



IMAGING OPTICS

> SOLUTIONS FOR ANY APPLICATION

About Navitar, Inc.

Navitar, Inc. is a network of companies that design, manufacture and distribute precision optical solutions. With manufacturing facilities in Rochester, New York and Denville, New Jersey, Navitar creates lenses used in a myriad of industries, including Biotechnology and Medical, Defense and Security, Industrial Imaging, and Projection Optics. Applications range from machine vision to assembly, and imaging to photonics research and development.

Navitar's optical, mechanical, electrical, and manufacturing engineers truly understand all phases of optical design and manufacturing. Contact Navitar today to find out how we can apply our experience to your unique situation, regardless of industry or application.

Precision Optical Solutions for Any Application



Biotechnology and Medical

Navitar has decades of experience designing and building imaging and optical systems for a variety of automated biotechnology applications.



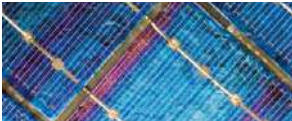
Defense and Security

Navitar offers optical solutions for military, homeland security, and law enforcement applications.



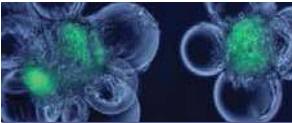
Projection Optics

Navitar designs and manufactures off-the-shelf and custom projection lenses for 2K, 4K and 3-chip projector applications.



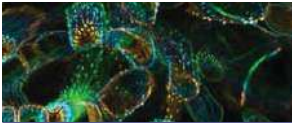
Industrial Imaging

Navitar is a leading supplier of optical solutions for machine vision, automation assembly, imaging, and testing.



Microscopy

Navitar designs high NA microscope objectives, custom tube lenses and integrated systems for customers in the microscopy sector.



Research & Development

Navitar produces high mag imaging lenses, custom microscope objectives and laser beam optics for hospitals, corporations and research institutions.

Contents



4 Custom



8 Zoom 6000 Lens System



14 12X Zoom Lens System



26 Motorized Solutions



28 Precise Eye Lens System



34 MicroMate Lens System



36 NUV-VIS Zoom System



38 Dual View Lens System



40 MTL System



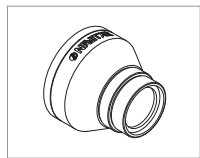
42 Illumination



44 Large Format Lenses



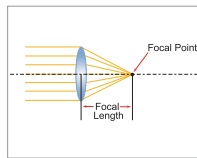
48 Low Mag Video Lenses



59 Converter Lenses



60 Telecentric Lenses



62 Quick Reference



64 Projection Lenses

Custom Lens Design

Optical Design, Manufacture, Testing and Precision Assembly

Navitar is a leading manufacturer of high quality optical components. We are well-equipped to produce large volume commercial orders as well as complex, custom-built prototypes - to exact customer specifications. We are skilled in designing high resolution, diffraction limited lens systems and ensure lens performance through extensive testing both during manufacture and after assembly. We strive to provide customers with best fit solutions that align with their unique needs and budget.

We are a vertically integrated company with skilled engineers, production and assembly staff. We can polish, edge, and coat optics in house, design and manufacture mechanical assemblies, and test onsite to ensure we have met the design specifications.

Custom Design Services

- Feasibility Study and Basic Initial Optical Design
- Optical, Mechanical and Electro-Optical Design
- Optical Fabrication
- Rapid Prototyping
- Precision Assembly
- High Volume Production
- Unbeatable Customer Service and Support

Custom Design Project Experience

- High NA Microscope Objectives
- 4K Fisheye Projection Lenses
- Digital Radiology Lenses
- 360° Surveillance Lenses
- Femtosecond Laser Optics
- Integrated Microscopy Systems for IVF Characterization
- Integrated Telecentric Inspection Systems
- Projection Lenses for Immersive Amusement Rides

Lens Manufacturing Tolerances

Attribute	Commercial Quality	Precision Quality	Ultra Precision Quality
Diameter (mm)	+0.00/-0.10	+0.000/-0.05	+0.000/-0.025
Center Thickness (mm)	0.150	0.050	0.005
Radius (power)	8 rings	4 rings	1 ring
Irregularity (waves @ 633nm)	1	0.25	0.1
Wedge (mm)	0.05	0.005	0.0025
Decenter (arc min)	0.05	0.01	0.005
Scratch-Dig	80-50	60-40	10-5
AR Coating (r avg)	< 1.5%	< 0.5%	< 0.25%

Contact us today to discuss your custom design.

info@navitar.com | 585.359.4000

Navitar's ultimate goal is to deliver unsurpassed, personalized optical solutions in a timely, cost-effective manner.

Custom OEM Design and Integrated Microscopy Solutions

Navitar offers integrated microscopy solutions for researchers and OEM customers. Our standard products are modular in design and easily combined to create unique optical assemblies that meet your project specifications and budget.

Best Fit Solutions for Your Unique Needs

We approach custom designs by comparing your product/ component, program or operation against benchmarks in terms of:

- Total cost of operations
- Product / operational competitiveness
- Ease of use / simplicity / usability
- Reliability

We work closely with you to determine feasibility and potential return resulting in a best fit solution.

Prototype to Volume Production –Vertically Integrated

Navitar is one of the few lens companies that can seamlessly integrate optical and mechanical engineering, rapid prototyping and volume custom lens production.

By eliminating the complexity of managing multiple suppliers, the entire design and prototyping process will be reduced, cycle times shortened, and you will get a consistently better product delivered routinely month after month than what is possible from any other manufacturer.



Custom OEM Project Experience

Inspection and Measuring

- 2.0X Scheimpflug adapter lens for drill bits, small mechanical parts and tool inspection for leading manufacturer of measuring machines for tool inspection
- High speed 2X, F/2.5 hyperspectral objective lens for large format designed for integration into an optical fault isolation system for packaged parts inspection. FL = 68.54 mm, WD = 19.05 mm (OPTICAL) 17.5 mm (MECHANICAL)
- 0.14X telecentric lens designed for leading automotive manufacturer fuse box inspection system. 300 mm WD, F/16, covers 41mm sensor

Biotech, Life Science and Medical

- 4X, 0.2 NA, microscope objective for a global biotechnology company that specializes in data analysis and live cell imaging instrumentation
- 25.5mm focal length, f/1.0, lens for use in a digital X-ray imaging application that will be used by radiology clinicians across the globe
- Integrated Microscopy Systems for IVF Characterization

Defense and Security

- 360° surveillance lenses
- Femtosecond laser optics

Projection Optics Design

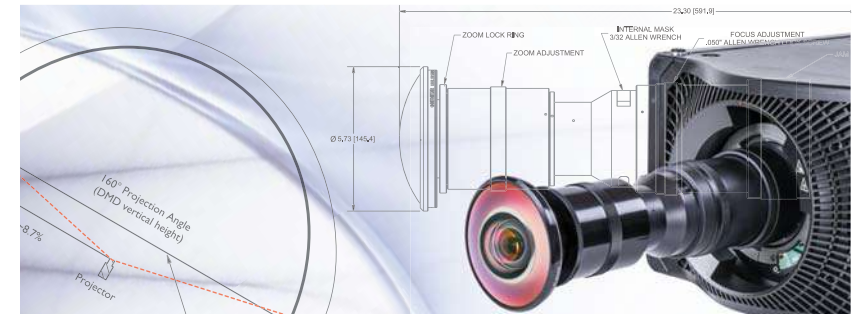
We work closely with leading projector manufacturers, producers of dome theater equipment, top simulation companies, providers of high resolution full motion immersive environments and the world's foremost creators, designers and builders of themed attractions.

Our design capabilities include:

- Relay and non-relay designs
- Rectilinear and fisheye designs
- Fisheye lenses and F-theta distortion
- Uniform pixel mapping at image edge
- Unique chip sets, color off-sets
- Panel size variations in light engines
- Customer masking requirements
- Tolerance and sensitivity analyses

Simulation and Amusement

- 0.9:1 4K accessory lens for Sony SRX-T615
- 0.65 HD high performance conversion lens for Sony GT-100
- 180° x 88° folded planetarium lens for high resolution Sony T420 (T423)
- Ultra-high resolution f/2.0 projection lens designed to work with the most state of the art LED simulation projectors. The collaborative design process spanned three companies and resulted in a cutting edge optical design for use in the most rigorous day/night training applications on the market.
- Fisheye projection lens with an integrated right angle fold mirror for use on the Christie HD14K-M projector. This was developed in partnership with one of the world leaders in creative entertainment



Microscope Objectives

Navitar and its Special Optics division specialize in the design and manufacture of custom microscope objective lenses for researchers and OEMs who require a solution to a complex application that cannot be solved by off-the-shelf microscope objective lenses.

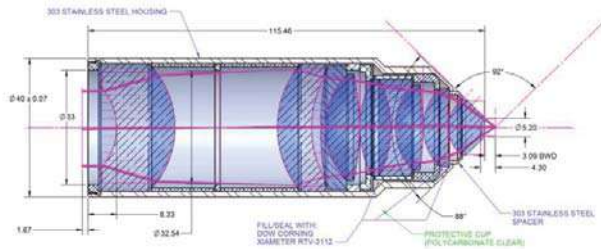
Our designs span working distances of 0.3mm to 55mm, cover wavelengths from visible (390-750) to near infrared (700-1400nm) and can be modified for aqueous, oil and vacuum environments with housings of stainless, ultem or titanium.

Our custom objectives are used in applications such as:

- Multi-photon Microscopy
- Cold Fermion/Atom Trapping
- Confocal Microscopy
- STED Microscopy
- Deep Tissues Imaging
- Microscopy and Analysis of Quantum Structures
- Super Resolution Microscopy
- Failure Analysis of Structural Materials
- Live Cell Fluorescent Microscopy

Examples of Custom Microscope Objectives:

- **Stanford University Department of Neurobiology**
0.96 NA objective, with stainless housing for life science research in aqueous environment. F#: 0.52, Aperture: 23, EFL: 12, WD: 1.5mm water, FOV: 0.4
- **Janelia Research Campus, HHMI**
0.65 NA Water Immersion Microscope objective lens used for excitation in the Bessel Beam Structured Plane Illumination Microscope designed by Eric Betzig



Zoom 6000™ Lens System

Unmatched Optical Performance

For high magnification applications, the Zoom 6000 series of lenses is the number one choice around the world. Recognized as the industry standard, our versatile 6.5X zoom lenses are designed to give you the magnification powers of traditional microscopes without the bulk or expense. They are easily integrated, assembled, and configured to your exact application. Compared with the competition, the Navitar Zoom 6000 series offers unmatched optical performance, repeatability and mechanical flexibility.



- Dynamic magnification range of 0.09-393.80X offers incredible versatility
- High contrast images and vivid colors help your equipment perform better
- 0.01-182.72 mm field coverage allows you to view a wide range of parts
- Working distance can be varied from 13 to 390 mm
- Add infinity corrected objective lenses to achieve unmatched edge flatness and clarity
- Body tubes with detents, apertures or motorized are available

Zoom 6000 Field of View Matrix (in mm at nominal W.D.)

Lens Attachment	Working Distance (mm)	Camera Format/Parameters	.5X Adapter Low - High	.67X Adapter Low - High	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.3X Adapter Low - High	5X Adapter Low - High (2)	Resolve Limit (µm) Low-High	Depth of Field (mm) Low-High
0.25X 0.006 - 0.018 NA 1-6044	300 (nominal) 220-390 (1) W.D. range	Mag.	0.09X - 0.56X	0.12X - 0.75X	0.18X - 1.13X	0.24X - 1.50X	0.35X - 2.25X	0.59X - 3.73X	0.88X - 5.62X	55.56 - 18.52	13.89 - 1.54
		1/2" Sensor	68.64 - 10.64	51.12 - 8.04	34.32 - 5.32	25.80 - 4.00	17.16 - 2.66	10.40 - 1.61	6.88 - 1.08	55.56 - 18.52	13.89 - 1.54
		2/3" Sensor	91.36 - 14.16	68.06 - 10.66	45.68 - 7.08	34.34 - 5.32	22.84 - 3.54	13.84 - 2.14	9.12 - 1.44	55.56 - 18.52	13.89 - 1.54
0.5X 0.011 - 0.035 NA 1-60110	175 (nominal) 143-187 (1) W.D. range	Mag.	0.18X - 1.13X	0.24X - 1.50X	0.35X - 2.25X	0.46X - 2.99X	0.70X - 4.50X	1.16X - 7.40X	1.75X - 11.25X	30.30 - 9.52	4.13 - 0.41
		1/3" Sensor	34.32 - 5.32	25.56 - 4.00	17.16 - 2.67	12.90 - 2.01	8.58 - 1.33	5.20 - 0.81	3.43 - 0.53	30.30 - 9.52	4.13 - 0.41
		1/2" Sensor	45.68 - 7.08	34.03 - 5.33	22.85 - 3.56	17.18 - 2.68	11.42 - 1.77	6.92 - 1.08	4.57 - 0.71	30.30 - 9.52	4.13 - 0.41
0.75X 0.017 - 0.053 NA 1-60111	113 (nominal) 100-119 (1) W.D. range	Mag.	0.27X - 1.69X	0.35X - 2.25X	0.53X - 3.38X	0.70X - 4.49X	1.05X - 6.75X	1.75X - 11.15X	2.63X - 16.88X	19.60 - 6.28	1.73 - 0.18
		1/3" Sensor	22.86 - 3.56	17.04 - 2.67	11.43 - 1.78	8.59 - 1.34	5.72 - 0.89	3.46 - 0.54	2.29 - 0.35	19.60 - 6.28	1.73 - 0.18
		1/2" Sensor	30.46 - 4.74	22.69 - 3.56	15.23 - 2.37	11.45 - 1.78	7.62 - 1.19	4.62 - 0.72	3.05 - 0.47	19.60 - 6.28	1.73 - 0.18
None 0.023 - 0.071 NA	92 (nominal) 81-93 (1) W.D. range	Mag.	0.35X - 2.25X	0.47X - 3.00X	0.70X - 4.50X	0.93X - 5.89X	1.40X - 9.00X	2.31X - 14.85X	3.50X - 22.50X	14.5 - 4.70	0.95 - 0.10
		1/3" Sensor	17.16 - 2.67	12.77 - 2.01	8.58 - 1.33	6.45 - 1.00	4.29 - 0.67	2.60 - 0.40	1.72 - 0.27	14.5 - 4.70	0.95 - 0.10
		1/2" Sensor	22.85 - 3.56	17.01 - 2.67	11.42 - 1.77	8.59 - 1.33	5.71 - 0.89	3.46 - 0.54	2.28 - 0.36	14.5 - 4.70	0.95 - 0.10
1.5X 0.034 - 0.106 NA 1-60112	51 (nominal) 48-52 (1) W.D. range	Mag.	0.53X - 3.38X	0.71X - 4.50X	1.05X - 6.75X	1.40X - 8.98X	2.10X - 13.50X	3.47X - 22.28X	5.25X - 33.75X	9.80 - 3.14	0.43 - 0.04
		1/3" Sensor	11.43 - 1.78	8.52 - 1.33	5.72 - 0.89	4.3 - 0.67	2.86 - 0.44	1.73 - 0.27	1.14 - 0.18	9.80 - 3.14	0.43 - 0.04
		1/2" Sensor	15.23 - 2.37	11.34 - 1.77	7.62 - 1.19	5.73 - 0.89	3.81 - 0.59	2.31 - 0.36	1.52 - 0.24	9.80 - 3.14	0.43 - 0.04
2.0X 0.040 - 0.142 NA 1-60113	36 (nominal) 34-37 (1) W.D. range	Mag.	0.70X - 4.50X	0.94X - 6.00X	1.40X - 9.00X	1.86X - 11.97X	2.80X - 18.00X	4.62X - 29.70X	7.00X - 45.00X	7.24 - 2.34	0.24 - 0.02
		1/3" Sensor	8.58 - 1.33	6.39 - 1.00	4.29 - 0.67	3.22 - 0.50	2.15 - 0.33	1.30 - 0.14	0.86 - 0.13	7.24 - 2.34	0.24 - 0.02
		1/2" Sensor	11.42 - 1.77	8.51 - 1.33	5.71 - 0.89	4.29 - 0.67	2.86 - 0.44	1.73 - 0.27	1.14 - 0.18	7.24 - 2.34	0.24 - 0.02

The above fields of view are measured diagonally in millimeters (Horizontal x Diagonal x Vertical = Diagonal x 0.8)
 (1) Working distance range when using 12 mm fine focus. Field of view will change with shorter or longer working distances.
 (2) When using 5X Adapter image quality is greatly reduced. Contact your Navitar sales representative for detailed specifications.
 (3) All systems using a 1" sensor should be discussed with a Navitar applications expert.
 NA varies depending on system magnification.

Zoom 6000 Performance Specifications

Zoom 6000 Combinations Lens Attachment + Prime Lens + Adapter	Working Distance (mm)	System Magnification Low-High	NA Objective Low-High	Resolve Limit (µm) Low-High	Matching Pixel Size (µm) Low-High	Depth of Field (mm) Low-High
0.25x + 6.5X Zoom + 0.5x	300	0.09 - 0.56	0.006 - 0.018	55.56 - 18.52	2.50 - 5.19	13.89 - 1.54
0.25x + 6.5X Zoom + 0.67x	300	0.12 - 0.75	0.006 - 0.018	55.56 - 18.52	3.33 - 6.95	13.89 - 1.54
0.25x + 6.5X Zoom + 1.0x	300	0.18 - 1.13	0.006 - 0.018	55.56 - 18.52	5.00 - 10.46	13.89 - 1.54
0.25x + 6.5X Zoom + 1.33x	300	0.23 - 1.51	0.006 - 0.018	55.56 - 18.52	6.65 - 13.91	13.89 - 1.54
0.25x + 6.5X Zoom + 2.0x	300	0.35 - 2.25	0.006 - 0.018	55.56 - 18.52	9.72 - 20.84	13.89 - 1.54
0.25x + 6.5X Zoom + 3.5x	300	0.61 - 3.98	0.006 - 0.018	55.56 - 18.52	17.50 - 36.61	13.89 - 1.54
0.25x + 6.5X Zoom + 5.0x	300	0.88 - 5.62	0.006 - 0.018	55.56 - 18.52	24.45 - 52.04	13.89 - 1.54
0.5x + 6.5X Zoom + 0.5x	175	0.18 - 1.13	0.011 - 0.035	30.30 - 9.52	2.73 - 5.38	4.13 - 0.41
0.5x + 6.5X Zoom + 0.67x	175	0.23 - 1.50	0.011 - 0.035	30.30 - 9.52	3.48 - 7.14	4.13 - 0.41
0.5x + 6.5X Zoom + 1.0x	175	0.35 - 2.25	0.011 - 0.035	30.30 - 9.52	5.30 - 10.71	4.13 - 0.41
0.5x + 6.5X Zoom + 1.33x	175	0.47 - 3.03	0.011 - 0.035	30.30 - 9.52	7.05 - 14.24	4.13 - 0.41
0.5x + 6.5X Zoom + 2.0x	175	0.70 - 4.50	0.011 - 0.035	30.30 - 9.52	10.61 - 21.42	4.13 - 0.41
0.5x + 6.5X Zoom + 3.5x	175	1.22 - 7.93	0.011 - 0.035	30.30 - 9.52	18.55 - 37.49	4.13 - 0.41
0.5x + 6.5X Zoom + 5.0x	175	1.75 - 11.25	0.011 - 0.035	30.30 - 9.52	26.51 - 53.55	4.13 - 0.41
0.75x + 6.5X Zoom + 0.5x	113	0.26 - 1.69	0.017 - 0.053	19.62 - 6.28	2.55 - 5.32	1.73 - 0.18
0.75x + 6.5X Zoom + 0.67x	113	0.35 - 2.25	0.017 - 0.053	19.62 - 6.28	3.43 - 7.08	1.73 - 0.18
0.75x + 6.5X Zoom + 1.0x	113	0.53 - 3.38	0.017 - 0.053	19.62 - 6.28	5.20 - 10.63	1.73 - 0.18
0.75x + 6.5X Zoom + 1.33x	113	0.70 - 4.54	0.017 - 0.053	19.62 - 6.28	6.92 - 14.13	1.73 - 0.18
0.75x + 6.5X Zoom + 2.0x	113	1.05 - 6.75	0.017 - 0.053	19.62 - 6.28	10.30 - 21.23	1.73 - 0.18
0.75x + 6.5X Zoom + 3.5x	113	1.86 - 12.06	0.017 - 0.053	19.62 - 6.28	18.20 - 37.21	1.73 - 0.18
0.75x + 6.5X Zoom + 5.0x	113	2.63 - 16.88	0.017 - 0.053	19.62 - 6.28	25.74 - 53.09	1.73 - 0.18
None + 6.5X Zoom + 0.5x	92	0.35 - 2.25	0.023 - 0.071	14.50 - 4.70	2.54 - 5.28	0.95 - 0.10
None + 6.5X Zoom + 0.67x	92	0.47 - 3.00	0.023 - 0.071	14.50 - 4.70	3.41 - 7.04	0.95 - 0.10
None + 6.5X Zoom + 1.0x	92	0.70 - 4.50	0.023 - 0.071	14.50 - 4.70	5.08 - 10.55	0.95 - 0.10
None + 6.5X Zoom + 1.33x	92	0.93 - 6.05	0.023 - 0.071	14.50 - 4.70	6.76 - 14.03	0.95 - 0.10
None + 6.5X Zoom + 2.0x	92	1.40 - 9.00	0.023 - 0.071	14.50 - 4.70	10.15 - 21.11	0.95 - 0.10
None + 6.5X Zoom + 3.5x	92	2.45 - 15.93	0.023 - 0.071	14.50 - 4.70	17.78 - 36.93	0.95 - 0.10
None + 6.5X Zoom + 5.0x	92	3.50 - 22.50	0.023 - 0.071	14.50 - 4.70	25.38 - 52.76	0.95 - 0.10
1.5x + 6.5X Zoom + 0.5x	51	0.53 - 3.38	0.034 - 0.106	9.80 - 3.14	2.60 - 5.32	0.43 - 0.04
1.5x + 6.5X Zoom + 0.67x	51	0.70 - 4.50	0.034 - 0.106	9.80 - 3.14	3.43 - 7.09	0.43 - 0.04
1.5x + 6.5X Zoom + 1.0x	51	1.05 - 6.75	0.034 - 0.106	9.80 - 3.14	5.15 - 10.63	0.43 - 0.04
1.5x + 6.5X Zoom + 1.33	51	1.40 - 9.08	0.034 - 0.106	9.80 - 3.14	6.85 - 14.14	0.43 - 0.04
1.5x + 6.5X Zoom + 2.0x	51	2.10 - 13.50	0.034 - 0.106	9.80 - 3.14	10.29 - 21.26	0.43 - 0.04
1.5x + 6.5X Zoom + 3.5x	51	3.68 - 23.89	0.034 - 0.106	9.80 - 3.14	18.03 - 37.21	0.43 - 0.04
1.5x + 6.5X Zoom + 5.0x	51	5.25 - 33.75	0.034 - 0.106	9.80 - 3.14	25.73 - 53.16	0.43 - 0.04
2.0x + 6.5X Zoom + 0.5x	36	0.70 - 4.50	0.046 - 0.142	7.24 - 2.34	2.54 - 5.29	0.24 - 0.02
2.0x + 6.5X Zoom + 0.67x	36	0.94 - 6.00	0.046 - 0.142	7.24 - 2.34	3.41 - 7.05	0.24 - 0.02
2.0x + 6.5X Zoom + 1.0x	36	1.40 - 9.00	0.046 - 0.142	7.24 - 2.34	5.08 - 10.58	0.24 - 0.02
2.0x + 6.5X Zoom + 1.33	36	1.86 - 12.10	0.046 - 0.142	7.24 - 2.34	6.76 - 14.07	0.24 - 0.02
2.0x + 6.5X Zoom + 2.0x	36	2.80 - 18.00	0.046 - 0.142	7.24 - 2.34	10.15 - 21.15	0.24 - 0.02
2.0x + 6.5X Zoom + 3.5x	36	4.90 - 31.85	0.046 - 0.142	7.24 - 2.34	17.78 - 37.03	0.24 - 0.02
2.0x + 6.5X Zoom + 5.0x	36	7.00 - 45.00	0.046 - 0.142	7.24 - 2.34	25.38 - 52.88	0.24 - 0.02

Assumptions:
1. Minimum resolvable feature size is half of the threshold line pair limit. Calculation = $1/3000 \times \text{Lens NA}$
2. Matching pixel size is that which will permit the minimum feature size to overlap two pixels. Calculation = $1/2(\text{Feature Size} \times \text{System Magnification})$
3. If the matching pixel size is greater than the camera pixel size, the system is "lens limited."
4. If the matching pixel size is less than the camera pixel size, the system is "camera limited."

