

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

7th Edition



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 **SWIR** 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.

Optem® FUSION Visible/SWIR Component Matrix

CLICK ME

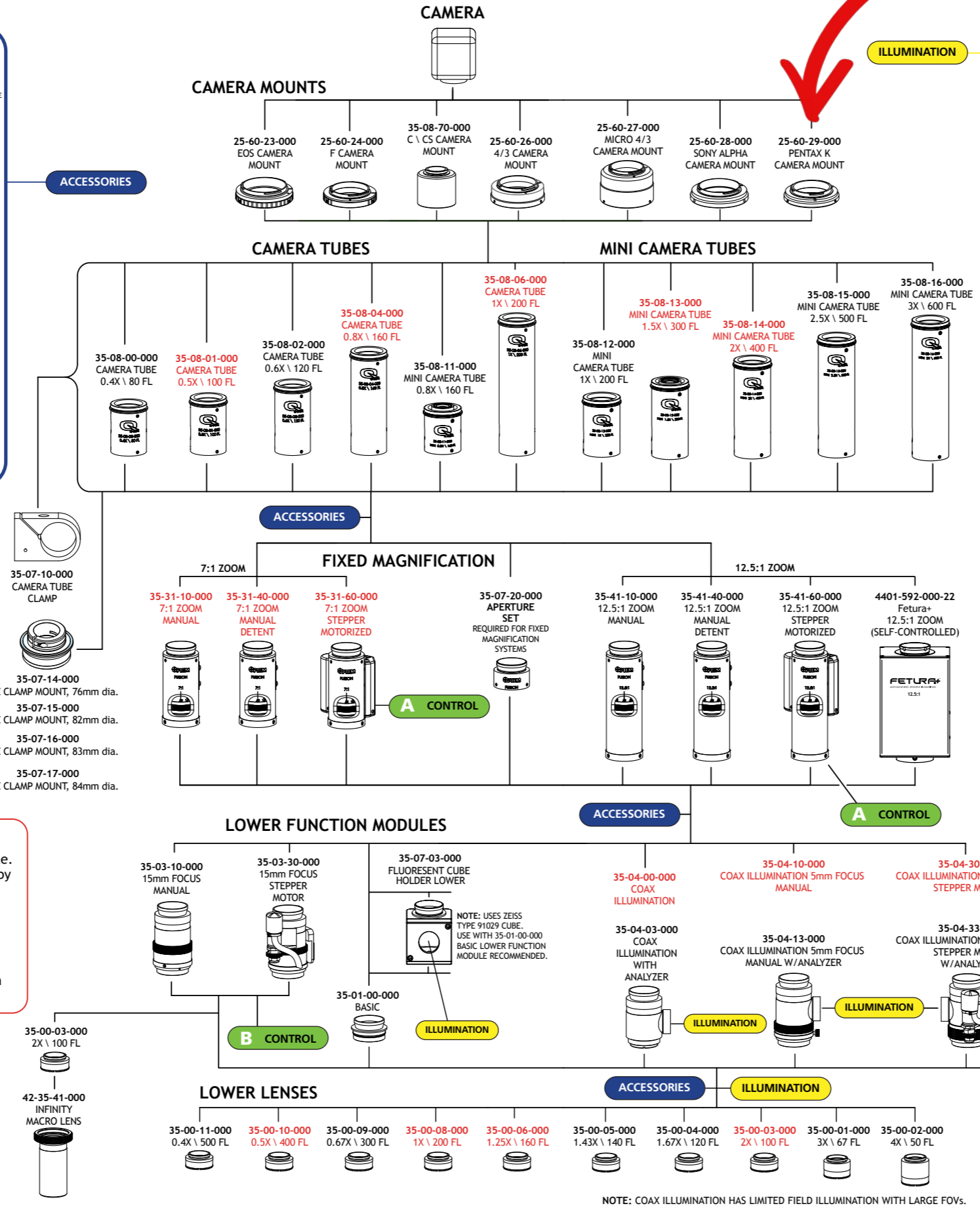
ACCESSORIES

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)



LIGHTING ACCESSORIES

29-69-02-000 POLARIZER
30-16-02-000 FIBER OPTIC LAMPHOUSE
30-16-01-000 10mm FIBER OPTIC ADAPTER
30-16-60-000 60" FLEXIBLE FIBER OPTIC
35-07-50-000 LED COAX ILLUMINATOR
29-69-13-000 LED COAX RIGHT ANGLE

