		
		Res (lp/mm)	54			68			90			135		
		Mag	1.0			1.3			1.7			2.5		
		DOF (mm)	1.8			1.1			0.63			0.28		
		1"	9.6	x	13	7.7	x	10	5.8	x	7.7	3.8	x	5.1
		4/3"	14	x	18	11	x	14	8.1	x	11	5.4	x	7.2
		APS-C	17	x	25	13	x	20	10	x	15	6.7	x	10
		35mm (FULL)	24	x	36	19	x	29	14	x	22	9.6	x	14
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44 18mm Stop	FOV (mm) Cam Format	NA	0.018			0.023			0.030			0.045		
		Res (lp/mm)	54			68			90			135		
		Mag	1.2			1.5			2.0			3.0		
		DOF (mm)	1.8			1.1			0.63			0.28		
		1"	8.0	x	11	6.4	x	8.5	4.8	x	6.4	3.2	x	4.3
		4/3"	11	x	15	9.0	x	12	6.8	x	9.0	4.5	x	6.0
		APS-C	14	x	21	11	x	17	8.4	x	13	5.6	x	8.4
		35mm (FULL)	20	x	30	16	x	24	12	x	18	8.0	x	12

- Useable FOV Limited by Coax illumination (>50% Illumination)
- FOV Limited by vignetting

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Lenses - Mini Camera Tubes

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm	1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm	1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm	2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm	3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm	4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm
32	28	24	20	15	10
12	13	14	15	15	10
0.038	0.043	0.050	0.060	0.090	0.12
113	129	150	180	270	360
1.9	2.1	2.5	3.0	4.5	6.0
0.40	0.31	0.23	0.16	0.070	0.039
3.5 x 4.7	3.1 x 4.1	2.6 x 3.5	2.2 x 2.9	1.5 x 2.0	1.1 x 1.5
5.1 x 6.8	4.5 x 6.0	3.8 x 5.1	3.2 x 4.3	2.1 x 2.8	1.6 x 2.1
7.2 x 9.6	6.3 x 8.4	5.4 x 7.2	4.5 x 6.0	3.0 x 4.0	2.3 x 3.0
8.9 x 13	7.8 x 12	6.7 x 10	5.6 x 8.4	3.7 x 5.6	2.8 x 4.2
0.056	0.064	0.075	0.090	0.13	0.18
169	193	225	270	405	540
2.5	2.9	3.3	4.0	6.0	8.0
0.18	0.14	0.101	0.070	0.031	0.018
2.6 x 3.5	2.3 x 3.1	2.0 x 2.6	1.7 x 2.2	1.1 x 1.5	0.83 x 1.1
3.8 x 5.1	3.4 x 4.5	2.9 x 3.8	2.4 x 3.2	1.6 x 2.1	1.2 x 1.6
5.4 x 7.2	4.7 x 6.3	4.1 x 5.4	3.4 x 4.5	2.3 x 3.0	1.7 x 2.3
6.7 x 10	5.8 x 8.8	5.0 x 7.5	4.2 x 6.3	2.8 x 4.2	2.1 x 3.1
0.056	0.064	0.075	0.090	0.13	0.18
169	193	225	270	405	540
3.1	3.6	4.2	5.0	7.5	10
0.18	0.14	0.10	0.070	0.031	0.018
3.1 x 4.1	2.7 x 3.6	2.3 x 3.1	1.9 x 2.6	1.3 x 1.7	0.96 x 1.3
4.3 x 5.8	3.8 x 5.0	3.2 x 4.3	2.7 x 3.6	1.8 x 2.4	1.4 x 1.8
5.3 x 8.0	4.7 x 7.0	4.0 x 6.0	3.3 x 5.0	2.2 x 3.3	1.7 x 2.5
7.7 x 12	6.7 x 10	5.8 x 8.6	4.8 x 7.2	3.2 x 4.8	2.4 x 3.6
0.056	0.064	0.075	0.090	0.13	0.18
169	193	225	270	405	540
3.8	4.3	5.0	6.0	9.0	12
0.18	0.14	0.10	0.070	0.031	0.018
2.6 x 3.4	2.2 x 3.0	1.9 x 2.6	1.6 x 2.1	1.1 x 1.4	0.80 x 1.1
3.6 x 4.8	3.2 x 4.2	2.7 x 3.6	2.3 x 3.0	1.5 x 2.0	1.1 x 1.5
4.5 x 6.7	3.9 x 5.9	3.3 x 5.0	2.8 x 4.2	1.9 x 2.8	1.4 x 2.1
6.4 x 9.6	5.6 x 8.4	4.8 x 7.2	4.0 x 6.0	2.7 x 4.0	2.0 x 3.0

Optical Performance - Fixed Magnification with LWD

Chart 1C

		2X M Plan Apo 28-21-02-001 WD: 34mm			5X M Plan Apo 28-21-05-001 WD: 41mm			10X M Plan Apo 28-21-10-000 WD: 34mm			20X M Plan Apo 28-21-11-001 WD: 20mm			
Max FOV Dia.		17			16			10			5.4			
Max Coax FOV Dia.		16			11			5.0			2.6			
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6 NO Stop	NA		0.057			0.14			0.30			0.42		
	Res (lp/mm)		170			420			900			1260		
	Mag		0.80			2.0			4.0			8.0		
	DOF (mm)		0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1/3 "	4.5	x	6.0	1.8	x	2.4	0.90	x	1.2	0.45	x	0.60
		1/2 "	6.0	x	8.0	2.4	x	3.2	1.2	x	1.6	0.60	x	0.80
		2/3 "	8.3	x	11	3.3	x	4.4	1.7	x	2.2	0.83	x	1.1
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12 NO Stop	NA		0.057			0.14			0.30			0.42		
	Res (lp/mm)		170			420			900			1260		
	Mag		1.0			2.5			5.0			10		
	DOF (mm)		0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1/3 "	3.6	x	4.8	1.4	x	1.9	0.72	x	0.96	0.36	x	0.48
		1/2 "	4.8	x	6.4	1.9	x	2.6	0.96	x	1.3	0.48	x	0.64
		2/3 "	6.6	x	8.8	2.6	x	3.5	1.3	x	1.8	0.66	x	0.88
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4 NO Stop	NA		0.057			0.14			0.30			0.42		
	Res (lp/mm)		170			420			900			1260		
	Mag		1.2			3.0			6.0			12		
	DOF (mm)		0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1/3 "	3.0	x	4.0	1.2	x	1.6	0.60	x	0.80	0.30	x	0.40
		1/2 "	4.0	x	5.3	1.6	x	2.1	0.80	x	1.1	0.40	x	0.53
		2/3 "	5.5	x	7.3	2.2	x	2.9	1.1	x	1.5	0.55	x	0.73
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2 NO Stop	NA		0.057			0.14			0.30			0.42		
	Res (lp/mm)		170			420			900			1260		
	Mag		1.6			4.0			8.0			16		
	DOF (mm)		0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1/3 "	2.3	x	3.0	0.90	x	1.2	0.45	x	0.60	0.23	x	0.30
		1/2 "	3.0	x	4.0	1.2	x	1.6	0.60	x	0.80	0.30	x	0.40
		2/3 "	4.1	x	5.5	1.7	x	2.2	0.83	x	1.1	0.41	x	0.55
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24 NO Stop	NA		0.057			0.14			0.30			0.42		
	Res (lp/mm)		170			420			900			1260		
	Mag		2.0			5.0			10			20		
	DOF (mm)		0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1/3 "	1.8	x	2.4	0.72	x	0.96	0.36	x	0.48	0.18	x	0.24
		1/2 "	2.4	x	3.2	0.96	x	1.3	0.48	x	0.64	0.24	x	0.32
		2/3 "	3.3	x	4.4	1.3	x	1.8	0.66	x	0.88	0.33	x	0.44

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

Objectives

50X M Plan Apo 28-21-50-001 WD: 13mm				5X HiRes 28-20-44-000 WD: 34mm			10X HiRes 28-20-45-000 WD: 19mm			20X HiRes 28-20-46-000 WD: 13mm		
2.3				10			5.2			4.5		
1.1				7.0			2.8			2.1		
0.55				0.225			0.45			0.60		
1650				675			1350			1800		
20				2.0			4.0			8.0		
0.0019				0.011			0.0028			0.0016		
0.18	x	0.24		1.8	x	2.4	0.90	x	1.2	0.45	x	0.60
0.24	x	0.32		2.4	x	3.2	1.2	x	1.6	0.60	x	0.80
0.33	x	0.44		3.3	x	4.4	1.7	x	2.2	0.83	x	1.1
0.55				0.225			0.45			0.60		
1650				675			1350			1800		
25				2.5			5.0			10		
0.0019				0.011			0.0028			0.0016		
0.14	x	0.19		1.4	x	1.9	0.72	x	0.96	0.36	x	0.48
0.19	x	0.26		1.9	x	2.6	0.96	x	1.3	0.48	x	0.64
0.26	x	0.35		2.6	x	3.5	1.3	x	1.8	0.66	x	0.88
0.55				0.225			0.45			0.60		
1650				675			1350			1800		
30				3.0			6.0			12		
0.0019				0.011			0.0028			0.0016		
0.12	x	0.16		1.2	x	1.6	0.60	x	0.80	0.30	x	0.40
0.16	x	0.21		1.6	x	2.1	0.80	x	1.1	0.40	x	0.53
0.22	x	0.29		2.2	x	2.9	1.1	x	1.5	0.55	x	0.73
0.55				0.225			0.45			0.60		
1650				675			1350			1800		
40				4.0			8.0			16		
0.0019				0.011			0.0028			0.0016		
0.090	x	0.12		0.90	x	1.2	0.45	x	0.60	0.23	x	0.30
0.12	x	0.16		1.2	x	1.6	0.60	x	0.80	0.30	x	0.40
0.17	x	0.22		1.7	x	2.2	0.83	x	1.1	0.41	x	0.55
0.55				0.225			0.45			0.60		
1650				675			1350			1800		
50				5.0			10			20		
0.0019				0.011			0.0028			0.0016		
0.072	x	0.096		0.72	x	0.96	0.36	x	0.48	0.18	x	0.24
0.096	x	0.13		0.96	x	1.3	0.48	x	0.64	0.24	x	0.32
0.13	x	0.18		1.3	x	1.8	0.66	x	0.88	0.33	x	0.44

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - Fixed Magnification with LWD

Chart 1D

		2X M Plan Apo 28-21-02-001 WD: 34mm			5X M Plan Apo 28-21-05-001 WD: 41mm			10X M Plan Apo 28-21-10-000 WD: 34mm			20X M Plan Apo 28-21-11-001 WD: 20mm			
Max FOV Dia.		17			16			10			5.4			
Max Coax FOV Dia.		16			11			5.0			2.6			
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36 NO Stop		NA	0.057			0.14			0.30			0.42		
		Res (lp/mm)	170			420			900			1260		
		Mag	3.0			7.5			15			30		
		DOF (mm)	0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	2/3 "	2.2	x	2.9	0.88	x	1.2	0.44	x	0.59	0.22	x	0.29
		1 "	3.2	x	4.3	1.3	x	1.7	0.64	x	0.85	0.32	x	0.43
		4/3 "	4.5	x	6.0	1.8	x	2.4	0.90	x	1.2	0.45	x	0.60
		APS-C	5.6	x	8.4	2.2	x	3.3	1.1	x	1.7	0.56	x	0.84
2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44 NO Stop		NA	0.057			0.14			0.30			0.42		
		Res (lp/mm)	170			420			900			1260		
		Mag	4.0			10			20			40		
		DOF (mm)	0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	2/3 "	1.7	x	2.2	0.66	x	0.88	0.33	x	0.44	0.17	x	0.22
		1 "	2.4	x	3.2	0.96	x	1.3	0.48	x	0.64	0.24	x	0.32
		4/3 "	3.4	x	4.5	1.4	x	1.8	0.68	x	0.90	0.34	x	0.45
		APS-C	4.2	x	6.3	1.7	x	2.5	0.84	x	1.3	0.42	x	0.63
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44 NO Stop		NA	0.057			0.14			0.30			0.42		
		Res (lp/mm)	170			420			900			1260		
		Mag	5.0			12.5			25			50		
		DOF (mm)	0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1 "	1.9	x	2.6	0.77	x	1.0	0.38	x	0.51	0.19	x	0.26
		4/3 "	2.7	x	3.6	1.1	x	1.4	0.54	x	0.72	0.27	x	0.36
		APS-C	3.3	x	5.0	1.3	x	2.0	0.67	x	1.0	0.33	x	0.50
		35mm(Full)	4.8	x	7.2	1.9	x	2.9	1.0	x	1.4	0.48	x	0.72
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44 NO Stop		NA	0.057			0.14			0.30			0.42		
		Res (lp/mm)	170			420			900			1260		
		Mag	6.0			15			30			60		
		DOF (mm)	0.18			0.029			0.0063			0.0032		
	FOV (mm) Cam Format	1 "	1.6	x	2.1	0.64	x	0.85	0.32	x	0.43	0.16	x	0.21
		4/3 "	2.3	x	3.0	0.90	x	1.2	0.45	x	0.60	0.23	x	0.30
		APS-C	2.8	x	4.2	1.1	x	1.7	0.56	x	0.84	0.28	x	0.42
		35mm(Full)	4.0	x	6.0	1.6	x	2.4	0.80	x	1.2	0.40	x	0.60