Zoom 6000™ UltraZoom

Combine Infinity-Corrected Objectives for Maximum Resolution and Magnification

Navitar's UltraZoom is ideal for semiconductor inspection, flow cytometry, and other high magnification applications. Its advanced design offers high resolution and outstanding contrast. This system incorporates infinity corrected, plan apochromatic objectives providing long working distances and excellent edge flatness and clarity. Resolution varies from 420 to 1,650 lines per mm, depending on the microscope objective used. The UltraZoom is also available with fine focus and/or coaxial illumination.

**Zoom 6000 UltraZoom Field of View Matrix
(for part number's 1-60190, 1-60191, 1-60349 and 1-60350 in mm)**

Objective Lens (Mitutoyo) Long W.D	Working Distance (mm)	Camera Format/ Parameters	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.3X Adapter Low - High
4X 0.20 NA* 1-55075	20	Mag.	1.99X - 9.14X	1.79X - 12.16X	2.78X - 18.29X	4.59X - 30.18X
		1/4" Sensor	2.01 - 0.44	2.24 - 0.33	1.44 - 0.22	0.87 - 0.13
		1/3" Sensor	3.02 - 0.66	3.35 - 0.49	2.16 - 0.33	1.31 - 0.20
		1/2" Sensor	(1) 5.15 - 0.87	4.47 - 0.66	2.87 - 0.44	1.74 - 0.27
		2/3" Sensor	(1) 5.15 - 1.20	6.15 - 0.90	3.95 - 0.60	2.39 - 0.36
5X 0.14 NA* 1-60226	34	Mag.	1.74X - 11.43X	2.30X - 15.00X	3.48X - 22.86X	5.74X - 37.72X
		1/4" Sensor	2.30 - 0.35	1.74 - 0.26	1.15 - 0.17	0.70 - 0.11
		1/3" Sensor	3.45 - 0.52	2.61 - 0.40	1.72 - 0.26	1.04 - 0.16
		1/2" Sensor	(1) 4.05 - 0.70	3.48 - 0.54	2.30 - 0.35	1.39 - 0.21
		2/3" Sensor	(1) 4.02 - 0.96	4.00 - 0.74	3.16 - 0.48	1.92 - 0.29
10X 0.28 NA* 1-60227	33	Mag.	3.48X - 22.86X	4.63X - 29.90X	6.96X - 45.72X	11.48X - 75.44X
		1/4" Sensor	1.15 - 0.17	0.86 - 0.13	0.57 - 0.09	0.35 - 0.05
		1/3" Sensor	1.72 - 0.26	1.30 - 0.20	0.86 - 0.13	0.52 - 0.08
		1/2" Sensor	(1) 2.10 - 0.35	1.73 - 0.27	1.15 - 0.17	0.70 - 0.11
20X 0.42 NA* 1-60228	20	Mag.	6.96X - 45.72X	9.30X - 59.90X	13.92X - 91.40X	22.97X - 150.88X
		1/4" Sensor	0.57 - 0.09	0.43 - 0.07	0.29 - 0.04	0.17 - 0.03
		1/3" Sensor	0.86 - 0.13	0.65 - 0.10	0.43 - 0.07	0.26 - 0.04
		1/2" Sensor	(1) 1.00 - 0.17	0.86 - 0.14	0.57 - 0.09	0.35 - 0.05
		2/3" Sensor	(1) 1.03 - 0.24	1.00 - 0.19	0.79 - 0.12	0.48 - 0.07
50X 0.55 NA* 1-60229	13	Mag.	17.40X - 114.30X	23.00X-150.00X	34.80X - 228.60X	57.42X - 377.19X
		1/4" Sensor	0.23 - 0.03	0.17 - 0.03	0.11 - 0.02	0.07 - 0.011
		1/3" Sensor	0.30 - 0.05	0.26 - 0.04	0.17 - 0.03	0.10 - 0.020
		1/2" Sensor	(1) 0.31 - 0.07	0.30 - 0.05	0.23 - 0.04	0.14 - 0.020
2/3" Sensor	(1) 0.30 - 0.10	(1) 0.30 - 0.07	(1) 0.30 - 0.05	0.19 - 0.030		

NOTE: (1) Entire zoom range is not used. *NA at high mag. NA varies with zoom settings.



Zoom 6000™ with Co-axial Illumination

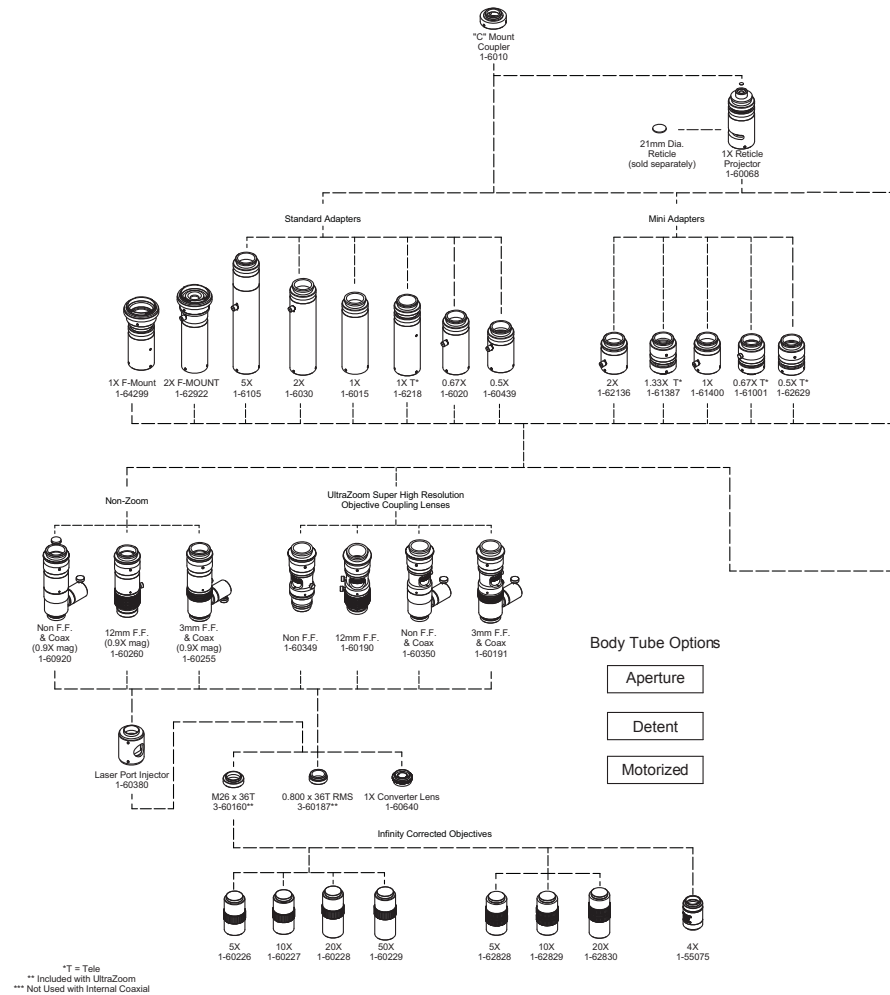
Navitar's Zoom 6000 with Internal Co-axial Illumination (1-60123) is an ideal solution for applications involving highly reflective surfaces, such as wafers, polished samples, and fluids. Designed to provide even illumination for higher magnification applications, coaxial illumination provides extremely detailed resolution, particularly when a high resolution camera is used.

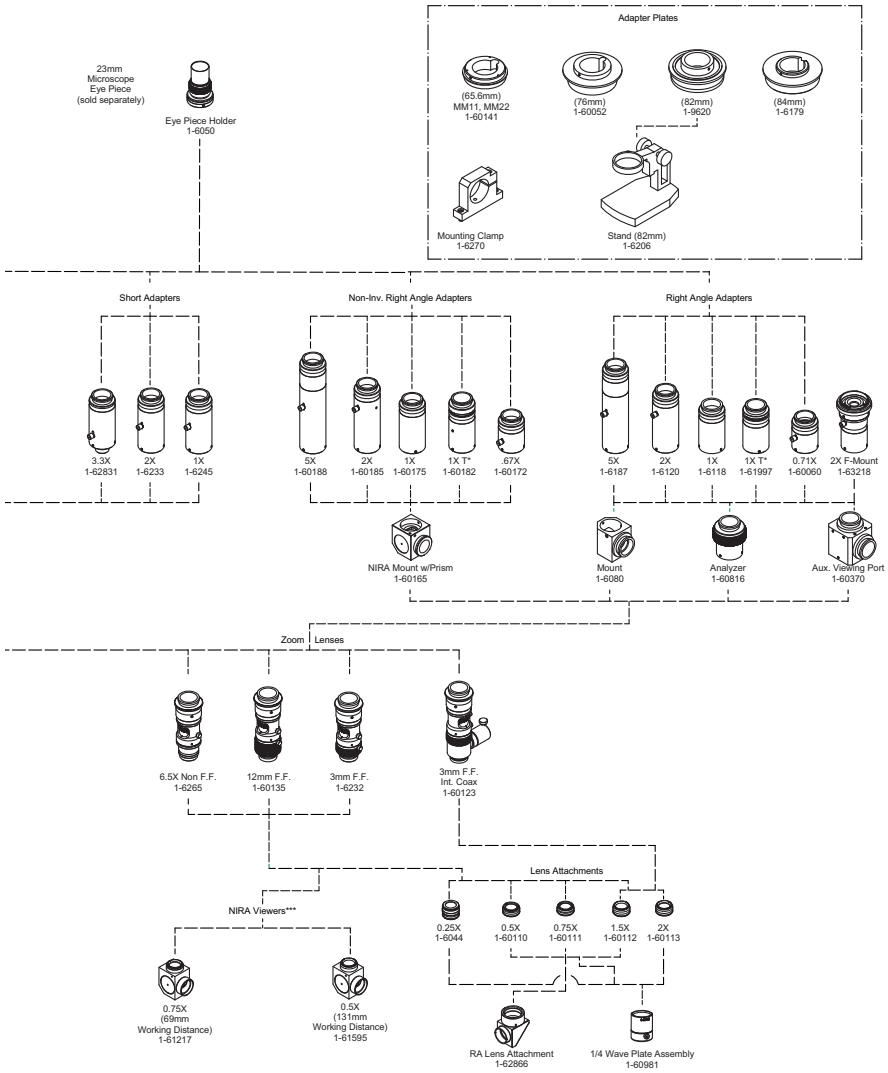
Zoom 6000 with Co-axial Illumination Field of View Matrix 1-60123 (in mm at nominal W.D.)

Lens Attachment	W.D. (mm)	Camera Format/Parameters	5X Adapter Low - High	67X Adapter Low - High	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.3X Adapter Low - High	5X Adapter Low - High
None 0.023-0.071 NA	92 (nominal) 90-93 (1) W.D. range	Mag.	0.35X - 2.25X	0.47X - 3.00X	0.70X - 4.50X	0.93X - 6.00X	1.40X - 9.00X	2.45X - 15.75X	3.50X - 22.50X
		1/4" Sensor	11.43 - 1.78	8.51 - 1.33	5.71 - 0.89	4.30X - 0.67	2.86 - 0.45	1.63 - 0.25	1.14 - 0.18
		1/3" Sensor	(2) 11.10 - 2.67	(2) 11.40 - 2.01	8.58 - 1.33	6.45 - 1.00	4.29 - 0.67	2.45 - 0.38	1.72 - 0.27
		1/2" Sensor	(2) 11.20 - 3.56	(2) 11.46 - 2.62	11.42 - 1.77	8.60 - 1.33	5.71 - 0.89	3.27 - 0.51	2.28 - 0.36
		2/3" Sensor	(2) 11.06 - 4.89	(2) 11.54 - 3.60	11.40 - 2.44	11.00 - 1.83	7.86 - 1.22	4.49 - 0.70	3.14 - 0.49
1.5X 0.034-0.106 NA 1-60112	51 (nominal) 51-53 (1) W.D. range	Mag.	0.53X - 3.38X	0.71X - 4.50X	1.05X - 6.75X	1.40X - 9.00X	2.10X - 13.50X	3.70X - 23.60X	5.25X - 33.75X
		1/4" Sensor	7.62 - 1.18	5.67 - 0.89	3.81 - 0.59	2.85 - 0.44	1.91 - 0.30	1.08 - 0.17	0.76 - 0.120
		1/3" Sensor	11.32 - 1.78	8.52 - 1.33	5.72 - 0.89	4.29 - 0.67	2.86 - 0.44	1.62 - 0.25	1.14 - 0.18
		1/2" Sensor	(2) 11.20 - 2.37	11.34 - 1.77	7.62 - 1.19	5.71 - 0.89	3.81 - 0.59	2.16 - 0.34	1.52 - 0.24
		2/3" Sensor	(2) 11.20 - 3.25	(2) 11.20 - 2.44	10.48 - 1.63	7.86 - 1.22	5.24 - 0.81	2.97 - 0.47	2.10 - 0.33
2.0X 0.046-0.1421 NA 1-60113	36 (nominal) 36-37 (1) W.D. range	Mag.	0.70X - 4.50X	0.94X - 6.00X	1.40X - 9.00X	1.86X-12.00X	2.80X - 18.00X	4.90X-31.50X	7.00X - 45.00X
		1/4" Sensor	5.71 - 0.89	4.26 - 0.67	2.86 - 0.45	2.15 - 0.33	1.43 - 0.23	0.82 - 0.13	0.57 - 0.09
		1/3" Sensor	8.57 - 1.33	6.39 - 1.00	4.29 - 0.67	3.22 - 0.50	2.15 - 0.33	1.22 - 0.19	0.86 - 0.13
		1/2" Sensor	(2) 11.20 - 1.77	8.51 - 1.33	5.71 - 0.89	4.30 - 0.67	2.86 - 0.44	1.63 - 0.25	1.14 - 0.18
		2/3" Sensor	(2) 11.20 - 2.44	(2) 11.70 - 1.83	7.86 - 1.22	5.91 - 0.92	3.93 - 0.61	2.24 - 0.35	1.57 - 0.24

NOTE:
 The internal coax will illuminate a circular area of about 11 mm in diameter. Any field of view larger than 11 mm will have darkened corners.
 Low power lens attachments can be used but produce increasing vinetting.
 (1) Working distance range when using 3 mm fine focus.
 (2) Entire zoom range is not used.

Zoom 6000™ System Diagram





12X Zoom Lens System

Navitar's Highest Combination of Zoom Range and Resolution

For high magnification applications requiring the optimal balance between optical performance, large zoom range and price, the 12X is an ideal choice. The 12X Zoom incorporates all the mechanical flexibility of the Zoom 6000 with extended zoom range, higher NA and unbeatable accuracy and repeatability for the most demanding applications. This outstanding combination of zoom range, coupled with large field coverage, means that you will now be able to view a wider range of parts with a single video inspection system and eliminate the need for bulky microscopes.

- Incredible 12X (0.58-7X) magnification for inspection of a wider range of parts
- Increased resolution with 0.004-0.550 NA
- Variable working distance from 13 to 341 mm
- Field of view from 0.006 mm to 85.71 mm with attachments
- Unmatched edge flatness and clarity
- Works with 1/4", 1/3", 1/2" and 2/3" format cameras
- The 12X Zoom System utilizes existing Zoom 6000 adapter tubes
- Body tubes with detents, apertures or motorized are available



12X Zoom Field of View Matrix (in mm)

Lens Attachment	W.D. (mm)	Camera Formats/Parameters	0.5X Adapter Low-High	0.67X Adapter Low-High	1X Adapter Low-High	1.33X Adapter Low-High	2X Adapter Low-High	3.3X Adapter Low-High	Resolve Limit (µm) Low-High	Depth of Field (mm) Low-High
0.25X (2)0.005 - 0.025 NA 1-50011	341	Mag.	0.07X - 0.87X	0.10X - 1.20X	0.15X - 1.75X	0.19X - 2.33X	0.29X - 3.50X	0.50X - 5.78X	66.66 - 13.34	20.00 - 0.80
		1/4" Sensor	57.14 - 4.59	41.16 - 3.40	27.60 - 2.28	21.05 - 1.72	13.90 - 1.14	8.36 - 0.69	66.66 - 13.34	20.00 - 0.80
		1/3" Sensor	85.71 - 6.89	61.73 - 5.10	41.38 - 3.42	31.57 - 2.57	20.69 - 1.71	12.54 - 1.04	66.66 - 13.34	20.00 - 0.80
		1/2" Sensor	—	82.32 - 6.80	55.16 - 4.56	42.10 - 3.43	27.58 - 2.28	16.72 - 1.38	66.66 - 13.34	20.00 - 0.80
2/3" Sensor	—	(1) 72.00 - 9.35	75.88 - 6.28	57.89 - 4.72	37.94 - 3.14	22.99 - 1.90	66.66 - 13.34	20.00 - 0.80		
0.5X 0.009 - 0.051 NA 1-50012	165	Mag.	0.14X - 1.75X	0.20X - 2.40X	0.29X - 3.50X	0.39X - 4.66X	0.58X - 7.00X	0.96X - 11.55X	37.04 - 6.66	6.17 - 0.19
		1/4" Sensor	28.57 - 2.28	20.58 - 1.70	13.79 - 1.14	10.25 - 0.86	6.90 - 0.76	4.18 - 0.35	37.04 - 6.66	6.17 - 0.19
		1/3" Sensor	42.85 - 3.42	30.87 - 2.55	20.69 - 1.71	15.38 - 1.29	10.34 - 0.86	6.27 - 0.52	37.04 - 6.66	6.17 - 0.19
		1/2" Sensor	—	41.16 - 3.40	27.58 - 2.28	20.51 - 1.72	13.79 - 1.14	8.36 - 0.69	37.04 - 6.66	6.17 - 0.19
2/3" Sensor	—	(1) 36.00 - 4.68	37.94 - 3.14	28.20 - 2.36	18.97 - 1.57	11.50 - 0.95	37.04 - 6.66	6.17 - 0.19		
0.75X 0.014 - 0.076 NA 1-50013	108	Mag.	0.22X - 2.62X	0.29X - 3.50X	0.44X - 5.30X	0.58X - 6.98X	0.87X - 10.50X	1.45X - 17.49X	23.80 - 4.44	2.55 - 0.09
		1/4" Sensor	18.18 - 1.52	13.72 - 1.14	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.78 - 0.23	23.80 - 4.44	2.55 - 0.09
		1/3" Sensor	27.27 - 2.29	20.58 - 1.70	13.79 - 1.14	10.34 - 0.85	6.89 - 0.57	4.18 - 0.35	23.80 - 4.44	2.55 - 0.09
		1/2" Sensor	—	27.44 - 2.27	18.34 - 1.52	13.79 - 1.14	9.19 - 0.76	5.56 - 0.46	23.80 - 4.44	2.55 - 0.09
2/3" Sensor	—	(1) 24.30 - 3.12	25.30 - 2.09	18.96 - 1.57	12.64 - 1.05	7.67 - 0.63	23.80 - 4.44	2.55 - 0.09		
None 0.019 - 0.101 NA	86	Mag.	0.29X - 3.49X	0.39X - 4.70X	0.58X - 7.00X	0.77X - 9.31X	1.16X - 14.00X	1.91X - 23.10X	18.52 - 3.34	1.39 - 0.05
		1/4" Sensor	13.79 - 1.14	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17	18.52 - 3.34	1.39 - 0.05
		1/3" Sensor	20.69 - 1.72	15.44 - 1.28	10.34 - 0.86	7.79 - 0.64	5.18 - 0.43	3.13 - 0.26	18.52 - 3.34	1.39 - 0.05
		1/2" Sensor	—	20.58 - 1.70	13.79 - 1.14	10.39 - 0.86	6.90 - 0.57	4.18 - 0.35	18.52 - 3.34	1.39 - 0.05
2/3" Sensor	—	(1) 18.20 - 2.34	18.97 - 1.57	14.28 - 1.18	9.49 - 0.78	5.75 - 0.48	18.52 - 3.34	1.39 - 0.05		
1.5X 0.028 - 0.151 NA 1-50014	50	Mag.	0.43X - 5.23X	0.58X - 7.00X	0.87X - 10.50X	1.16X - 14.00X	1.74X - 21.00X	2.87X - 34.65X	12.34 - 2.24	0.64 - 0.02
		1/4" Sensor	9.30 - 0.76	6.86 - 0.57	4.60 - 0.38	3.44 - 0.28	2.30 - 0.19	1.39 - 0.12	12.34 - 2.24	0.64 - 0.02
		1/3" Sensor	13.95 - 1.14	10.29 - 0.85	6.89 - 0.57	5.17 - 0.44	3.45 - 0.29	2.09 - 0.17	12.34 - 2.24	0.64 - 0.02
		1/2" Sensor	—	13.72 - 1.13	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.78 - 0.23	12.34 - 2.24	0.64 - 0.02
2/3" Sensor	—	(1) 12.20 - 1.55	12.64 - 1.05	9.48 - 0.78	6.33 - 0.52	3.83 - 0.323	12.34 - 2.24	0.64 - 0.02		
2.0X 0.038 - 0.202 NA 1-50015	37	Mag.	0.58X - 6.98X	0.78X - 9.40X	1.16X - 14.00X	1.54X - 18.6X	2.32X - 28.00X	3.83X - 46.20X	9.00 - 1.66	0.35 - 0.01
		1/4" Sensor	6.89 - 0.57	5.14 - 0.43	3.45 - 0.29	2.59 - 0.21	1.73 - 0.15	1.05 - 0.09	9.00 - 1.66	0.35 - 0.01
		1/3" Sensor	10.34 - 0.85	7.72 - 0.64	5.18 - 0.43	3.89 - 0.32	2.59 - 0.22	1.57 - 0.13	9.00 - 1.66	0.35 - 0.01
		1/2" Sensor	—	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17	9.00 - 1.66	0.35 - 0.01
2/3" Sensor	—	(1) 9.10 - 1.17	9.49 - 0.78	7.14 - 0.59	4.75 - 0.40	2.88 - 0.24	9.00 - 1.66	0.35 - 0.01		

(1) Vignetting occurs at zoom settings less than 0.9X
 (2) NA varies depending on zoom setting. The above fields of view are measured diagonally in millimeters (Horizontal = Diagonal x 0.8 and Vertical = Diagonal x 0.6).