COAX

OBLIQUE

29-69-21-000 FIBER OPTIC RINGLIGHT ADAPTER
29-60-81-000 FIBER OPTIC RINGLIGHT
29-60-83-000 110v HALOGEN ILLUMINATOR
29-60-84-000 220v HALOGEN ILLUMINATOR
35-07-40-000 LED RINGLIGHT ADAPTER
35-07-41-000 LED RINGLIGHT

SWIR

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**

A CONTROL

35-05-20-000 2 AXIS STEPPER CONTROLLER 24v POWER SUPPLY INC
35-05-00-000 2 AXIS STEPPER CONTROLLER OEM BOARD

B CONTROL

35-05-99-000 CONTROLLER ADAPTER FOR FOCUS MODULES (REQUIRED FOR ALL MOTORIZED FOCUS MODULES.)

30-17-37-000 (N. AMER. CORD)
30-17-36-000 (EURO CORD)
30-17-33-000 (U.K. CORD)

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.

30-16-50-000 OBJECTIVE RINGLIGHT 40 INCHES

NOTE: COAX ILLUMINATION HAS LIMITED FIELD ILLUMINATION WITH LARGE FOVS.

Optical Performance - Fixed Magnification with Lower Lenses

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	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
FOV (mm) 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	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
FOV (mm) 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	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
FOV (mm) 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	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
FOV (mm) 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	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
FOV (mm) 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

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

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

FOV Limited by vignetting

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Optical Performance - Fixed Magnification with Lower Lenses - Mini Camera Tubes

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	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
	FOV (mm) Cam Format	2/3"	11 x 15	8.8 x 12	6.6 x 8.8
	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	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
	FOV (mm) Cam Format	2/3"	8.3 x 11	6.6 x 8.8	5.0 x 6.6
	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	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
	FOV (mm) Cam Format	1"	9.6 x 13	7.7 x 10	5.8 x 7.7
	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	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
	FOV (mm) Cam Format	1"	8.0 x 11	6.4 x 8.5	4.8 x 6.4
	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

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

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

Optical Performance - Fixed Magnification with LWD Objectives

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	

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

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

-- FOV Limited by vignetting

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

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Optical Performance - Fixed Magnification with LWD Objectives - Mini Camera Tubes

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
	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	
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	
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	

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

-- 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

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 Lens

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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
	Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.067	0.46	0.084	0.58	0.11	0.77	0.17	1.2
	DOF (mm)	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
	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
	Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.084	0.58	0.11	0.73	0.14	0.97	0.21	1.5
	DOF (mm)	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
	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
	Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.10	0.70	0.13	0.87	0.17	1.2	0.25	1.7
	DOF (mm)	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
	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
	Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.13	0.93	0.17	1.2	0.22	1.5	0.34	2.3
	DOF (mm)	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
	1/2"	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
	Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.17	1.2	0.21	1.5	0.28	1.9	0.42	2.9
	DOF (mm)	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"	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

		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	
Max FOV Dia.		50		44		38		31		21		16	
Max Coax FOV Dia.		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
	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	0.21	1.5	0.24	1.7	0.28	1.9	0.34	2.3	0.50	3.5	0.67	4.6
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
	FOV (mm) Cam Format	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
	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	0.26	1.8	0.30	2.1	0.35	2.4	0.42	2.9	0.63	4.3	0.84	5.8
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
	FOV (mm) Cam Format	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
	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	0.32	2.2	0.36	2.5	0.42	2.9	0.50	3.5	0.76	5.2	1.0	7.0
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
	FOV (mm) Cam Format	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
	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	0.42	2.9	0.48	3.3	0.56	3.9	0.67	4.6	1.0	7.0	1.3	9.3
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
	FOV (mm) Cam Format	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
	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	0.53	3.6	0.60	4.1	0.70	4.8	0.84	5.8	1.3	8.7	1.7	12
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024
	FOV (mm) Cam Format	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

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

-- FOV Limited by vignetting

ND = Not recommended for Coax illumination

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Optical Performance - OPTEM 7:1 Zoom with Lower Lens - Mini Camera Tubes

