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Optem® Zoom 70XL
7:1 Micro-Inspection Zoom Lens System

The Optem Zoom 70XL is specifically designed to stand up to the grueling conditions of automated imaging. The "XL" stands for Xtended Life backed by superior engineering and only the highest-quality components and materials.

The Zoom 70XL Lens System features robust optomechanics to deliver defect-free performance out to 250,000 zoom cycles... guaranteed! The Zoom 70XL features a three-piece modular design in most configurations for maximum flexibility.

With a wide variety of function options and magnification accessories, Zoom 70XL can be configured to cover a wide range of micro-imaging applications.

Base Configuration (1X TV Tube with no Aux. Lens)	(@ Low Mag.)	(@ High Mag.)
Magnification Range	0.75X	5.25X
Numerical Aperture	0.024	0.080
Resolution	72 lp/mm	240 lp/mm
Depth-of-Field	0.98 mm	0.09 mm
Working Distance	89 mm	89 mm
FOV (1/3" Camera)	4.80 x 6.40 mm	0.69 x 0.92 mm
FOV (1/2" Camera)	6.40 x 8.53 mm	0.91 x 1.23 mm
FOV (2/3" Camera)	8.80 x 11.73 mm	1.26 x 1.69 mm
FOV (1" Camera)	12.80 x 17.07 mm	1.85 x 2.46 mm
Min. Configuration (0.375X TV Tube + 0.18X Aux. Lens)	(@ Low Mag.)	(@ High Mag.)
Working Distance	468 mm	468 mm
Magnification Range	0.051X	0.35X
Numerical Aperture	0.0043	0.015
Resolution	13 lp/mm	45 lp/mm
Depth-of-Field	31 mm	2.5 mm
Max. Configuration (2.0X TV Tube + 20X HR Obj.)	(@ Low Mag.)	(@ High Mag.)
Magnification Range	14X	100X
Numerical Aperture	0.24	0.60
Resolution	720 lp/mm	1800 lp/mm
Depth-of-Field	0.0098 mm	0.0016 mm
Working Distance	13 mm	13 mm



Specifying Your Optem Lens System

To specify your Optem Lens System identify the parameters of your application and select the modular components which deliver the optimum imaging solution.

STEP 1. Determine the Field-of-View (FOV) you require by choosing your intended camera format (1/3", 1/2", 2/3" etc.), and using the dimensions of that camera format to calculate the optical magnification required (see camera dimensions below):

$$\text{Optical Mag.} = \frac{\text{Camera dimension (mm)}}{\text{FOV desired (mm)}}$$

STEP 2. The Zoom 70XL **base configuration** consists of a Manual Zoom, a Basic Lower Function Module and a 1X TV Tube, which yields an optical magnification range of 0.75X - 5.25X.

Given your optical magnification requirement from STEP 1, determine if your needs fall into the **base configuration** range of 0.75X - 5.25X. If you require higher than 5.25X optical magnification, you can add an Auxiliary Lens with a magnification factor greater than 1X, AND/OR you can choose a TV Tube with a magnification factor greater than 1X (keeping in mind that Aux. Lenses affect the working distance of the system and TV Tubes do not).

Referring to the Optical Performance Charts (p. 6-9), you can select the best combination of Aux. Lens (if necessary) and TV Tube to best meet the parameters of your application.

STEP 3. Select the Upper Zoom Module: The upper module has the following options available: iris, detents and motorization (see System Diagram p. 10-11).

Select the Lower Function Module: Lower Function Modules integrate the features and functions desired in your lens system which include: coaxial illumination, internal focus and motorization (see System Diagram p. 10-11).

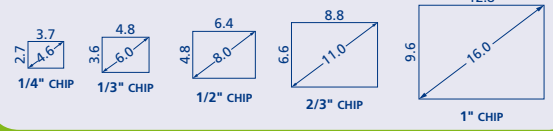
STEP 4. When completed, you will have identified the following four components required for your functional Zoom 70XL Lens System.

1) TV Tube
2) Upper Zoom Module
3) Lower Function Module
4) Auxiliary Lens (if needed)

Optem Lens Systems are specifically designed to deliver maximum versatility for your micro-inspection needs. If you do not see a standard configuration that meets your requirements, Qioptiq offers efficient and affordable custom modifications to meet special parameters.

Useful Formulas & Definitions

CAMERA CHIP DIMENSIONS (mm):



DEPTH-OF-FIELD (DOF):
The axial depth of the space on both sides of the object plane within which the object can be moved without objectionable loss of sharpness.

$$DOF = \lambda \div NA^2$$

λ = Wavelength of Light (Green Light = 0.000550mm or 550nm)

MAGNIFICATION:
The ratio of image size to actual object size.

Optical Mag. = Camera Chip dim. ÷ Field-of-View (FOV)
Electronic Mag. = Monitor Diag. ÷ Camera Diag.

NUMERICAL APERTURE (NA):
A measurement of the light collecting ability of the lens. A higher NA translates to a brighter image, better resolution, and shallower depth-of-field.

Zoom and Function Modules

Upper Zoom Modules

The specific Upper Zoom Module selected will determine the type of zoom operation for your Zoom 70XL System.



MANUAL ZOOM MODULE – Provides basic hand-driven 7:1 zoom function.

IRIS DIAPHRAGM MODULE – Provides manual 7:1 zoom with manual iris illumination control for increased depth-of-field and/or maintain consistent image brightness across your entire field.