 -- Useable FOV Limited by Coax illumination (>50% Illumination)

 -- FOV Limited by vignetting

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Objectives - Mini Camera Tubes

50X M Plan Apo 28-21-50-001 WD: 13mm	5X HiRes 28-20-44-000 WD: 34mm	10X HiRes 28-20-45-000 WD: 19mm	20X HiRes 28-20-46-000 WD: 13mm
2.3	10	5.2	4.5
1.1	7.0	2.8	2.1
0.55	0.225	0.45	0.60
1650	675	1350	1800
75	7.5	15	30
0.0019	0.011	0.0028	0.0016
0.088 x 0.12	0.88 x 1.2	0.44 x 0.59	0.22 x 0.29
0.13 x 0.17	1.3 x 1.7	0.64 x 0.85	0.32 x 0.43
0.18 x 0.24	1.8 x 2.4	0.90 x 1.2	0.45 x 0.60
0.22 x 0.33	2.2 x 3.3	1.1 x 1.7	0.56 x 0.84
0.55	0.225	0.45	0.60
1650	675	1350	1800
100	10	20	40
0.0019	0.011	0.0028	0.0016
0.066 x 0.088	0.66 x 0.88	0.33 x 0.44	0.17 x 0.22
0.096 x 0.13	0.96 x 1.3	0.48 x 0.64	0.24 x 0.32
0.14 x 0.18	1.4 x 1.8	0.68 x 0.90	0.34 x 0.45
0.17 x 0.25	1.7 x 2.5	0.84 x 1.3	0.42 x 0.63
0.55	0.225	0.45	0.60
1650	675	1350	1800
125	12.5	25	50
0.0019	0.011	0.0028	0.0016
0.08 x 0.10	0.77 x 1.0	0.38 x 0.51	0.19 x 0.26
0.11 x 0.14	1.1 x 1.4	0.54 x 0.72	0.27 x 0.36
0.13 x 0.20	1.3 x 2.0	0.67 x 1.0	0.33 x 0.50
0.19 x 0.29	1.9 x 2.9	0.96 x 1.4	0.48 x 0.72
0.55	0.225	0.45	0.60
1650	675	1350	1800
150	15	30	60
0.0019	0.011	0.0028	0.0016
0.064 x 0.085	0.64 x 0.85	0.32 x 0.43	0.16 x 0.21
0.090 x 0.12	0.90 x 1.2	0.45 x 0.60	0.23 x 0.30
0.11 x 0.17	1.1 x 1.7	0.56 x 0.84	0.28 x 0.42
0.16 x 0.24	1.6 x 2.4	0.80 x 1.2	0.40 x 0.60

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - OPTEM 7:1 Zoom with Lower

Chart 2A

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm		0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm		0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm		1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm		
Max FOV Dia.		156		125		94		63		
Max Coax FOV Dia.		NR		NR		NR		19		
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.067	0.46	0.084	0.58	0.11	0.77	0.17	1.2	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1/3"	54 x 71	7.8 x 10	43 x 57	6.2 x 8.3	32 x 43	4.7 x 6.2	21 x 29	3.1 x 4.1
		1/2"	71 x 95	10 x 14	57 x 76	8.3 x 11	43 x 57	6.2 x 8.3	29 x 38	4.1 x 5.5
		2/3"	98 x 131	14 x 19	79 x 105	11 x 15	59 x 79	8.5 x 11	39 x 52	5.7 x 7.6
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.084	0.58	0.11	0.73	0.14	0.97	0.21	1.5	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1/3"	43 x 57	6.2 x 8.3	34 x 46	5.0 x 6.6	26 x 34	3.7 x 5.0	17 x 23	2.5 x 3.3
		1/2"	57 x 76	8.3 x 11	46 x 61	6.6 x 8.8	34 x 46	5.0 x 6.6	23 x 30	3.3 x 4.4
		2/3"	79 x 105	11 x 15	63 x 84	9.1 x 12	47 x 63	6.8 x 9.1	31 x 42	4.6 x 6.1
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.10	0.70	0.13	0.87	0.17	1.2	0.25	1.7	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1/3"	36 x 48	5.2 x 6.9	29 x 38	4.1 x 5.5	21 x 29	3.1 x 4.1	14 x 19	2.1 x 2.8
		1/2"	48 x 63	6.9 x 9.2	38 x 51	5.5 x 7.4	29 x 38	4.1 x 5.5	19 x 25	2.8 x 3.7
		2/3"	65 x 87	9.5 x 13	52 x 70	7.6 x 10	39 x 52	5.7 x 7.6	26 x 35	3.8 x 5.1
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.13	0.93	0.17	1.2	0.22	1.5	0.34	2.3	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1/3"	27 x 36	3.9 x 5.2	21 x 29	3.1 x 4.1	16 x 21	2.3 x 3.1	11 x 14	1.6 x 2.1
		1/2"	36 x 48	5.2 x 6.9	29 x 38	4.1 x 5.5	21 x 29	3.1 x 4.1	14 x 19	2.1 x 2.8
		2/3"	49 x 65	7.1 x 9.5	39 x 52	5.7 x 7.6	29 x 39	4.3 x 5.7	20 x 26	2.8 x 3.8
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.17	1.2	0.21	1.5	0.28	1.9	0.42	2.9	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1/3"	21 x 29	3.1 x 4.1	17 x 23	2.5 x 3.3	13 x 17	1.9 x 2.5	8.6 x 11	1.2 x 1.7
		1/2"	29 x 38	4.1 x 5.5	23 x 30	3.3 x 4.4	17 x 23	2.5 x 3.3	11 x 15	1.7 x 2.2
		2/3"	39 x 52	5.7 x 7.6	31 x 42	4.6 x 6.1	24 x 31	3.4 x 4.6	16 x 21	2.3 x 3.0

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

NR = Not recommended for Coax illumination

Lens

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm		1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm		1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm		2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm		3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm		4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm	
50		44		38		31		21		16	
19		19		18		19		13		9.4	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.21	1.5	0.24	1.7	0.28	1.9	0.34	2.3	0.50	3.5	0.67	4.6
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
17 x 23	2.5 x 3.3	15 x 20	2.2 x 2.9	13 x 17	1.9 x 2.5	11 x 14	1.6 x 2.1	7.1 x 9.5	1.0 x 1.4	5.4 x 7.1	0.78 x 1.0
23 x 30	3.3 x 4.4	20 x 27	2.9 x 3.9	17 x 23	2.5 x 3.3	14 x 19	2.1 x 2.8	9.5 x 13	1.4 x 1.8	7.1 x 10	1.0 x 1.4
31 x 42	4.6 x 6.1	28 x 37	4.0 x 5.3	24 x 31	3.4 x 4.6	20 x 26	2.8 x 3.8	13 x 17	1.9 x 2.5	10 x 13	1.4 x 1.9
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.26	1.8	0.30	2.1	0.35	2.4	0.42	2.9	0.63	4.3	0.84	5.8
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
14 x 18	2.0 x 2.6	12 x 16	1.7 x 2.3	10 x 14	1.5 x 2.0	8.6 x 11	1.24 x 1.7	5.7 x 7.6	0.83 x 1.1	4.3 x 5.7	0.62 x 0.83
18 x 24	2.6 x 3.5	16 x 21	2.3 x 3.1	14 x 18	2.0 x 2.6	11 x 15	1.7 x 2.2	7.6 x 10	1.1 x 1.5	5.7 x 7.6	0.83 x 1.1
25 x 34	3.6 x 4.9	22 x 29	3.2 x 4.2	19 x 25	2.7 x 3.6	16 x 21	2.3 x 3.0	10 x 14	1.5 x 2.0	7.9 x 10	1.1 x 1.5
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.32	2.2	0.36	2.5	0.42	2.9	0.50	3.5	0.76	5.2	1.0	7.0
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
11 x 15	1.7 x 2.2	10 x 13	1.4 x 1.9	8.6 x 11	1.2 x 1.7	7.1 x 9.5	1.0 x 1.4	4.8 x 6.4	0.69 x 0.92	3.6 x 4.8	0.52 x 0.69
15 x 20	2.2 x 2.9	13 x 18	1.9 x 2.6	11 x 15	1.7 x 2.2	9.5 x 13	1.4 x 1.8	6.4 x 8.5	0.92 x 1.2	4.8 x 6.3	0.69 x 0.92
21 x 28	3.0 x 4.0	18 x 24	2.7 x 3.5	16 x 21	2.3 x 3.0	13 x 17	1.9 x 2.5	8.7 x 12	1.3 x 1.7	6.5 x 8.7	0.95 x 1.3
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.42	2.9	0.48	3.3	0.56	3.9	0.67	4.6	1.0	7.0	1.3	9.3
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
8.6 x 11	1.2 x 1.7	7.5 x 10	1.1 x 1.4	6.4 x 8.6	0.93 x 1.2	5.4 x 7.1	0.78 x 1.0	3.6 x 4.8	0.52 x 0.69	2.7 x 3.6	0.39 x 0.52
11 x 15	1.7 x 2.2	10 x 13	1.4 x 1.9	8.6 x 11	1.2 x 1.7	7.1 x 9.5	1.0 x 1.4	4.8 x 6.4	0.69 x 0.92	3.6 x 4.8	0.52 x 0.69
16 x 21	2.3 x 3.0	14 x 18	2.0 x 2.7	12 x 16	1.7 x 2.3	9.8 x 13	1.4 x 1.9	6.6 x 8.7	0.95 x 1.3	4.9 x 6.5	0.71 x 0.95
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.53	3.6	0.60	4.1	0.70	4.8	0.84	5.8	1.3	8.7	1.7	12
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
6.9 x 9.1	0.99 x 1.3	6.0 x 8.0	0.87 x 1.2	5.1 x 6.9	0.74 x 0.99	4.3 x 5.7	0.62 x 0.83	2.9 x 3.8	0.41 x 0.55	2.1 x 2.9	0.31 x 0.41
9.1 x 12	1.3 x 1.8	8.0 x 11	1.2 x 1.5	6.9 x 9.1	0.99 x 1.3	5.7 x 7.6	0.83 x 1.1	3.8 x 5.1	0.55 x 0.74	2.9 x 3.8	0.41 x 0.55
13 x 17	1.8 x 2.4	11 x 15	1.6 x 2.1	9.4 x 13	1.4 x 1.8	7.9 x 10	1.1 x 1.5	5.2 x 7.0	0.76 x 1.0	3.9 x 5.2	0.57 x 0.76