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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039	
	Res (lp/mm)	14	47	18	58	24	78	35	116	
	Mag	0.25	1.7	0.32	2.2	0.42	2.9	0.63	4.4	
	DOF (mm)	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
		Res (lp/mm)	14	47	18	58	24	78	35	116
Mag		0.34	2.3	0.42	2.9	0.56	3.9	0.84	5.8	
DOF (mm)		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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
		Res (lp/mm)	14	47	18	58	24	78	35	116
	Mag	0.42	2.9	0.53	3.6	0.70	4.8	1.1	7.3	
	DOF (mm)	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	0.0047	0.016	0.0059	0.019	0.0079	0.026	0.012	0.039
		Res (lp/mm)	14	47	18	58	24	78	35	116
Mag		0.50	3.5	0.63	4.4	0.84	5.8	1.3	8.7	
DOF (mm)		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

		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		
Max FOV Dia.		50		44		38		31		21		16		
Max Coax FOV Dia.		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	
1.5X Mini Camera Tube 35-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16	
	Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465	
	Mag	0.79	5.4	0.90	6.2	1.1	7.3	1.3	8.7	1.9	13	2.5	17	
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024	
	FOV (mm) Cam Format	2/3"	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
		1"	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
		4/3"	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
		APS-C	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
	2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
		Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
Mag		1.1	7.3	1.2	8.3	1.4	9.7	1.7	12	2.5	17	3.4	23	
DOF (mm)		2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024	
FOV (mm) Cam Format		2/3"	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
		1"	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
		4/3"	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
		APS-C	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
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44		NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
		Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
	Mag	1.3	9.1	1.5	10	1.8	12	2.1	15	3.1	22	4.2	29	
	DOF (mm)	2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024	
	FOV (mm) Cam Format	2/3"	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
		1"	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
		4/3"	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
		APS-C	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
	3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	NA	0.015	0.048	0.017	0.055	0.020	0.065	0.024	0.078	0.035	0.12	0.047	0.16
		Res (lp/mm)	44	145	51	166	59	194	71	233	106	349	142	465
Mag		1.6	11	1.8	12	2.1	15	2.5	17	3.8	26	5.0	35	
DOF (mm)		2.6	0.24	2.0	0.19	1.5	0.14	1.0	0.094	0.45	0.042	0.25	0.024	
FOV (mm) Cam Format		2/3"	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
		1"	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
		4/3"	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
		APS-C	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

-- 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

Optical Performance - OPTEM 7:1 Zoom with LWD Objectives

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) Cam Format	1/3"	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
			1/2"	14 x 19	2.1 x 2.8	5.7 x 7.6	0.83 x 1.1	2.9 x 3.8	0.41 x 0.55
	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) Cam Format	1/3"	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
			1/2"	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
2/3"			16 x 21	2.3 x 3.0	6.3 x 8.4	0.91 x 1.2	3.1 x 4.2	0.46 x 0.61	
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) Cam Format	1/3"	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
			1/2"	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
	2/3"		13 x 17	1.9 x 2.5	5.2 x 7.0	0.76 x 1.0	2.6 x 3.5	0.38 x 0.51	
	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) Cam Format	1/3"	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	0.16 x 0.21
			1/2"	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
2/3"			9.8 x 13	1.4 x 1.9	3.9 x 5.2	0.57 x 0.76	2.0 x 2.6	0.28 x 0.38	
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) Cam Format	1/3"	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
			1/2"	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	

		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			
Max FOV Dia.		1.2		6.4		3.1		1.7			
Max Coax FOV Dia.		0.83		4.9		2.2		1.1			
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag		
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA	0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60		
		Res (lp/mm)	708	1260	177	581	354	1163	708	1800	
		Mag	3.4	23	0.84	5.8	1.7	12	3.4	23	
	DOF (mm)	0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158		
		FOV (mm) Cam Format	1/3"	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
			1/2"	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
	2/3"		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	
	0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA	0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60	
			Res (lp/mm)	708	1260	177	581	354	1163	708	1800
			Mag	4.2	29	1.1	7.3	2.1	15	4.2	29
DOF (mm)		0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158		
		FOV (mm) Cam Format	1/3"	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
			1/2"	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
2/3"			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	
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4		NA	0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60	
			Res (lp/mm)	708	1260	177	581	354	1163	708	1800
			Mag	5.0	35	1.3	8.7	2.5	17	5.0	35
	DOF (mm)	0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158		
		FOV (mm) Cam Format	1/3"	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
			1/2"	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
	2/3"		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	
	0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA	0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60	
			Res (lp/mm)	708	1260	177	581	354	1163	708	1800
			Mag	6.7	46	1.7	12	3.4	23	6.7	46
DOF (mm)		0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158		
		FOV (mm) Cam Format	1/3"	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
			1/2"	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
2/3"			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	
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24		NA	0.24	0.42	0.059	0.19	0.12	0.39	0.24	0.60	
			Res (lp/mm)	708	1260	177	581	354	1163	708	1800
			Mag	8.4	58	2.1	15	4.2	29	8.4	58
	DOF (mm)	0.010	0.0032	0.16	0.015	0.041	0.0038	0.010	0.00158		
		FOV (mm) Cam Format	1/3"	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
			1/2"	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
	2/3"		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	

-- 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.