DETENT MODULE – Obtain specific and repeatable magnification stops throughout the 7:1 zoom range without the complexity and cost of motorization. Detents are ideal for metrology applications where each position can be calibrated. Factory-set stops are located at 0.75X, 1.0X, 1.5X, 2.0X, 3.0X, 4.0X, and 5.0X





MOTORIZED ZOOM MODULE – Provides automated zoom function in either DC or Stepper Motorized versions. All Stepper Motorized Models come complete with homing and limit sensors.

Lower Function Modules

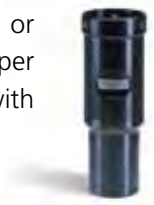
When configuring your Zoom 70XL Lens System, choose from the following Lower Modules to specify the lighting and focus functions of your systems:

- **BASIC MODULE**
- **INTERNAL FOCUS MODULE** (motor avail.)
- **COAXIAL ILLUMINATION MODULE**
- **INTERNAL FOCUS COAXIAL MODULE** (motor avail.)

If you require specialized optical performance, select from these special Lower Function Modules to boost magnification or provide flexible working distance.

OBJECTIVE MODULES - Integrate Infinity-Corrected Objectives utilizing one of four Objective Lower Function Modules. All are equipped with M26 x 36T threads to accept Optem and Mitutoyo Objectives. An RMS thread adapter is available for Nikon and Olympus Objectives (See p. 9 for Objectives performance).





VARIABLE WORKING DISTANCE AUXILIARY LENS - Intended for applications requiring working distances between 127mm (5") and 432mm (17"). Covers magnification factors 0.288X at 127mm, and 0.109X at 432mm (See p. 9 for VWD factors).

RESOLUTION:

The ability to distinguish or separate fine detail. Expressed in line pairs per millimeter (lp/mm). Numerical Aperture (NA) is the controlling factor over resolution... the higher the NA, the brighter the image, and the better the resolution.

Visual Resolution (lp/mm) = 3000 X NA
1 ÷ lp/mm = Approx. microns (µ) resolved

VIGNETTING:

The blockage of rays from off-axis object points by constraining apertures. Vignetting results in the darkening of the corners on your monitor.



Illumination Options



Illumination Options

The Zoom 70XL Lens System offers a variety of illumination options to meet a variety of imaging requirements.

You have two basic illumination options which can be integrated with your Zoom 70XL System... coaxial illumination or oblique ring light illumination.

Coaxial Illumination Options

Coaxial (or vertical) illumination is most useful on highly reflective objects. Optem's Coaxial Illuminators project cool, white light perpendicularly onto the specimen for exceptional contrast and field uniformity.

Select from one of several coaxial-equipped Lower Function Modules when specifying your Zoom 70XL lens system and integrate one of the three following options of coaxial illumination.

FIBER OPTIC COAXIAL ILLUMINATORS – Integrate coaxial illumination from you choice of either 110V or 220V Optem VSI Fiber Optic Illuminators using flexible 40- or 60-inch flexible fiber bundles.



LED COAXIAL ILLUMINATORS – Programmable 1-Watt LED Coaxial Illuminators offer reduced power requirements and heat generation with substantial service life gains.

LED Coaxial illuminators are available in straight and right-angle configurations to meet your specific space requirements, and feature compact designs and simplified cable management. These can be driven by stand-alone, single-channel programmable controllers. Coaxial LEDs emit brilliant cool light in the visible spectrum and deliver virtually identical optical performance to our traditional Fiber Optic Coaxial Illuminator.

10W HALOGEN COAXIAL ILLUMINATORS – When economy is high priority, Halogen light sources are available with a 6V Variable Transformer (110V / 220V) (see System Diagram p. 10-11).

POLARIZED LIGHT – When imaging highly reflective subjects, Polarizer Modules with built-in Analyzers are available to introduce polarization to both LED and Fiber Optic Coaxial Illumination paths.

Oblique Ring Light Options

Dark Field Illumination is generally used on 3-D objects to cast light rays at an angle onto an object, thus better defining its surface profile. Optem offers the following dark field illuminators for the Zoom 70XL System.

FIBER OPTIC RING LIGHTS – Ring light Illuminators are ideal to better define features of dimension-rich subjects. Driven with the same VSI Fiber Optic Illuminator as conventional coaxial systems. Qioptiq offers Ring lights specifically designed for a variety of configurations, including integration of objectives (see System Diagram p. 10-11).

Motorization & Configuration Accessories

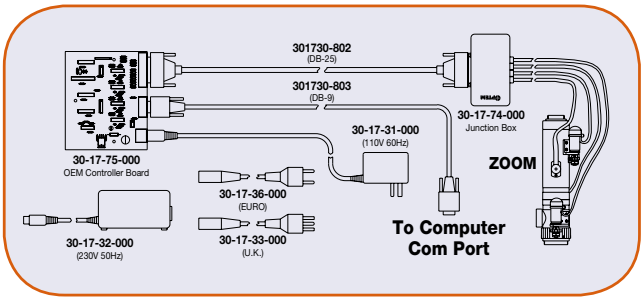


Motorizing Lens System

Optem Lens Systems can be specified with motorized zoom and/or focus functions.