Optical Performance - OPTEM 7:1 Zoom with Lower

Chart 2B

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm		0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm		0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm		1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm		
Max FOV Dia.		156		125		94		63		
Max Coax FOV Dia.		NR		NR		NR		19		
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.25	1.7	0.32	2.2	0.42	2.9	0.63	4.4	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	2/3"	26 x 35	3.8 x 5.1	21 x 28	3.0 x 4.0	16 x 21	2.3 x 3.0	10 x 14	1.5 x 2.0
		1"	38 x 51	5.5 x 7.4	30 x 41	4.4 x 5.9	23 x 30	3.3 x 4.4	15 x 20	2.2 x 2.9
		4/3"	54 x 71	7.8 x 10	43 x 57	6.2 x 8.3	32 x 43	4.7 x 6.2	21 x 29	3.1 x 4.1
		APS-C	66 x 100	10 x 14	53 x 80	7.7 x 12	40 x 60	5.8 x 8.7	27 x 40	3.8 x 5.8
	2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
			14	47	18	58	24	78	35	116
			0.34	2.3	0.42	2.9	0.56	3.9	0.84	5.8
			25	2.4	16	1.5	9.2	0.85	4.1	0.38
FOV (mm) Cam Format		2/3"	20 x 26	2.8 x 3.8	16 x 21	2.3 x 3.0	12 x 16	1.7 x 2.3	7.9 x 10	1.1 x 1.5
		1"	29 x 38	4.1 x 5.5	23 x 30	3.3 x 4.4	17 x 23	2.5 x 3.3	11 x 15	1.7 x 2.2
		4/3"	40 x 54	5.8 x 7.8	32 x 43	4.7 x 6.2	24 x 32	3.5 x 4.7	16 x 21	2.3 x 3.1
		APS-C	50 x 75	7.2 x 11	40 x 60	5.8 x 8.7	30 x 45	4.3 x 6.5	20 x 30	2.9 x 4.3
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.42	2.9	0.53	3.6	0.70	4.8	1.1	7.3	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1"	23 x 30	3.3 x 4.4	18 x 24	2.6 x 3.5	14 x 18	2.0 x 2.6	9.1 x 12	1.3 x 1.8
		4/3"	32 x 43	4.7 x 6.2	26 x 34	3.7 x 5.0	19 x 26	2.8 x 3.7	13 x 17	1.9 x 2.5
		APS-C	40 x 60	5.8 x 8.7	32 x 48	4.6 x 6.9	24 x 36	3.5 x 5.2	16 x 24	2.3 x 3.5
		35mm(Full)	57 x 86	8.3 x 12	46 x 69	6.6 x 9.9	34 x 51	5.0 x 7.4	23 x 34	3.3 x 5.0
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (mm)	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
		14	47	18	58	24	78	35	116	
		0.50	3.5	0.63	4.4	0.84	5.8	1.3	8.7	
		25	2.4	16	1.5	9.2	0.85	4.1	0.38	
	FOV (mm) Cam Format	1"	19 x 25	2.8 x 3.7	15 x 20	2.2 x 2.9	11 x 15	1.7 x 2.2	7.6 x 10	1.1 x 1.5
		4/3"	27 x 36	3.9 x 5.2	21 x 29	3.1 x 4.1	16 x 21	2.3 x 3.1	11 x 14	1.6 x 2.1
		APS-C	33 x 50	4.8 x 7.2	27 x 40	3.8 x 5.8	20 x 30	2.9 x 4.3	13 x 20	1.9 x 2.9
		35mm(Full)	48 x 71	6.9 x 10	38 x 57	5.5 x 8.3	29 x 43	4.1 x 6.2	19 x 29	2.8 x 4.1

-- Useable FOV Limited by Coax illumination (>50% Illumination)

-- FOV Limited by vignetting

NR = Not recommended for Coax illumination

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Lens - Mini Camera Tubes

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm		1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm		1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm		2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm		3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm		4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm	
50		44		38		31		21		16	
19		19		18		19		13		9.4	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
0.79	5.4	0.90	6.2	1.1	7.3	1.3	8.7	1.9	13	2.5	17
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
8.4 x 11	1.2 x 1.6	7.3 x 10	1.1 x 1.4	6.3 x 8.4	0.91 x 1.2	5.2 x 7.0	0.76 x 1.0	3.5 x 4.7	0.51 x 0.67	2.6 x 3.5	0.38 x 0.51
12 x 16	1.8 x 2.4	11 x 14	1.5 x 2.1	9.1 x 12	1.3 x 1.8	7.6 x 10	1.1 x 1.5	5.1 x 6.8	0.74 x 0.98	3.8 x 5.1	0.55 x 0.74
17 x 23	2.5 x 3.3	15 x 20	2.2 x 2.9	13 x 17	1.9 x 2.5	11 x 14	1.6 x 2.1	7.1 x 9.5	1.0 x 1.4	5.4 x 7.1	0.78 x 1.0
21 x 32	3.1 x 4.6	19 x 28	2.7 x 4.0	16 x 24	2.3 x 3.5	13 x 20	1.9 x 2.9	8.8 x 13	1.3 x 1.9	6.6 x 10	0.96 x 1.4
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
1.1	7.3	1.2	8.3	1.4	9.7	1.7	12	2.5	17	3.4	23
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
6.3 x 8.4	0.91 x 1.2	5.5 x 7.3	0.80 x 1.1	4.7 x 6.3	0.68 x 0.91	3.9 x 5.2	0.57 x 0.76	2.6 x 3.5	0.38 x 0.51	2.0 x 2.6	0.28 x 0.38
9.1 x 12	1.3 x 1.8	8.0 x 11	1.2 x 1.5	6.9 x 9.1	0.99 x 1.3	5.7 x 7.6	0.83 x 1.1	3.8 x 5.1	0.55 x 0.74	2.9 x 3.8	0.41 x 0.55
13 x 17	1.9 x 2.5	11 x 15	1.6 x 2.2	9.6 x 13	1.4 x 1.9	8.0 x 11	1.2 x 1.6	5.4 x 7.1	0.78 x 1.0	4.0 x 5.4	0.58 x 0.78
16 x 24	2.3 x 3.5	14 x 21	2.0 x 3.0	12 x 18	1.7 x 2.6	9.9 x 15	1.4 x 2.2	6.6 x 10	0.96 x 1.4	5.0 x 7.5	0.72 x 1.1
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
1.3	9.1	1.5	10	1.8	12	2.1	15	3.1	22	4.2	29
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
7.3 x 9.8	1.1 x 1.4	6.4 x 8.5	0.93 x 1.2	5.5 x 7.3	0.79 x 1.1	4.6 x 6.1	0.66 x 0.88	3.0 x 4.1	0.44 x 0.59	2.3 x 3.0	0.33 x 0.44
10 x 14	1.5 x 2.0	9.0 x 12	1.3 x 1.7	7.7 x 10	1.1 x 1.5	6.4 x 8.6	0.93 x 1.2	4.3 x 5.7	0.62 x 0.83	3.2 x 4.3	0.47 x 0.62
13 x 19	1.8 x 2.8	11 x 17	1.6 x 2.4	9.5 x 14	1.4 x 2.1	8.0 x 12	1.2 x 1.7	5.3 x 8.0	0.77 x 1.2	4.0 x 6.0	0.58 x 0.87
18 x 27	2.6 x 4.0	16 x 24	2.3 x 3.5	14 x 21	2.0 x 3.0	11 x 17	1.7 x 2.5	7.6 x 11	1.1 x 1.7	5.7 x 8.6	0.83 x 1.2
0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
44	145	51	166	59	194	71	233	106	349	142	465
1.6	11	1.8	12	2.1	15	2.5	17	3.8	26	5.0	35
2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
6.1 x 8.1	0.88 x 1.2	5.3 x 7.1	0.77 x 1.0	4.6 x 6.1	0.66 x 0.88	3.8 x 5.1	0.55 x 0.74	2.5 x 3.4	0.37 x 0.49	1.9 x 2.5	0.28 x 0.37
8.6 x 11	1.2 x 1.7	7.5 x 10	1.1 x 1.4	6.4 x 8.6	0.93 x 1.2	5.4 x 7.1	0.78 x 1.0	3.6 x 4.8	0.52 x 0.69	2.7 x 3.6	0.39 x 0.52
11 x 16	1.5 x 2.3	9.3 x 14	1.3 x 2.0	8.0 x 12	1.2 x 1.7	6.6 x 10	0.96 x 1.4	4.4 x 6.6	0.64 x 0.96	3.3 x 5.0	0.48 x 0.72
15 x 23	2.2 x 3.3	13 x 20	1.9 x 2.9	11 x 17	1.7 x 2.5	9.5 x 14	1.4 x 2.1	6.4 x 9.5	0.92 x 1.4	4.8 x 7.1	0.69 x 1.0

Optical Performance - OPTEM 7:1 Zoom with LWD

Chart 2C

		2X M Plan Apo 28-21-02-001 WD: 34mm		5X M Plan Apo 28-21-05-001 WD: 41mm		10X M Plan Apo 28-21-10-000 WD: 34mm	
Max FOV Dia.		14		6.9		3.2	
Max Coax FOV Dia.		11		6.5		2.2	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	0.34	2.3	0.84	5.8	1.7	12
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm)	11 x 14	1.6 x 2.1	4.3 x 5.7	0.62 x 0.83	2.1 x 2.9	0.31 x 0.41
	Cam Format	1/3"	1/2"	1/2"	1/2"	1/2"	1/2"
	2/3"	20 x 26	2.8 x 3.8	7.9 x 10	1.1 x 1.5	3.9 x 5.2	0.57 x 0.76
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	0.42	2.9	1.1	7.3	2.1	15
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm)	8.6 x 11	1.2 x 1.7	3.4 x 4.6	0.50 x 0.66	1.7 x 2.3	0.25 x 0.33
	Cam Format	1/3"	1/2"	1/2"	1/2"	1/2"	1/2"
	2/3"	11 x 15	1.7 x 2.2	4.6 x 6.1	0.66 x 0.88	2.3 x 3.0	0.33 x 0.44
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	0.50	3.5	1.3	8.7	2.5	17
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm)	7.1 x 9.5	1.0 x 1.4	2.9 x 3.8	0.41 x 0.55	1.4 x 1.9	0.21 x 0.28
	Cam Format	1/3"	1/2"	1/2"	1/2"	1/2"	1/2"
	2/3"	9.5 x 13	1.4 x 1.8	3.8 x 5.1	0.55 x 0.74	1.9 x 2.5	0.28 x 0.37
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	0.67	4.6	1.7	12	3.4	23
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm)	5.4 x 7.1	0.78 x 1.0	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4	0.16 x 0.21
	Cam Format	1/3"	1/2"	1/2"	1/2"	1/2"	1/2"
	2/3"	7.1 x 9.5	1.0 x 1.4	2.9 x 3.8	0.41 x 0.55	1.4 x 1.9	0.21 x 0.28
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	0.84	5.8	2.1	15	4.2	29
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm)	4.3 x 5.7	0.62 x 0.83	1.7 x 2.3	0.25 x 0.33	0.86 x 1.1	0.12 x 0.17
	Cam Format	1/3"	1/2"	1/2"	1/2"	1/2"	1/2"
	2/3"	5.7 x 7.6	0.83 x 1.1	2.3 x 3.0	0.33 x 0.44	1.1 x 1.5	0.17 x 0.22
	2/3"	7.9 x 10	1.1 x 1.5	3.1 x 4.2	0.46 x 0.61	1.6 x 2.1	0.23 x 0.30

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

50X M Plan Apo is NOT recommended for use with a 7:1 Zoom
0.4X and 0.5X Camera Tubes are not recommended for use with
a 7:1 Zoom and Microscope Objectives.