12X Zoom Performance Specifications

12X Zoom Combinations Lens Attach. + Prime Lens + Adapter	Working Distance (mm)	System Mag. Low-High	NA Objective Low-High	Resolve Limit (µm) Low-High	Matching Pixel Size (µm)		Depth of Field Low-High
					Low-High	Low-High	
0.25x + 12X Zoom + 0.5x	341	0.07 - 0.87	0.005 - 0.025	66.66 - 13.34	2.33 - 5.8		20.00 - 0.80
0.25x + 12X Zoom + 0.67x	341	0.10 - 1.17	0.005 - 0.025	66.66 - 13.34	3.33 - 7.80		20.00 - 0.80
0.25x + 12X Zoom + 1.0x	341	0.15 - 1.75	0.005 - 0.025	66.66 - 13.34	5.00 - 11.67		20.00 - 0.80
0.25x + 12X Zoom + 1.33x	341	0.19 - 2.33	0.005 - 0.025	66.66 - 13.34	6.33 - 15.54		20.00 - 0.80
0.25x + 12X Zoom + 2.0x	341	0.29 - 3.50	0.005 - 0.025	66.66 - 13.34	9.67 - 23.34		20.00 - 0.80
0.25x + 12X Zoom + 3.5x	341	0.51 - 6.13	0.005 - 0.025	66.66 - 13.34	16.99 - 40.88		20.00 - 0.80
0.5x + 12X Zoom + 0.5x	165	0.14 - 1.75	0.009 - 0.051	37.04 - 6.66	2.59 - 5.82		6.17 - 0.19
0.5x + 12X Zoom + 0.67x	165	0.19 - 2.35	0.009 - 0.051	37.04 - 6.66	3.60 - 7.68		6.17 - 0.19
0.5x + 12X Zoom + 1.0x	165	0.29 - 3.50	0.009 - 0.051	37.04 - 6.66	5.38 - 11.45		6.17 - 0.19
0.5x + 12X Zoom + 1.33x	165	0.39 - 4.66	0.009 - 0.051	37.04 - 6.66	7.22 - 15.51		6.17 - 0.19
0.5x + 12X Zoom + 2.0x	165	0.58 - 7.00	0.009 - 0.051	37.04 - 6.66	10.74 - 22.89		6.17 - 0.19
0.5x + 12X Zoom + 3.5x	165	1.02 - 12.30	0.009 - 0.051	37.04 - 6.66	18.89 - 40.95		6.17 - 0.19
0.75x + 12X Zoom + 0.5x	108	0.22 - 2.62	0.014 - 0.076	23.80 - 4.44	2.61 - 5.81		2.55 - 0.09
0.75x + 12X Zoom + 0.67x	108	0.29 - 3.52	0.014 - 0.076	23.80 - 4.44	3.45 - 7.73		2.55 - 0.09
0.75x + 12X Zoom + 1.0x	108	0.44 - 5.25	0.014 - 0.076	23.80 - 4.44	5.24 - 11.52		2.55 - 0.09
0.75x + 12X Zoom + 1.33x	108	0.58 - 6.98	0.014 - 0.076	23.80 - 4.44	6.90 - 15.49		2.55 - 0.09
0.75x + 12X Zoom + 2.0x	108	0.87 - 10.50	0.014 - 0.076	23.80 - 4.44	10.35 - 23.05		2.55 - 0.09
0.75x + 12X Zoom + 3.5x	108	1.53 - 18.40	0.014 - 0.076	23.80 - 4.44	18.20 - 40.84		2.55 - 0.09
None + 12X Zoom + 0.5x	86	0.29 - 3.49	0.019 - 0.101	18.52 - 3.34	2.68 - 5.82		1.39 - 0.05
None + 12X Zoom + 0.67x	86	0.39 - 4.69	0.019 - 0.101	18.52 - 3.34	3.42 - 7.74		1.39 - 0.05
None + 12X Zoom + 1.0x	86	0.58 - 7.00	0.019 - 0.101	18.52 - 3.34	5.09 - 11.55		1.39 - 0.05
None + 12X Zoom + 1.33x	86	0.77 - 9.31	0.019 - 0.101	18.52 - 3.34	7.13 - 5.54		1.39 - 0.05
None + 12X Zoom + 2.0x	86	1.16 - 14.00	0.019 - 0.101	18.52 - 3.34	10.17 - 23.10		1.39 - 0.05
None + 12X Zoom + 3.5x	86	2.03 - 24.50	0.019 - 0.101	18.52 - 3.34	18.79 - 40.91		1.39 - 0.05
1.5x + 12X Zoom + 0.5x	50	0.43 - 5.23	0.028 - 0.151	12.34 - 2.24	2.65 - 5.85		0.64 - 0.02
1.5x + 12X Zoom + 0.67x	50	0.58 - 7.04	0.028 - 0.151	12.34 - 2.24	3.45 - 7.78		0.64 - 0.02
1.5x + 12X Zoom + 1.0x	50	0.87 - 10.50	0.028 - 0.151	12.34 - 2.24	5.18 - 11.60		0.64 - 0.02
1.5x + 12X Zoom + 1.33x	50	1.16 - 14.00	0.028 - 0.151	12.34 - 2.24	7.15 - 15.68		0.64 - 0.02
1.5x + 12X Zoom + 2.0x	50	1.74 - 21.00	0.028 - 0.151	12.34 - 2.24	10.74 - 23.34		0.64 - 0.02
1.5x + 12X Zoom + 3.5x	50	3.05 - 36.80	0.028 - 0.151	12.34 - 2.24	18.81 - 41.21		0.64 - 0.02
2.0x + 12X Zoom + 0.5x	37	0.58 - 6.98	0.038 - 0.202	9.00 - 1.66	2.61 - 5.79		0.35 - 0.01
2.0x + 12X Zoom + 0.67x	37	0.78 - 9.38	0.038 - 0.202	9.00 - 1.66	3.42 - 7.79		0.35 - 0.01
2.0x + 12X Zoom + 1.0x	37	1.16 - 14.00	0.038 - 0.202	9.00 - 1.66	5.09 - 11.62		0.35 - 0.01
2.0x + 12X Zoom + 1.33x	37	1.54 - 18.60	0.038 - 0.202	9.00 - 1.66	6.93 - 15.43		0.35 - 0.01
2.0x + 12X Zoom + 2.0x	37	2.32 - 28.00	0.038 - 0.202	9.00 - 1.66	10.17 - 23.24		0.35 - 0.01
2.0x + 12X Zoom + 3.5x	37	4.06 - 49.00	0.038 - 0.202	9.00 - 1.66	18.27 - 40.67		0.35 - 0.01

Assumptions:
 1. Minimum resolvable feature size is half of the threshold line pair limit. Calculation = 1/(3000 x Lens NA)
 2. Matching pixel size is that which will permit the minimum feature size to overlap two pixels. Calculation = 1/2(Feature Size x System Magnification)
 3. If the matching pixel size is greater than the camera pixel size, the system is "lens limited"; if less than the camera pixel size, the system is "camera limited."

12X UltraZoom

Unmatched Optical Quality for High Magnification Applications

Navitar's 12X UltraZoom incorporates infinity corrected objectives in an advanced design that offers long working distances and outstanding edge flatness and clarity. The UltraZoom is also available with fine focus or with fine focus and coaxial illumination.



12X UltraZoom Field of View Matrix for 1-50502, 1-50503 and 1-50504 (mm)

Objective Lens (Mitutoyo) Long W.D.	W.D. (mm)	Camera Formats/ Parameters	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.3X Adapter Low - High
4X 0.14 NA* 1-55075	20	Mag.	(1) 2.90X - 13.35X	(2) 2.61X - 17.75X	2.19X - 26.69X	3.61X - 44.04X
		1/4" Sensor	1.38 - 0.30	1.53 - 0.23	1.83 - 0.15	1.11 - 0.09
		1/3" Sensor	2.07 - 0.45	2.30 - 0.34	2.74 - 0.22	1.66 - 0.14
		1/2" Sensor	2.76 - 0.60	3.06 - 0.45	3.65 - 0.30	2.21 - 0.18
		2/3" Sensor	3.79 - 0.82	4.21 - 0.62	5.02 - 0.41	3.04 - 0.25
5X 0.14 NA* 1-60226	34	Mag.	(1) 3.57X - 16.66X	(2) 3.26X - 22.16X	2.77X - 33.31X	4.52X - 55.05X
		1/4" Sensor	1.12 - 0.24	1.22 - 0.18	1.44 - 0.12	0.89 - 0.07
		1/3" Sensor	1.68 - 0.36	1.84 - 0.27	2.17 - 0.18	1.33 - 0.11
		1/2" Sensor	2.24 - 0.48	2.45 - 0.36	2.89 - 0.24	1.77 - 0.15
		2/3" Sensor	—	2.45 - 0.49	3.97 - 0.33	2.44 - 0.20
10X 0.28 NA* 1-60227	33	Mag.	(1) 7.14X - 33.31X	(2) 6.50X - 44.30X	5.54X - 66.63X	9.03X - 110.10X
		1/4" Sensor	0.56 - 0.12	0.61 - 0.09	0.72 - 0.06	0.44 - 0.04
		1/3" Sensor	0.84 - 0.18	0.92 - 0.13	1.08 - 0.09	0.66 - 0.05
		1/2" Sensor	1.12 - 0.24	1.23 - 0.18	1.44 - 0.12	0.89 - 0.07
		2/3" Sensor	—	1.23 - 0.25	1.99 - 0.17	1.22 - 0.10
20X 0.42 NA* 1-60228	20	Mag.	(1) 14.28X - 64.63X	(2) 13.10X - 85.96X	11.08X - 133.25X	18.07X - 220.21X
		1/4" Sensor	0.28 - 0.06	0.30 - 0.04	0.36 - 0.03	0.22 - 0.02
		1/3" Sensor	0.42 - 0.09	0.46 - 0.07	0.54 - 0.04	0.33 - 0.03
		1/2" Sensor	0.56 - 0.12	0.61 - 0.09	0.72 - 0.06	0.44 - 0.04
		2/3" Sensor	—	0.61 - 0.13	0.99 - 0.08	0.61 - 0.05
50X 0.55 NA* 1-60229	13	Mag.	(1) 35.69X - 166.57X	(2) 40.00X - 221.54X	27.50X - 333.13X	45.17X - 550.52X
		1/4" Sensor	0.11 - 0.02	0.10 - 0.02	0.14 - 0.01	0.09 - 0.007
		1/3" Sensor	0.17 - 0.04	0.15 - 0.05	0.22 - 0.02	0.13 - 0.010
		1/2" Sensor	0.22 - 0.05	0.20 - 0.04	(2) 0.17 - 0.03	0.18 - 0.010
		2/3" Sensor	—	0.20 - 0.05	0.40 - 0.03	0.24 - 0.020

NOTE: This system is not recommended for use with a 2/3" Sensor.
 (1) Zoom setting at 1.5X.
 (2) Zoom setting at 1.0X.
 *NA at high mag. NA varies with zoom setting.

12X Zoom with Co-axial Illumination

Navitar's 12X Zoom with Internal Co-axial Illumination (1-50487) is ideal for applications involving highly reflective surfaces, such as wafers, polished samples, and fluids. Designed to provide even illumination for higher magnification applications, it provides extremely detailed resolution under incident lighting, particularly when a high resolution camera is used. Various illumination sources can be used.

Field of View Matrix for 12X Zoom with Co-axial Illumination - 1-50487 (mm)

Lens Attachment	W. D. (mm)	Camera Formats/ Parameters	.67X Adapter Low - High	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.3X Adapter Low - High
None 0.019 - 0.101 NA (2)	86	Mag.	0.39X - 4.70X	0.58X - 7.00X	0.77X - 9.31X	1.16X - 14.00X	1.39X - 0.05X
		1/4" Sensor	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17
		1/3" Sensor	15.44 - 1.28	10.34 - 0.86	7.80 - 0.64	5.18 - 0.43	3.13 - 0.26
		1/2" Sensor	20.58 - 1.70	13.79 - 1.14	10.39 - 0.86	6.90 - 0.57	4.18 - 0.35
		2/3" Sensor	(1) 18.20 - 2.34	18.97 - 1.57	14.28 - 1.18	9.49 - 0.78	5.75 - 0.48
1.5X 0.028 - 0.151 NA (2) 1-50014	50	Mag.	0.58X - 7.00X	0.87 - 10.50X	1.16X - 14.00X	1.74X - 21.00X	2.87X - 34.65X
		1/4" Sensor	6.86 - 0.57	4.60 - 0.38	3.45 - 0.29	2.30 - 0.19	1.39 - 0.12
		1/3" Sensor	10.29 - 0.85	6.89 - 0.57	5.17 - 0.43	3.45 - 0.29	2.09 - 0.17
		1/2" Sensor	13.72 - 1.13	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.78 - 0.23
		2/3" Sensor	(1) 12.20 - 1.55	12.64 - 1.05	9.48 - 0.79	6.33 - 0.52	3.83 - 0.32
2.0X 0.038 - 0.202 NA (2) 1-50015	37	Mag.	0.78X - 9.40X	1.16X - 14.00X	1.54X - 18.6X	2.32X - 28.00X	3.83X - 46.20X
		1/4" Sensor	5.14 - 0.43	3.45 - 0.29	2.59 - 0.22	1.73 - 0.15	1.05 - 0.09
		1/3" Sensor	7.72 - 0.64	5.18 - 0.43	3.89 - 0.32	2.59 - 0.22	1.57 - 0.13
		1/2" Sensor	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17
		2/3" Sensor	(1) 9.10 - 1.17	9.49 - 0.78	7.14 - 0.59	4.75 - 0.40	2.88 - 0.24

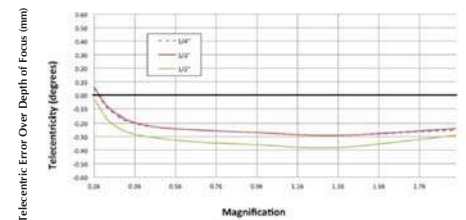
NOTE:
The internal coax will illuminate a circular area of about 14 mm in diameter. Any field of view larger than 14 mm will have darkened corners.
Low power lens attachments can be used but produce increasing vignetted.
(1) Zoom Setting at 1.0X.
(2) NA varies depending on zoom setting

12X Telecentric Zoom

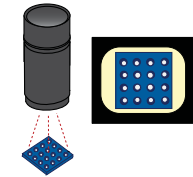
Navitar offers a 12X Telecentric zoom system that allows users to reach a true telecentric condition to within 0.4 degrees, while maintaining constant perspective and magnification. Ideal for a wide range of applications, including precise dimensional measurement of objects or pattern recognition.

There are four telecentric adapters available for use with the 12X Zoom lens: straight (no coax), straight with coax, right-angle adapter without coax and right-angle folded with coax. When combined with the 1-50993 12X zoom the telecentric attachments will have a nominal working distance of 173mm +/- 2mm. The working distance can be modified by the factory from 165 to 188mm. Magnifications range from 0.16X to 1.94X with the 1X adapter, and 0.32X to 3.88X with the 2X adapter. Maximum field of view is 50 mm. An upper 2X F-mount adapter may be used to couple an F-Mount camera.

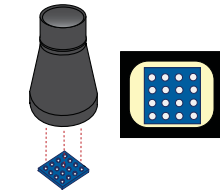
12X Telecentric Zoom – Telecentricity



Conventional Lens



12X Telecentric Lens



12X Telecentric Zoom Lens Specifications

Mag.	Telecentricity (degrees)			Object NA	Image NA	Object Depth of Focus (mm)	Telecentric Error (mm)			FOV Size (mm)			Approx. MTF (lp/mm)	Resolvable Features (µm)
	1/4"	1/3"	1/2"				1/4"	1/3"	1/2"	1/4"	1/3"	1/2"		
0.16X	0.05	0.06	-0.03	0.005	0.032	19.4	0.018	0.020	-0.009	25.0	37.3	49.7	15	66
0.23X	-0.10	-0.09	-0.18	0.007	0.031	9.7	-0.017	-0.016	-0.030	17.4	26.1	34.8	22	46
0.33X	-0.19	-0.18	-0.27	0.010	0.030	5.2	-0.016	-0.016	-0.024	12.1	18.2	24.3	30	34
0.47X	-0.23	-0.23	-0.31	0.013	0.028	3.0	-0.012	-0.012	-0.016	8.5	12.8	17.0	39	26
0.67X	-0.25	-0.25	-0.34	0.016	0.024	1.9	-0.008	-0.008	-0.011	5.9	8.9	11.9	49	21
0.96X	-0.27	-0.27	-0.36	0.020	0.021	1.3	-0.006	-0.006	-0.008	4.2	6.3	8.4	59	17
1.36X	-0.29	-0.29	-0.38	0.024	0.017	0.9	-0.004	-0.005	-0.006	2.9	4.4	5.9	71	14
1.94X	-0.25	-0.24	-0.29	0.028	0.015	0.6	-0.003	-0.003	-0.003	2.1	3.1	4.1	84	12

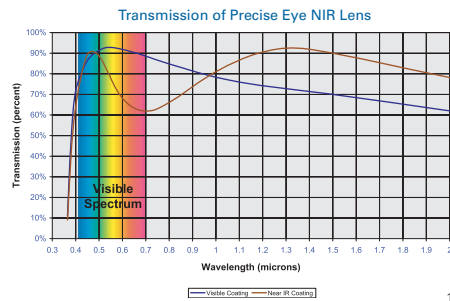
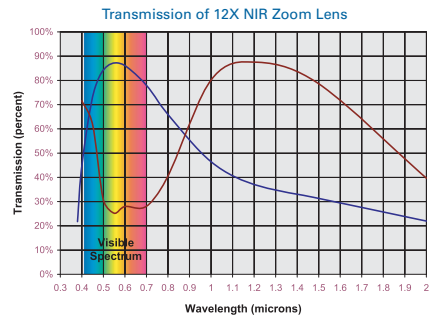
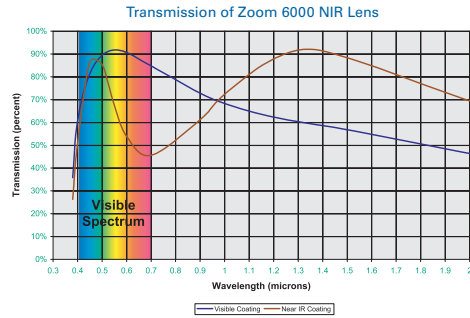
NIR Lens System for Zoom 6000, 12X Zoom and Precise Eye

Navitar's NIR Zoom lens system offers high resolution and unparalleled sensitivity for capturing microscopic images. We have specially coated the glass on our high magnification systems to be optimized for imaging in the 700-1550nm wavelength range.

Body tubes with detents and apertures or motorized systems are available.

Note: Since NIR lenses are not operating within the visible spectrum, the resulting image is slightly different than when using a standard zoom system. The standard lens resolution limits of an NIR lens are based on an assumed average wavelength of 0.5 microns and is inversely proportional to wavelength (maximum MTF = 3000xNA in the visible wavelength). Therefore, substituting a wavelength of 1.5 microns will reduce the maximum resolution by a factor of 3. In practice, this means a slight reduction of contrast at the higher wavelengths.

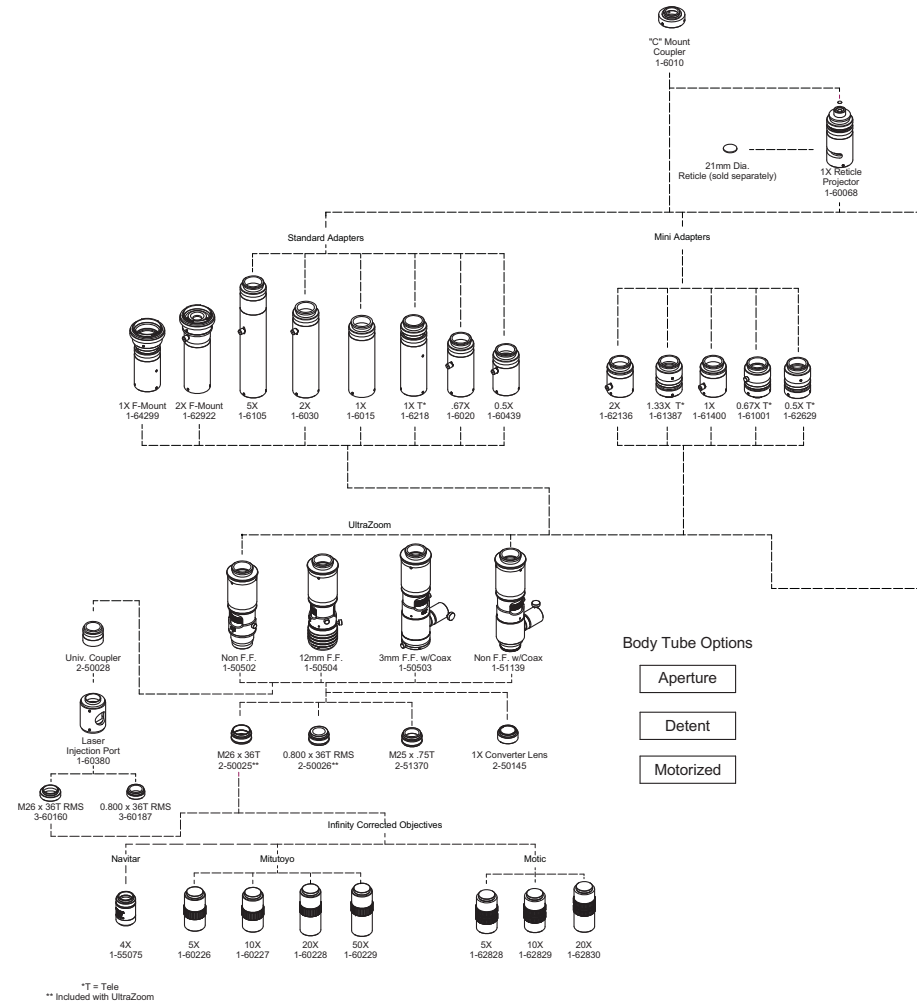
(When changing wavelengths in the NIR region minor refocus might be required.)



Applications Where Navitar NIR Optics are Useful

- Wafer characterization
- Laser beam profiling
- Optical component measurement and analysis
- Fiber alignment and inspection
- Assembly and monitoring
- Hyperspectral microscopy

12X Zoom System Diagram



Differential Interference Contrast (DIC) Modules

Available for Zoom 6000 and 12X Zoom Systems

Two Differential Interference Contrast (DIC) modules are available from Navitar:

- DIC Assembly Nikon-High Resolution module (1-63726)
- Original DIC Assembly module (1-63102)

Both modules can be used on any ultra coax version (zoom or non-zoom) of the Zoom 6000 and 12X Zoom.

DIC, when used with reflected light, can often be interpreted as a true three-dimensional representation of the surface geometry. It provides a clear distinction between raised and lowered regions in the specimen being viewed.