STEPPER MOTOR – The stepper motors provide accurate repeatability of zoom magnification and/or focus using a Hall-effect sensor to set repeatable home position. A desktop rocker switch controller offers manual control and features an RS-232 port for automated computer control. Includes controller instructions with a list of RS-232 control commands, a Windows® control program, and startup LabVIEW control program. An OEM controller board version is available for streamlined integration.





DC MOTOR – DC motors provide continuous control of zoom magnification and/or focus. A desktop joystick controller offers simultaneous control of both zoom and focus functions.



Configuration Accessories

In addition to modifying the physical configuration and orientation of your imaging path utilizing Right-Angle and U-bend TV Tubes (see System Diagram p. 10-11), you can extend the versatility of your Zoom 70XL Lens System with two new innovations in form and function.

MID-SYSTEM, RIGHT-ANGLE MODULE – This accessory allows the introduction of a 90° of your optical axis at the mid-body point of your Zoom 70XL Lens System. Users can now integrate any Zoom 70XL Lower Function Module below the right-angle turn, maintaining full working distance and affording greater configuration flexibility. NOTE: the Mid-System Right-Angle Module produces a mirror (reversed) image.



DUAL-MAGNIFICATION MODULE – Simultaneously integrate two Zoom 70XL Zoom Modules with TV Tube, and/or Optem FMOS Fixed Tubes over a single subject. This permits real-time dual fixed and/or zoom imaging of your object of interest with your choice of magnifications, FOVs, camera formats and camera types. Integrate any of the full range of FMOS, Zoom 70XL and Zoom 125C Lower Function Modules below the Dual-Mag Module, or integrate vertical illumination through the compact Dual-Mag coaxial block.



Optical Performance - Oblique/Substage Illumination

			0.18X Aux Lens 29-20-09-000 (No Spacer) WD: 468 mm		0.25X Aux Lens 29-20-09-000 WD: 310 mm		0.5X Aux Lens 29-20-38-000 WD: 178 mm		0.75X Aux Lens 29-20-39-000 WD: 114 mm		Base Configuration No Aux Lens required WD: 89 mm		1.5X Aux Lens 29-20-40-000 WD: 52 mm		2.0X Aux Lens 29-20-41-000 WD: 32 mm	
			Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.375X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.051	0.35	0.070	0.49	0.14	0.98	0.21	1.5	0.28	1.95	0.42	2.9	0.56	3.9
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	71.1 x 94.8	10.3 x 13.7	51.2 x 68.3	7.38 x 9.8	25.6 x 34.1	3.69 x 4.92	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
		1/2"	94.8 x 126	13.7 x 18.2	68.3 x 91.0	9.8 x 13.1	34.1 x 45.5	4.92 x 6.56	22.8 x 30.3	3.28 x 4.38	17.1 x 22.8	2.46 x 3.28	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64
		2/3"	130 x 174	18.8 x 25.1	93.9 x 125	13.5 x 18.1	46.9 x 62.6	6.77 x 9.03	31.3 x 41.7	4.51 x 6.02	23.5 x 31.3	3.38 x 4.51	15.6 x 20.9	2.26 x 3.01	11.7 x 15.6	1.69 x 2.26
0.5X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.068	0.47	0.094	0.65	0.19	1.3	0.28	2.0	0.38	2.6	0.56	3.9	0.75	5.2
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	53.3 x 71.1	7.69 x 10.3	38.4 x 51.2	5.54 x 7.38	19.2 x 25.6	2.77 x 3.69	12.8 x 17.1	1.85 x 2.46	9.60 x 12.8	1.38 x 1.85	6.40 x 8.5	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
		1/2"	71.1 x 94.8	10.3 x 13.7	51.2 x 68.3	7.38 x 9.85	25.6 x 34.1	3.69 x 4.92	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46	8.5 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
		2/3"	97.8 x 130	14.1 x 18.8	70.4 x 93.9	10.2 x 13.5	35.2 x 46.9	5.08 x 6.77	23.5 x 31.3	3.38 x 4.51	17.6 x 23.5	2.54 x 3.38	11.7 x 15.6	1.69 x 2.26	8.80 x 11.7	1.27 x 1.69
		1"	142 x 190	20.5 x 27.4	102 x 137	14.8 x 19.7	51.2 x 68.3	7.38 x 9.85	34.1 x 45.5	4.92 x 6.56	25.6 x 34.1	3.69 x 4.92	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46
0.67X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.090	0.62	0.13	0.87	0.25	1.7	0.38	2.6	0.50	3.5	0.75	5.2	1.0	6.9
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	40.0 x 53.3	5.77 x 7.69	28.8 x 38.4	4.15 x 5.54	14.4 x 19.2	2.08 x 2.77	9.60 x 12.8	1.38 x 1.85	7.20 x 9.60	1.04 x 1.38	4.80 x 6.40	0.69 x 0.92	3.60 x 4.80	0.52 x 0.69
		1/2"	53.3 x 71.1	7.69 x 10.3	38.4 x 51.2	5.54 x 7.38	19.2 x 25.6	2.77 x 3.69	12.8 x 17.1	1.85 x 2.46	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
		2/3"	73.3 x 97.7	10.6 x 14.1	52.8 x 70.4	7.61 x 10.1	26.4 x 35.2	3.81 x 5.07	17.6 x 23.5	2.54 x 3.38	13.2 x 17.6	1.90 x 2.54	8.80 x 11.7	1.27 x 1.69	6.60 x 8.80	0.95 x 1.27
		1"	107 x 142	15.4 x 20.5	76.8 x 102	11.1 x 14.8	38.4 x 51.2	5.54 x 7.38	25.6 x 34.1	3.69 x 4.92	19.2 x 25.6	2.77 x 3.69	12.8 x 17.1	1.85 x 2.46	9.60 x 12.8	1.38 x 1.85
1.0X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.14	0.94	0.19	1.3	0.38	2.6	0.56	3.9	0.75	5.2	1.1	7.8	1.5	10
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	26.7 x 35.6	3.85 x 5.13	19.2 x 25.6	2.77 x 3.69	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46
		1/2"	35.6 x 47.4	5.13 x 6.84	25.6 x 34.1	3.69 x 4.92	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62
		2/3"	48.9 x 65.2	7.05 x 9.40	35.2 x 46.9	5.08 x 6.77	17.6 x 23.5	2.54 x 3.38	11.7 x 15.6	1.69 x 2.26	8.80 x 11.7	1.27 x 1.69	5.87 x 7.82	0.85 x 1.13	4.40 x 5.87	0.63 x 0.85
		1"	71.1 x 94.8	10.3 x 13.7	51.2 x 68.3	7.38 x 9.85	25.6 x 34.1	3.69 x 4.92	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
1.5X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.20	1.4	0.28	2.0	0.56	3.9	0.84	5.9	1.1	7.8	1.7	12	2.3	16
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	17.8 x 23.7	2.56 x 3.42	12.8 x 17.1	1.85 x 2.46	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
		1/2"	23.7 x 31.6	3.42 x 4.56	17.1 x 22.8	2.46 x 3.28	8.53 x 11.4	1.23 x 1.64	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82	2.84 x 3.79	0.41 x 0.55	2.13 x 2.84	0.31 x 0.41
		2/3"	32.6 x 43.5	4.70 x 6.27	23.5 x 31.3	3.38 x 4.51	11.7 x 15.6	1.69 x 2.26	7.82 x 10.4	1.13 x 1.50	5.87 x 7.82	0.85 x 1.13	3.91 x 5.21	0.56 x 0.75	2.93 x 3.91	0.42 x 0.56
		1"	47.4 x 63.2	6.84 x 9.12	34.1 x 45.5	4.92 x 6.56	17.1 x 22.8	2.46 x 3.28	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82
2.0X TV Tube		NA	0.0043	0.015	0.0060	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	13	45	18	60	36	120	54	180	72	240	108	360	144	480
		Mag	0.27	1.9	0.38	2.6	0.75	5.2	1.1	7.8	1.5	10	2.3	16	3.0	21
		DOF (mm)	31	2.5	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	13.3 x 17.8	1.92 x 2.56	9.60 x 12.8	1.38 x 1.85	4.80 x 6.40	0.69 x 0.92	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46	1.60 x 2.13	0.23 x 0.31	1.20 x 1.60	0.17 x 0.23
		1/2"	17.8 x 23.7	2.56 x 3.42	12.8 x 17.1	1.85 x 2.46	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
		2/3"	24.4 x 32.6	3.53 x 4.70	17.6 x 23.5	2.54 x 3.38	8.80 x 11.7	1.27 x 1.69	5.87 x 7.82	0.85 x 1.13	4.40 x 5.87	0.63 x 0.85	2.93 x 3.91	0.42 x 0.56	2.20 x 2.93	0.32 x 0.42
		1"	35.6 x 47.4	5.13 x 6.84	25.6 x 34.1	3.69 x 4.92	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62
Max FOV at Low Mag (Dia.):			160 mm ø		110 mm ø		56 mm ø		37 mm ø		28 mm ø		19 mm ø		14 mm ø	