Objectives

20X M Plan Apo 28-21-11-001 WD: 20mm		5X HiRes 28-20-44-000 WD: 34mm		10X HiRes 28-20-45-000 WD: 19mm		20X HiRes 28-20-46-000 WD: 13mm	
1.2		6.4		3.1		1.7	
0.83		4.9		2.2		1.1	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
3.4	23	0.84	5.8	1.7	12	3.4	23
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158
1.1 x 1.4	0.16 x 0.21	4.3 x 5.7	0.62 x 0.83	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4	0.16 x 0.21
1.4 x 1.9	0.21 x 0.28	5.7 x 7.6	0.83 x 1.1	2.9 x 3.8	0.41 x 0.55	1.4 x 1.9	0.21 x 0.28
2.0 x 2.6	0.28 x 0.38	7.9 x 10	1.1 x 1.5	3.9 x 5.2	0.57 x 0.76	2.0 x 2.6	0.28 x 0.38
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
4.2	29	1.1	7.3	2.1	15	4.2	29
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158
0.86 x 1.1	0.12 x 0.17	3.4 x 4.6	0.50 x 0.66	1.7 x 2.3	0.25 x 0.33	0.9 x 1.1	0.12 x 0.17
1.1 x 1.5	0.17 x 0.22	4.6 x 6.1	0.66 x 0.88	2.3 x 3.0	0.33 x 0.44	1.1 x 1.5	0.17 x 0.22
1.6 x 2.1	0.23 x 0.30	6.3 x 8.4	0.91 x 1.2	3.1 x 4.2	0.46 x 0.61	1.6 x 2.1	0.23 x 0.30
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
5.0	35	1.3	8.7	2.5	17	5.0	35
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158
0.71 x 0.95	0.10 x 0.14	2.9 x 3.8	0.41 x 0.55	1.4 x 1.9	0.21 x 0.28	0.71 x 0.95	0.10 x 0.14
0.95 x 1.3	0.14 x 0.18	3.8 x 5.1	0.55 x 0.74	1.9 x 2.5	0.28 x 0.37	0.95 x 1.3	0.14 x 0.18
1.3 x 1.7	0.19 x 0.25	5.2 x 7.0	0.76 x 1.0	2.6 x 3.5	0.38 x 0.51	1.3 x 1.7	0.19 x 0.25
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
6.7	46	1.7	12	3.4	23	6.7	46
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158
0.54 x 0.71	0.078 x 0.10	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4	0.16 x 0.21	0.54 x 0.71	0.078 x 0.10
0.71 x 0.95	0.10 x 0.14	2.9 x 3.8	0.41 x 0.55	1.4 x 1.9	0.21 x 0.28	0.71 x 0.95	0.10 x 0.14
0.98 x 1.3	0.14 x 0.19	3.9 x 5.2	0.57 x 0.76	2.0 x 2.6	0.28 x 0.38	0.98 x 1.3	0.14 x 0.19
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
8.4	58	2.1	15	4.2	29	8.4	58
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158
0.43 x 0.57	0.062 x 0.083	1.7 x 2.3	0.25 x 0.33	0.86 x 1.1	0.12 x 0.17	0.43 x 0.57	0.062 x 0.083
0.57 x 0.76	0.083 x 0.11	2.3 x 3.0	0.33 x 0.44	1.1 x 1.5	0.17 x 0.22	0.57 x 0.76	0.083 x 0.11
0.79 x 1.0	0.11 x 0.15	3.1 x 4.2	0.46 x 0.61	1.6 x 2.1	0.23 x 0.30	0.79 x 1.0	0.11 x 0.15

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - OPTEM 7:1 Zoom with LWD

Chart 2D

		2X M Plan Apo 28-21-02-001 WD: 34mm		5X M Plan Apo 28-21-05-001 WD: 41mm		10X M Plan Apo 28-21-10-000 WD: 34mm	
Max FOV Dia.		14		6.9		3.2	
Max Coax FOV Dia.		11		6.5		2.2	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	1.3	8.7	3.2	22	6.30	44
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm) Cam Format	2/3"	5.2 x 7.0	0.76 x 1.0	2.1 x 2.8	0.30 x 0.40	1.0 x 1.4
		1"	7.6 x 10	1.1 x 1.5	3.0 x 4.1	0.44 x 0.59	1.5 x 2.0
		4/3"	11 x 14	1.6 x 2.1	4.3 x 5.7	0.62 x 0.83	2.1 x 2.9
		APS-C	13 x 20	1.9 x 2.9	5.3 x 8.0	0.77 x 1.2	2.7 x 4.0
2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	1.7	12	4.2	29	8.4	58
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm) Cam Format	2/3"	3.9 x 5.2	0.57 x 0.76	1.6 x 2.1	0.23 x 0.30	0.79 x 1.0
		1"	5.7 x 7.6	0.83 x 1.1	2.3 x 3.0	0.33 x 0.44	1.1 x 1.5
		4/3"	8.0 x 11	1.2 x 1.6	3.2 x 4.3	0.47 x 0.62	1.6 x 2.1
		APS-C	10 x 15	1.4 x 2.2	4.0 x 6.0	0.58 x 0.87	2.0 x 3.0
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	2.1	15	5.3	36	11	73
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm) Cam Format	1"	4.6 x 6.1	0.66 x 0.88	1.8 x 2.4	0.26 x 0.35	0.91 x 1.2
		4/3"	6.4 x 8.6	0.93 x 1.2	2.6 x 3.4	0.37 x 0.50	1.3 x 1.7
		APS-C	8.0 x 12	1.2 x 1.7	3.2 x 4.8	0.46 x 0.69	1.6 x 2.4
		35mm(Full)	11 x 17	1.7 x 2.5	4.6 x 6.9	0.66 x 0.99	2.3 x 3.4
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	NA	0.024	0.057	0.059	0.14	0.12	0.30
	Res (lp/mm)	71	170	177	420	354	900
	Mag	2.5	17	6.3	44	13	87
	DOF (mm)	1.0	0.18	0.16	0.029	0.041	0.0063
	FOV (mm) Cam Format	1"	3.8 x 5.1	0.55 x 0.74	1.5 x 2.0	0.22 x 0.29	0.76 x 1.0
		4/3"	5.4 x 7.1	0.78 x 1.0	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4
		APS-C	6.6 x 10	0.96 x 1.4	2.7 x 4.0	0.38 x 0.58	1.3 x 2.0
		35mm(Full)	10 x 14	1.4 x 2.1	3.8 x 5.7	0.55 x 0.83	1.9 x 2.9

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

50X M Plan Apo is NOT recommended for use with a 7:1 Zoom
0.4X and 0.5X Camera Tubes are not recommended for use with
a 7:1 Zoom and Microscope Objectives.

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Objectives - Mini Camera Tubes

20X M Plan Apo 28-21-11-001 WD: 20mm		5X HiRes 28-20-44-000 WD: 34mm		10X HiRes 28-20-45-000 WD: 19mm		20X HiRes 28-20-46-000 WD: 13mm	
1.2		6.4		3.1		1.7	
0.83		4.9		2.2		1.1	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
13	87	3.2	22	6.3	44	13	87
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.0016
0.52 x 0.70	0.076 x 0.10	2.1 x 2.8	0.30 x 0.40	1.0 x 1.4	0.15 x 0.20	0.52 x 0.70	0.076 x 0.10
0.76 x 1.0	0.11 x 0.15	3.0 x 4.1	0.44 x 0.59	1.5 x 2.0	0.22 x 0.29	0.76 x 1.02	0.11 x 0.15
1.1 x 1.4	0.16 x 0.21	4.3 x 5.7	0.62 x 0.83	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4	0.16 x 0.21
1.3 x 2.0	0.19 x 0.29	5.3 x 8.0	0.77 x 1.2	2.7 x 4.0	0.38 x 0.58	1.3 x 2.0	0.19 x 0.29
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
17	116	4.2	29	8.4	58	17	116
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.0016
0.39 x 0.52	0.057 x 0.076	1.6 x 2.1	0.23 x 0.30	0.79 x 1.0	0.11 x 0.15	0.39 x 0.52	0.057 x 0.076
0.57 x 0.76	0.083 x 0.11	2.3 x 3.0	0.33 x 0.44	1.1 x 1.5	0.17 x 0.22	0.57 x 0.76	0.083 x 0.11
0.80 x 1.1	0.12 x 0.16	3.2 x 4.3	0.47 x 0.62	1.6 x 2.1	0.23 x 0.31	0.80 x 1.1	0.12 x 0.16
0.99 x 1.5	0.14 x 0.22	4.0 x 6.0	0.58 x 0.87	2.0 x 3.0	0.29 x 0.43	0.99 x 1.5	0.14 x 0.22
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
21	145	5.3	36	11	73	21	145
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.0016
0.46 x 0.61	0.066 x 0.088	1.8 x 2.4	0.26 x 0.35	0.91 x 1.2	0.13 x 0.18	0.46 x 0.61	0.066 x 0.088
0.64 x 0.86	0.093 x 0.12	2.6 x 3.4	0.37 x 0.50	1.3 x 1.7	0.19 x 0.25	0.64 x 0.86	0.093 x 0.12
0.80 x 1.2	0.12 x 0.17	3.2 x 4.8	0.46 x 0.69	1.6 x 2.4	0.23 x 0.35	0.80 x 1.2	0.12 x 0.17
1.1 x 1.7	0.17 x 0.25	4.6 x 6.9	0.66 x 0.99	2.3 x 3.4	0.33 x 0.50	1.1 x 1.7	0.17 x 0.25
0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60
708	1260	177	581	354	1163	708	1800
25	174	6.3	44	13	87	25	174
0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.0016
0.38 x 0.51	0.055 x 0.074	1.5 x 2.0	0.22 x 0.29	0.76 x 1.0	0.11 x 0.15	0.38 x 0.51	0.055 x 0.074
0.54 x 0.71	0.078 x 0.10	2.1 x 2.9	0.31 x 0.41	1.1 x 1.4	0.16 x 0.21	0.54 x 0.71	0.078 x 0.10
0.66 x 1.0	0.096 x 0.14	2.7 x 4.0	0.38 x 0.58	1.3 x 2.0	0.19 x 0.29	0.66 x 1.0	0.096 x 0.14
0.95 x 1.4	0.14 x 0.21	3.8 x 5.7	0.55 x 0.83	1.9 x 2.9	0.28 x 0.41	0.95 x 1.4	0.14 x 0.21

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - OPTEM 12.5:1 Zoom and Chart 3A

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm		0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm		0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm		1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm	
Max FOV Dia.		145		116		87		58	
Max Coax FOV Dia.		NR		NR		NR		20	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.045	0.55	0.056	0.69	0.075	0.92	0.11	1.4
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1/3" 1/2" 2/3"	80 x 107	6.5 x 8.7	64 x 86	5.2 x 7.0	48 x 64	3.9 x 5.2	32 x 43	2.6 x 3.5
		107 x 143	8.7 x 12	86 x 114	7.0 x 9.3	64 x 86	5.2 x 7.0	43 x 57	3.5 x 4.6
		147 x 196	12 x 16	118 x 157	9.6 x 13	88 x 118	7.2 x 9.6	59 x 79	4.8 x 6.4
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA Res (lp/mm) Mag DOF (m m)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.056	0.69	0.070	0.86	0.093	1.2	0.14	1.7
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1/3" 1/2" 2/3"	64 x 86	5.2 x 7.0	51 x 69	4.2 x 5.6	39 x 51	3.1 x 4.2	26 x 34	2.1 x 2.8
		86 x 114	7.0 x 9.3	69 x 91	5.6 x 7.4	51 x 69	4.2 x 5.6	34 x 46	2.8 x 3.7
		118 x 157	9.6 x 13	94 x 126	7.7 x 10	71 x 94	5.7 x 7.7	47 x 63	3.8 x 5.1
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.067	0.83	0.084	1.0	0.11	1.4	0.17	2.1
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1/3" 1/2" 2/3"	54 x 71	4.3 x 5.8	43 x 57	3.5 x 4.6	32 x 43	2.6 x 3.5	21 x 29	1.7 x 2.3
		71 x 95	5.8 x 7.7	57 x 76	4.6 x 6.2	43 x 57	3.5 x 4.6	29 x 38	2.3 x 3.1
		98 x 131	8.0 x 11	79 x 105	6.4 x 8.5	59 x 79	4.8 x 6.4	39 x 52	3.2 x 4.3
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.090	1.1	0.11	1.4	0.15	1.8	0.22	2.8
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1/3" 1/2" 2/3"	40 x 54	3.3 x 4.3	32 x 43	2.6 x 3.5	24 x 32	2.0 x 2.6	16 x 21	1.3 x 1.7
		54 x 71	4.3 x 5.8	43 x 57	3.5 x 4.6	32 x 43	2.6 x 3.5	21 x 29	1.7 x 2.3
		74 x 98	6.0 x 8.0	59 x 79	4.8 x 6.4	44 x 59	3.6 x 4.8	29 x 39	2.4 x 3.2
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.11	1.4	0.14	1.7	0.19	2.3	0.28	3.5
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1/3" 1/2" 2/3"	32 x 43	2.6 x 3.5	26 x 34	2.1 x 2.8	19 x 26	1.6 x 2.1	13 x 17	1.0 x 1.4
		43 x 57	3.5 x 4.6	34 x 46	2.8 x 3.7	26 x 34	2.1 x 2.8	17 x 23	1.4 x 1.9
		59 x 79	4.8 x 6.4	47 x 63	3.8 x 5.1	35 x 47	2.9 x 3.8	24 x 31	1.9 x 2.6