Using the DIC module in reflected light situations

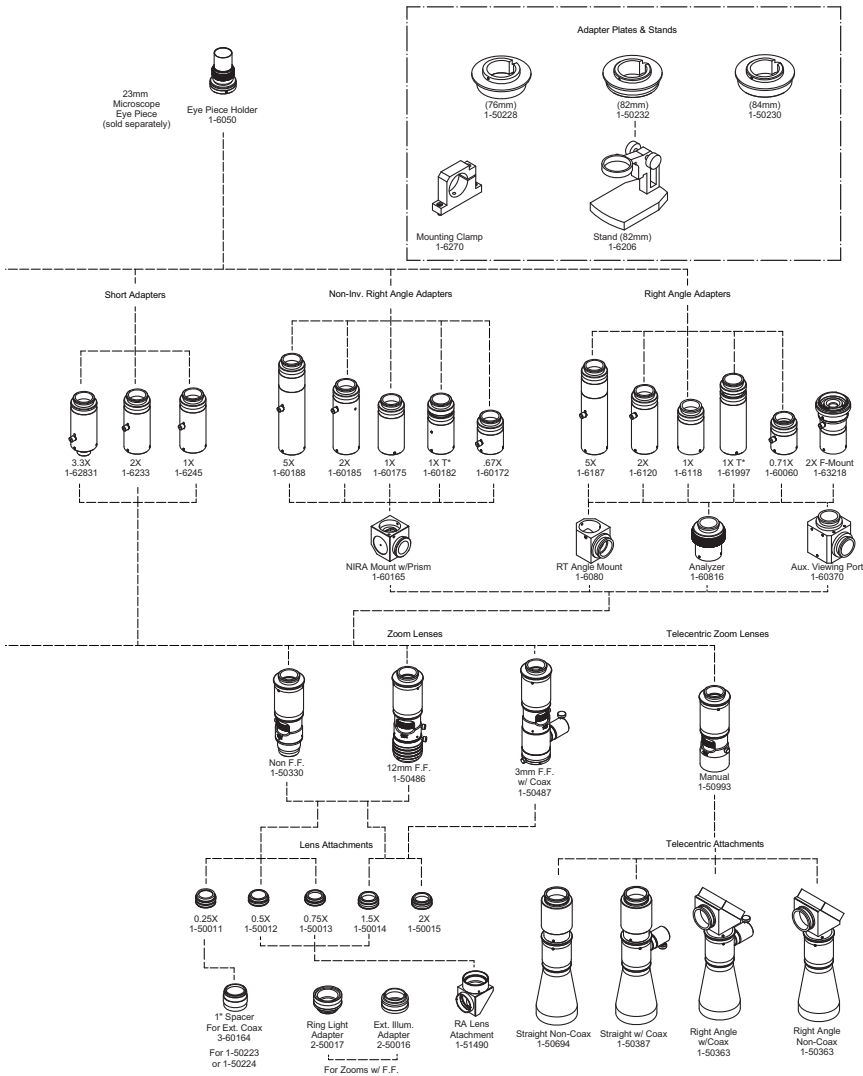
Two polarizers, one in the illumination axis and one in the viewing axis, are crossed at 90 degrees such that when looking at a perfectly mirrored surface all light is extinguished by the second polarizer.

A prism, made from two pieces of quartz, is then placed between the illuminator beamsplitter and the objective. Due to the optical properties of the quartz, the polarized beam is split into two. The two beams, separated by a minuscule amount, are polarized at 90 degrees to each other and one beam is shifted in relation to the other - a phase shift.

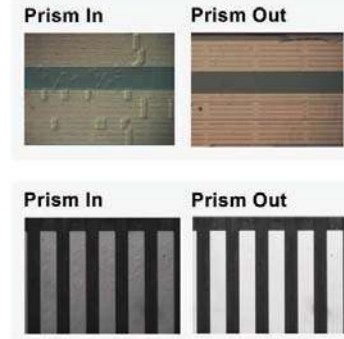
If the subject being viewed exhibits properties that change the length of the optical path of either beam (such as surface profiles, optical densities, etc.), both beams will experience further phase shifts.

With transverse movement of the prism the phase shifting performance of the prism may be accentuated and the final image is modified. By adding a polarization modifier, such as a 1/4 wave plate, after the illumination polarizer, the final effects are modified further.

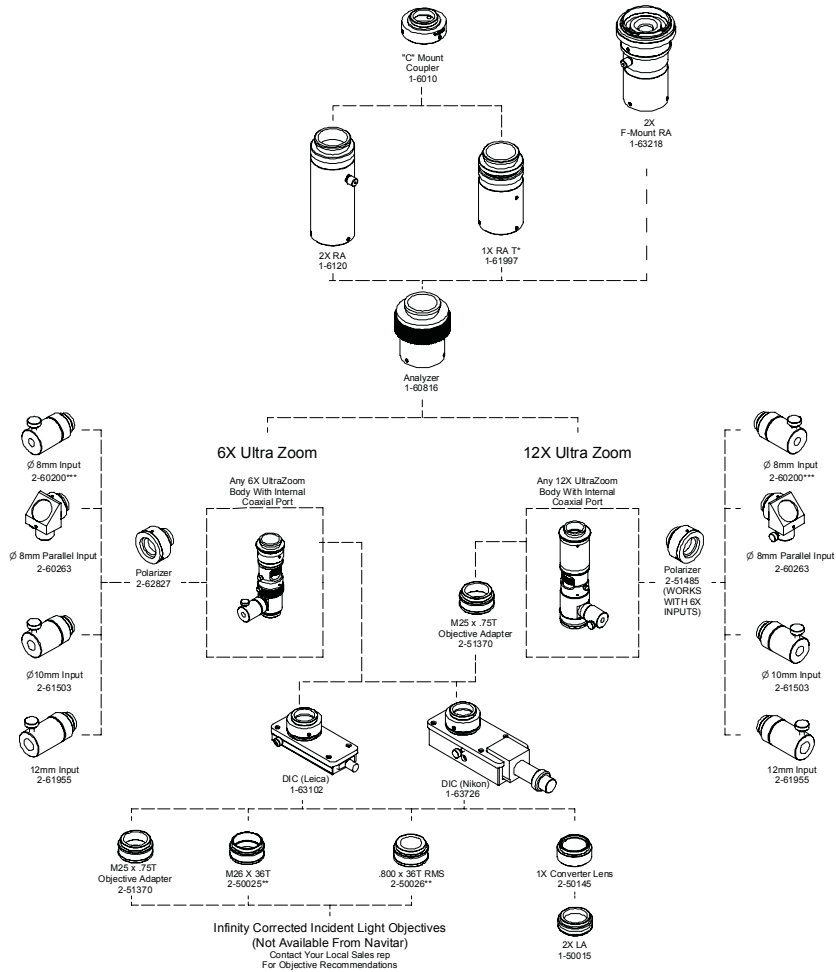
The DIC module works with object side NAs ranging from 0.05 to 0.50, with optimum performance in the range from 0.15 to 0.4. Lens attachments, operating in the above range will serve for macro applications. Any infinity corrected objectives designed for incident light will suffice for micro applications. Operating parameters, such as magnification and FOV, will be the same as Navitar's existing tables for the zoom system being used.



3D topography of a flat panel display circuit highlighted by employing differential interference contrast (DIC) and the Zoom 6000.



DIC Module System Diagram



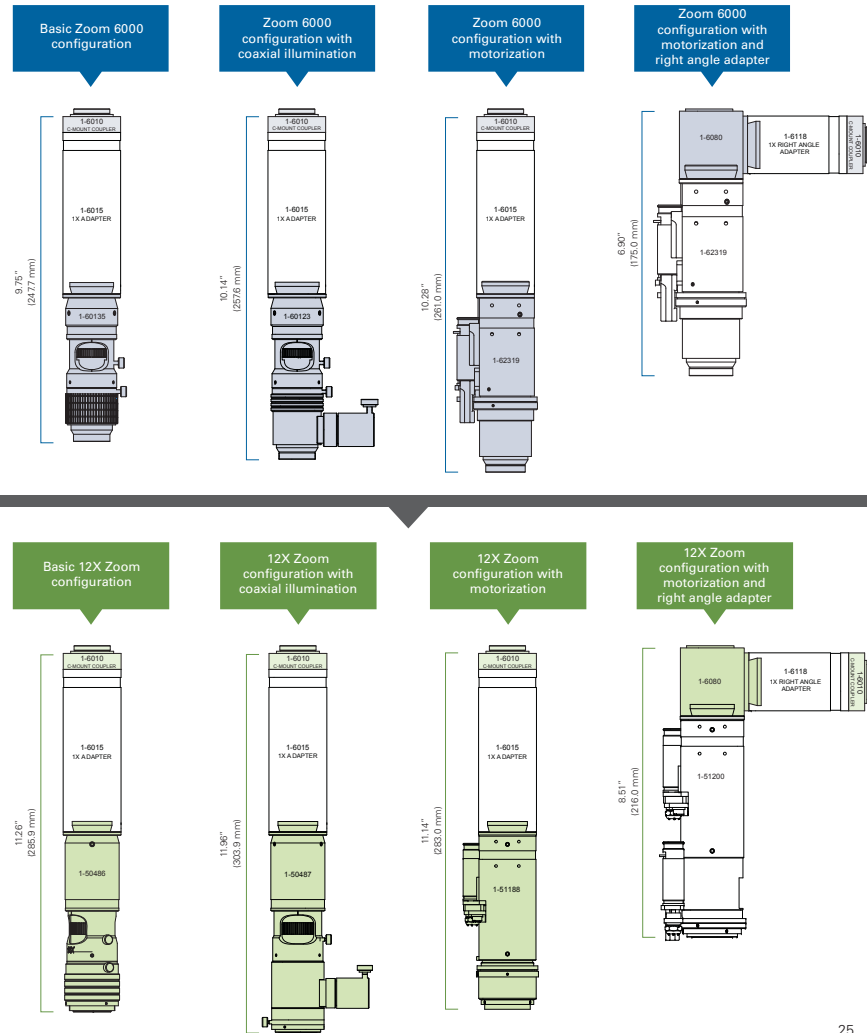
*T = Tele
 ** Included With 12X UltraZooms
 *** Included With Manual 6000 UltraZooms

Zoom 6000™ and 12X Zoom Accessories

<p>Right Angle Accessories</p> <p>The RA mount (1-6080) introduces a 90° bend in the optical axis, shortening the overall length of the system. The resulting image will be mirrored, thus erect and read backwards from right to left when viewed with a camera.</p>	<p>Laser Injection Port</p> <p>Navitar's Laser Injection Port (1-60380) provides a means of introducing a laser beam into the Zoom 6000 system. It is normally used between the end of the zoom lens and an infinity corrected objective so that the objective condenses the laser beam into a highly concentrated spot. A beamsplitter cube, rather than a plate, is used to minimize aberrations.</p>
<p>Non-Inverting Right Angle Accessories</p> <p>The Non-Inverting RA mount (1-60165) introduces a 90° bend in the optical axis. The use of a penta prism results in an image that is erect and reads left to right.</p>	<p>Auxiliary Viewing Port</p> <p>The Auxiliary Viewing Port (1-60370) provides a second output port for an additional camera or for direct vision using an eyepiece. A 50/50 beam splitter cube is used for minimal image degradation.</p>
<p>Object Side Inverting & Non-Inverting Right Angle Attachments</p> <p>Navitar offers a series of attachments that are fitted to the object side of our Zoom 6000 and 12X systems. See system diagrams.</p>	<p>Infinity Corrected Objectives</p> <p>Infinity Corrected Objectives can be attached to any UltraZoom to increase the system magnification and decrease working distance.</p>
<p>Adapter Plates</p> <p>Navitar offers a variety of different microscope converter plates so you can use your zoom system with Nikon, Olympus, Meiji, and Leica focus mounts.</p>	<p>Quarter Wave Plate</p> <p>A Quarter Wave Plate (1-60981) has the unique feature of taking the polarized light and circularly polarizing the beam (sort of a spiraling effect). When this beam reflects off a specular object, the spiraling reverses, and upon re-striking the quarter wave plate, the beam is extinguished. This technique is useful in eliminating reflections from wafers and circuit boards. For use with Zoom 6000 Coaxial lens.</p>
<p>Polarizer/Analyzer</p> <p>When used in conjunction with a polarized light source, an analyzer (1-60816) allows for cross polarization of the light in the imaging system. This reduces reflections that can deteriorate the image quality. The analyzer must be used in conjunction with the right angle adapters.</p>	<p>Zoom Xtender</p> <p>The Xtender is designed to offer working distances beyond that achievable with standard attachments.</p>
<p>Aperture Control</p> <p>Lens systems can be designed with an internal iris that can be manipulated without cutting into the field of view. The iris permits the reduction of image intensity at the image plane, which reduces "blooming" and other damaging artifacts. The iris can also be closed down to essentially "stop down" the lens to reduce the Numerical Aperture of the lens. This narrowing of the light gathering cone produces a significant increase in the depth of field.</p>	<p>F-Mount Zoom Adapters</p> <p>F-mount adapters allow use of F-mount Cameras. Not recommended for use with the 12X Zoom System with sensors over 16 mm, or the Zoom 6000 sensors over 30mm.</p>



Zoom 6000™ and 12X Zoom Modular Design Combinations



Motorized System Options

More Robust Design

Navitar's motorization design, available on the 12X and Zoom 6000 systems, integrates magnetic Hall Effect sensors with reference position location. Hall Effect sensors are solid state devices with no moving parts.

Integrated Hall Effect Solid State Sensor Technology

- Unaffected by ambient light
- Unaffected by environmental contamination
- Unaffected by line voltage

Users can choose to motorize both the zoom and focus axis, or just the zoom. Navitar offers three different motor types:

- 2-Phase Stepping Motor (Faulhaber)
- 5-Phase Stepping Motor (Oriental, Vexta)
- DC Servo with Encoder (Faulhaber)

Most motorized lenses are built to order, which may affect standard lead times.



Motorized Zoom 6000 Options

Version	Motor Type		
	2 σ Stepper	5 σ Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-62318	1-64426	1-62310
3 mm Motorized Fine Focus w/ Coax	1-62319	1-64428	1-62311
12 mm Manual Fine Focus	1-62523	1-64430	1-62522
3 mm Manual Fine Focus w/ Coax	1-62525	1-64432	1-62524
Non Fine Focus, Non Coax	1-62605	1-64434	1-62606
Non Fine Focus w/ Coax	1-62608	1-64436	1-62609

Motorized 12X Zoom Options

Version	Motor Type		
	2 σ Stepper	5 σ Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-51188	1-52000	1-51190
3 mm Motorized Fine Focus w/ Coax	1-51200	1-52002	1-51202
12 mm Manual Fine Focus	1-51319	1-52004	1-51337
3 mm Manual Fine Focus w/ Coax	1-51311	1-52006	1-51338
Non Fine Focus, Non Coax	1-51314	1-52008	1-51335
Non Fine Focus w/ Coax	1-51318	1-52010	1-51336

Motorized Zoom 6000 UltraZoom Options

Version	Motor Type		
	2 σ Stepper	5 σ Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-62316	1-64439	1-62308
3 mm Motorized Fine Focus w/ Coax	1-62317	1-64441	1-62309
12 mm Manual Fine Focus	1-62517	1-64443	1-62516
3 mm Manual Fine Focus w/ Coax	1-62639	1-64445	1-62633
Non Fine Focus, Non Coax	1-62637	1-64447	1-62631
Non Fine Focus w/ Coax	1-62638	1-64449	1-62632

Motorized 12X UltraZoom Options

Version	Motor Type		
	2 σ Stepper	5 σ Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-51192	1-52013	1-51194
3 mm Motorized Fine Focus w/ Coax	1-51196	1-52015	1-51198
12 mm Manual Fine Focus	1-51325	1-52017	1-51333
3 mm Manual Fine Focus w/ Coax	1-51326	1-52019	1-51334
Non Fine Focus, Non Coax	1-51320	1-52021	1-51331
Non Fine Focus w/ Coax	1-51324	1-52023	1-51332

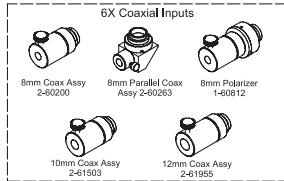
NOTE: Zooms using 5 phase stepping motors require user to order the correct cable harness between zoom and controller.

Mounting Options for Motorized Lenses

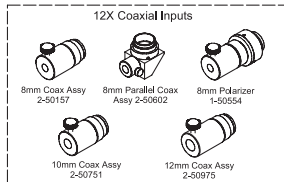
Navitar also offers flat mounting assemblies for easy integration of our motorized zoom lenses into any application. The flat mounts securely attach to the zoom body using 4 hex screws. Four additional 1/4-20 thru holes are integrated into the mounts to provide a robust attachment point to a machine surface.

6X	12X
1-62572 (Standard)	1-51272 (Standard)
1-64546 (Imperial)	1-52045 (Imperial)
1-64547 (Metric)	1-52046 (Metric)

Coaxial Inputs for Motorized Lenses



Coaxial Inputs for Zoom 6000	Description and Fiber Input Size
2-60200	8 mm diameter
2-61503	10 mm diameter
2-61955	12 mm diameter
2-60263	8 mm parallel coaxial
1-60812	8 mm polarizer



Coaxial Inputs for 12X Zoom	Description and Fiber Input Size
2-50157	8 mm diameter
2-50751	10 mm diameter
2-50975	12 mm diameter
2-50602	8 mm parallel coaxial
1-50554	8 mm polarizer

*Coax parts must be ordered separately for all motorized lenses.

Motorized Controllers

All Navitar 12X and Zoom 6000 motorized systems can be ordered with a fully integrated control system, featuring single or dual axis control via serial RS-232 or USB.

Software includes Demo Application User Interface "GUI" for simple axis control. Connections are made via two 15-pin high density d-sub connectors. Arrangements can be made for supplying the underlying software code for OEM platform assimilation.

System Requirements

Operating Systems Supported for Serial RS-232 and USB:

- Windows 7, 8.1, 10 (32 & 64 bit)

Computer Requirements:

- Windows Operating System (OS)
- Port: 1 serial or 1 USB port (can be a hub)
- Hard Disk: 1 M bytes
- RAM: Same as OS (if OS works, controller will work)

Available Control Systems

Part #	Description
Board Level*	
2-62577	2 phase stepper PCB Kit
1-40167	5 phase stepper PCB Kit
2-62509	Servo with encoder PCB Kit
Enclosures*	
1-62420	2 phase enclosure
1-40168	5 phase flanged enclosure
1-40169	5 phase desktop enclosure
1-62508	Servo with encoder enclosure
Accessories & Power Supplies	
1-40170	5 phase cable harness
1-62504	Universal power supply, 90-264vAC, 47-63Hz
8-62503	Domestic power supply, 120 vAC, 60Hz
8-62501	USB cable (6 feet)
8-62502	RS-232 cable (6 feet)
1-40040	24V Universal Power Supply w/ Plug Kit

* Control systems do not include power supply.

Part Number	Output Connector	Input Voltage	Universal Plug Kit			
1-62504	2.1mm x 5.5mm	86-286vAC	24vDC	1.5A		Std. US Plug
8-62503	2.1mm x 5.5mm	120vAC	24vDC	1.05A		Std. US Plug
1-40040	2.1mm x 5.5mm	90-264vAC	24vDC	1.25A	Medical Rated	Yes

Precise Eye Fixed Lens System

Offering high magnification for fixed inspection applications, Navitar's Precise Eye series of lenses is designed to provide superior optical performance over standard C-mount video lenses.

- High resolution, f/4.5 optical quality for high precision measurement and inspection
- Long working distance makes lighting and handling easier
- Coaxial lighting available for shadow-free illumination
- Compatible with high-magnification infinity corrected objectives
- Mechanically stable for the most demanding vibration environments
- Modular design for flexibility
- Optics attach to any C-mount camera
- Short tube length (~4 inches/101.6mm) and small diameter (1.25 inches/31.8mm)
- Allows for coaxial illumination and/or 3 mm fine focus
- High transmission (>70%) over the visible to near IR spectrum



Precise Eye Field of View Matrix (in mm at nominal working distance)

Lens Attachment	W.D. (mm)	Camera Format & Parameters	0.5X Adapter 1-62088 H x V	0.67X Adapter 1-61453 H x V	1.0X Adapter 1-61445 H x V	1.33X Adapter 1-61448 H x V	2.0X Adapter 1-61450 H x V
0.25X 0.018 NA DOF 1.59 mm 1-6044	310 (nominal)	Mag.	0.23X	0.30X	0.45X	0.60X	0.90X
		1/4" Sensor	14.2 x 10.7	10.6 x 8.0	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7
		1/3" Sensor	21.3 x 16.0	15.9 x 11.9	10.7 x 8.0	8.0 x 6.0	5.3 x 4.0
0.5X 0.035 NA DOF 0.40 mm 1-60110	175 (nominal)	Mag.	0.45X	0.60X	0.90X	1.20X	1.80X
		1/4" Sensor	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3
		1/3" Sensor	10.7 x 8.0	8.0 x 6.0	5.3 x 4.0	4.0 x 3.0	2.7 x 2.0
0.75X 0.054 NA DOF 0.18 mm 1-60111	113 (nominal)	Mag.	0.68X	0.90X	1.35X	1.80X	2.70X
		1/4" Sensor	4.7 x 3.6	3.5 x 2.7	2.4 x 1.8	1.8 x 1.3	1.2 x 0.9
		1/3" Sensor	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3
1.5X 0.106 NA DOF 0.04 mm 1-60112	51 (nominal)	Mag.	1.35X	1.81X	2.70X	3.59X	5.40X
		1/4" Sensor	2.4 x 1.8	1.8 x 1.3	1.2 x 0.9	0.9 x 0.7	0.6 x 0.4
		1/3" Sensor	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7
2.0X 0.142 NA DOF 0.02 mm 1-60113	36 (nominal)	Mag.	1.80X	2.41X	3.60X	4.79X	7.20X
		1/4" Sensor	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7	0.7 x 0.5	0.4 x 0.3
		1/3" Sensor	2.7 x 2.0	2.0 x 1.5	1.3 x 1.0	1.0 x 0.8	0.7 x 0.5

NOTE: (1) Working distance range when using 3 mm fine focus. Field of view will change with shorter or longer working distances.

Precise Eye Performance Specifications

Precise Eye Combinations Lens Attachment + Precise Eye + Adapter	W.D. (mm)	Magnification	NA Object Side	Resolve Limits (µm)	Depth of Field (mm)	Required Matching Pixel Size (µm)
0.25x + Precise Eye + 0.5x	310	0.23x	0.018	18.8	1.59	2.1
0.25x + Precise Eye + 0.67x	310	0.30x	0.018	18.8	1.59	2.8
0.25x + Precise Eye + 1.0x	310	0.45x	0.018	18.8	1.59	4.2
0.25x + Precise Eye + 1.33x	310	0.60x	0.018	18.8	1.59	5.6
0.25x + Precise Eye + 2.0x	310	0.90x	0.018	18.8	1.59	8.4
0.5x + Precise Eye + 0.5x	175	0.45x	0.035	9.4	0.40	2.1
0.5x + Precise Eye + 0.67x	175	0.60x	0.035	9.4	0.40	2.8
0.5x + Precise Eye + 1.0x	175	0.90x	0.035	9.4	0.40	4.2
0.5x + Precise Eye + 1.33x	175	1.20x	0.035	9.4	0.40	5.6
0.5x + Precise Eye + 2.0x	175	1.80x	0.035	9.4	0.40	8.4
0.75x + Precise Eye + 0.5x	113	0.68x	0.054	6.2	0.18	2.1
0.75x + Precise Eye + 0.67x	113	0.90x	0.054	6.2	0.18	2.8
0.75x + Precise Eye + 1.0x	113	1.35x	0.054	6.2	0.18	4.2
0.75x + Precise Eye + 1.33x	113	1.80x	0.054	6.2	0.18	5.6
0.75x + Precise Eye + 2.0x	113	2.70x	0.054	6.2	0.18	8.4
None + Precise Eye + 0.5x	92	0.90x	0.071	4.6	0.10	2.1
None + Precise Eye + 0.67x	92	1.21x	0.071	4.6	0.10	2.8
None + Precise Eye + 1.0x	92	1.80x	0.071	4.6	0.10	4.2
None + Precise Eye + 1.33x	92	2.39x	0.071	4.6	0.10	5.6
None + Precise Eye + 2.0x	92	3.60x	0.071	4.6	0.10	8.4
1.5x + Precise Eye + 0.5x	51	1.35x	0.106	3.2	0.04	2.1
1.5x + Precise Eye + 0.67x	51	1.81x	0.106	3.2	0.04	3.0
1.5x + Precise Eye + 1.0x	51	2.70x	0.106	3.2	0.04	4.4
1.5x + Precise Eye + 1.33x	51	3.59x	0.106	3.2	0.04	5.8
1.5x + Precise Eye + 2.0x	51	5.40x	0.106	3.2	0.04	8.6
2.0x + Precise Eye + 0.5x	36	1.80x	0.142	2.4	0.02	2.1
2.0x + Precise Eye + 0.67x	36	2.41x	0.142	2.4	0.02	2.8
2.0x + Precise Eye + 1.0x	36	3.60x	0.142	2.4	0.02	4.2
2.0x + Precise Eye + 1.33x	36	4.79x	0.142	2.4	0.02	5.6
2.0x + Precise Eye + 2.0x	36	7.20x	0.142	2.4	0.02	8.4

Assumptions:

1. Minimum resolvable feature size is half of the threshold line pair limit. Calculation = $1/(3000 \times \text{Lens NA})$
2. Matching pixel size is that which will permit the minimum feature size to overlap two pixels. Calculation = $1/2(\text{Feature Size} \times \text{System Magnification})$
3. If the matching pixel size is greater than the camera pixel size, the system is "lens limited"; if it's less than the camera pixel size, the system is "camera limited."