-- FOV Limited by vignetting at low mags. Approximate maximum illuminated FOV given as diameter above.

Optical Performance - Coaxial Illumination

NOTE: 0.18X, 0.25X and 0.5X Aux Lenses are not recommended for use with coaxial illumination			0.75X Aux Lens 29-20-39-000 WD: 114 mm		Base Configuration No Aux Lens Required WD: 89 mm		1.5X Aux Lens 29-20-40-000 WD: 52 mm		2.0X Aux Lens 29-20-41-000 WD: 32 mm	
			Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.375X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	0.21	1.5	0.28	1.95	0.42	2.9	0.56	3.9
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	-- --	-- --	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
		1/2"	-- --	-- --	-- --	-- --	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64
		2/3"	-- --	-- --	-- --	-- --	15.6 x 20.9	2.26 x 3.01	11.7 x 15.6	1.69 x 2.26
0.5X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	0.28	2.0	0.38	2.6	0.56	3.9	0.75	5.2
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	-- --	-- --	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
		1/2"	-- --	-- --	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
		2/3"	-- --	-- --	-- --	-- --	11.7 x 15.6	1.69 x 2.26	8.80 x 11.7	1.27 x 1.69
		1"	-- --	-- --	-- --	-- --	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46
0.67X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	0.38	2.6	0.50	3.5	0.75	5.2	1.0	6.9
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	9.60 x 12.8	1.38 x 1.85	7.20 x 9.60	1.04 x 1.38	4.80 x 6.40	0.69 x 0.92	3.60 x 4.80	0.52 x 0.69
		1/2"	-- --	-- --	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
		2/3"	-- --	-- --	13.2 x 17.6	1.90 x 2.54	8.80 x 11.7	1.27 x 1.69	6.60 x 8.80	0.95 x 1.27
		1"	-- --	-- --	-- --	-- --	12.8 x 17.1	1.85 x 2.46	9.60 x 12.8	1.38 x 1.85
1.0X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	0.56	3.9	0.75	5.2	1.1	7.8	1.5	10
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46
		1/2"	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62
		2/3"	11.7 x 15.6	1.69 x 2.26	8.80 x 11.7	1.27 x 1.69	5.87 x 7.82	0.85 x 1.13	4.40 x 5.87	0.63 x 0.85
		1"	-- --	-- --	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
1.5X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	0.84	5.9	1.1	7.80	1.7	12	2.3	16
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
		1/2"	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82	2.84 x 3.79	0.41 x 0.55	2.13 x 2.84	0.31 x 0.41
		2/3"	7.82 x 10.4	1.13 x 1.50	5.87 x 7.82	0.85 x 1.13	3.91 x 5.21	0.56 x 0.75	2.93 x 3.91	0.42 x 0.56
		1"	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82
2.0X TV Tube		NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
		Res (lp/mm)	54	180	72	240	108	360	144	480
		Mag	1.1	7.8	1.5	10	2.3	16	3.0	21
		DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	1/3"	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46	1.60 x 2.13	0.23 x 0.31	1.20 x 1.60	0.17 x 0.23
		1/2"	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
		2/3"	5.87 x 7.82	0.85 x 1.13	4.40 x 5.87	0.63 x 0.85	2.93 x 3.91	0.42 x 0.56	2.20 x 2.93	0.32 x 0.42
		1"	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62
Max FOV at Low Mag (Dia.):			8.9 mm ø		12 mm ø		13 mm ø		10 mm ø	

-- FOV Limited by illumination at low mags. Approximate maximum illuminated FOV given as diameter above. -- Not recommended due to significant illumination losses throughout entire zoom range.



Optical Performance
Variable Working Distance Lower Module

Working Distance	Auxiliary Lens Mag.
5"	0.288
6"	0.253
7"	0.226
8"	0.202
9"	0.184
10"	0.169
11"	0.158
12"	0.147
13"	0.138
14"	0.130
15"	0.123
16"	0.116
17"	0.109

Long-Working Distance Objectives

Achieve significantly higher magnifications and increased resolution. Combine your Zoom 70XL with the expanded line of Optem LWD Infinity-Corrected Objectives.

When integrating objectives onto your Zoom 70XL Lens System, You will need to specify one of four Objective Lower Function Modules (see System Diagram p. 10-11).

Optem M-Plan APO, LWD Objectives

Eliminate chromatic aberration across exceptionally flat fields for the ultimate in high-magnification accuracy. Select from 2X, 5X, 10X, and 20X Long-Working Distance Objectives. These objectives are exact replacements for Mitutoyo 378 series objectives and are ideal for metrology applications.

LWD Infinity-Corrected M-Plan APO Objectives

- 2X M Plan APO, LWD..... 28-21-02-000
- 5X M Plan APO, LWD 28-21-05-000
- 10X M Plan APO, LWD 28-21-10-000
- 20X M Plan APO, LWD..... 28-21-11-000



Optem High-Resolution, LWD Objectives

Specifically designed to capture maximum resolution at the high-end magnifications of Optem Zoom Lenses, the 5X, 10X and 20X Optem HR Objectives are ideal for applications where distinguishing every finite detail is critical.

LWD Infinity-Corrected Hi Res Objectives

- 5X High-Resolution, LWD..... 28-20-44-000
- 10X High-Resolution, LWD..... 28-20-45-000
- 20X High-Resolution, LWD..... 28-20-46-000