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

NR = Not recommended for Coax illumination

Fetura+ with Lower Lens

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm		1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm		1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm		2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm		3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm		4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm	
46		41		35		29		19		15	
19		19		17		20		13		9.9	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.14	1.7	0.16	2.0	0.19	2.3	0.22	2.8	0.34	4.1	0.45	5.5
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
26 x 34	2.1 x 2.8	23 x 30	1.8 x 2.4	19 x 26	1.6 x 2.1	16 x 21	1.3 x 1.7	11 x 14	0.87 x 1.2	8.0 x 11	0.65 x 0.87
34 x 46	2.8 x 3.7	30 x 40	2.4 x 3.2	26 x 34	2.1 x 2.8	21 x 29	1.7 x 2.3	14 x 19	1.2 x 1.5	11 x 14	0.87 x 1.2
47 x 63	3.8 x 5.1	41 x 55	3.3 x 4.5	35 x 47	2.9 x 3.8	29 x 39	2.4 x 3.2	20 x 26	1.6 x 2.1	15 x 20	1.2 x 1.6
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.18	2.2	0.20	2.5	0.23	2.9	0.28	3.5	0.42	5.2	0.56	6.9
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
21 x 27	1.7 x 2.2	18 x 24	1.5 x 1.9	15 x 21	1.3 x 1.7	13 x 17	1.0 x 1.4	8.6 x 11	0.70 x 0.9	6.4 x 8.6	0.52 x 0.70
27 x 37	2.2 x 3.0	24 x 32	1.9 x 2.6	21 x 27	1.7 x 2.2	17 x 23	1.4 x 1.9	11 x 15	0.9 x 1.2	8.6 x 11	0.70 x 0.93
38 x 50	3.1 x 4.1	33 x 44	2.7 x 3.6	28 x 38	2.3 x 3.1	24 x 31	1.9 x 2.6	16 x 21	1.3 x 1.7	12 x 16	0.96 x 1.3
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.21	2.6	0.24	3.0	0.28	3.5	0.34	4.1	0.50	6.2	0.67	8.3
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
17 x 23	1.4 x 1.9	15 x 20	1.2 x 1.6	13 x 17	1.0 x 1.4	11 x 14	0.87 x 1.2	7.1 x 10	0.58 x 0.77	5.4 x 7.1	0.43 x 0.58
23 x 30	1.9 x 2.5	20 x 27	1.6 x 2.2	17 x 23	1.4 x 1.9	14 x 19	1.2 x 1.5	10 x 13	0.77 x 1.0	7.1 x 9.5	0.58 x 0.77
31 x 42	2.6 x 3.4	28 x 37	2.2 x 3.0	24 x 31	1.9 x 2.6	20 x 26	1.6 x 2.1	13 x 17	1.1 x 1.4	9.8 x 13	0.80 x 1.1
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.28	3.5	0.32	3.9	0.37	4.6	0.45	5.5	0.67	8	0.90	11
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
13 x 17	1.0 x 1.4	11 x 15	0.91 x 1.2	9.6 x 13	0.78 x 1.0	8.0 x 11	0.65 x 0.87	5.4 x 7.1	0.44 x 0.58	4.0 x 5.4	0.33 x 0.43
17 x 23	1.4 x 1.9	15 x 20	1.2 x 1.6	13 x 17	1.0 x 1.4	11 x 14	0.87 x 1.2	7.1 x 10	0.58 x 0.77	5.4 x 7.1	0.43 x 0.58
24 x 31	1.9 x 2.6	21 x 28	1.7 x 2.2	18 x 24	1.4 x 1.9	15 x 20	1.2 x 1.6	10 x 13	0.80 x 1.1	7.4 x 9.8	0.60 x 0.80
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.35	4.3	0.40	4.9	0.47	5.8	0.56	6.9	0.84	10.3	1.1	14
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
10 x 14	0.83 x 1.1	9.0 x 12	0.73 x 0.97	7.7 x 10	0.63 x 0.83	6.4 x 8.6	0.52 x 0.70	4.3 x 5.7	0.35 x 0.46	3.2 x 4.3	0.26 x 0.35
14 x 18	1.1 x 1.5	12 x 16	0.97 x 1.3	10 x 14	0.83 x 1.1	8.6 x 11	0.70 x 0.93	5.7 x 7.6	0.46 x 0.62	4.3 x 5.7	0.35 x 0.46
19 x 25	1.5 x 2.0	17 x 22	1.3 x 1.8	14 x 19	1.1 x 1.5	12 x 16	0.96 x 1.3	7.9 x 10	0.64 x 0.85	5.9 x 7.9	0.48 x 0.64

Optical Performance - OPTEM 12.5:1 Zoom and Chart 3B

		0.4X Lower Lens 35-00-11-000 WD: 490mm EFL: 500mm		0.5X Lower Lens 35-00-10-000 WD: 390mm EFL: 400mm		0.67X Lower Lens 35-00-09-000 WD: 290mm EFL: 300mm		1X Lower Lens 35-00-08-000 WD: 190mm EFL: 200mm	
Max FOV Dia.		145		116		87		58	
Max Coax FOV Dia.		NR		NR		NR		20	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.17	2.1	0.21	2.6	0.28	3.5	0.42	5.2
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 2/3" 1" 4/3" APS-C	39 x 52	3.2 x 4.3	31 x 42	2.6 x 3.4	24 x 31	1.9 x 2.6	16 x 21	1.3 x 1.7
		57 x 76	4.6 x 6.2	46 x 61	3.7 x 4.9	34 x 46	2.8 x 3.7	23 x 30	1.9 x 2.5
		80 x 107	6.5 x 8.7	64 x 86	5.2 x 7.0	48 x 64	3.9 x 5.2	32 x 43	2.6 x 3.5
		99 x 149	8.1 x 12	80 x 120	6.5 x 9.7	60 x 90	4.8 x 7.3	40 x 60	3.2 x 4.9
	NA Res (lp/mm) Mag DOF (m m)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.22	2.8	0.28	3.5	0.37	4.6	0.56	6.9
		44	1.5	28	0.98	16	0.55	7.0	0.25
2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (m m)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.22	2.8	0.28	3.5	0.37	4.6	0.56	6.9
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 2/3" 1" 4/3" APS-C	29 x 39	2.4 x 3.2	24 x 31	1.9 x 2.6	18 x 24	1.4 x 1.9	12 x 16	0.96 x 1.3
		43 x 57	3.5 x 4.6	34 x 46	2.8 x 3.7	26 x 34	2.1 x 2.8	17 x 23	1.4 x 1.9
		60 x 80	4.9 x 6.5	48 x 64	3.9 x 5.2	36 x 48	2.9 x 3.9	24 x 32	2.0 x 2.6
		75 x 112	6.1 x 9.1	60 x 90	4.8 x 7.3	45 x 67	3.6 x 5.5	30 x 45	2.4 x 3.6
	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.28	3.5	0.35	4.3	0.47	5.8	0.70	8.6
		44	1.5	28	0.98	16	0.55	7.0	0.25
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.28	3.5	0.35	4.3	0.47	5.8	0.70	8.6
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1" 4/3" APS-C 35mm(Full)	34 x 46	2.8 x 3.7	27 x 37	2.2 x 3.0	21 x 27	1.7 x 2.2	14 x 18	1.1 x 1.5
		48 x 64	3.9 x 5.2	39 x 51	3.1 x 4.2	29 x 39	2.3 x 3.1	19 x 26	1.6 x 2.1
		60 x 90	4.8 x 7.3	48 x 72	3.9 x 5.8	36 x 54	2.9 x 4.4	24 x 36	1.9 x 2.9
		86 x 129	7.0 x 10	69 x 103	5.6 x 8.3	51 x 77	4.2 x 6.3	34 x 51	2.8 x 4.2
	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.34	4.1	0.42	5.2	0.56	6.9	0.84	10
		44	1.5	28	0.98	16	0.55	7.0	0.25
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	NA Res (lp/mm) Mag DOF (mm)	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		11	58	14	72	18	96	27	144
		0.34	4.1	0.42	5.2	0.56	6.9	0.84	10
		44	1.5	28	0.98	16	0.55	7.0	0.25
	FOV (mm) Cam Format 1" 4/3" APS-C 35mm(Full)	29 x 38	2.3 x 3.1	23 x 30	1.9 x 2.5	17 x 23	1.4 x 1.9	11 x 15	0.93 x 1.2
		40 x 54	3.3 x 4.3	32 x 43	2.6 x 3.5	24 x 32	2.0 x 2.6	16 x 21	1.3 x 1.7
		50 x 75	4.0 x 6.1	40 x 60	3.2 x 4.9	30 x 45	2.4 x 3.6	20 x 30	1.6 x 2.4
		71 x 107	5.8 x 8.7	57 x 86	4.6 x 7.0	43 x 64	3.5 x 5.2	29 x 43	2.3 x 3.5

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

NR = Not recommended for Coax illumination

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Fetura+ with Lower Lens - Mini Camera Tubes