Ultra Precise Eye

Navitar offers a variety of Ultra Precise Eye systems ideal for high magnification applications. The advanced design produces outstanding contrast and precision, while providing higher resolution and magnification than the standard Precise Eye. These systems incorporate infinity corrected objectives to provide long working distances and excellent edge flatness and clarity. The Ultra Precise Eye is also available with fine focus (1-61521) or with fine focus and coaxial illumination (1-61522).



Ultra Precise Eye Magnification Matrix (in mm)

Infinity Corrected Objective (Mitutoyo)	W.D. (mm)	Camera Format & Parameters	0.5X Adapter 1-62088 H x V	0.67X Adapter 1-61453 H x V	1.0X Adapter 1-61445 H x V	1.33X Adapter 1-61448 H x V	2.0X Adapter 1-61450 H x V
4X 0.14 NA 1-60226	20	Mag.	1.78X	2.39X	3.56X	4.73X	7.12X
		1/4" Sensor	1.80 x 1.35	1.34 x 1.01	0.90 x 0.67	0.68 x 0.51	0.45 x 0.34
		1/3" Sensor	2.70 x 2.02	2.01 x 1.51	1.35 x 1.01	1.01 x 0.76	0.67 x 0.51
		1/2" Sensor	3.60 x 2.70	2.68 x 2.01	1.80 x 1.35	1.35 x 1.01	0.90 x 0.67
		2/3" Sensor	4.94 x 3.71	3.69 x 2.77	2.47 x 1.85	1.86 x 1.39	1.24 x 0.93
5X 0.14 NA 1-60226	34	Mag.	2.23X	2.98X	4.45X	5.92X	8.90X
		1/4" Sensor	1.44 x 1.08	1.07 x 0.80	0.72 x 0.54	0.54 x 0.41	0.36 x 0.27
		1/3" Sensor	2.16 x 1.62	1.61 x 1.21	1.08 x 0.81	0.81 x 0.61	0.54 x 0.40
		1/2" Sensor	2.88 x 2.16	2.15 x 1.61	1.44 x 1.08	1.08 x 0.81	0.72 x 0.54
		2/3" Sensor	3.96 x 2.97	2.95 x 2.21	1.98 x 1.48	1.49 x 1.12	0.99 x 0.74
10X 0.28 NA 1-60227	33	Mag.	4.45X	5.96X	8.90X	11.80X	17.80X
		1/4" Sensor	0.72 x 0.54	0.54 x 0.40	0.36 x 0.27	0.27 x 0.20	0.18 x 0.13
		1/3" Sensor	1.08 x 0.81	0.80 x 0.60	0.54 x 0.40	0.41 x 0.30	0.27 x 0.20
		1/2" Sensor	1.44 x 1.08	1.07 x 0.80	0.72 x 0.54	0.54 x 0.41	0.36 x 0.27
		2/3" Sensor	1.98 x 1.48	1.48 x 1.11	0.99 x 0.74	0.74 x 0.56	0.49 x 0.37
20X 0.42 NA 1-60228	20	Mag.	8.90X	11.90X	17.80X	23.70X	35.60X
		1/4" Sensor	0.36 x 0.27	0.27 x 0.20	0.18 x 0.13	0.14 x 0.10	0.09 x 0.07
		1/3" Sensor	0.54 x 0.40	0.40 x 0.30	0.27 x 0.20	0.20 x 0.15	0.13 x 0.10
		1/2" Sensor	0.72 x 0.54	0.54 x 0.40	0.36 x 0.27	0.27 x 0.20	0.18 x 0.13
		2/3" Sensor	0.99 x 0.74	0.74 x 0.55	0.49 x 0.37	0.37 x 0.28	0.25 x 0.19
50X 0.55 NA 1-60229	13	Mag.	22.30X	29.80X	44.50X	59.20X	89.00X
		1/4" Sensor	0.14 x 0.11	0.11 x 0.08	0.07 x 0.05	0.05 x 0.04	0.04 x 0.03
		1/3" Sensor	0.22 x 0.16	0.16 x 0.12	0.11 x 0.08	0.08 x 0.06	0.05 x 0.04
		1/2" Sensor	0.29 x 0.22	0.21 x 0.16	0.14 x 0.11	0.11 x 0.08	0.07 x 0.05
		2/3" Sensor	0.40 x 0.30	0.30 x 0.22	0.20 x 0.15	0.15 x 0.11	0.10 x 0.07

NOTE: The O-I remains constant for each body tube (main assembly) regardless of which infinity corrected objective and adapter are selected: 1-61517 I-O = 219 mm, 1-61521 I-O = 243 mm, 1-61522 I-O = 263 mm

Precise Eye with Co-axial Illumination

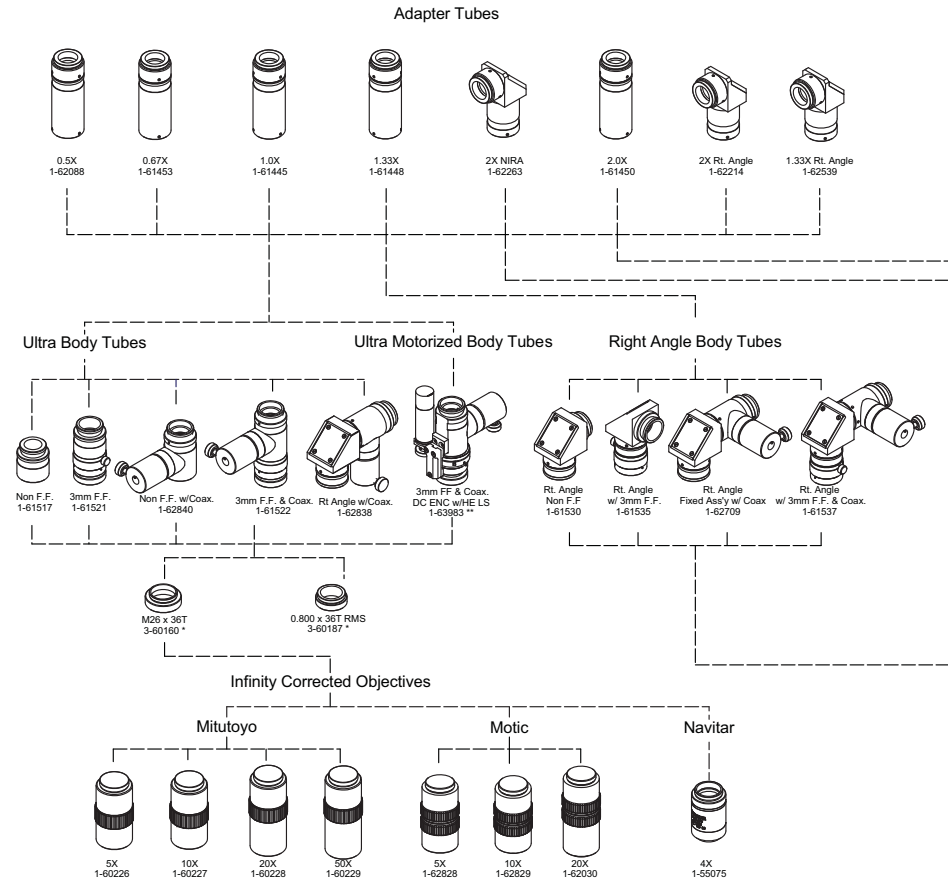
Navitar's Precise Eye with Internal Co-axial Illumination (1-61446) is an ideal solution for applications involving highly reflective surfaces, such as wafers, polished samples, and fluids. Designed to provide even illumination for higher magnification applications, coaxial illumination provides extremely detailed resolution, particularly when a high resolution camera is used.

Precise Eye Field of View Matrix for Co-axial Illumination (in mm at nominal working distance)

Lens Attachment	W.D. (mm)	Camera Format & Parameters	0.5X Adapter 1-62088 H x V	0.67X Adapter 1-61453 H x V	1.0X Adapter 1-61445 H x V	1.33X Adapter 1-61446 H x V	2.0X Adapter 1-61450 H x V
0.5X 0.035 NA DOF 0.40 mm 1-60110	175 (nominal) 170-190 (1) W.D. Range	Mag.	0.45X	0.60X	0.90X	1.20X	1.80X
		1/4" Sensor	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3
		1/3" Sensor	10.7 x 8.0	8.0 x 6.0	5.3 x 4.0	4.0 x 3.0	2.7 x 2.0
		1/2" Sensor	14.2 x 10.7	10.6 x 8.0	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7
0.75X 0.054 NA DOF 0.17 mm 1-60111	113 (nominal) 110-120 (1) W.D. Range	Mag.	0.68X	0.90X	1.35X	1.80X	2.70X
		1/4" Sensor	4.7 x 3.6	3.5 x 2.7	2.4 x 1.8	1.8 x 1.3	1.2 x 0.9
		1/3" Sensor	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3
		1/2" Sensor	9.5 x 7.1	7.1 x 5.3	4.7 x 3.6	3.6 x 2.7	2.4 x 1.8
None 0.070 NA DOF 0.10 mm 1-60112	92 (nominal) 90-93 (1) W.D. Range	Mag.	0.90X	1.21X	1.80X	2.39X	3.60X
		1/4" Sensor	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7
		1/3" Sensor	5.3 x 4.0	4.0 x 3.0	2.7 x 2.0	2.0 x 1.5	1.3 x 1.0
		1/2" Sensor	7.1 x 5.3	5.3 x 4.0	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3
1.5X 0.106 NA DOF 0.046 mm 1-60112	51 (nominal) 49-51 (1) W.D. Range	Mag.	1.35X	1.81X	2.70X	3.59X	5.40X
		1/4" Sensor	2.4 x 1.8	1.8 x 1.3	1.2 x 0.9	0.9 x 0.7	0.6 x 0.4
		1/3" Sensor	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7
		1/2" Sensor	4.7 x 3.6	3.5 x 2.7	2.4 x 1.8	1.8 x 1.3	1.2 x 0.9
2.0X 0.142 NA DOF 0.025 mm 1-60113	36 (nominal) 35-36 (1) W.D. Range	Mag.	1.80X	2.41X	3.60X	4.79X	7.20X
		1/4" Sensor	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7	0.7 x 0.5	0.4 x 0.3
		1/3" Sensor	2.7 x 2.0	2.0 x 1.5	1.3 x 1.0	1.0 x 0.8	0.7 x 0.5
		1/2" Sensor	3.6 x 2.7	2.7 x 2.0	1.8 x 1.3	1.3 x 1.0	0.9 x 0.7
		2/3" Sensor	4.9 x 3.7	3.6 x 2.7	2.4 x 1.8	1.8 x 1.4	1.2 x 0.9

NOTE:
The internal coax will illuminate a circular area of about 11 mm in diameter. Any field of view larger than 11 mm will have darkened corners.
(1) Working distance range when using 3 mm fine focus. Field of view will change with shorter or longer working distance.

Precise Eye System Diagram

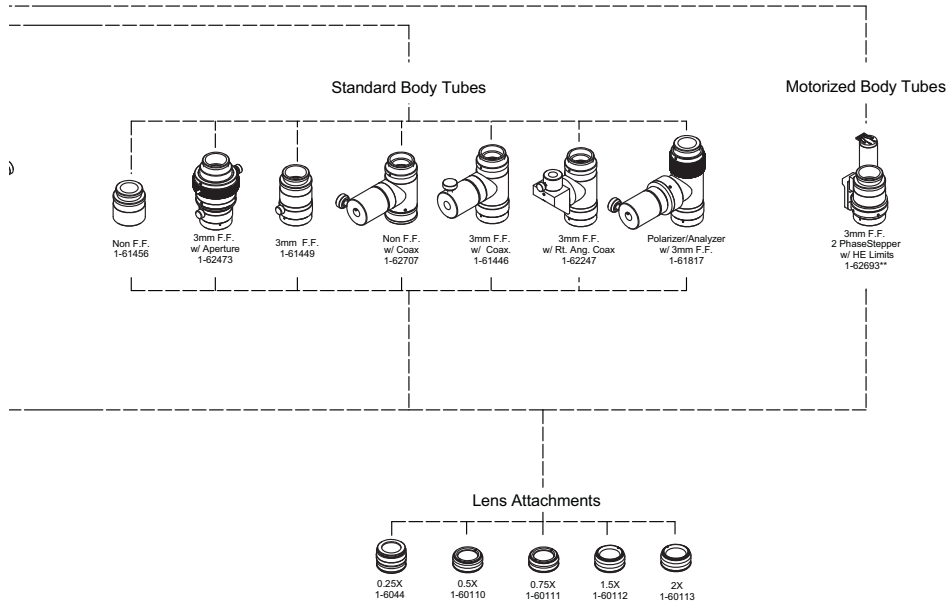
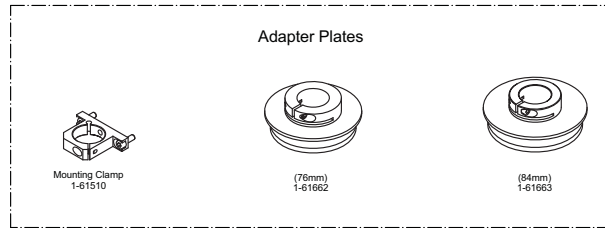


* Included with ULTRA PRECISE EYE
** Items are Special Order (Contact Navitar for Additional Information).

MicroMate 3:1 Zoom Lens System

The MicroMate was designed specifically to work with today's high resolution 4/3" sensor cameras. It images onto a 22.5mm diagonal with no vignetting when combined with infinity corrected objectives. The modular design allows for seamless integration of traditional microscope options, such as fluorescence, DIC, brightfield and darkfield imaging.

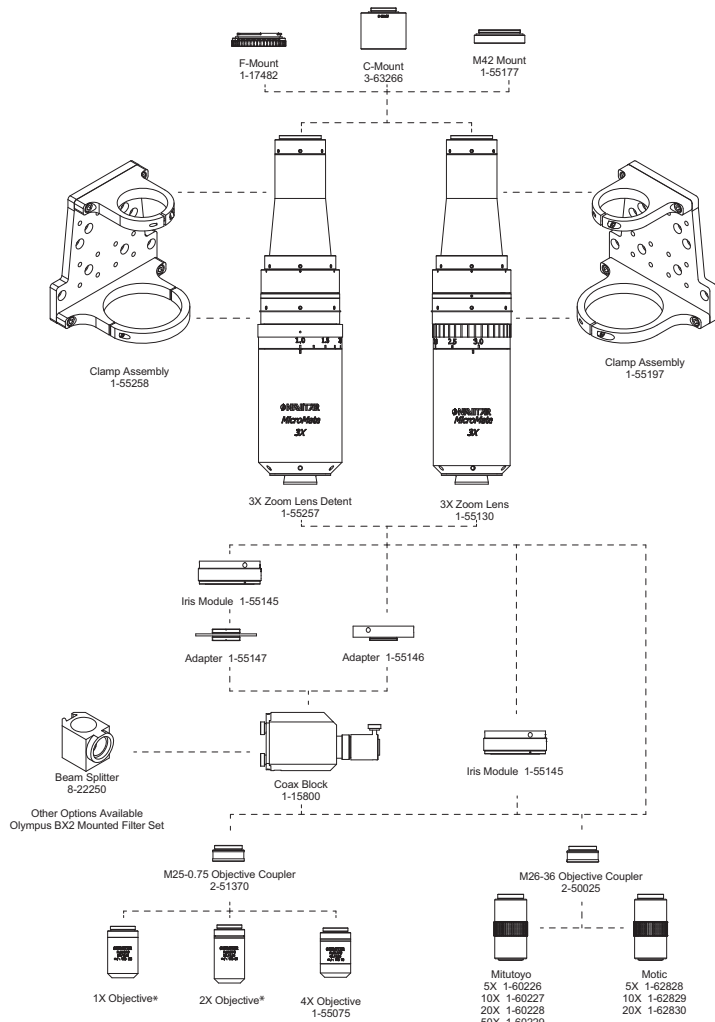
- Designed for 4/3" sensor (22.5mm diameter image)
- Large field of view
- Four times as much data while retaining pixel resolution
- NA remains fixed over the entire zoom range
- Fixed pupil position
- Modular design



System Performance Specifications - Infinity Corrected Objective + Zoom

	1x + Zoom	2x + Zoom	4x + Zoom	5x + Zoom	10x + Zoom	20x + Zoom	50x + Zoom
Objective Magnification	1.00	2.00	4.00	5.00	10.00	20.00	50.00
Objective Focal Length (mm)	200.00	100.20	50.00	40.00	20.00	10.00	4.00
Working Distance (mm)	129.00	53.60	20.00	34.00	33.00	20.00	13.00
Afocal Magnification	1x - 3x	1x - 3x	1x - 3x	1x - 3x	1x - 3x	1x - 3x	1x - 3x
System Magnification (200mm Tube Lens)	1x - 3x	2x - 6x	4x - 12x	5x - 15x	10x - 30x	20x - 60x	50x - 150x
Object Field Low Mag (mm)	22.50	11.25	5.63	4.40	2.20	1.10	0.44
Object Field High Mag (mm)	7.30	3.70	1.80	1.50	0.73	0.37	0.15
Object NA Low Mag	0.05	0.10	0.20	0.14	0.28	0.42	0.55
Object NA High Mag	0.05	0.10	0.20	0.14	0.28	0.42	0.55
Resolution Low Mag (µm)	6.40	3.30	1.68	2.40	1.20	0.80	0.60
Resolution High Mag (µm)	6.40	3.30	1.68	2.40	1.20	0.80	0.60
Pixel Match Low Mag (µm)	3.20	3.30	3.30	5.90	5.90	7.90	15.00
Pixel Match High Mag (µm)	9.60	10.00	10.10	18.00	18.00	24.00	45.00
DOF Low Mag (µm)	185.00	50.00	13.60	26.00	6.40	2.80	1.70
DOF High Mag (µm)	185.00	50.00	13.60	26.00	6.40	2.80	1.70

MicroMate System Diagram



*Contact your Navitar sales representative for exact design specifications and product availability.

HIGH MAGNIFICATION IMAGING

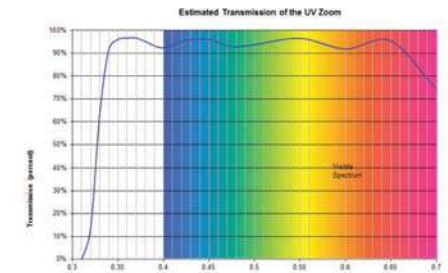
NUV-VIS Zoom Lens System

The NUV-VIS Zoom is a motorized imaging lens system that operates within a spectral range of 330nm to 700nm and offers a 6.2:1 zoom ratio. It is an ideal digital imaging solution for high magnification microscopy and OEM applications such as protein crystallography, forensic evidence analysis and surface defect inspection.