Optical Performance - Objectives with coaxial Illumination

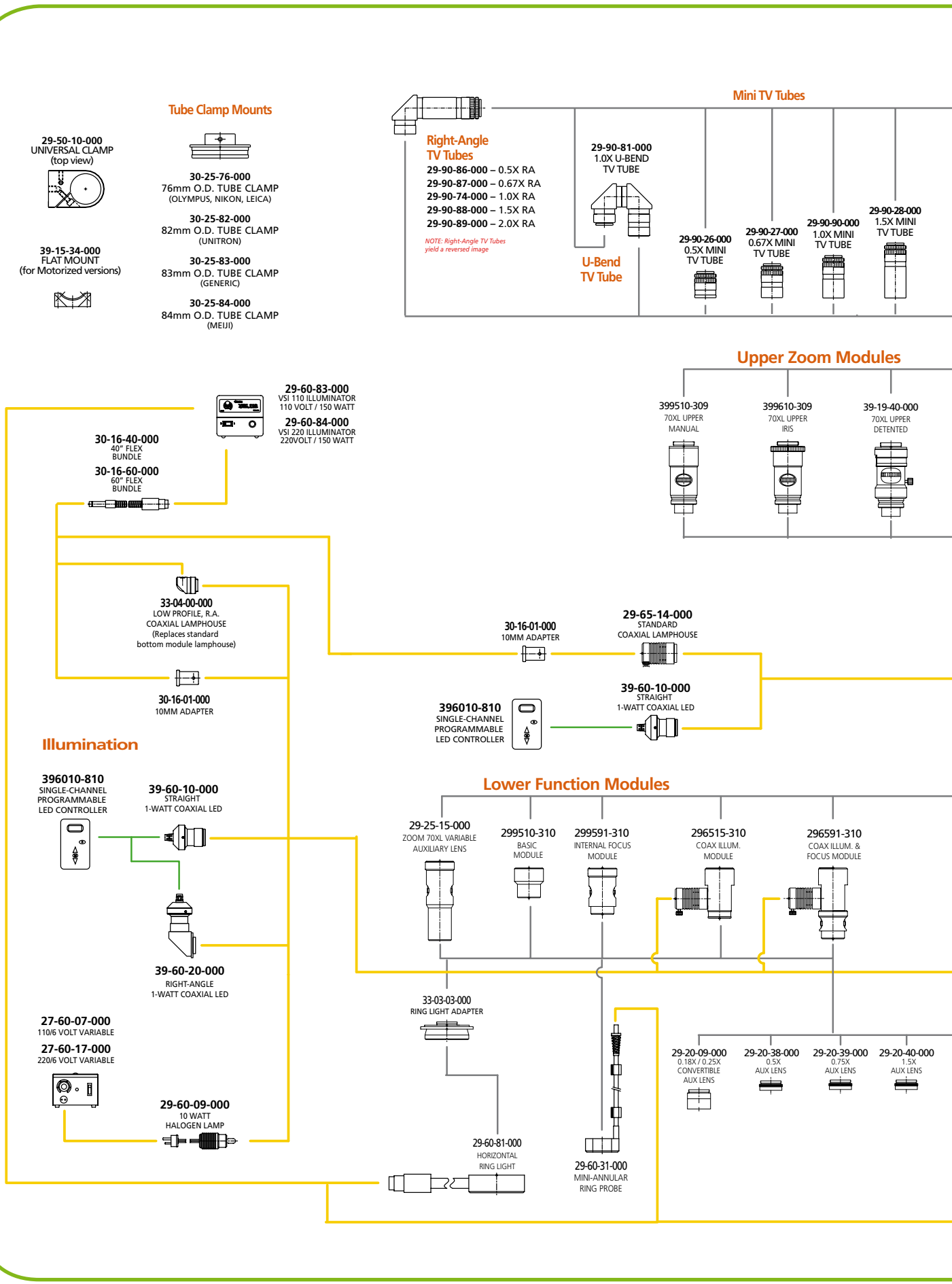
* Zoom 70XL does not pass full NA of Optem 5X and 10X HR Objectives