1.25X Lower Lens 35-00-06-000 WD: 155mm EFL: 160mm		1.43X Lower Lens 35-00-05-000 WD: 135mm EFL: 140mm		1.67 Lower Lens 35-00-04-000 WD: 110mm EFL: 120mm		2X Lower Lens 35-00-03-000 WD: 95mm EFL: 100mm		3X Lower Lens 35-00-01-000 WD: 50mm EFL: 67mm		4X Lower Lens 35-00-02-000 WD: 32mm EFL: 50mm	
46		41		35		29		19		15	
19		19		17		20		13		9.9	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.53	6.5	0.60	7.4	0.70	8.6	0.84	10	1.3	16	1.7	21
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
13 x 17	1.0 x 1.4	11 x 15	0.89 x 1.2	9.4 x 13	0.77 x 1.0	7.9 x 10	0.64 x 0.85	5.2 x 7.0	0.43 x 0.57	3.9 x 5.2	0.32 x 0.43
18 x 24	1.5 x 2.0	16 x 21	1.3 x 1.7	14 x 18	1.1 x 1.5	11 x 15	0.93 x 1.2	7.6 x 10	0.62 x 0.82	5.7 x 7.6	0.46 x 0.62
26 x 34	2.1 x 2.8	23 x 30	1.8 x 2.4	19 x 26	1.6 x 2.1	16 x 21	1.3 x 1.7	11 x 14	0.87 x 1.2	8.0 x 11	0.65 x 0.87
32 x 48	2.6 x 3.9	28 x 42	2.3 x 3.4	24 x 36	1.9 x 2.9	20 x 30	1.6 x 2.4	13 x 20	1.1 x 1.6	9.9 x 15	0.81 x 1.2
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.70	8.6	0.80	9.9	0.93	12	1.1	14	1.7	21	2.2	28
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
9.4 x 13	0.77 x 1.0	8.3 x 11	0.67 x 0.89	7.1 x 9.4	0.57 x 0.77	5.9 x 7.9	0.48 x 0.64	3.9 x 5.2	0.32 x 0.43	2.9 x 3.9	0.24 x 0.32
14 x 18	1.1 x 1.5	12 x 16	0.97 x 1.3	10 x 14	0.83 x 1.1	8.6 x 11	0.70 x 0.93	5.7 x 7.6	0.46 x 0.62	4.3 x 5.7	0.35 x 0.46
19 x 26	1.6 x 2.1	17 x 23	1.4 x 1.8	14 x 19	1.2 x 1.6	12 x 16	0.98 x 1.3	8.0 x 11	0.65 x 0.87	6.0 x 8.0	0.49 x 0.65
24 x 36	1.9 x 2.9	21 x 31	1.7 x 2.5	18 x 27	1.5 x 2.2	15 x 22	1.2 x 1.8	9.9 x 15	0.81 x 1.2	7.5 x 11	0.61 x 0.91
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
0.88	11	1.0	12	1.2	14	1.4	17	2.1	26	2.8	35
4.5	0.16	3.4	0.12	2.5	0.09	1.8	0.062	0.78	0.027	0.44	0.015
11 x 15	0.89 x 1.2	9.6 x 13	0.78 x 1.0	8.2 x 11	0.67 x 0.89	6.9 x 9.1	0.56 x 0.74	4.6 x 6.1	0.37 x 0.49	3.4 x 4.6	0.28 x 0.37
15 x 21	1.3 x 1.7	14 x 18	1.1 x 1.5	12 x 15	0.94 x 1.3	9.6 x 13	0.78 x 1.0	6.4 x 8.6	0.52 x 0.70	4.8 x 6.4	0.39 x 0.52
19 x 29	1.5 x 2.3	17 x 25	1.4 x 2.0	14 x 22	1.2 x 1.7	12 x 18	0.97 x 1.5	8.0 x 12	0.65 x 0.97	6.0 x 9.0	0.48 x 0.73
27 x 41	2.2 x 3.3	24 x 36	1.9 x 2.9	21 x 31	1.7 x 2.5	17 x 26	1.4 x 2.1	11 x 17	0.93 x 1.4	8.6 x 13	0.70 x 1.0
0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
34	180	39	206	45	240	54	288	81	432	108	576
1.1	13	1.2	15	1.4	17	1.7	21	2.5	31	3.4	41
4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
9.1 x 12	0.74 x 0.99	8.0 x 11	0.65 x 0.87	6.9 x 9.1	0.56 x 0.74	5.7 x 7.6	0.46 x 0.62	3.8 x 5.1	0.31 x 0.41	2.9 x 3.8	0.23 x 0.31
13 x 17	1.0 x 1.4	11 x 15	0.91 x 1.2	9.6 x 13	0.78 x 1.0	8.0 x 11	0.65 x 0.87	5.4 x 7.1	0.44 x 0.58	4.0 x 5.4	0.33 x 0.43
16 x 24	1.3 x 1.9	14 x 21	1.1 x 1.7	12 x 18	0.97 x 1.5	9.9 x 15	0.81 x 1.2	6.6 x 10	0.54 x 0.81	5.0 x 7.5	0.40 x 0.61
23 x 34	1.9 x 2.8	20 x 30	1.6 x 2.4	17 x 26	1.4 x 2.1	14 x 21	1.2 x 1.7	9.5 x 14	0.77 x 1.2	7.1 x 11	0.58 x 0.87

Optical Performance - OPTEM 12.5:1 Zoom and Chart 3C

		2X M Plan Apo 28-21-02-001 WD: 34mm				5X M Plan Apo 28-21-05-001 WD: 41mm				10X M Plan Apo 28-21-10-000 WD: 34mm						
Max FOV Dia.		14				6.8				3.3						
Max Coax FOV Dia.		11				4.6				2.2						
		Low Mag		High Mag		Low Mag		High Mag		Low Mag		High Mag				
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA		0.018		0.057		0.045		0.14		0.090		0.30			
	Res (lp/mm)		54		170		135		420		270		900			
	Mag		0.22		2.8		0.56		6.9		1.1		14			
	DOF (mm)		1.8		0.18		0.28		0.029		0.070		0.0063			
	FOV (mm)	Cam Format	1/3 "		16 x 21		1.3 x 1.7		6.4 x 8.6		0.52 x 0.70		3.2 x 4.3		0.26 x 0.35	
			1/2 "		21 x 29		1.7 x 2.3		8.6 x 11		0.70 x 0.93		4.3 x 5.7		0.35 x 0.46	
			2/3 "		29 x 39		2.4 x 3.2		12 x 16		0.96 x 1.3		5.9 x 7.9		0.48 x 0.64	
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA		0.018		0.057		0.045		0.14		0.090		0.30			
	Res (lp/mm)		54		170		135		420		270		900			
	Mag		0.28		3.5		0.70		8.6		1.4		17			
	DOF (m m)		1.8		0.18		0.28		0.029		0.070		0.0063			
	FOV (mm)	Cam Format	1/3 "		13 x 17		1.0 x 1.4		5.1 x 6.9		0.42 x 0.56		2.6 x 3.4		0.21 x 0.28	
			1/2 "		17 x 23		1.4 x 1.9		6.9 x 9.1		0.56 x 0.74		3.4 x 4.6		0.28 x 0.37	
			2/3 "		24 x 31		1.9 x 2.6		9.4 x 13		0.77 x 1.0		4.7 x 6.3		0.38 x 0.51	
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4	NA		0.018		0.057		0.045		0.14		0.090		0.30			
	Res (lp/mm)		54		170		135		420		270		900			
	Mag		0.34		4.1		0.84		10		1.7		21			
	DOF (mm)		1.8		0.18		0.28		0.029		0.070		0.0063			
	FOV (mm)	Cam Format	1/3 "		11 x 14		0.87 x 1.2		4.3 x 5.7		0.35 x 0.46		2.1 x 2.9		0.17 x 0.23	
			1/2 "		14 x 19		1.2 x 1.5		5.7 x 7.6		0.46 x 0.62		2.9 x 3.8		0.23 x 0.31	
			2/3 "		20 x 26		1.6 x 2.1		7.9 x 10		0.64 x 0.85		3.9 x 5.2		0.32 x 0.43	
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA		0.018		0.057		0.045		0.14		0.090		0.30			
	Res (lp/mm)		54		170		135		420		270		900			
	Mag		0.45		5.5		1.1		14		2.2		28			
	DOF (mm)		1.8		0.18		0.28		0.029		0.070		0.0063			
	FOV (mm)	Cam Format	1/3 "		8.0 x 11		0.65 x 0.87		3.2 x 4.3		0.26 x 0.35		1.6 x 2.1		0.13 x 0.17	
			1/2 "		11 x 14		0.87 x 1.2		4.3 x 5.7		0.35 x 0.46		2.1 x 2.9		0.17 x 0.23	
			2/3 "		15 x 20		1.2 x 1.6		5.9 x 7.9		0.48 x 0.64		2.9 x 3.9		0.24 x 0.32	
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA		0.018		0.057		0.045		0.14		0.090		0.30			
	Res (lp/mm)		54		170		135		420		270		900			
	Mag		0.56		6.9		1.4		17		2.8		35			
	DOF (mm)		1.8		0.18		0.28		0.029		0.070		0.0063			
	FOV (mm)	Cam Format	1/3 "		6.4 x 8.6		0.52 x 0.70		2.6 x 3.4		0.21 x 0.28		1.3 x 1.7		0.10 x 0.14	
			1/2 "		8.6 x 11		0.70 x 0.93		3.4 x 4.6		0.28 x 0.37		1.7 x 2.3		0.14 x 0.19	
			2/3 "		12 x 16		0.96 x 1.3		4.7 x 6.3		0.38 x 0.51		2.4 x 3.1		0.19 x 0.26	

-- Useable FOV Limited by Coax illumination (>50% Illumination)

-- FOV Limited by vignetting

50X M Plan Apo is NOT recommended for use with a 12.5:1 Zoom
0.4X and 0.5X Camera Tubes are not recommended for use with
a 12.5:1 Zoom and Microscope Objectives.

Fetura+ with LWD Objectives

20X M Plan Apo 28-21-11-001 WD: 20mm		5X HiRes 28-20-44-000 WD: 34mm		10X HiRes 28-20-45-000 WD: 19mm		20X HiRes 28-20-46-000 WD: 13mm	
1.2		6.6		3.2		1.6	
0.83		5.0		2.3		1.1	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
2.2	28	0.56	6.9	1.1	14	2.2	28
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
1.6 x 2.1	0.13 x 0.17	6.4 x 8.6	0.52 x 0.70	3.2 x 4.3	0.26 x 0.35	1.6 x 2.1	0.13 x 0.17
2.1 x 2.9	0.17 x 0.23	8.6 x 11	0.70 x 0.93	4.3 x 5.7	0.35 x 0.46	2.1 x 2.9	0.17 x 0.23
2.9 x 3.9	0.24 x 0.32	12 x 16	0.96 x 1.3	5.9 x 7.9	0.48 x 0.64	2.9 x 3.9	0.24 x 0.32
0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
2.8	35	0.70	8.6	1.4	17	2.8	35
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
1.3 x 1.7	0.10 x 0.14	5.1 x 6.9	0.42 x 0.56	2.6 x 3.4	0.21 x 0.28	1.3 x 1.7	0.10 x 0.14
1.7 x 2.3	0.14 x 0.19	6.9 x 9.1	0.56 x 0.74	3.4 x 4.6	0.28 x 0.37	1.7 x 2.3	0.14 x 0.19
2.4 x 3.1	0.19 x 0.26	9.4 x 13	0.77 x 1.0	4.7 x 6.3	0.38 x 0.51	2.4 x 3.1	0.19 x 0.26
0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
3.4	41	0.84	10.4	1.7	21	3.4	41
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
1.1 x 1.4	0.087 x 0.12	4.3 x 5.7	0.35 x 0.46	2.1 x 2.9	0.17 x 0.23	1.1 x 1.4	0.087 x 0.12
1.4 x 1.9	0.12 x 0.15	5.7 x 7.6	0.46 x 0.62	2.9 x 3.8	0.23 x 0.31	1.4 x 1.9	0.12 x 0.15
2.0 x 2.6	0.16 x 0.21	7.9 x 10	0.64 x 0.85	3.9 x 5.2	0.32 x 0.43	2.0 x 2.6	0.16 x 0.21
0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
4.5	55	1.1	14	2.2	28	4.5	55
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.80 x 1.1	0.065 x 0.087	3.2 x 4.3	0.26 x 0.35	1.6 x 2.1	0.13 x 0.17	0.80 x 1.1	0.065 x 0.087
1.1 x 1.4	0.087 x 0.12	4.3 x 5.7	0.35 x 0.46	2.1 x 2.9	0.17 x 0.23	1.1 x 1.4	0.087 x 0.12
1.5 x 2.0	0.12 x 0.16	5.9 x 7.9	0.48 x 0.64	2.9 x 3.9	0.24 x 0.32	1.5 x 2.0	0.12 x 0.16
0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
5.6	69	1.4	17	2.8	35	5.6	69
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.64 x 0.86	0.052 x 0.070	2.6 x 3.4	0.21 x 0.28	1.3 x 1.7	0.10 x 0.14	0.64 x 0.86	0.052 x 0.070
0.86 x 1.1	0.070 x 0.093	3.4 x 4.6	0.28 x 0.37	1.7 x 2.3	0.14 x 0.19	0.86 x 1.1	0.070 x 0.093
1.2 x 1.6	0.096 x 0.13	4.7 x 6.3	0.38 x 0.51	2.4 x 3.1	0.19 x 0.26	1.2 x 1.6	0.096 x 0.13

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - OPTEM 12.5:1 Zoom and Chart 3D