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

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Optical Performance - OPTEM 7:1 Zoom with LWD Objectives - Mini Camera Tubes

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	0.15 x 0.20
		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	0.22 x 0.29
		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	0.31 x 0.41
		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	0.38 x 0.58
	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	0.11 x 0.15	
	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	0.17 x 0.22	
	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	0.23 x 0.31	
	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	0.29 x 0.43	
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	0.13 x 0.18	
	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	0.19 x 0.25	
	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	0.23 x 0.35	
	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	0.33 x 0.50	
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	0.11 x 0.15	
	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	0.16 x 0.21	
	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	0.19 x 0.29	
	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	0.28 x 0.41	

		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	
Max FOV Dia.		1.2		6.4		3.1		1.7	
Max Coax FOV Dia.		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		

- 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

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 Fetura+ with Lower Lens

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	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048	
	Res (lp/mm)	11	58	14	72	18	96	27	144	
	Mag	0.045	0.55	0.056	0.69	0.075	0.92	0.11	1.4	
	DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		Res (lp/mm)	11	58	14	72	18	96	27	144
		Mag	0.056	0.69	0.070	0.86	0.093	1.2	0.14	1.7
DOF (m m)		44	1.5	28	0.98	16	0.55	7.0	0.25	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		2/3"	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	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		Res (lp/mm)	11	58	14	72	18	96	27	144
		Mag	0.067	0.83	0.084	1.0	0.11	1.4	0.17	2.1
	DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		Res (lp/mm)	11	58	14	72	18	96	27	144
		Mag	0.090	1.1	0.11	1.4	0.15	1.8	0.22	2.8
DOF (mm)		44	1.5	28	0.98	16	0.55	7.0	0.25	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		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	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
		Res (lp/mm)	11	58	14	72	18	96	27	144
		Mag	0.11	1.4	0.14	1.7	0.19	2.3	0.28	3.5
	DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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

		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		
Max FOV Dia.		46		41		35		29		19		15		
Max Coax FOV Dia.		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	
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19	
	Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576	
	Mag	0.14	1.7	0.16	2.0	0.19	2.3	0.22	2.8	0.34	4.1	0.45	5.5	
	DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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
	0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
		Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
		Mag	0.18	2.2	0.20	2.5	0.23	2.9	0.28	3.5	0.42	5.2	0.56	6.9
DOF (mm)		4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		2/3"	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
0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4		NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
		Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
		Mag	0.21	2.6	0.24	3.0	0.28	3.5	0.34	4.1	0.50	6.2	0.67	8.3
	DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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
	0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
		Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
		Mag	0.28	3.5	0.32	3.9	0.37	4.6	0.45	5.5	0.67	8	0.90	11
DOF (mm)		4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		2/3"	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
1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24		NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
		Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
		Mag	0.35	4.3	0.40	4.9	0.47	5.8	0.56	6.9	0.84	10.3	1.1	14
	DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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

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

-- FOV Limited by vignetting

NR = Not recommended for Coax illumination

CLICK ME



Optical Performance - OPTEM 12.5:1 Zoom and Fetura+ with Lower Lens - Mini Camera Tubes