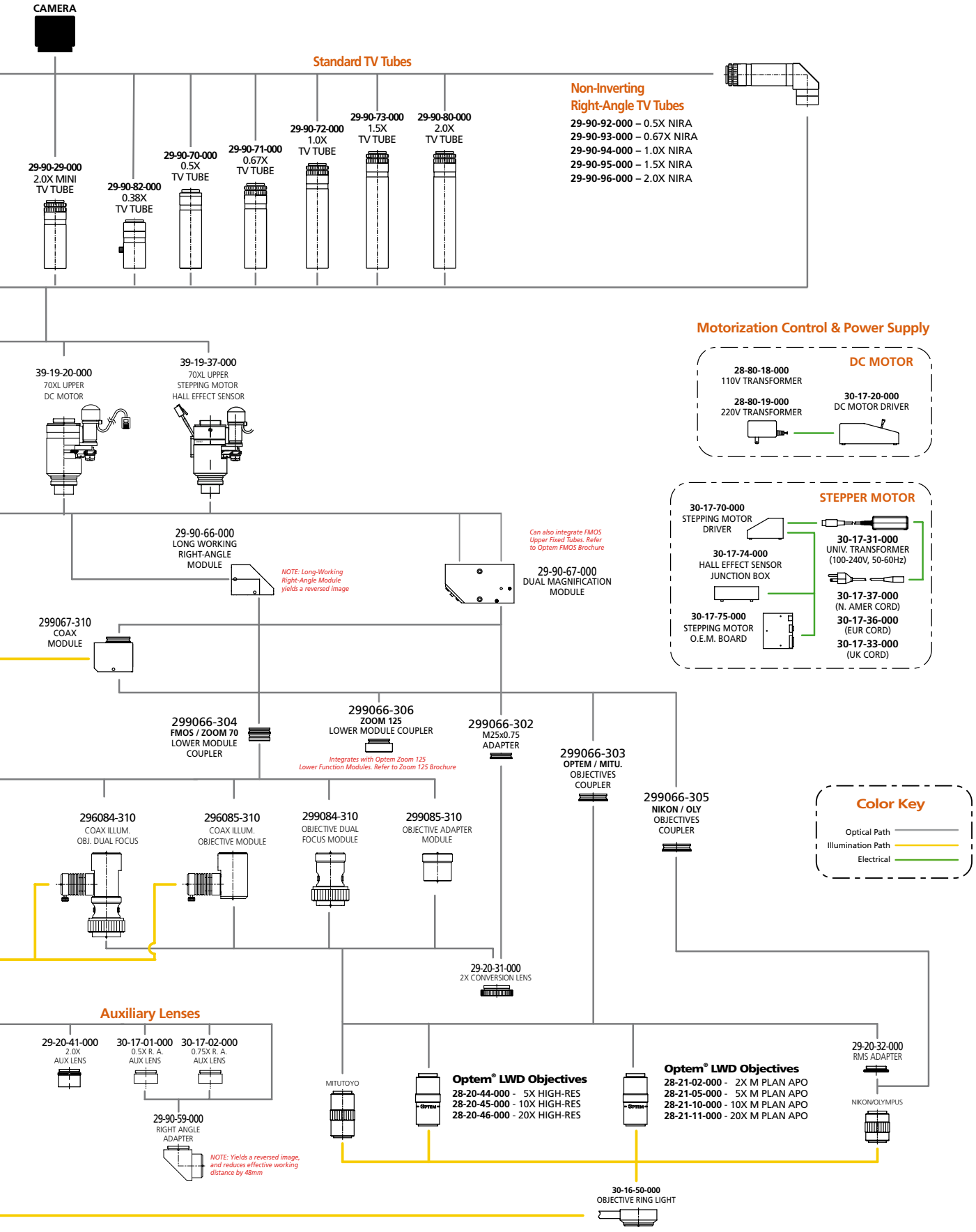
NOTE: 0.375X TV Tube is not recommended for use with Optem Objectives			2x M Plan APO LWD Objective 28-21-02-000 WD: 34 mm		5X M Plan APO LWD Objective 28-21-05-000 WD: 34 mm		10X M Plan APO LWD Objective 28-21-10-000 WD: 34 mm		20X M Plan APO LWD Objective 28-21-11-000 WD: 20 mm		5X High-Res* LWD Objective 28-20-44-000 WD: 34 mm		10X High-Res* LWD Objective 28-20-45-000 WD: 19 mm		20X High-Res LWD Objective 28-20-46-000 WD: 13 mm	
			Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.5X TV Tube		NA	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60
		Res (lp/mm)	72	165	180	420	360	900	720	1260	180	570	360	1170	720	1800
		Mag	0.36	2.5	0.90	6.2	1.8	12	3.6	25	0.90	6.2	1.8	12	3.6	25
		DOF (mm)	0.98	0.19	0.16	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016
	FOV (mm) Cam Format	1/3"	10.0 x 13.3	1.44 x 1.92	4.00 x 5.33	0.58 x 0.77	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	4.00 x 5.33	0.58 x 0.77	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19
		1/2"	13.3 x 17.8	1.92 x 2.56	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26
		2/3"	-- --	-- --	7.33 x 9.78	1.06 x 1.41	3.67 x 4.89	0.53 x 0.71	-- --	-- --	-- --	-- --	-- --	-- --	1.83 x 2.44	0.26 x 0.35
0.67X TV Tube		NA	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60
		Res (lp/mm)	72	165	180	420	360	900	720	1260	180	570	360	1170	720	1800
		Mag	0.48	3.3	1.2	8.3	2.4	17	4.8	33	1.2	8.3	2.4	17	4.8	33
		DOF (mm)	0.98	0.19	0.16	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016
	FOV (mm) Cam Format	1/3"	7.50 x 10.0	1.08 x 1.44	3.00 x 4.00	0.43 x 0.58	1.50 x 2.00	0.22 x 0.29	0.75 x 1.00	0.11 x 0.14	3.00 x 4.00	0.43 x 0.58	1.50 x 2.00	0.22 x 0.29	0.75 x 1.00	0.11 x 0.14
		1/2"	10.0 x 13.3	1.44 x 1.92	4.00 x 5.33	0.58 x 0.77	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	4.00 x 5.33	0.58 x 0.77	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19
		2/3"	13.7 x 18.3	1.98 x 2.64	5.50 x 7.33	0.79 x 1.06	2.75 x 3.66	0.40 x 0.53	1.37 x 1.83	0.20 x 0.26	5.50 x 7.33	0.79 x 1.06	2.75 x 3.66	0.40 x 0.53	1.37 x 1.83	0.20 x 0.26
		1"	-- --	-- --	8.00 x 10.7	1.15 x 1.54	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
1.0 TV Tube		NA	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60
		Res (lp/mm)	72	165	180	420	360	900	720	1260	180	570	360	1170	720	1800
		Mag	0.72	5.0	1.8	12	3.6	25	7.2	50	1.8	12	3.6	25	7.2	50
		DOF (mm)	0.98	0.19	0.16	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016