- Designed for a 2/3" sensor
- Focal length range of 80-497mm
- Motorized for easy magnification adjustments
- Combine with infinity corrected imaging microscope objectives, Plan Apo NUV long working distance microscope objectives, and high power UV focusing objectives
- Operates within 330nm to 700nm spectral range
- Can be modified for manual actuation

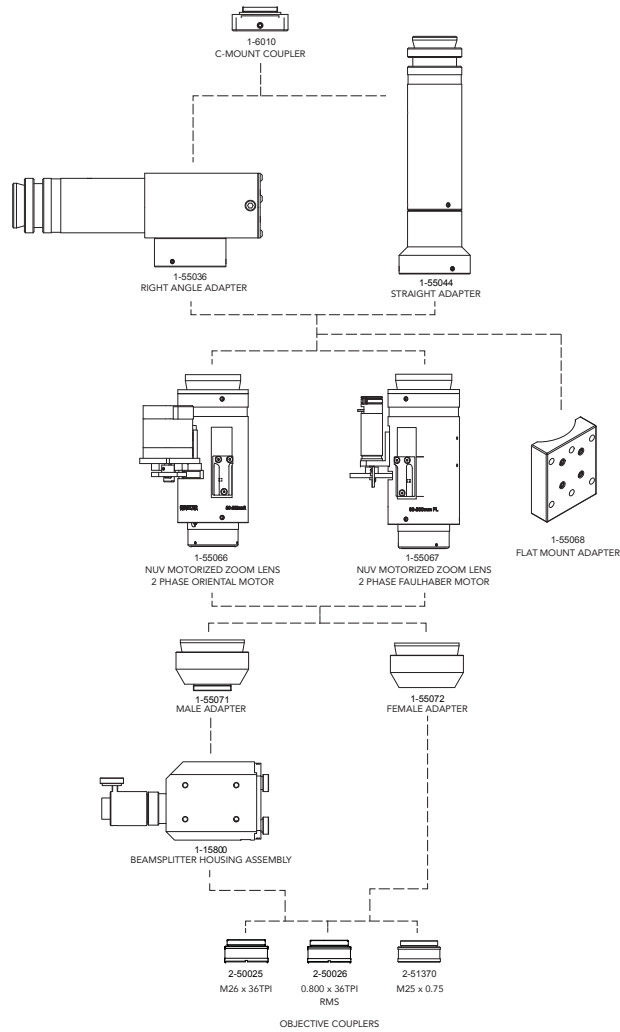


Zoom Ratio	6.2:1
Magnification	0.4x - 2.5x
Focal Length Range (mm)	80 - 497
Spectral Range (nm)	330 - 700
NA: Image Side	0.019 - 0.024
Distortion	< 0.2% across entire field
Max. Sensor Coverage	2/3"
Camera Mount	C-Mount
Zoom Drive Mechanism	2 Phase Stepping Motor Hall-Effect Limit Sensors

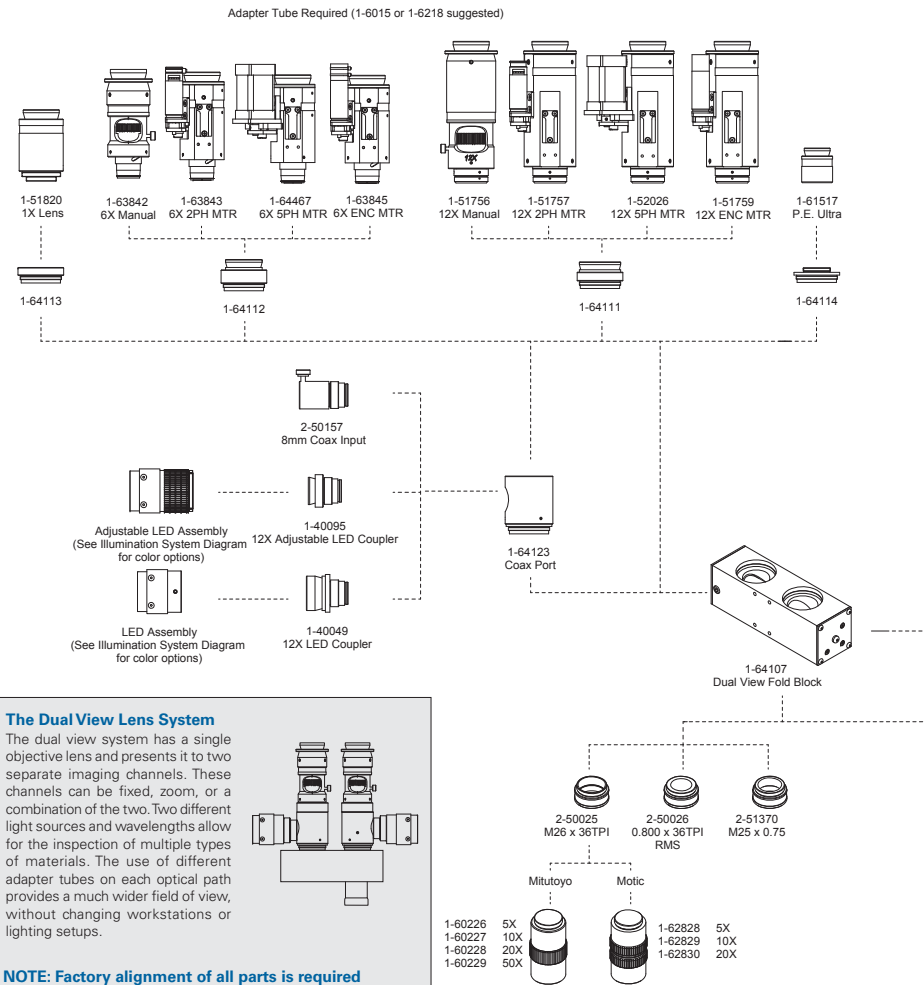


Objective Lens (Mitutoyo) Plan Apo NUV	Working Distance (mm)	NA	Depth of Field (μ)	Camera Format	1.0X Adapter Low Mag HxV	1.0X Adapter High Mag HxV
10X	30.5	0.28	6.4	Mag	4.0X	24.9X
				1/4" Sensor	0.80 x 0.60	0.13 x 0.10
				1/3" Sensor	1.20 x 0.90	0.19 x 0.14
				1/2" Sensor	1.60 x 1.20	0.26 x 0.19
2/3" Sensor	2.20 x 1.65	0.35 x 0.27				
20X	17.0	0.40	3.1	Mag	8.0X	49.7X
				1/4" Sensor	0.40 x 0.30	0.06 x 0.05
				1/3" Sensor	0.60 x 0.45	0.10 x 0.07
				1/2" Sensor	0.80 x 0.60	0.13 x 0.10
2/3" Sensor	1.10 x 0.83	0.18 x 0.13				
50X	15.0	0.42	0.8	Mag	20.0X	124.3X
				1/4" Sensor	0.16 x 0.12	0.03 x 0.02
				1/3" Sensor	0.24 x 0.18	0.04 x 0.03
				1/2" Sensor	0.32 x 0.24	0.05 x 0.04
2/3" Sensor	0.44 x 0.33	0.07 x 0.05				

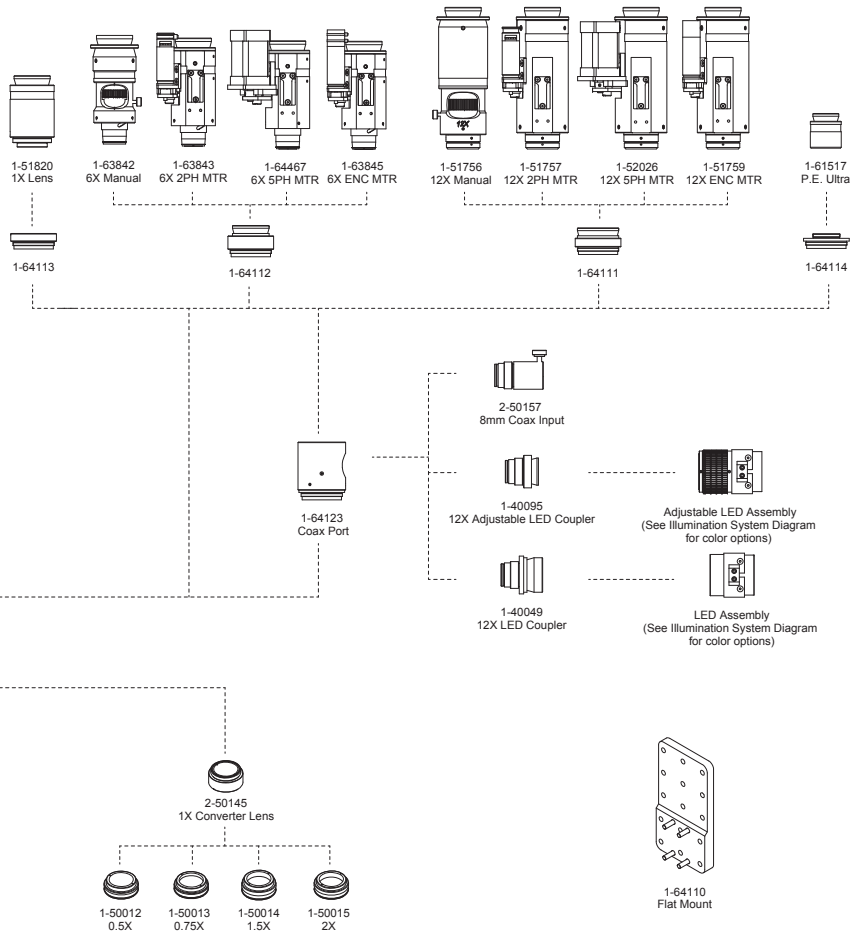
NUV-VIS Zoom System Diagram



Dual View Lens System Diagram



Adapter Tube Required (1-6015 or 1-6218 suggested)



Modular Tube Lens System (MTL)

Navitar's new line of modular tube lenses offer the ideal optical solution for OEM and research imaging and measurement applications including metrology, flat panel inspection and cell imaging.

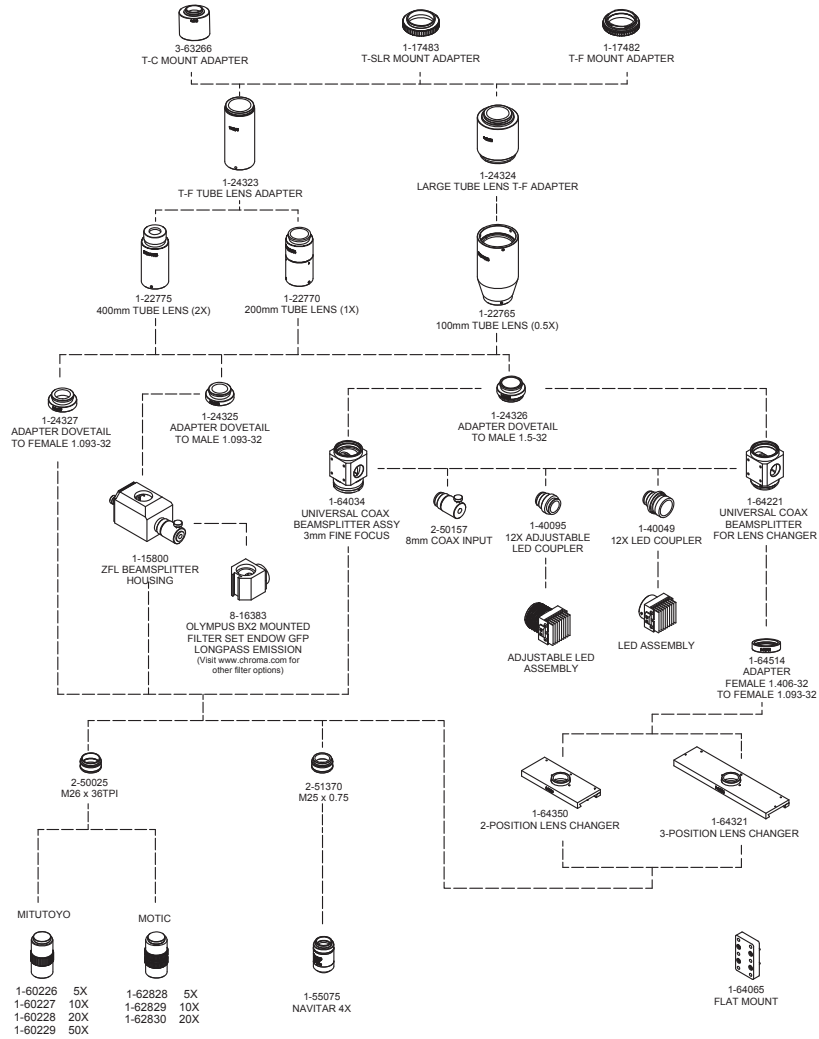


- 200mm focal length design for use with infinity corrected objectives
- 0.5x, 1x and 2x magnification modular tube lenses will cover camera sensors from 11-33mm
- 2 and 3 position objective changer available for using multiple objectives and magnifications
- Use with Brightfield, Transmitted, Reflected, and Köhler illumination techniques to produce high resolution high magnification images
- Perfect for industrial and life science applications

MTL Field of View Matrix

Objective Lens	Working Distance (mm)	Camera Formats / Parameters	0.5X Tube Lens H x V	1.0X Tube Lens H x V	2.0X Tube Lens H x V
4X Navitar	20	2/3" Sensor	3.30 x 4.40	2.20 x 1.65	1.10 x 0.82
		1" Sensor	-	3.20 x 2.40	1.60 x 1.20
		4/3" Sensor	-	4.60 x 3.45	2.30 x 1.70
		33mm	-	-	3.30 x 2.40
5X Mitutoyo	34	2/3" Sensor	3.52 x 2.64	1.76 x 1.32	0.88 x 0.66
		1" Sensor	-	2.56 x 1.92	1.28 x 0.96
		4/3" Sensor	-	3.46 x 2.60	1.73 x 0.30
		33mm	-	-	2.64 x 1.99
10X Mitutoyo	33.5	2/3" Sensor	1.76 x 1.32	0.88 x 0.66	0.44 x 0.33
		1" Sensor	-	1.28 x 0.96	0.64 x 0.48
		4/3" Sensor	-	1.73 x 0.30	0.87 x 0.65
		33mm	-	-	1.32 x 0.99
20X Mitutoyo	20	2/3" Sensor	0.88 x 0.66	0.44 x 0.33	0.22 x 0.16
		1" Sensor	-	0.64 x 0.48	0.32 x 0.24
		4/3" Sensor	-	0.87 x 0.65	0.43 x 0.32
		33mm	-	-	0.66 x 0.49
50X Mitutoyo	13	2/3" Sensor	0.36 x 0.26	0.18 x 0.13	0.09 x 0.06
		1" Sensor	-	0.26 x 0.19	0.13 x 0.09
		4/3" Sensor	-	0.35 x 0.26	0.17 x 0.13
		33mm	-	-	0.26 x 0.19

MTL System Diagram



Illumination Products

Navitar offers LED ring lights, Brightlight LED coaxial illuminators, fiber optic illuminators, and power supplies.

Fiber Optic Lighting

These fiber optic illuminators consist of a Halogen illumination system with a variable light intensity control. They accept a single or dual light pipe or an attachable ring light for illuminating a wider area. These illuminators offer low operating temperature and low noise output.

Available Fiber Optic Accessories

Model	Description
1-6192	Ring light w/ 1.28" inside diameter, 0.5" input ferrule, 3 foot length (Also available in 6ft, 8ft, 10ft and 15ft lengths)
1-61214	Ring light w/ 1.28" inside diameter, 0.718" input ferrule, 3 foot length (Also available in 6ft and 8ft lengths)
1-60926	Ring light w/ 4.5" inside diameter, 0.718" input ferrule, 3 foot length
2-50017	Ring light adapter for any 12X with fine focus
1-60106	Flexible light pipe for co-axial, 0.5" input ferrule, 3 foot length (Also available in 6ft, 8ft, 10ft, 12ft and 15ft lengths)
1-60162	Flexible light pipe for co-axial, 0.718" input ferrule, 3 foot length (Also available in 6ft, 8ft and 12ft lengths)
1-6267	2" x 2" fiber optic back light, 0.718" input ferrule, 40" length
8-61313	Dual gooseneck, 0.718" input ferrule
1-60787	Coupler to convert 0.5" input ferrule to 0.718" input ferrule
EKE	Long-life replacement lamp; 200 hour life, 21V, 3250° K
EJV	Standard replacement lamp; 40 hour life, 21V, 3350° K

LED Illumination

Two LED based products are available from Navitar: Brightlight coaxial illuminators and Ring Light illuminators. Designed to match the optical performance of our vision systems, each illumination system was created to work with a specific system, such as Navitar's Zoom 6000, 12X Zoom or Precise Eye system. Each lighting component incorporates the correct number of individual LEDs, placed in the optimal optical position, to provide powerful, even illumination across a given field of view.

Benefits Include:

- Longer life
- Minimum power loss
- Narrow wavelength band (red, constant color temperature (white))
- Small packaging with optimal heat management
- No fan vibration
- Lower cost

Fiber Optics Power Supplies

Navitar offers a selection of compact, rugged, AC/DC Halogen light sources with solid state dimmers for variable light intensity and maximum lamp life.

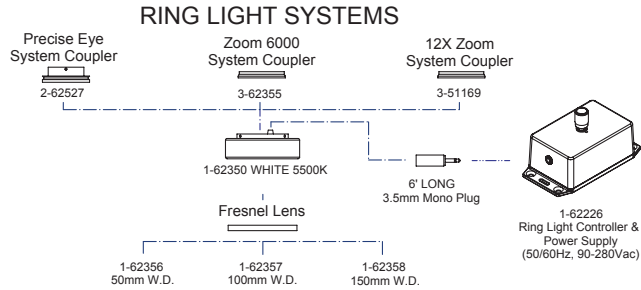
Model	Description
8-61172	120 volt fiber optic power supply, 150w EKE lamp, 0.720" fiber receptacle (CSA, UL, CE compliant)
1-60563	220 volt fiber optic power supply, 150w EKE lamp, 0.720" fiber receptacle (CSA, UL, CE compliant)
8-61892	90-285 volt DC regulated fiber optic power supply, 150w EKE lamp, 0.720" fiber receptacle (CSA, UL, CE compliant)
1-63720	Light Source DC regulated 150W, 120/220V. CSA and CE certified.

Internal Coaxial Input Ports

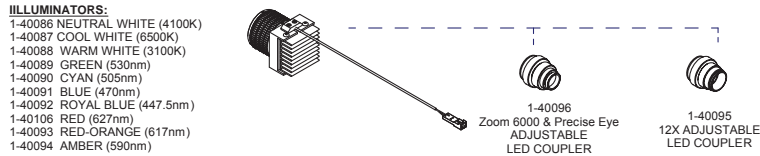
For Zoom 6000	Description
2-60200	8 mm diameter fiber input
2-61503	10 mm diameter fiber input
2-61955	12 mm diameter fiber input
2-60263	8 mm diameter input parallel coaxial
1-60812	8 mm diameter input polarizer
For 12X Zoom	Description
2-50157	8 mm diameter fiber input
2-50751	10 mm diameter fiber input
2-50975	12 mm diameter fiber input
2-50602	8 mm diameter input parallel coaxial
1-50554	8 mm diameter input polarizer



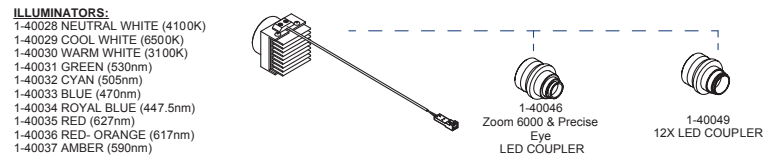
LED Illumination System Diagram



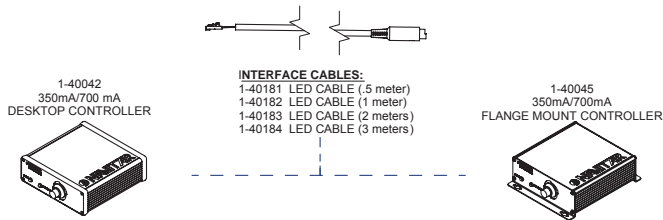
ADJUSTABLE COAXIAL LED ASSEMBLIES



BRIGHTLIGHT ASSEMBLIES



CONTROLLERS



*** USB, RS-232, & POWER SUPPLY INCLUDED ***

LARGE FORMAT IMAGING

EasyReader Imaging System

The EasyReader large format lenses were designed and constructed to allow for system modularity. This creates a wide range of customization in optical parameters such as magnification, working distance, field of view, sensor size, NA, F/#, and camera mount type.



- Combinations will cover camera sensor formats from 16mm diagonal - 90mm linear arrays
- Magnification range of 0.20x to 5.10x
- On axis illumination optional on 1" and 4/3" camera formats
- Minimal system distortion
- Average relative illumination > 95% from center to edge
- Working distance options from 24mm - 159mm

BACK LENS

	Focal Length: 50mm	Focal Length: 65mm	Focal Length: 122mm	Focal Length: 179mm	Focal Length: 255mm
Diagonal >	Max Sensor: 16mm	Max Sensor: 23mm	Max Sensor: 43mm	Max Sensor: 63mm	Max Sensor: 90mm
Focal Length: 50mm	Mag: 1.00X	Mag: 1.30X	Mag: 2.40X	Mag: 3.60X	Mag: 5.10X
NA=0.2 WD=24mm	FOV: 12.80 x 9.60	FOV: 12.80 x 9.60	FOV: 12.80 x 9.60	FOV: 17.50	FOV: 17.60
Depth of Focus: 0.012mm	F/1.3	F/1.4	F/2.1	F/2.4	F/2.6
Focal Length: 65mm	Mag: 0.77X	Mag: 1.00X	Mag: 1.900X	Mag: 2.70X	Mag: 3.90X
NA=0.15 WD=48mm	FOV: 18.40 x 13.80	FOV: 18.40 x 13.80	FOV: 18.40 x 13.80	FOV: 23.30	FOV: 23.00
Depth of Focus: 0.021mm	F/1.4	F/1.6	F/2.1	F/2.4	F/2.6
Focal Length: 122mm	Mag: 0.41X	Mag: 0.53X	Mag: 1.00X	Mag: 1.50X	Mag: 2.10X
NA=0.08 WD=87mm	FOV: 35.40 x 25.80	FOV: 35.40 x 25.80	FOV: 35.40 x 25.80	FOV: 42.00	FOV: 42.80
Depth of Focus: 0.074mm	F/1.8	F/2.1	F/3.1	F/4.5	F/5.3
Focal Length: 179mm	Mag: 0.28X	Mag: 0.36X	Mag: 0.68X	Mag: 1.00X	Mag: 1.40X
NA=0.06 WD=135mm	FOV: 50.40 x 37.80	FOV: 50.40 x 37.80	FOV: 50.40 x 37.80	FOV: 63.00	FOV: 64.20
Depth of Focus: 0.160mm	F/2.0	F/2.4	F/3.6	F/4.5	F/5.3
Focal Length: 255mm	Mag: 0.20X	Mag: 0.25X	Mag: 0.48X	Mag: 0.70X	Mag: 1.00X
NA=0.04 WD=159mm	FOV: 72.00 x 54.00	FOV: 72.00 x 54.00	FOV: 72.00 x 54.00	FOV: 90.00	FOV: 90.00
Depth of Focus: 0.325mm	F/2.1	F/2.6	F/4.1	F/5.3	F/6.4

NOTE: FOV measurement is in millimeters.

FRONT LENS

Zeiss Lenses

Zeiss ZF lenses offer the image quality associated with professional photography for technical and industrial applications. The ZF lenses are compatible with the Nikon F-Bayonet, the globally recognized standard for high-resolution industrial cameras with large format image sensors.

Zeiss ZF lenses feature manual focusing of the highest precision and the robust design. High image definition, color purity, stray light absorption, and excellent distortion correction.



	Part #	Mount	Image Diagonal (mm)	Focal Length (mm)	F/# Range	Minimum Operating Distance (meters)	Image Size at MOD		Filter Thread
							Width (mm)	Height (mm)	
Standard	1-18808	F-mount	43	18	3.5-22	0.30	440	290	M 82x0.75
	1-18809	F-mount	43	21	2.8-22	0.22	190	124	M 82x0.75
	1-18810	F-mount	43	25	2.8-22	0.17	830	550	M 58x0.75
	1-18811	F-mount	43	28	2.0-22	0.24	170	110	M 58x0.75
	1-18812	F-mount	43	35	2.0-22	0.30	190	130	M 58x0.75
	1-18813	F-mount	43	50	1.4-16	0.45	240	160	M 58x0.75
	1-18814	F-mount	43	50	2.0-22	0.24	720	480	M 67x0.75
	1-18815	F-mount	43	85	1.4-16	1.00	360	240	M 72x0.75
	1-18816	F-mount	43	100	2.0-22	0.44	720	480	M 67x0.75

Kowa Lenses

These large format lenses are optimized for machine vision, inspection, quality control, etc. Their rugged, compact design makes them ideal for demanding applications. Low distortion allows them to be used for close distance inspection and correspond to 4K line scan cameras.



	Part #	Mount	Image Diagonal (mm)	Focal Length (mm)	F/# Range	Minimum Operating Distance (meters)	Image Size at MOD		Filter Thread
							Width (mm)	Height (mm)	
Standard	1-19711	F-mount	43.3	28	2.8-16	0.30	388	291	M 72x0.75
	1-19712	F-mount	43.3	35	2.8-16	0.26	210	158	M 52x0.75
	1-19713	F-mount	43.3	50	2.8-16	0.26	135	102	M 52x0.75
3CCD	1-19908	F-mount	30.0	28	2.8-22	0.50	247	185	M 72x0.75
4/3"	1-19909	F-mount	43.3	50	1.9-16	0.50	269	202	M 52x0.75
	1-19910	C-mount	23.0	12	2.0-22	0.10	182	136	M 55x0.75
	1-19911	C-mount	23.0	16	2.0-22	0.10	135	101	M 40.5x0.5
	1-19912	C-mount	23.0	25	2.0-16	0.15	125	93	M 40.5x0.5
	1-19913	C-mount	23.0	35	2.0-16	0.20	100	75	M 37.5x0.5
	1-19914	C-mount	23.0	50	2.0-22	0.30	100	75	M 37.5x0.5

Navitar Machine Vision Video Lenses

Navitar offers quality video lenses from wide angle to telephoto all with high resolution, low distortion and even illumination across the image plane of your camera.