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	FOV (mm) Cam Format	NA	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048	
		Res (lp/mm)	11	58	14	72	18	96	27	144	
		Mag	0.17	2.1	0.21	2.6	0.28	3.5	0.42	5.2	
		DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25	
	2/3"	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		
		1"	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	
		4/3"	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	
		APS-C	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	
	2X Mini Camera Tube 35-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	FOV (mm) Cam Format	NA	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
			Res (lp/mm)	11	58	14	72	18	96	27	144
			Mag	0.22	2.8	0.28	3.5	0.37	4.6	0.56	6.9
			DOF (m m)	44	1.5	28	0.98	16	0.55	7.0	0.25
2/3"		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		
		1"	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	
		4/3"	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	
		APS-C	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	
2.5X Mini Camera Tube 35-08-15-000 EFL: 500mm Image Circle Dia. (mm) 44		FOV (mm) Cam Format	NA	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
			Res (lp/mm)	11	58	14	72	18	96	27	144
			Mag	0.28	3.5	0.35	4.3	0.47	5.8	0.70	8.6
			DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25
	1"	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		
		4/3"	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	
		APS-C	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	
		35mm(Full)	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	
	3X Mini Camera Tube 35-08-16-000 EFL: 600mm Image Circle Dia. (mm) 44	FOV (mm) Cam Format	NA	0.0036	0.019	0.0045	0.024	0.0060	0.032	0.0090	0.048
			Res (lp/mm)	11	58	14	72	18	96	27	144
			Mag	0.34	4.1	0.42	5.2	0.56	6.9	0.84	10
			DOF (mm)	44	1.5	28	0.98	16	0.55	7.0	0.25
1"		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		
		4/3"	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	
		APS-C	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	
		35mm(Full)	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	

		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			
Max FOV Dia.		46		41		35		29		19		15			
Max Coax FOV Dia.		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		
1.25X Mini Camera Tube	FOV (mm) Cam Format	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19	
		Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576	
		Mag	0.53	6.5	0.60	7.4	0.70	8.6	0.84	10	1.3	16	1.7	21	
		DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015	
	2/3"	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		
		1"	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	
		4/3"	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	
		APS-C	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	
	1.43X Mini Camera Tube	FOV (mm) Cam Format	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
			Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
			Mag	0.70	8.6	0.80	9.9	0.93	12	1.1	14	1.7	21	2.2	28
			DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
2/3"		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		
		1"	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	
		4/3"	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	
		APS-C	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	
1.67 Mini Camera Tube		FOV (mm) Cam Format	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
			Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
			Mag	0.88	11	1.0	12	1.2	14	1.4	17	2.1	26	2.8	35
			DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.09	1.8	0.062	0.78	0.027	0.44	0.015
	2/3"	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		
		1"	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	
		4/3"	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	
		APS-C	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	
	2X Mini Camera Tube	FOV (mm) Cam Format	NA	0.011	0.060	0.013	0.069	0.015	0.080	0.018	0.096	0.027	0.14	0.036	0.19
			Res (lp/mm)	34	180	39	206	45	240	54	288	81	432	108	576
			Mag	1.1	13	1.2	15	1.4	17	1.7	21	2.5	31	3.4	41
			DOF (mm)	4.5	0.16	3.4	0.12	2.5	0.089	1.8	0.062	0.78	0.027	0.44	0.015
2/3"		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		
		1"	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	
		4/3"	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	
		APS-C	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	

-- 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

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Optical Performance - OPTEM 12.5:1 Zoom and Fetura+ with LWD Objectives

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		
0.4X Camera Tube 35-08-00-000 EFL: 80mm Image Circle Dia. (mm) 9.6		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
	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.

		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		
Max FOV Dia.		1.2		6.6		3.2		1.6		
Max Coax FOV Dia.		0.83		5.0		2.3		1.1		
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
NA		0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60	
Res (lp/mm)		540	1260	135	675	270	1350	540	1800	
Mag		2.2	28	0.56	6.9	1.1	14	2.2	28	
DOF (mm)		0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format	1/3"	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	
	1/2"	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	
	2/3"	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	
0.5X Camera Tube 35-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	NA	0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60	
	Res (lp/mm)	540	1260	135	675	270	1350	540	1800	
	Mag	2.8	35	0.70	8.6	1.4	17	2.8	35	
	DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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
	0.6X Camera Tube 35-08-02-000 EFL: 120mm Image Circle Dia. (mm) 14.4	NA	0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
		Res (lp/mm)	540	1260	135	675	270	1350	540	1800
		Mag	3.4	41	0.84	10.4	1.7	21	3.4	41
DOF (mm)		0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		2/3"	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
0.8X Camera Tube 35-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2		NA	0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
		Res (lp/mm)	540	1260	135	675	270	1350	540	1800
		Mag	4.5	55	1.1	14	2.2	28	4.5	55
	DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
	FOV (mm) Cam Format	1/3"	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
		1/2"	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
		2/3"	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
	1X Camera Tube 35-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	NA	0.18	0.42	0.045	0.23	0.090	0.45	0.18	0.60
		Res (lp/mm)	540	1260	135	675	270	1350	540	1800
		Mag	5.6	69	1.4	17	2.8	35	5.6	69
DOF (mm)		0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format		1/3"	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
		1/2"	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
		2/3"	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 Fetura+ with LWD Objectives - Mini Camera Tubes