	FOV (mm) Cam Format	1/3"	5.00 x 6.67	0.72 x 0.96	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	0.50 x 0.67	0.072 x 0.096	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	0.50 x 0.67	0.072 x 0.096
		1/2"	6.67 x 8.89	0.96 x 1.28	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.10 x 0.13
		2/3"	9.17 x 12.2	1.32 x 1.76	3.67 x 4.89	0.53 x 0.71	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	3.67 x 4.89	0.53 x 0.71	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18
		1"	13.3 x 17.8	1.92 x 2.56	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26
1.5X TV Tube		NA	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60
		Res (lp/mm)	72	165	180	420	360	900	720	1260	180	570	360	1170	720	1800
		Mag	1.1	7.5	2.7	19	5.4	37	11	75	2.7	19	5.4	37	11	75
		DOF (mm)	0.98	0.19	0.16	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016
	FOV (mm) Cam Format	1/3"	3.33 x 4.44	0.48 x 0.64	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.10 x 0.13	0.33 x 0.44	0.048 x 0.064	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064
		1/2"	4.44 x 5.93	0.64 x 0.85	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	0.44 x 0.59	0.064 x 0.085	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	0.44 x 0.59	0.064 x 0.085
		2/3"	6.11 x 8.15	0.88 x 1.18	2.44 x 3.26	0.35 x 0.47	1.22 x 1.63	0.18 x 0.24	0.61 x 0.81	0.088 x 0.12	2.44 x 3.26	0.35 x 0.47	1.22 x 1.63	0.18 x 0.24	0.61 x 0.81	0.088 x 0.12
		1"	8.89 x 11.9	1.28 x 1.71	3.56 x 4.74	0.51 x 0.68	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	3.56 x 4.74	0.51 x 0.68	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17
2.0X TV Tube		NA	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60
		Res (lp/mm)	72	165	180	420	360	900	720	1260	180	570	360	1170	720	1800
		Mag	1.44	10	3.6	25	7.2	50	14	100	3.6	25	7.2	50	14	100
		DOF (mm)	0.98	0.19	0.16	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016
	FOV (mm) Cam Format	1/3"	2.50 x 3.33	0.36 x 0.48	1.00 x 1.33	0.14 x 0.19	0.50 x 0.67	0.072 x 0.096	0.25 x 0.33	0.036 x 0.048	1.00 x 1.33	0.144 x 0.19	0.50 x 0.67	0.072 x 0.096	0.25 x 0.33	0.036 x 0.048
		1/2"	3.33 x 4.44	0.48 x 0.64	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064
		2/3"	4.58 x 6.11	0.66 x 0.88	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	0.46 x 0.61	0.066 x 0.088	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	0.46 x 0.61	0.066 x 0.088
		1"	6.67 x 8.89	0.96 x 1.28	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13
Max FOV at Low Mag (Dia.):			**14 mm ø**		**6.1 mm ø**		**2.8 mm ø**		**1.1 mm ø**		**5.3 mm ø**		**2.0 mm ø**		**1.4 mm ø**	