Our large selection of low magnification video lenses includes Fujinon, Kowa, SWIR, Zoom 7000, etc. for industrial applications. Quality construction coupled with precision engineering results in video optics that are sharp, high resolution and optically precise.



4/3" Format Lenses

		Megapixel Fixed Focal Length Lenses				
Model		1-19910	1-19911	1-19912	1-19913	1-19914
Focal Length (mm)		12	16	25	35	50
Iris Range/F-Stop		2.0 - 22	2.0 - 22	2.0 - 16	2.0 - 16	2.0 - 22
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Zoom	—	—	—	—	—
Object Area (mm)	4/3"	182.0 x 136.0	135.0 x 101.0	125.0 x 93.0	100.0 x 75.0	100.0 x 75.0
	1"	126.6 x 94.6	93.9 x 70.2	86.9 x 64.7	69.6 x 52.2	69.6 x 52.2
	2/3"	87.0 x 65.0	64.5 x 48.3	59.8 x 44.5	47.8 x 35.9	47.8 x 35.9
Filter Diameter (mm)		Ø55.0 P=0.75	Ø40.5 P=0.50	Ø40.5 P=0.50	Ø37.5 P=0.50	Ø37.5 P=0.50
Mount		C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)		270	250	250	210	220

1" Format Lenses

		6 Megapixel Fixed Focal Length Lenses				
Model		1-24420	1-24421	1-24422	1-24423	1-24424
Focal Length (mm)		12	16	25	35	50
Iris Range/F-Stop		1.8 - 16	1.8 - 22	1.8 - 16	2.0 - 16	2.0 - 22
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Zoom	—	—	—	—	—
Object Area (mm)	1"	125.0 x 93.0	93.5 x 69.9	86.0 x 64.0	70.0 x 52.5	70.0 x 52.5
	2/3"	85.9 x 63.9	64.3 x 48.1	59.1 x 44.0	48.1 x 36.1	48.1 x 36.1
Focusing Range (m)		0.10 - ∞	0.10 - ∞	0.15 - ∞	0.20 - ∞	0.30 - ∞
Filter Diameter (mm)		Ø40.5 P=0.50	Ø34.0 P=0.50	Ø34.0 P=0.50	Ø34.0 P=0.50	Ø34.0 P=0.50
Mount		C-Mount	C-Mount	C-Mount	C-Mount	C-Mount

Navitar Machine Vision Video Lenses

1" Format Lenses

Megapixel Fixed Focal Length Lenses									
Model	NMV-6M1	NMV-8M1	NMV-12M1	NMV-16M1	NMV-25M1	NMV-35M1	NMV-50M1	NMV-75M1	
Focal Length (mm)	6	8	12	16	25	35	50	75	
Iris Range/F-Stop	1.8-16	1.4-16	1.4-16	1.4-16	1.4-16	1.4-16	1.4-16	1.8-16	
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ screw locks	
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	
	Zoom	—	—	—	—	—	—	—	
Object Area (mm)	1"	267.4 x 196.3	147.0 x 110.5	307.5 x 230.5	227.0 x 170.5	140.8 x 105.6	96.9 x 72.7	115.2 x 86.4	157.9 x 118.4
	2/3"	183.8 x 134.9	101.2 x 75.9	211.2 x 158.4	156.2 x 117.1	96.8 x 72.6	66.6 x 50.0	79.2 x 59.4	108.6 x 81.4
	1/2"	133.7 x 98.1	73.6 x 55.2	153.6 x 115.2	113.6 x 85.2	70.4 x 52.8	48.5 x 36.4	57.6 x 43.1	78.9 x 59.2
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.3 - ∞	0.3 - ∞	0.3 - ∞	0.3 - ∞	0.5 - ∞	0.5 - ∞	
Filter Diameter (mm)	—	Ø55 P=0.75	Ø35 P=0.50	Ø35.5 P=0.50	Ø35.5 P=0.50	Ø35.5 P=0.50	Ø40.5 P=0.50	Ø46 P=0.75	
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	
Weight (grams)	220	200	150	140	125	130	200	180	

Model	Fixed Focal Length		High Speed			Zoom	
	NMV-2514	NMV-5018	DO-1795	DO-2595	DO-5095	NMV-6X16	
Focal Length (mm)	25	50	17	25.0	50	16-100	
Iris Range/F-Stop	1.4 - Close	1.8 - Close	0.95 - 16	0.95 - 16	0.95 - 16	1.9 - Close	
Control	Iris	Manual	Manual	Manual w/ lock screws	Manual w/ lock screws	Manual	
	Focus	Manual	Manual	Manual w/ lock screws	Manual w/ lock screws	Manual	
	Zoom	—	—	—	—	Manual	
Object Area (mm)	1"	27 x 21	15 x 11	363 x 272	243 x 182	140 x 105	Wide 81.2 x 60.9 Tele 13.6 x 10.2
	2/3"	—	—	250 x 187	167 x 125	97 x 72	—
	1/2"	—	—	182 x 136	121 x 91	70 x 53	—
Focusing Range (m)	0.5 - ∞	0.7 - ∞	0.5 - ∞	0.5 - ∞	0.6 - ∞	1.1 - ∞	
Filter Diameter (mm)	Ø34 P=0.5	Ø40.5 P=0.50	Ø40.5 P=0.50	Ø40.5 P=0.50	Ø62 P=0.75	Ø58 P=0.75	
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	
Weight (grams)	81	145	170	140	490	829	

Navitar Machine Vision Video Lenses

2/3" Format Lenses

Megapixel Fixed Focal Length Lenses								
Model	NMV-5M23	NMV-8M23	NMV-12M23	NMV-16M23	NMV-25M23	NMV-35M23	NMV-50M23	
Focal Length (mm)	5	8	12	16	25	35	50	
Iris Range/F-Stop	2.8 x 16	1.4 - close	1.4 - close	1.4 - 16	1.4 - 16	2.0 - 16	2.8 - 22	
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	
	Zoom	—	—	—	—	—	—	
Object Area (mm)	1"	—	—	—	—	—	—	
	2/3"	197 x 148	117 x 88	110 x 83	113 x 84	71 x 53	48 x 36	29 x 22
	1/2"	110 x 105	84 x 63	79 x 59	80 x 60	51 x 38	33 x 26	21 x 16
	1/3"	82 x 78	63 x 47	59 x 44	60 x 45	38 x 28	25 x 19	16 x 12
1/4"	55 x 52	49 x 31	39 x 29	40 x 30	25 x 14	16 x 13	10 x 8	
Focusing Range (m)	0.10 - ∞	0.12 - ∞	0.15 - ∞	0.2 - ∞	0.2 - ∞	0.2 - ∞	0.2 - ∞	
Filter Diameter (mm)	Ø40.5 P=0.50	Ø27 P=0.50	Ø27 P=0.50	Ø25.5 P=0.50	Ø27.0 P=0.50	Ø27.0 P=0.50	Ø27.0 P=0.50	
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	
Weight (grams)	85	83	75	81	89	89	92	

Fixed Focal Length Lenses								
Model	NMV-6	NMV-8	NMV-12	NMV-16	NMV-25	NMV-35	NMV-50	
Focal Length (mm)	6	8	12	16	25	35	50	
Iris Range/F-Stop	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16	1.6 - 16	1.6 - 16	2.0 - 22	
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	
	Zoom	—	—	—	—	—	—	
Object Area (mm)	1"	—	—	—	—	—	—	
	2/3"	367 x 251	260 x 184	237 x 173	112 x 83	119 x 89	127 x 95	85 x 64
	1/2"	264 x 181	187 x 132	170 x 125	80 x 60	86 x 64	91 x 68	61 x 46
	1/3"	198 x 136	140 x 99	127 x 93	60 x 45	64 x 48	68 x 51	46 x 34
1/4"	132 x 90	93 x 66	85 x 62	40 x 30	43 x 32	45 x 34	30 x 23	
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.2 - ∞	0.2 - ∞	0.35 - ∞	0.5 - ∞	
Filter Diameter (mm)	—	Ø27.0 P=0.50	Ø27.0 P=0.50	Ø27.0 P=0.50	Ø27.0 P=0.50	Ø30.5 P=0.50	Ø30.5 P=0.50	
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	
Weight (grams)	63	60	63	55	58	85	88	

Navitar Machine Vision Video Lenses

2/3" Format Lenses

10 Megapixel Fixed Focal Length Lenses							
Model	1-19552	1-19553	1-19554	1-19555	1-19556	1-19557	1-19558
Focal Length (mm)	5.0	8.5	12.0	16.0	25.0	35.0	50.0
Iris Range/F-Stop	1.8-16	1.8-22	1.8-11	1.8-16	1.8-16	2.0-16	2.8-16
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Zoom	—	—	—	—	—	—
Object Area (mm)	2/3"	197.0 x 147.0	133.2 x 99.6	80.7 x 60.2	61.1 x 45.7	36.7 x 27.5	23.4 x 17.6
	1/2"	143.2 x 107.0	96.9 x 72.4	58.7 x 43.8	44.4 x 33.2	26.7 x 20.0	17.0 x 12.8
	1/3"	107.4 x 80.2	72.7 x 54.3	44.0 x 32.8	33.2 x 24.9	20.0 x 15.0	12.8 x 9.6
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.1 - ∞
Filter Diameter (mm)	Ø46.0 P=0.75	Ø34.0 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø34.0 P=0.50	Ø30.5 P=0.50
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	120	115	105	90	95	160	170

5 Megapixel Fixed Focal Length Lenses				
Model	1-24830	1-24831	1-24832	1-24833
Focal Length (mm)	12.5	16.0	25.0	35.0
Iris Range/F-Stop	1.4-16	1.4-16	1.4-16	1.4-16
Control	Iris	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Focus	Manual w/ lock screws	Manual w/ lock screws	Manual w/ lock screws
	Zoom	—	—	—
Object Area (mm)	2/3"	81.4 x 60.9	64.6 x 48.4	35.1 x 26.3
	1/2"	59.2 x 44.3	47.0 x 35.2	25.5 x 19.1
	1/3"	44.4 x 33.2	35.2 x 26.4	19.1 x 14.3
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.1 - ∞
Filter Diameter (mm)	Ø30.5 P=0.50	Ø30.5 P=0.50	Ø30.5 P=0.50	Ø30.5 P=0.50
Mount	C-Mount	C-Mount	C-Mount	C-Mount

Navitar Machine Vision Video Lenses

2/3" Format Lenses

Fixed Focal Length Lenses						
Model	NMV-75	NMV-100	NAV-1614	NAV-2514	NAV-3520	NAV-5028
Focal Length (mm)	75	100	16	25	35	50
Iris Range/F-Stop	2.5 - 22	2.8 - 32	1.4 - 16	1.4 - 16	2.0 - 22	2.8 - 22
Control	Iris	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws
	Focus	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws	Manual w/lock screws
	Zoom	—	—	—	—	—
Object Area (mm)	2/3"	51 x 38	37 x 27	119 x 89	72 x 54	46 x 34
	1/2"	37 x 27	27 x 20	87 x 65	52 x 39	33 x 25
	1/3"	28 x 20	20 x 15	65 x 49	39 x 29	25 x 19
	1/4"	18 x 13	13 x 10	43 x 32	26 x 19	17 x 13
Focusing Range (m)	1.2 - ∞	2.0 - ∞	0.25 - ∞	0.25 - ∞	0.25 - ∞	0.5 - ∞
Filter Diameter (mm)	Ø34.0 P=0.50	Ø40.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	15	150	42	45	490	829

Model	Telecentric, Fixed Focal Length	Zoom		
	TC-5028	NMV-6X11.5	Zoom 7000E	Zoom 7000
Focal Length (mm)	50	11.5 - 69	12.5 - 75 (6x) (Macro)	18 - 108 (6x) (Close-up Focusing)
Iris Range/F-Stop	2.8 - Close	1.4 - Close	1.8 - Close	2.5 - Close
Control	Iris	Manual	Manual	Manual
	Focus	Manual	Manual	Manual
	Zoom	—	Manual	Manual
Object Area (mm)	2/3"	8.1 x 6.1	Wide 73 x 55 Tele 13 x 10	Wide 504 x 378 Tele 83 x 64
	1/2"	5.9 x 4.4	—	Wide 367 x 275 Tele 50 x 45
	1/3"	3.8 x 3.3	—	Wide 274 x 206 Tele 45 x 34
	1/4"	2.9 x 2.2	—	Wide 183 x 137 Tele 30 x 22
Focusing Range (m)	0.5 - ∞ *	1.0 - ∞	1.0 - ∞ (102 at Macro)	0.13 - ∞
Filter Diameter (mm)	Ø37 P=0.75	Ø46 P=0.75	Ø49 P=0.75	Ø52 P=0.75
Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	318	410	370	595

Navitar Machine Vision Video Lenses

1/2" Format Lenses

Model	Wide Angle Fixed Focal Length				Fixed Focal Length		Zoom
	NMV-4WA	NMV-5WA	NMV-6WA	NMV-12WA	NAV-614	NMV-1214	NMV-6X8
Focal Length (mm)	3.5	4.5	6	12	6	12	8-48
Iris Range/F-Stop	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - Close	1.0 - Close
Control	Iris	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws
	Focus	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws	Manual w/lock Screws
Control	Zoom	—	—	—	—	—	Manual
	1"	—	—	—	—	—	—
Object Area (mm)	2/3"	—	—	—	—	—	—
	1/2"	396 x 247	260 x 180	174 x 128	167 x 123	176 x 130	17 x 13
	1/3"	297 x 185	195 x 135	130 x 96	125 x 92	132 x 97	—
	1/4"	198 x 123	130 x 90	87 x 64	83 x 61	88 x 65	—
	1/4"	—	—	—	—	—	Wide 74.3 x 54.9 Tele 12.3 x 9.3
Focusing Range (m)	0.2 - ∞	0.2 - ∞	0.2 - ∞	0.3 - ∞	0.3 - ∞	0.3 - ∞	1.0 - ∞
Filter Diameter (mm)	—	—	Ø25.5 P=0.50	Ø30.5 P=0.50	Ø30.5 P=0.75	Ø30.5 P=0.50	Ø46 P=0.75
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	73	71	60	60	50	90	395

1/3" Format Lenses

Model	Fixed Focal Length	Zoom
	DO-2814	ZOOM 7010
Focal Length (mm)	2.8	8.5 - 90
Iris Range/F-Stop	1.4 - Close	2.5 - Close
Control	Iris	Manual
	Focus	Manual
Control	Zoom	—
	1"	—
Object Area (mm)	2/3"	—
	1/2"	—
	1/3"	579 x 414
	1/4"	386 x 276
	1/4"	—
Focusing Range (meters)	0.3 Fixed	0.18 - ∞
Filter Diameter (mm)	No Filter Thread	No Filter Thread
Mount	CS-Mount	C-Mount
Weight (grams)	60	437

*Focusing range in non-telecentric mode.



Fujinon Machine Vision Video Lenses

1" Format Lenses

Model	Fixed Focal Length					
	CF12.5HA-1	CF16HA-1	CF25HA-1	CF35HA-1	CF50HA-1	CF75HA-1
Focal Length (mm)	12.5	16	25	35	50	75
Iris Range/F-Stop	1.4 - 22	1.4 - 22	1.4 - 22	1.4 - 22	1.8 - 22	1.8 - 22
Control	Iris	Manual	Manual	Manual	Manual	Manual
	Focus	Manual	Manual	Manual	Manual	Manual
Control	Zoom	—	—	—	—	—
	1"	120 x 90	100 x 75	65 x 48	73 x 55	76 x 57
Object Area (mm)	2/3"	—	—	—	—	—
	1/2"	—	—	—	—	—
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.2 - ∞	0.4 - ∞	0.9 - ∞
Filter Diameter (mm)	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	280	280	300	190	200	300

2/3" Format Lenses

Model	Fixed Focal Length Megapixel					
	HF12.5SA-1	HF16SA-1	HF25SA-1	HF35SA-1	HF50SA-1	HF75SA-1
Focal Length (mm)	12.5	16	25	35	50	75
Iris Range/F-Stop	F1.4 - F22	F1.4 - F22	F1.4 - F22	F1.4 - F22	F1.8 - F22	F1.8 - F22
Control	Iris	Manual	Manual	Manual	Manual	Manual
	Focus	Manual	Manual	Manual	Manual	Manual
Control	Zoom	—	—	—	—	—
	1"	—	—	—	—	—
Object Area (mm)	2/3"	83 x 62	69 x 51	44 x 33	50 x 38	70 x 52
	1/2"	60 x 45	50 x 37	32 x 24	37 x 27	51 x 38
	1/3"	45 x 34	37 x 28	24 x 18	27 x 21	38 x 28
	1/4"	—	—	—	—	—
	1/4"	—	—	—	—	—
Focusing Range (meters)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.2 - ∞	0.2 - ∞*	0.9 - ∞**
Filter Diameter (mm)	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75	Ø49 P=0.75
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	295	285	315	185	240	300

Fujinon Machine Vision Video Lenses

2/3" Format Lenses

Model	Fixed Focal Length						
	HF9HA-1B	HF12.5HA-1B	HF16HA-1B	HF25HA-1B	HF35HA-1B	HF50HA-1B	HF75HA-1B
Focal Length (mm)	9	12.5	16	25	35	50	75
Iris Range/F-Stop	1.4 - Close	1.4 - Close	1.4 - Close	1.4 - Close	1.6 - Close	2.3 - Close	2.8 - Close
Control	Iris	Manual	Manual	Manual	Manual	Manual	Manual
	Focus	Manual	Manual	Manual	Manual	Manual	Manual
	Zoom	—	—	—	—	—	—
Object Area (mm)	1"	—	—	—	—	—	—
	2/3"	108 x 81	78 x 58	63 x 47	53 x 40	59 x 44	77 x 57
	1/2"	79 x 59	57 x 42	46 x 34	38 x 29	43 x 32	56 x 42
	1/3"	59 x 44	42 x 32	34 x 26	29 x 22	32 x 24	42 x 31
	1/4"	44 x 33	32 x 24	26 x 19	22 x 16	24 x 18	31 x 24
Focusing Range (meters)	0.1 - ∞	0.1 - ∞	0.1 - ∞	0.15 - ∞	0.25 - ∞*	0.5 - ∞	1.1 - ∞
Filter Diameter (mm)	Ø27 P=0.75	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø25.5 P=0.50	Ø30.5 P=0.50
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	55	45	45	45	45	45	55

NOTES:
 * All Fujinon "HF" lenses come with focus and iris locking screws.
 * Using an extension tube longer than 5mm will increase the M.O.D. to 0.3m.
 ** Using an extension tube longer than 5mm will increase the M.O.D. to 0.5m.

1/2" Format Lenses

Model	Fixed Focal Length	
	DF6HA-1B*	
Focal Length (mm)	6	
Iris Range/F-Stop	1.2 - Close	
Control	Iris	Manual
	Focus	Manual
	Zoom	—
Object Area (mm)	1"	—
	2/3"	—
	1/2"	122 x 92
	1/3"	92 x 69
	1/4"	69 x 52
Focusing Range (m)	0.1 - ∞	
Filter Diameter (mm)	Ø27 P=0.5	
Mount	C-Mount	
Weight (grams)	45	

*Locking screws on focus and iris are standard.

1/3" Format Lenses for 3CCD Cameras

Model	Fixed Focal Length		
	TF2.8DA-8	TF4DA-8	TF15DA-8
Focal Length (mm)	2.8	4	15
Iris Range/F-Stop	2.2 - Close	2.2 - Close	2.2 - Close
Control	Iris	Manual	Manual
	Focus	Manual	Manual
	Zoom	—	—
Object Area (mm)	1"	—	—
	2/3"	—	—
	1/2"	—	—
	1/3"	218 x 153	131 x 98
	1/4"	145 x 102	87 x 65
Focusing Range (m)	0.1 - ∞	0.1 - ∞	0.1 - ∞
Filter Diameter (mm)	No Filter Thread	Ø27 P=0.5	Ø25.5 P=0.5
Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	75	70	60

SWIR Hyperspectral Lenses

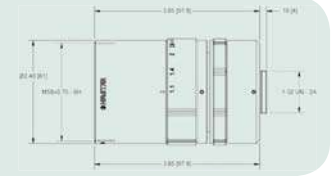
Navitar's fixed focal length SWIR Hyperspectral lenses are specifically designed for SWIR (short wave infrared) cameras and applications. Lenses are available from 8mm to 50mm focal lengths. These lenses are ideal for a variety of imaging applications where SWIR cameras are employed such as perimeter surveillance, food sorting, toll-way monitoring, border and port security, quality control or aerial imaging.



Model	Fixed Focal Length					
	SWIR-8	SWIR-12	SWIR-16	SWIR-25	SWIR-35	SWIR-50
Focal Length (mm)	8	12	16	25	35	50
Iris Range/F-Stop	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16	1.4 - 16
Control	Iris	Manual	Manual	Manual	Manual	Manual
	Focus	Manual	Manual	Manual	Manual	Manual
	Zoom	—	—	—	—	—
Object Area (mm)	1"	147.0 x 110.5	307.5 x 230.5	227.0 x 170.5	192.0 x 144.0	133.5 x 100.1
	2/3"	101.2 x 75.9	211.2 x 158.4	156.2 x 117.1	132.0 x 99.0	91.8 x 68.8
	1/2"	73.6 x 55.2	153.6 x 115.2	113.6 x 85.2	96.0 x 72.0	66.7 x 50.0
Focusing Range (m)	0.1 - ∞	0.3 - ∞	0.3 - ∞	0.3 - ∞	0.3 - ∞	0.5 - ∞
Filter Diameter (mm)	Ø55 P=0.75	Ø35.5 P=0.5	Ø35.5 P=0.5	Ø35.5 P=0.5	Ø35.5 P=0.5	Ø40.5 P=0.5
Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount	C-Mount
Weight (grams)	205	160	150	125	130	200

Custom SWIR Lens Design Experience

Navitar offers custom-designed SWIR solutions and welcomes your project request. We have designed and built several custom lenses, including a system that detects visible near infrared (NIR) and short wave infrared (SWIR) wavelengths (500 - 1600 nm). The custom design was a F/1.35, 25 mm, C-mount lens.



Please contact your account manager for a custom SWIR quote today.

Video Lens Accessories

Extenders (for use with all lenses except SWIR)

A range extender, installed between the lens and camera, will extend the focal length and increase the effective aperture (F/number) of a video lens. For example, using the 2XE range extender will extend the focal length by two times (2X) and double the effective aperture of the following lens: (2X) 50 mm, F/1.3 lens = 100 mm F/2.6

Extension Tube Kit

We also offer an extension tube kit, which allows you to turn standard fixed focal length lenses into macro lenses. The tube(s) mount between the camera and the lens, making it possible for you to focus a C-mount lens at a much closer distance.

Available Accessories

Model	Description
HE15-1	1.5 X Extender, 13.08 mm long, Ø45
HE20-1	2.0X Extender, 13.74 mm long, Ø45
2XE	2.0X Extender, 11.12 mm long, Ø31.92
NMV-EXT	Extension Tube Kit, 5 pieces, 38.5mm total (0.5 mm, 1 mm, 5 mm, 10 mm, 22 mm)
3-6073	5 mm Extension Tube

Zoom 7000 Series



The Zoom 7000 is a versatile, close-focusing macro video lens specifically designed for applications where objects over 1" in diameter must be imaged. It offers parfocality over the entire zoom range and is compatible with cameras 2/3" or smaller.



The Motorized Zoom 7000 with 2-phase stepper motor for zoom, focus and aperture control is ideal for automated quality inspection and assembly, biomedical imaging, printed circuit board (PCB) and electronic inspection, and fuel gauge monitoring.