		2X M Plan Apo 28-21-02-001 WD: 34mm		5X M Plan Apo 28-21-05-001 WD: 41mm		10X M Plan Apo 28-21-10-000 WD: 34mm	
Max FOV Dia.		14		6.8		3.3	
Max Coax FOV Dia.		11		4.6		2.2	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	NA	0.018	0.057	0.045	0.14	0.090	0.30
	Res (lp/mm)	54	170	135	420	270	900
	Mag	0.84	10	2.1	26	4.2	52
	DOF (mm)	1.8	0.18	0.28	0.029	0.070	0.0063
	FOV (mm) 2/3"	7.9 x 10	0.64 x 0.85	3.1 x 4.2	0.26 x 0.34	1.6 x 2.1	0.13 x 0.17
	FOV (mm) 1"	11 x 15	0.93 x 1.2	4.6 x 6.1	0.37 x 0.49	2.3 x 3.0	0.19 x 0.25
	FOV (mm) 4/3"	16 x 21	1.3 x 1.7	6.4 x 8.6	0.52 x 0.70	3.2 x 4.3	0.26 x 0.35
	FOV (mm) APS-C	20 x 30	1.6 x 2.4	8.0 x 12	0.65 x 0.97	4.0 x 6.0	0.32 x 0.49
	Cam Format						
	NA	0.018	0.057	0.045	0.14	0.090	0.30
2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	Res (lp/mm)	54	170	135	420	270	900
	Mag	1.1	14	2.8	35	5.6	69
	DOF (m m)	1.8	0.178	0.28	0.029	0.070	0.0063
	FOV (mm) 2/3"	5.9 x 7.9	0.48 x 0.64	2.4 x 3.1	0.19 x 0.26	1.2 x 1.6	0.096 x 0.13
	FOV (mm) 1"	8.6 x 11	0.70 x 0.93	3.4 x 4.6	0.28 x 0.37	1.7 x 2.3	0.14 x 0.19
	FOV (mm) 4/3"	12 x 16	0.98 x 1.3	4.8 x 6.4	0.39 x 0.52	2.4 x 3.2	0.20 x 0.26
	FOV (mm) APS-C	15 x 22	1.2 x 1.8	6.0 x 9.0	0.48 x 0.73	3.0 x 4.5	0.24 x 0.36
	Cam Format						
	NA	0.018	0.057	0.045	0.14	0.090	0.30
	Res (lp/mm)	54	170	135	420	270	900
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44	Mag	1.4	17	3.5	43	7.0	86
	DOF (mm)	1.8	0.18	0.28	0.029	0.070	0.0063
	FOV (mm) 1"	6.9 x 9.1	0.56 x 0.74	2.7 x 3.7	0.22 x 0.30	1.4 x 1.8	0.11 x 0.15
	FOV (mm) 4/3"	9.6 x 13	0.78 x 1.0	3.9 x 5.1	0.31 x 0.42	1.9 x 2.6	0.16 x 0.21
	FOV (mm) APS-C	12 x 18	0.97 x 1.5	4.8 x 7.2	0.39 x 0.58	2.4 x 3.6	0.19 x 0.29
	FOV (mm) 35mm(Full)	17 x 26	1.4 x 2.1	6.9 x 10	0.56 x 0.83	3.4 x 5.1	0.28 x 0.42
	Cam Format						
	NA	0.018	0.057	0.045	0.14	0.090	0.30
	Res (lp/mm)	54	170	135	420	270	900
	Mag	1.7	21	4.2	52	8.4	104
3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	DOF (mm)	1.8	0.18	0.28	0.029	0.070	0.0063
	FOV (mm) 1"	5.7 x 7.6	0.46 x 0.62	2.3 x 3.0	0.19 x 0.25	1.1 x 1.5	0.093 x 0.12
	FOV (mm) 4/3"	8.0 x 11	0.65 x 0.87	3.2 x 4.3	0.26 x 0.35	1.6 x 2.1	0.13 x 0.17
	FOV (mm) APS-C	9.9 x 15	0.81 x 1.2	4.0 x 6.0	0.32 x 0.49	2.0 x 3.0	0.16 x 0.24
	FOV (mm) 35mm(Full)	14 x 21	1.2 x 1.7	5.7 x 8.6	0.46 x 0.70	2.9 x 4.3	0.23 x 0.35
	Cam Format						
	NA	0.018	0.057	0.045	0.14	0.090	0.30
	Res (lp/mm)	54	170	135	420	270	900
	Mag	1.7	21	4.2	52	8.4	104
	DOF (mm)	1.8	0.18	0.28	0.029	0.070	0.0063

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

50X M Plan Apo is NOT recommended for use with a 12.5:1 Zoom
0.4X and 0.5X Camera Tubes are not recommended for use with
a 12.5:1 Zoom and Microscope Objectives.

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Fetura+ with LWD Objectives - Mini Camera Tubes

20X M Plan Apo 28-21-11-001 WD: 20mm		5X HiRes 28-20-44-000 WD: 34mm		10X HiRes 28-20-45-000 WD: 19mm		20X HiRes 28-20-46-000 WD: 13mm	
1.2		6.6		3.2		1.6	
0.83		5.0		2.3		1.1	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
8.4	104	2.1	26	4.2	52	8.4	104
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.79 x 1.0	0.064 x 0.085	3.1 x 4.2	0.26 x 0.34	1.6 x 2.1	0.13 x 0.17	0.79 x 1.0	0.064 x 0.085
1.1 x 1.5	0.093 x 0.12	4.6 x 6.1	0.37 x 0.49	2.3 x 3.0	0.19 x 0.25	1.1 x 1.5	0.093 x 0.12
1.6 x 2.1	0.13 x 0.17	6.4 x 8.6	0.52 x 0.70	3.2 x 4.3	0.26 x 0.35	1.6 x 2.1	0.13 x 0.17
2.0 x 3.0	0.16 x 0.24	8.0 x 12	0.65 x 0.97	4.0 x 6.0	0.32 x 0.49	2.0 x 3.0	0.16 x 0.24
0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
11	138	2.8	35	5.6	69	11	138
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.59 x 0.79	0.048 x 0.064	2.4 x 3.1	0.19 x 0.26	1.2 x 1.6	0.096 x 0.13	0.59 x 0.79	0.048 x 0.064
0.86 x 1.1	0.070 x 0.093	3.4 x 4.6	0.28 x 0.37	1.7 x 2.3	0.14 x 0.19	0.86 x 1.1	0.070 x 0.093
1.2 x 1.6	0.098 x 0.13	4.8 x 6.4	0.39 x 0.52	2.4 x 3.2	0.20 x 0.26	1.2 x 1.6	0.098 x 0.13
1.5 x 2.2	0.12 x 0.18	6.0 x 9.0	0.48 x 0.73	3.0 x 4.5	0.24 x 0.36	1.5 x 2.2	0.12 x 0.18
0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
14	173	3.5	43	7.0	86	14	173
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.69 x 0.91	0.056 x 0.074	2.7 x 3.7	0.22 x 0.30	1.4 x 1.8	0.11 x 0.15	0.69 x 0.91	0.056 x 0.074
0.96 x 1.3	0.078 x 0.10	3.9 x 5.1	0.31 x 0.42	1.9 x 2.6	0.16 x 0.21	0.96 x 1.3	0.078 x 0.10
1.2 x 1.8	0.097 x 0.15	4.8 x 7.2	0.39 x 0.58	2.4 x 3.6	0.19 x 0.29	1.2 x 1.8	0.097 x 0.15
1.7 x 2.6	0.14 x 0.21	6.9 x 10	0.56 x 0.83	3.4 x 5.1	0.28 x 0.42	1.7 x 2.6	0.14 x 0.21
0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60
540	1260	135	675	270	1350	540	1800
17	207	4.2	52	8.4	104	17	207
0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016
0.57 x 0.76	0.046 x 0.062	2.3 x 3.0	0.19 x 0.25	1.1 x 1.5	0.093 x 0.12	0.57 x 0.76	0.046 x 0.062
0.80 x 1.1	0.065 x 0.087	3.2 x 4.3	0.26 x 0.35	1.6 x 2.1	0.13 x 0.17	0.80 x 1.1	0.065 x 0.087
0.99 x 1.5	0.081 x 0.12	4.0 x 6.0	0.32 x 0.49	2.0 x 3.0	0.16 x 0.24	0.99 x 1.5	0.081 x 0.12
1.4 x 2.1	0.12 x 0.17	5.7 x 8.6	0.46 x 0.70	2.9 x 4.3	0.23 x 0.35	1.4 x 2.1	0.12 x 0.17

Note: Hi Res Objectives are not flat-field and therefore limited by field curvature at lower magnifications with both fixed and zoom systems.

Optical Performance - Infinity Macro Lens with 2X

Chart 4

42-35-41-000

		WD: 500mm 0.14X	WD: 400mm 0.17X	WD: 300mm 0.21X
Max FOV Dia.		275	225	175
Fixed Mag. 1X Camera Tube 35-08-06-000 Image Circle Dia. (mm) 24 18mm Stop	NA	0.0061	0.0075	0.0096
	Res (lp/mm)	18	22	29
	Mag	0.14	0.17	0.21
	DOF (mm)	15	10	6.2
	FOV (mm)	26 x 35	22 x 29	17 x 23
	Cam Format	35 x 47	29 x 39	23 x 30
	2/3"	49 x 65	40 x 53	31 x 41

Max FOV Dia.		240		200		150	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
7:1 Zoom 1X Camera Tube Image Circle Dia. (mm) 24	NA	0.0016	0.0053	0.0020	0.0064	0.0025	0.0083
	Res (lp/mm)	4.8	16	5.9	19	7.5	25
	Mag	0.057	0.39	0.070	0.48	0.090	0.62
	DOF (mm)	220	20	148	14	90	8.3
	FOV (mm)	63 x 84	9.1 x 12	52 x 69	7.5 x 10	40 x 54	5.8 x 7.8
	Cam Format	84 x 112	12 x 16	69 x 92	10 x 13	54 x 71	7.8 x 10
	2/3"	116 x 154	17 x 22	95 x 126	14 x 18	74 x 98	11 x 14

Max FOV Dia.		210		175		135	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
12:1 Zoom 1X Camera Tube 35-08-06-000 Image Circle Dia. (mm) 24	NA	0.0012	0.0065	0.0015	0.0080	0.0019	0.010
	Res (lp/mm)	3.7	20	4.5	24	5.8	31
	Mag	0.038	0.47	0.046	0.57	0.060	0.74
	DOF (mm)	378	13	255	8.9	154	5.4
	FOV (mm)	95 x 126	7.7 x 10	78 x 103	6.3 x 8.4	60 x 80	4.9 x 6.5
	Cam Format	126 x 168	10 x 14	103 x 138	8.4 x 11	80 x 107	6.5 x 8.7
	2/3"	173 x 231	14 x 19	142 x 190	12 x 15	111 x 147	9.0 x 12

 -- FOV Limited by vignetting

1X Camera Tube shown. For other Camera tubes, multiply the magnification in the chart by the Camera tube mag., and divide the FOV values by the Camera tube mag. NA, Resolution, and DOF are not affected by the Camera Tube.

NOTE: Wide Angle Objective is not recommended for use with coaxial Illumination.

The Wide Angle Objective can be focused out to infinity. At WDs greater than 1m, it can be thought of as a video lens.

Fixed Mag:	
EFL:	73 *CT mag
f/# :	200/Stop Diameter*CT mag

NOTE: The Camera Tube Magnification will affect the EFL and the f/# of the video lens.