-- FOV Limited by illumination at low mags. Approximate maximum illuminated FOV given as diameter above.

-- Not recommended due to significant illumination losses throughout entire zoom range.

Zoom 70XL Lens System Diagram




CAMERA
Standard TV Tubes
29-90-29-000 2.0X MINI TV TUBE
29-90-82-000 0.38X TV TUBE
29-90-70-000 0.5X TV TUBE
29-90-71-000 0.67X TV TUBE
29-90-72-000 1.0X TV TUBE
29-90-73-000 1.5X TV TUBE
29-90-80-000 2.0X TV TUBE
Non-Inverting Right-Angle TV Tubes
29-90-92-000 – 0.5X NIRA
29-90-93-000 – 0.67X NIRA
29-90-94-000 – 1.0X NIRA
29-90-95-000 – 1.5X NIRA
29-90-96-000 – 2.0X NIRA
Motorization Control & Power Supply
DC MOTOR
28-80-18-000 110V TRANSFORMER
28-80-19-000 220V TRANSFORMER
30-17-20-000 DC MOTOR DRIVER
STEPPER MOTOR
30-17-70-000 STEPPING MOTOR DRIVER
30-17-74-000 HALL EFFECT SENSOR JUNCTION BOX
30-17-75-000 STEPPING MOTOR O.E.M. BOARD
30-17-31-000 UNIV. TRANSFORMER (100-240V, 50-60Hz)
30-17-37-000 (N. AMER CORD)
30-17-36-000 (EUR CORD)
30-17-33-000 (UK CORD)
39-19-20-000 70XL UPPER DC MOTOR
39-19-37-000 70XL UPPER STEPPING MOTOR HALL EFFECT SENSOR
29-90-66-000 LONG WORKING RIGHT-ANGLE MODULE
NOTE: Long-Working Right-Angle Module yields a reversed image
Can also integrate FMOS Upper Fixed Tubes. Refer to Optem FMOS Brochure
29-90-67-000 DUAL MAGNIFICATION MODULE
299067-310 COAX MODULE
299066-304 FMOS / ZOOM 70 LOWER MODULE COUPLER
299066-306 ZOOM 125 LOWER MODULE COUPLER
Integrates with Optem Zoom 125 Lower Function Modules. Refer to Zoom 125 Brochure
299066-302 M25x0.75 ADAPTER
299066-303 OPTEM / MITU. OBJECTIVES COUPLER
299066-305 NIKON / OLY OBJECTIVES COUPLER
Color Key
Optical Path
Illumination Path
Electrical
296084-310 COAX ILLUM. OBJ. DUAL FOCUS
296085-310 COAX ILLUM. OBJECTIVE MODULE
299084-310 OBJECTIVE DUAL FOCUS MODULE
299085-310 OBJECTIVE ADAPTER MODULE
29-20-31-000 2X CONVERSION LENS
Auxiliary Lenses
29-20-41-000 2.0X AUX LENS
30-17-01-000 0.5X R. A. AUX LENS
30-17-02-000 0.75X R. A. AUX LENS
29-90-59-000 RIGHT ANGLE ADAPTER
NOTE: Yields a reversed image, and reduces effective working distance by 48mm
MITUTOYO
Optem® LWD Objectives
28-20-44-000 - 5X HIGH-RES
28-20-45-000 - 10X HIGH-RES
28-20-46-000 - 20X HIGH-RES
Optem® LWD Objectives
28-21-02-000 - 2X M PLAN APO
28-21-05-000 - 5X M PLAN APO
28-21-10-000 - 10X M PLAN APO
28-21-11-000 - 20X M PLAN APO
29-20-32-000 RMS ADAPTER
NIKON/OLYMPUS
30-16-50-000 OBJECTIVE RING LIGHT



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...and Manufacturing Advancement

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