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) Cam Format	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
		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
		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
		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
	NA	0.018	0.057	0.045	0.14	0.090	0.30	
	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) Cam Format	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	
	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	
	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	
	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	
NA	0.018	0.057	0.045	0.14	0.090	0.30		
Res (lp/mm)	54	170	135	420	270	900		
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) Cam Format	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	
	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	
	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	
	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	
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		
FOV (mm) Cam Format	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	
	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	
	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	
	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	

		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	
Max FOV Dia.		1.2		6.6		3.2		1.6	
Max Coax FOV Dia.		0.83		5.0		2.3		1.1	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
Low Mag	0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60	
High Mag	540	1260	135	675	270	1350	540	1800	
Mag	8.4	104	2.1	26	4.2	52	8.4	104	
DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format	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	
Low Mag	0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60	
High Mag	540	1260	135	675	270	1350	540	1800	
Mag	11	138	2.8	35	5.6	69	11	138	
DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format	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	
Low Mag	0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60	
High Mag	540	1260	135	675	270	1350	540	1800	
Mag	14	173	3.5	43	7.0	86	14	173	
DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format	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	
Low Mag	0.18	0.42	0.045	0.225	0.090	0.45	0.18	0.60	
High Mag	540	1260	135	675	270	1350	540	1800	
Mag	17	207	4.2	52	8.4	104	17	207	
DOF (mm)	0.018	0.0032	0.28	0.011	0.070	0.0028	0.018	0.0016	
FOV (mm) Cam Format	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	

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

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) Cam Format	1/3"	26 x 35	22 x 29	17 x 23
	1/2"	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) Cam Format	1/3"	63 x 84	9.1 x 12	52 x 69	7.5 x 10	40 x 54	5.8 x 7.8
	1/2"	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) Cam Format	1/3"	95 x 126	7.7 x 10	78 x 103	6.3 x 8.4	60 x 80	4.9 x 6.5
	1/2"	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

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

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

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
	Res (lp/mm)	14	28	35	56
	Mag	0.25	0.50	0.63	1.0
	DOF (mm)	11.77	2.94	1.88	0.74
FOV (mm) Cam Format	1/3"	14.4 x 19.2	7.2 x 9.6	5.8 x 7.7	3.6 x 4.8
	1/2"	19.2 x 25.6	9.6 x 12.8	7.7 x 10.2	4.8 x 6.4
	2/3"	26.4 x 35.2	13.2 x 17.6	10.6 x 14.1	6.6 x 8.8
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2 8mm Stop	NA	0.010	0.020	0.025	0.040
	Res (lp/mm)	14	28	35	56
	Mag	0.40	0.80	1.0	1.6
	DOF (mm)	11.77	2.94	1.88	0.74
FOV (mm) Cam Format	1/2"	12.0 x 16.0	6.0 x 8.0	4.8 x 6.4	3.0 x 4.0
	2/3"	16.5 x 22.0	8.3 x 11.0	6.6 x 8.8	4.1 x 5.5
	1"	24.0 x 32.0	12.0 x 16.0	9.6 x 12.8	6.0 x 8.0
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
	Res (lp/mm)	21	42	52	84
	Mag	0.50	1.00	1.25	2.00
	DOF (mm)	5.23	1.31	0.84	0.33
FOV (mm) Cam Format	2/3"	13.2 x 17.6	6.6 x 8.8	5.3 x 7.0	3.3 x 4.4
	1"	19.2 x 25.6	9.6 x 12.8	7.7 x 10.2	4.8 x 6.4
	4/3"	27.0 x 36.0	13.5 x 18.0	10.8 x 14.4	6.8 x 9.0
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36 12mm Stop	NA	0.015	0.030	0.038	0.060
	Res (lp/mm)	21	42	52	84
	Mag	0.75	1.5	1.9	3.0
	DOF (mm)	5.23	1.31	0.84	0.33
FOV (mm) Cam Format	2/3"	8.8 x 11.7	4.4 x 5.9	3.5 x 4.7	2.2 x 2.9
	1"	12.8 x 17.1	6.4 x 8.5	5.1 x 6.8	3.2 x 4.3
	4/3"	18.0 x 24.0	9.0 x 12.0	7.2 x 9.6	4.5 x 6.0
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
	Res (lp/mm)	21	42	52	84
	Mag	1.00	2.0	2.50	4.0
	DOF (mm)	5.23	1.31	0.84	0.33
FOV (mm) Cam Format	2/3"	6.6 x 8.8	3.3 x 4.4	2.6 x 3.5	1.7 x 2.2
	1"	9.6 x 12.8	4.8 x 6.4	3.8 x 5.1	2.4 x 3.2
	4/3"	13.5 x 18.0	6.8 x 9.0	5.4 x 7.2	3.4 x 4.5