7:1 Zoom:	
EFL (low mag):	30*CT mag
EFL (high mag):	210*CT mag
f/#: (low mag):	18*CT mag
f/#: (high mag):	38*CT mag

Lower Lens
35-00-03-000

WD: 200mm 0.30X	WD: 150mm 0.38X	WD: 100mm 0.50X	WD: 50mm 0.75X
125	100	75	50
0.013	0.017	0.023	0.034
40	51	68	103
0.30	0.38	0.50	0.77
3.1	2.0	1.1	0.48
12 x 16	9.6 x 13	7.1 x 9.5	4.7 x 6.3
16 x 21	13 x 17	9.5 x 13	6.3 x 8.4
22 x 29	18 x 23	13 x 17	8.6 x 11

110		85		65		43	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.0035	0.012	0.0044	0.015	0.0059	0.020	0.0090	0.030
11	35	13	44	18	59	27	89
0.13	0.87	0.16	1.1	0.21	1.5	0.32	2.2
45	4.2	29	2.7	16	1.5	6.9	0.64
29 x 38	4.1 x 5.5	23 x 30	3.3 x 4.4	17 x 23	2.5 x 3.3	11 x 15	1.6 x 2.2
38 x 51	5.5 x 7.4	30 x 41	4.4 x 5.9	23 x 30	3.3 x 4.4	15 x 20	2.2 x 2.9
52 x 70	7.6 x 10	42 x 56	6.1 x 8.1	31 x 42	4.5 x 6.0	21 x 27	3.0 x 4.0

95		77		58		38	
Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.0027	0.014	0.0034	0.018	0.0045	0.024	0.0069	0.037
8.1	43	10	54	14	73	21	110
0.084	1.0	0.11	1.3	0.14	1.7	0.21	2.6
78	2.7	50	1.7	28	0.97	12	0.42
43 x 57	3.5 x 4.6	34 x 46	2.8 x 3.7	26 x 34	2.1 x 2.8	17 x 22	1.4 x 1.8
57 x 76	4.6 x 6.2	46 x 61	3.7 x 4.9	34 x 45	2.8 x 3.7	22 x 30	1.8 x 2.4
79 x 105	6.4 x 8.5	63 x 84	5.1 x 6.8	47 x 62	3.8 x 5.1	31 x 41	2.5 x 3.3

12.5:1 Zoom:	
EFL (low mag):	20*CT mag
EFL (high mag):	250*CT mag
f/#: (low mag):	15.5*CT mag
f/#: (high mag):	36*CT mag

Optical Performance - Fixed Magnification SWIR

Chart 5A

		0.5X Lower Lens 45-00-10-000 WD: 390mm EFL: 400mm			1X Lower Lens 45-00-08-000 WD: 190mm EFL: 200mm			1.25X Lower Lens 45-00-06-000 WD: 155mm EFL: 160mm			2X Lower Lens 45-00-03-000 WD: 95mm EFL: 100mm		
Max FOV Dia.		80			40			32			20		
Max Coax FOV Dia.		13			12			12			15		
0.5X Camera Tube 45-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12 8mm Stop	NA	0.010			0.020			0.025			0.040		
		14			28			35			56		
	Mag	0.25			0.50			0.63			1.0		
		11.77			2.94			1.88			0.74		
	FOV (mm) Cam Format	1/3"			7.2 x 9.6			5.8 x 7.7			3.6 x 4.8		
		1/2"			9.6 x 12.8			7.7 x 10.2			4.8 x 6.4		
		2/3"			13.2 x 17.6			10.6 x 14.1			6.6 x 8.8		
	NA	0.010			0.020			0.025			0.040		
		14			28			35			56		
	Mag	0.40			0.80			1.0			1.6		
		11.77			2.94			1.88			0.74		
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2 8mm Stop	FOV (mm) Cam Format	1/2"			6.0 x 8.0			4.8 x 6.4			3.0 x 4.0		
		2/3"			8.3 x 11.0			6.6 x 8.8			4.1 x 5.5		
		1"			12.0 x 16.0			9.6 x 12.8			6.0 x 8.0		
	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	0.50			1.00			1.25			2.00		
		5.23			1.31			0.84			0.33		
	FOV (mm) Cam Format	2/3"			6.6 x 8.8			5.3 x 7.0			3.3 x 4.4		
		1"			9.6 x 12.8			7.7 x 10.2			4.8 x 6.4		
		4/3"			13.5 x 18.0			10.8 x 14.4			6.8 x 9.0		
1.0X Camera Tube 45-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24 12mm Stop	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	0.75			1.5			1.9			3.0		
		5.23			1.31			0.84			0.33		
	FOV (mm) Cam Format	2/3"			4.4 x 5.9			3.5 x 4.7			2.2 x 2.9		
		1"			6.4 x 8.5			5.1 x 6.8			3.2 x 4.3		
		4/3"			9.0 x 12.0			7.2 x 9.6			4.5 x 6.0		
	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	1.00			2.0			2.50			4.0		
		5.23			1.31			0.84			0.33		
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36 12mm Stop	FOV (mm) Cam Format	2/3"			3.3 x 4.4			2.6 x 3.5			1.7 x 2.2		
		1"			4.8 x 6.4			3.8 x 5.1			2.4 x 3.2		
		4/3"			6.8 x 9.0			5.4 x 7.2			3.4 x 4.5		
	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	1.00			2.0			2.50			4.0		
		5.23			1.31			0.84			0.33		
	FOV (mm) Cam Format	2/3"			3.3 x 4.4			2.6 x 3.5			1.7 x 2.2		
		1"			4.8 x 6.4			3.8 x 5.1			2.4 x 3.2		
		4/3"			6.8 x 9.0			5.4 x 7.2			3.4 x 4.5		
2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44 12mm Stop	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	1.00			2.0			2.50			4.0		
		5.23			1.31			0.84			0.33		
	FOV (mm) Cam Format	2/3"			3.3 x 4.4			2.6 x 3.5			1.7 x 2.2		
		1"			4.8 x 6.4			3.8 x 5.1			2.4 x 3.2		
		4/3"			6.8 x 9.0			5.4 x 7.2			3.4 x 4.5		
	NA	0.015			0.030			0.038			0.060		
		21			42			52			84		
	Mag	1.00			2.0			2.50			4.0		
		5.23			1.31			0.84			0.33		

- Useable FOV Limited by Coax illumination (>50% Illumination)
- FOV Limited by vignetting

Note:

- SWIR Specifications based on primary wavelength of 1177nm
- FUSION SWIR supports operating waveband from 700 - 1700 nm

	Height	x	Width	Diag.
2/3"	6.6	x	8.8	11
1"	9.6	x	12.8	16
4/3"	13.5	x	18	22.5
APS-C*	16.7	x	25.1	30
35mm (Full)	24	x	36	43.3

*Also known as Half Frame 35mm format

Optical Performance - OPTEM 7:1 Zoom SWIR

Chart 5B

		0.5X Lower Lens 45-00-10-000 WD: 390mm EFL: 400mm		1X Lower Lens 45-00-08-000 WD: 190mm EFL: 200mm		1.25X Lower Lens 45-00-06-000 WD: 155mm EFL: 160mm		2X Lower Lens 45-00-03-000 WD: 95mm EFL: 100mm			
Max FOV Dia.		125		63		50		31			
Max Coax FOV Dia.		NR		19		19		19			
0.5X Camera Tube 45-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12			Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
	NA		0.0059	0.019	0.012	0.039	0.015	0.048	0.024	0.078	
	Res (lp/mm)		8	26	17	54	21	67	33	109	
	Mag		0.11	0.73	0.21	1.45	0.26	1.84	0.42	2.90	
	DOF (mm)		34	3.3	8.2	0.77	5.2	0.51	2.0	0.193	
	FOV (mm)	Cam Format	1/3"	34 x 46	5.0 x 6.6	17 x 23	2.5 x 3.3	14 x 18	2.0 x 2.6	9 x 11	1.2 x 1.7
			1/2"	46 x 61	6.6 x 8.8	23 x 30	3.3 x 4.4	18 x 25	2.6 x 3.5	11 x 15	1.7 x 2.2
			2/3"	63 x 84	9.1 x 12.1	31 x 42	4.6 x 6.1	25 x 34	3.6 x 4.8	16 x 21	2.3 x 3.0
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA		0.0059	0.019	0.012	0.039	0.015	0.048	0.024	0.078	
	Res (lp/mm)		8	26	17	54	21	67	33	109	
	Mag		0.17	1.17	0.34	2.30	0.42	2.90	0.67	4.60	
	DOF (mm)		34	3.3	8.2	0.77	5.2	0.51	2.0	0.193	
	FOV (mm)	Cam Format	1/2"	29 x 38	4.1 x 5.5	14 x 19	2.1 x 2.8	11.4 x 15	1.7 x 2.2	7.2 x 9.6	1.0 x 1.4
			2/3"	39 x 52	5.6 x 7.5	20 x 26	2.9 x 3.8	16 x 21	2.3 x 3.0	9.9 x 13	1.4 x 1.9
			1"	57 x 76	8.2 x 10.9	28 x 38	4.2 x 5.6	23 x 30	3.3 x 4.4	14.3 x 19	2.1 x 2.8
	1.0X Camera Tube 45-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA		0.0059	0.019	0.012	0.039	0.015	0.048	0.024	0.078
Res (lp/mm)		8	26	17	54	21	67	33	109		
Mag		0.21	1.45	0.42	2.90	0.53	3.60	0.84	5.80		
DOF (mm)		34	3.3	8.2	0.77	5.2	0.51	2.0	0.193		
FOV (mm)		Cam Format	2/3"	31 x 42	4.6 x 6.1	16 x 21	2.3 x 3.0	12.5 x 16.6	1.83 x 2.4	7.9 x 10.5	1.1 x 1.5
			1"	46 x 61	6.6 x 8.8	23 x 30	3.3 x 4.4	18.1 x 24	2.7 x 3.6	11.5 x 15.3	1.7 x 2.2
			4/3"	64 x 86	9.3 x 12.4	32 x 43	4.7 x 6.2	25 x 34	3.8 x 5.0	16.1 x 22	2.3 x 3.1
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36		NA		0.0059	0.019	0.012	0.039	0.015	0.048	0.024	0.078
	Res (lp/mm)		8	26	17	54	21	67	33	109	
	Mag		0.32	2.18	0.63	4.40	0.79	5.40	1.26	8.70	
	DOF (mm)		34	3.3	8.2	0.77	5.2	0.51	2.0	0.193	
	FOV (mm)	Cam Format	2/3"	21 x 28	3.0 x 4.0	10 x 14	1.5 x 2.0	8.4 x 11	1.2 x 1.6	5.2 x 7.0	0.8 x 1.0
			1"	30 x 40	4.4 x 5.9	15 x 20	2.2 x 2.9	12 x 16	1.8 x 2.4	7.6 x 10	1.1 x 1.5
			4/3"	43 x 57	6.2 x 8.3	21 x 29	3.1 x 4.1	17 x 23	2.5 x 3.3	11 x 14	1.6 x 2.1
	2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	NA		0.0059	0.019	0.012	0.039	0.015	0.048	0.024	0.078
Res (lp/mm)		8	26	17	54	21	67	33	109		
Mag		0.42	2.90	0.84	5.80	1.05	7.29	1.69	11.50		
DOF (mm)		34	3.3	8.2	0.77	5.2	0.51	2.0	0.193		
FOV (mm)		Cam Format	2/3"	16 x 21	2.3 x 3.0	7.9 x 10	1.1 x 1.5	6.3 x 8.4	0.9 x 1.2	3.9 x 5.2	0.6 x 0.8
			1"	23 x 30	3.3 x 4.4	11 x 15	1.7 x 2.2	9.1 x 12	1.3 x 1.8	5.7 x 7.6	0.8 x 1.1
			4/3"	32 x 43	4.7 x 6.2	16 x 21	2.3 x 3.1	13 x 17	1.9 x 2.5	8.0 x 11	1.2 x 1.6

Useable FOV Limited by Coax illumination (>50% Illumination)

FOV Limited by vignetting

FUSION Flexibility...

At the heart of FUSION's extreme versatility, is the simplicity of stacking a variety of modules to affect magnification, function, form and wavelength of the lens system.

Following are the basic required components of a functional FUSION lens assembly. From here, features and accessories are easily swapped in to meet your requirements.

Camera Mount
Mates FUSION with C, CS, F, EOS, 4/3-mount cameras and more

Camera Tube
Modifies magnification to your camera optimizing chip coverage & performance

Core Optical Module
Determines optical function: Fixed, 7:1 or 12.5:1 zoom magnification—motorized or manual

Lower Function Module
Integrates internal focus—motorized or manual—and coaxial LED illumination options

Lower Lens
Modifies taking magnification to affect field of view, NA and working distance

Modular design allows FUSION to evolve quickly and easily

With a simple change-out of a few modules, you can modify FUSION performance, function, form and wavelength to meet the evolving requirements of your system. This streamlines prototyping stages and aids the evolution of your system.



Optem FUSION
Extreme Micro-Imaging Versatility

Notes



Your Key to Photonic Innovation...

Qioptiq serves a wide variety of applications across the industrial manufacturing sector. With a rich history of delivering innovative photonic components, modules and instruments to integrators, engineers and OEMs, we also offer custom-tailored photonic solutions to maximize the potential and capabilities of tomorrow's many processes and industrial manufacturing systems.

...and Manufacturing Advancement

For technical information
www.excelitas.com
Inspection@excelitas.com

North America
Toll free: 800-724-4274

Europe
Tel: +49 551 6935-0

Asia Pacific
Tel: +65 6499 7766