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	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
	Mag	0.11	0.73	0.21	1.45
FOV (mm) Cam Format	DOF (mm)	34	3.3	8.2	0.77
	1/3"	34 x 46	5.0 x 6.6	17 x 23	2.5 x 3.3
	1/2"	46 x 61	6.6 x 8.8	23 x 30	3.3 x 4.4
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.17	1.17	0.34	2.30
	DOF (mm)	34	3.3	8.2	0.77
	1/2"	29 x 38	4.1 x 5.5	14 x 19	2.1 x 2.8
1.0X Camera Tube 45-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.21	1.45	0.42	2.90
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	31 x 42	4.6 x 6.1	16 x 21	2.3 x 3.0
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.32	2.18	0.63	4.40
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	21 x 28	3.0 x 4.0	10 x 14	1.5 x 2.0
2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.42	2.90	0.84	5.80
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	16 x 21	2.3 x 3.0	7.9 x 10	1.1 x 1.5
0.5X Camera Tube 45-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.11	0.73	0.21	1.45
	DOF (mm)	34	3.3	8.2	0.77
	1"	23 x 30	3.3 x 4.4	11 x 15	1.7 x 2.2
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.17	1.17	0.34	2.30
	DOF (mm)	34	3.3	8.2	0.77
	1"	29 x 38	4.1 x 5.5	14 x 19	2.1 x 2.8
1.0X Camera Tube 45-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.21	1.45	0.42	2.90
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	31 x 42	4.6 x 6.1	16 x 21	2.3 x 3.0
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.32	2.18	0.63	4.40
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	21 x 28	3.0 x 4.0	10 x 14	1.5 x 2.0
2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.42	2.90	0.84	5.80
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	16 x 21	2.3 x 3.0	7.9 x 10	1.1 x 1.5
0.5X Camera Tube 45-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.11	0.73	0.21	1.45
	DOF (mm)	34	3.3	8.2	0.77
	1"	23 x 30	3.3 x 4.4	11 x 15	1.7 x 2.2
0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.17	1.17	0.34	2.30
	DOF (mm)	34	3.3	8.2	0.77
	1"	29 x 38	4.1 x 5.5	14 x 19	2.1 x 2.8
1.0X Camera Tube 45-08-06-000 EFL: 200mm Image Circle Dia. (mm) 24	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.21	1.45	0.42	2.90
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	31 x 42	4.6 x 6.1	16 x 21	2.3 x 3.0
1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.32	2.18	0.63	4.40
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	21 x 28	3.0 x 4.0	10 x 14	1.5 x 2.0
2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.42	2.90	0.84	5.80
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	16 x 21	2.3 x 3.0	7.9 x 10	1.1 x 1.5
0.5X Camera Tube 45-08-01-000 EFL: 100mm Image Circle Dia. (mm) 12	Low Mag	0.0059	0.019	0.012	0.039
	High Mag	0.012	0.039	0.015	0.048
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0.8X Camera Tube 45-08-04-000 EFL: 160mm Image Circle Dia. (mm) 19.2	Low Mag	0.0059	0.019	0.012	0.039
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1.5X Mini Camera Tube 45-08-13-000 EFL: 300mm Image Circle Dia. (mm) 36	Low Mag	0.0059	0.019	0.012	0.039
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2.0X Mini Camera Tube 45-08-14-000 EFL: 400mm Image Circle Dia. (mm) 44	Low Mag	0.0059	0.019	0.012	0.039
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	Res (lp/mm)	8	26	17	54
FOV (mm) Cam Format	Mag	0.42	2.90	0.84	5.80
	DOF (mm)	34	3.3	8.2	0.77
	2/3"	16 x 21	2.3 x 3.0	7.9 x 10	1.1 x 1.5
0.5X Camera Tube 45					