The Zoom 7010 Macro Zoom lens is designed for a 1/3" or smaller camera and has a 10X zoom ratio. This lens allows close-up image capture without extension tubes or close-up lenses and the up-to-10X magnification variable (zooming) capability allows small objects to be expanded for close-up observation.



The Zoom 7000E is designed for use where industrial inspection and imaging features are less essential. It offers a 6:1 zoom ratio over a focal range of 12.5 mm to 75 mm. The Zoom 7000E incorporates many of the features of the Zoom 7000 and 7010 systems at an attractive price.

Zoom 7000 Series

Zoom 7000 Field of View

W.D. (mm)	2/3" High Mag.		2/3" Low Mag.		1/2" High Mag.		1/2" Low Mag.		1/3" High Mag.		1/3" Low Mag.		1/4" High Mag.		1/4" Low Mag.	
	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V
127	8	6.0	48	36	5.8	4.4	35.0	26.3	4.3	3.2	25.9	19.4	2.9	2.2	17.5	13.2
152	10	7.5	60	45	7.3	5.5	43.8	32.9	5.4	4.1	32.4	24.3	3.7	2.8	21.9	16.5
178	12	9.0	72	54	8.7	6.6	52.6	39.4	6.5	4.9	38.9	29.2	4.4	3.3	26.3	19.7
203	14	10.5	84	63	10.2	7.7	61.3	46.0	7.6	5.7	45.5	34	5.1	3.9	30.7	23.0
229	16	12.0	96	72	11.7	8.8	70.1	52.6	8.6	6.5	51.8	38.9	5.9	4.4	35.1	26.3
254	18	13.5	108	81	13.1	9.9	78.8	59.1	9.7	7.3	58.3	43.7	6.6	5.0	39.4	29.6
279	20	15.0	120	90	14.6	11.0	87.6	65.7	10.8	8.1	64.8	48.6	7.3	5.5	43.8	32.9
305	22	16.5	132	99	16.1	12.0	96.4	72.3	11.9	8.9	71.9	53.5	8.1	6.0	48.2	36.2
With Close-up Lens Removed																
610	42	30	252	180	30.7	21.9	184.0	131.4	22.7	21.1	136.1	97.2	15.4	11.0	92.0	65.7
762	54	39	324	234	39.4	28.5	236.5	170.8	29.2	25.9	175.0	126.4	19.7	14.3	118.3	85.4
914	66	48	396	288	48.2	35.0	289.1	210.2	35.6	25.9	213.8	155.5	24.1	17.5	144.6	105.1
1,067	78	57	468	342	56.9	41.6	341.6	249.7	42.1	30.8	252.7	184.7	28.5	20.8	170.8	124.9
1,219	90	66	540	396	65.7	48.2	394.2	289.1	48.6	35.6	291.6	213.8	32.9	24.1	197.1	144.6

Taken from 2/3", 1/2", 1/3" & 1/4" camera monitor systems with an approximate 10% overfill. All dimensions are in mm. Focus adjustment comes with locking screw. Iris and Zoom can be modified upon request.

Zoom 7010 Field of View

W.D. (mm)	1/3" High Mag.		1/3" Low Mag.		1/4" High Mag.		1/4" Low Mag.	
	H	V	H	V	H	V	H	V
178	7.36	5.52	74.40	55.80	4.88	3.66	49.60	37.20
203	9.12	6.84	92.80	69.60	6.08	4.56	61.60	46.20
229	10.96	8.22	111.20	83.40	7.28	5.46	74.40	55.80
254	12.48	9.36	128.40	94.80	8.32	6.24	84.00	63.00
279	13.92	10.44	140.80	105.60	9.28	6.96	93.60	70.20
305	16.80	12.60	170.40	127.80	11.20	8.40	113.60	85.20
With Close-up Lens Removed								
406	18.40	13.80	188.00	141.00	12.24	9.18	125.60	94.20
508	25.00	18.00	244.00	183.00	16.00	12.00	162.40	121.80
610	29.60	22.20	304.00	228.00	19.76	14.82	202.40	151.80
914	44.80	33.60	456.00	342.00	29.84	22.38	304.00	228.00
1,219	60.00	45.00	616.00	462.00	40.00	30.00	410.40	307.80

Taken from 1/3" and 1/4" camera monitor systems with an approximate 10% overfill.

Zoom 7000E Field of View with Macro

W.D. (mm)	2/3" High Mag.		1/2" High Mag.		1/3" High Mag.		1/4" High Mag.	
	H	V	H	V	H	V	H	V
25	-	-	-	-	-	-	-	-
51	64	45	46.7	32.9	34.6	24.3	23.4	16.5
76	79	56	57.7	40.9	42.7	30.2	28.9	20.5
102	94	67	68.6	48.9	50.7	36.2	34.3	24.5
127	109	78	79.6	56.9	58.9	42.1	39.8	28.5
152	124	89	90.5	65.0	67.0	48.1	45.3	32.5
178	139	100	101.5	73.0	75.1	54.0	50.8	36.5
203	-	-	-	-	-	-	-	-

Taken from 2/3", 1/2", 1/3" and 1/4" camera monitor systems with an approximate 10% overfill. All dimensions are in mm.

Zoom 7000E Field of View without Macro

W.D. (mm)	2/3" High Mag.		2/3" Low Mag.		1/2" High Mag.		1/2" Low Mag.		1/3" High Mag.		1/3" Low Mag.		1/4" High Mag.		1/4" Low Mag.	
	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V
Soft Focus to 914.4mm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
914	84	62	504	372	61.3	45.3	367.9	271.6	45.4	33.5	272.2	200.9	30.7	22.7	184.0	135.8
1,067	100	74	600	444	73	54	438	324.1	54	40	324	239.8	36.5	27.0	219.0	162.1
1,219	116	86	696	516	84.7	62.8	508.1	376.7	62.6	46.4	375.8	278.6	42.4	31.4	254.1	188.4
1,372	132	98	792	588	96.4	71.5	578.2	429.2	71.3	52.92	427.7	317.5	48.2	35.8	289.1	214.6
1,524	148	110	888	660	108	80.3	648	481.8	79.9	59.4	479.5	356.4	54.0	40.2	324.0	240.9
1,676	168	122	984	732	119.7	89.1	718.3	534.4	88.6	65.9	531.4	395.3	59.9	44.6	359.2	267.2
1,829	180	134	1080	804	131.4	97.8	788.4	586.9	97.2	72.4	583.2	434.2	65.7	48.9	394.2	293.5

Taken from 2/3", 1/2", 1/3" and 1/4" camera monitor systems with an approximate 10% overfill. All dimensions are in mm.

Converter Lenses for Block Cameras

Navitar Converter Lenses

Block cameras have long been used for numerous security, surveillance and industrial applications. Until recently, however, there were very few high quality converter lenses either to improve long-distance viewing or increase magnification.

Ideal for use in Unmanned Aerial Vehicles (UAVs), border security, and industrial automation, Navitar's converter lenses are compact and lightweight, and offer higher quality and a greater range of magnifications than those currently on the market.

Technical Information

Navitar's converter lenses easily interface with block cameras to provide optimal zoom ranges. Relative illumination ranges from 50% to 88%. Part numbers and descriptions may be found below. For outline drawings and specifications detailing optical performance and FOV changes, visit navitar.com

Part Number	Description
1-19271	2X Teleconverter Lens
1-19390	0.4X Teleconverter Lens

Designs exist for magnifications ranging from 4X to 0.4X. Please call for more information.

Mounting Options

Navitar recognizes that each customer's application is unique. Our design team will work closely with each user to develop the best mounting option for your specific project.

Camera Testing

Navitar has tested several cameras with the converter lenses, including Sony's FCB-980S, FCB-EX1000, FCB-H10, FCB-H11, and FCB-EX1020.

Because of the vast number of camera product offerings available we will arrange for a lens to be sent to your company for testing.

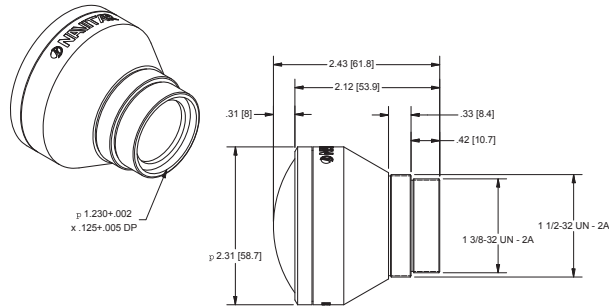
*Navitar's wide-angle converter lenses are design-only, and have yet to be prototyped.

Features

- High Quality
- Lightweight Aluminum Design
- High Resolution
- Compact Size
- Internal & External Threads

Applications

- Unmanned Aerial Vehicles (UAVs)
- Border Security
- Industrial Robotics
- Speed Enforcement
- Machine Vision
- Packaging
- Athletic Events
- Campus Surveillance
- Distance Learning



Telecentric Lenses

Benefits of Telecentric Lenses

One of the most important benefits of a telecentric lens is that image magnification does not change as object distance varies. A telecentric lens views and displays the entire object from the same prospective angle, therefore, three-dimensional features will not exhibit the perspective distortion and image position errors present when using a standard lens. Objects inside deep holes are visible throughout the field, undistorted, therefore, telecentric lenses are extremely useful for inspecting three-dimensional objects or scenes where image size and shape accuracy are critical.



MagniStar® Series

These high-resolution, low distortion lenses are designed to work with camera formats of 2/3" and smaller and also support megapixel cameras with 3.5µm pixels. Applications include metrology, flat panel inspection, curved surface inspection, and other imaging applications when greater depth of field is required.

Key Advantages:

- Bi-telecentric
- Adjustable built-in iris*
- Excellent MTF performance
- Less than 0.1% image distortion
- No parallax error

MagniStar® Bi-Telecentric Lenses - C Mount

Part #	Mag.	Telecentricity (degree)	Distortion (%)	FOV 1/3" H x V (mm)	FOV 1/2" H x V (mm)	FOV 1/1.8" H x V (mm)	FOV 2/3" H x V (mm)	WD (mm)	F#	MTF@ 70 lp/mm (%)	Field Depth (mm)	Length (mm)	Mount Part #
1-23723	0.05X	0.03	0.02	94.1 x 70.6	125.5 x 94.1	140.7 x 104.3	172.5 x 129.4	530	F/8	>51	260	630	1-23866
1-23522	0.128X	0.05	0.01	37.5 x 28.1	50.0 x 37.5	56.1 x 41.6	68.8 x 51.6	176	F/7	>55	31	283	1-23782
1-23591	0.243X	0.04	0.02	19.8 x 14.8	26.3 x 19.8	29.5 x 21.9	36.2 x 27.2	103	F/8	>50	11	165	1-23783
1-23524	0.528X	0.09	0.035	9.1 x 6.8	12.1 x 9.1	13.6 x 10.1	16.7 x 12.5	44	F/7	>51	2	134	1-23781
1-24162	1.0X	0.04	0.002	4.8 x 3.6	6.4 x 4.8	7.2 x 5.3	8.8 x 6.6	62	F/11	>42	0.9	66	1-24218
1-24056	2.0X	0.02	0.01	2.4 x 1.8	3.2 x 2.4	3.6 x 2.7	4.4 x 3.3	56	F/11	>39	0.3	103	1-24219

MagniStar® Bi-Telecentric Lens - F Mount - Large Format

Part #	Mag.	Telecentricity (degree)	Distortion (%)	FOV 1" H x V (mm)	FOV 4/3" H x V (mm)	FOV 43.3mm H x V (mm)	WD (mm)	F#	MTF@ 70 lp/mm (%)	Field Depth (mm)	Length (mm)	Mount Part #
1-24531	0.5X	0.047	0.02	25.6 x 19.2	36 x 27	72 x 48	172	F/16	>23	4	359	1-24541

*No iris in large format model 1-24531

12X Telecentric Zoom System

The 12X Telecentric Zoom system allows users to reach a true telecentric condition to within less than 0.4° while maintaining constant perspective and magnification. This means that even if the object is slightly out of focus, the size of the image will not change. The 12X Telecentric Zoom provides field coverage from 50 mm down to 4 mm and the coaxial illumination allows clear viewing, even when working with mirror-like surfaces. Also available without coaxial illumination.



Wide Magnification Range and Ultra Long Working Distance

The 12X Telecentric Zoom provides adjustable focal lengths over a 0.16X to 1.94X magnification range. You no longer have to be limited by telecentric lenses that only offer fixed magnification. Now you have field coverage from 50 mm down to 4 mm at a 188 mm working distance.

12X Telecentric Zoom Lens Specifications

Mag.	Telecentricity (degrees)			Object NA	Image NA	Object Depth of Focus (mm)	Telecentric Error (mm)				Object Size			Approx. MTF (lp/mm)	Resolvable Features (microns)
	1/4"	1/3"	1/2"				1/4"	1/3"	1/2"	1/4"	1/3"	1/2"			
0.16	0.05	0.06	-0.03	0.005	0.032	19.4	0.018	0.020	-0.009	25.0	37.3	49.7	15	66	
0.23	-0.10	-0.09	-0.18	0.007	0.031	9.7	-0.017	-0.016	-0.030	17.4	26.1	34.8	22	46	
0.33	-0.19	-0.18	-0.27	0.010	0.030	5.2	-0.016	-0.016	-0.024	12.1	18.2	24.3	30	34	
0.47	-0.23	-0.23	-0.31	0.013	0.028	3.0	-0.012	-0.012	-0.016	8.5	12.8	17.0	39	26	
0.67	-0.25	-0.25	-0.34	0.016	0.024	1.9	-0.008	-0.008	-0.011	5.9	8.9	11.9	49	21	
0.96	-0.27	-0.27	-0.36	0.020	0.021	1.3	-0.006	-0.006	-0.008	4.2	6.3	8.4	59	17	
1.36	-0.29	-0.29	-0.38	0.024	0.017	0.9	-0.004	-0.005	-0.006	2.9	4.4	5.9	71	14	
1.94	-0.25	-0.24	-0.29	0.028	0.015	0.6	-0.003	-0.003	-0.003	2.1	3.1	4.1	84	12	

Working Distance = 188 mm for all magnifications.

Video Telecentric

TC-5028

The Navitar TC-5028 telecentric lens is a 50 mm F/2.8 telecentric lens which reduces or eliminates viewing angle error and magnification error while providing high resolution and contrast with low distortion. This compact, lightweight lens can be used with 1/3", 1/2" and 2/3" format cameras and is usable from 0.5X to 1.0X, 1:1.

Specifications for Telecentric Use	
Magnifications	0.5 1.0X
Distortion at 0.5X	-0.3%
Distortion at 1.0X	Less than - 0.1%
Distance from Front Lens to Object	0.5X:115mm 1.0X:85mm

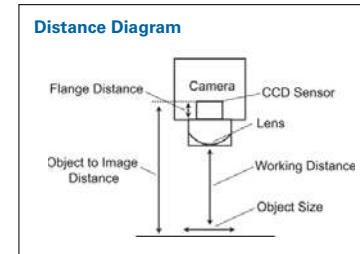
TC-5028 Video Lens Specifications		
Focal Length	50 mm	
Iris Range/ F-Stop	2.8 - Close	
Control	Iris	Manual
	Focus	Manual
	Zoom	N/A
		2/3"
Object Area at M.O.D (HxV)	1/2"	5.9 x 4.4
	1/3"	3.8 x 3.3
	1/4"	2.9 x 2.2
Focusing Range (meters)	0.5 - infinity	
Field Angle (HxV)	2/3"	10° 03' x 7° 33'
	1/2"	7° 19' x 5° 29'
	1/3"	5° 29' x 4° 07'
	1/4"	3° 39' x 2° 45'
Back Focal Length (mm)	32.5	
Filter Diameter	Ø37 P=0.75	
Mount	C-mount	
Weight (grams)	318	
Exit Pupil Position	48.1 (from image plane)	
Vignetting	97%	
Filter Size	M37.5 x 0.5	

How to Determine the Focal Length Required

To choose the proper lens for an application consider the following:

- Field of View (FOV) - The size of the area to be imaged.
- Working Distance (WD) - Distance from the camera lens to the object or area under surveillance.
- CCD - The size of the camera's image sensor device.

Be consistent. If you are measuring the width of your object, use the horizontal CCD specifications, etc. If you are working in inches, do your calculations in inches and convert to millimeters at the end.



Understanding Focal Length

Video lenses are classified into three categories according to focal length: standard, wide angle and telephoto. Focal length is the distance between the camera sensor and the center of the lens. The greater the focal length, the larger the image will appear. Therefore, the greater the focal length, the more the lens becomes telephoto in application.

- **Standard Lens** - size of the object being viewed is unchanged.
- **Wide Angle Lens** - provides a wider field of view and therefore a smaller image of the object being viewed
- **Telephoto Lens** - produces a larger image of a distant object. The longer the focal length, the larger the object will appear.

$$FL = \frac{CCD \times WD}{FOV}$$

Example: You have a 1/3" C-mount CCD camera (4.8 mm horizontal). There is a 12" (305 mm) distance between the object and the front of the lens. The field of view, or object size, is 2.5" (64 mm). The conversion factor is 1" = 25.4 mm (round up).

Calculation in mm:
 $FL = 4.8 \text{ mm} \times 305 \text{ mm} / 64 \text{ mm}$
 $FL = 1464 \text{ mm} / 64 \text{ mm}$
 $FL = 23 \text{ mm}$ Lens Required

Calculation in inches:
 $FL = 0.19" \times 12" / 2.5"$
 $FL = 2.28" / 2.5"$
 $FL = 0.912" \times 25.4 \text{ mm/inch}$
 $FL = 23 \text{ mm}$ Lens Required

Understanding F/#

The f/number is an indication of the brightness of the lens. It is the measurement of the ratio between the focal length and the diameter of the entrance pupil (where the light enters the lens). It determines the amount of light reaching the camera sensor. The smaller the value, the larger the opening and the brighter the image produced by the lens.

Image Size

A lens produces images in the form of a circle, called the image circle. In a video camera, the imaging element has a rectangular sensor area (the image size) that detects the image produced within the image circle. The ratio of the length of the horizontal to vertical sides of a video image is called the aspect ratio, which is normally 4:3 (H:V) for a standard video camera.

Image Size Chart

Image Sensor	Image Circle	Horizontal	Vertical
1/3"	Ø6.0 mm	4.8 mm	3.6 mm
1/2"	Ø8.0 mm	6.4 mm	4.8 mm
2/3"	Ø11.0 mm	8.8 mm	6.6 mm
1"	Ø16.0 mm	12.8 mm	9.6 mm
4/3"	Ø22.5 mm	17.3 mm	13.0 mm
35mm	Ø43.0 mm	36.0 mm	24.0 mm

Image Sensor Size (units in mm)

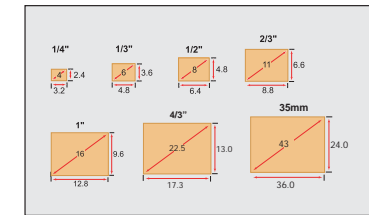
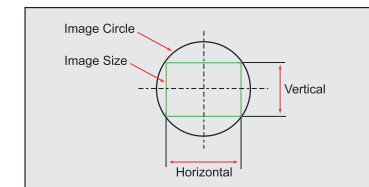


Image Size

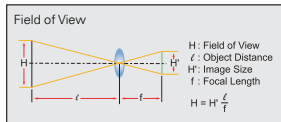
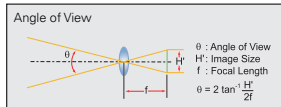


Minimum Object Distance

Minimum object distance (M.O.D.) indicates how close the lens can be placed to the object for shooting. It is measured from the vertex of the front glass of the lens.

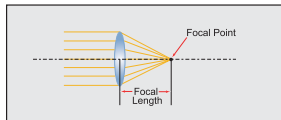
Angle of View and Field of View

The angle of view is the shooting range that can be viewed by the lens given a specified image size. Normally the angle of view is measured assuming a lens is focused at infinity. The angle of view can be calculated if the focal length and image size are known. If the distance of the object is finite, the angle is not used. Instead, the dimension of the range that can actually be shot, or the field of view, is used.



Focal Length

Distance between the principle point in the optical system and the focal point. For a single thin lens, the focal length is equal to the distance between the center of the lens and the focal point.

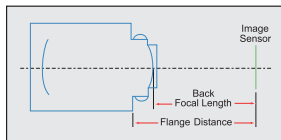


Back Focal Length

Distance between vertex of the rear element lens and image sensor.

Flange Distance

Distance between mechanical mount surface and image sensor (in air).
 C-Mount=17.526 mm / .690"
 CS-Mount=12.526 mm / .493"



Relationship Between Angle of View and Image Sensor Size

Cameras with different image sensor chip sizes (such as 1/3", 1/2", 2/3", 1" and 4/3"), using the same focal length lens, will each yield a different field of view.

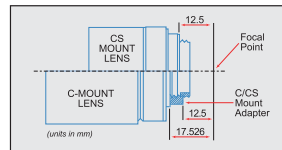
Lenses designed for a larger image sensor device will work on a new, smaller size camera. However, if a lens designed for a smaller format image sensor device (i.e. 1/3") is placed on a larger one (i.e. 2/3"), the image on the monitor will have dark corners. Image sensor sizes are in a ratio of 1:0.69:0.5:0.38:0.25. This means that a 1/2" format is 50% of a 1" format, a 1/2" format is 75% of a 2/3" format and a 1/3" format is 75% of a 1/2" format.

Camera to Monitor Magnification

Camera Format	Monitor Size (diagonal)					
	9"	14"	15"	18"	20"	27"
1/3"	38.1X	59.2X	63.5X	76.2X	84.6X	114.1X
1/2"	28.6X	44.5X	47.6X	57.2X	63.5X	85.7X
2/3"	20.8X	32.3X	34.6X	41.6X	46.2X	62.3X
1"	14.3X	22.2X	23.8X	28.6X	31.8X	42.9X
4/3"	10.6X	16.4X	17.6X	21.1X	23.5X	31.7X

C-Mount and CS-Mount Lens Compatibility

When using a C-mount lens for a CS-mount camera, a C/CS-mount adapter (5mm thick) is required.



General Lens Formulas

Magnification

$m = \text{Image Size} / \text{Object Size}$

Object to Image Distance

$OI = [FL \times (1+m)^2] / m$
 $OI = m(FL) + (FL+VOA+BF) + FL/m$
 VOA = Vertex to Vertex Lens Length

Object to Lens Distance

$OL = FL + FL(m)$

Lens to Image Distance

$LI = FL + FL/m$
 (- distance to the nodal points:
 $FL + FL(m)$ to the front vertex.)

$F/\# = 1/(2NA)$
 $F/\# = FL / \text{Entrance Pupil Diameter}$
 $NA = 1/2 F/\#$
 $NA = \sin \theta/2$

Effective F/#

Eff. $F/\# = F/\# (m+1)$

Clear Aperture (Minimum)

Aperture = $FL / (F/\#)$

Depth of Focus

$DoF = 0.00002/NA^2$ (in inches)
 $DoF = 0.0005/NA^2$ (in mm)

Conversion Factors

1 inch = 25.4 millimeters
 1 meter = 39.37 inches
 1 degree = $\pi/180$ radians
 1 degree = 0.0174533 radians
 1 micron (μ) = 0.001 millimeter
 1 micron (μ) = 1,000 nanometers
 1 micron (μ) = 10,000 angstroms

PROJECTION LENSES

HemiStar® Fisheye Projection Lenses

Navitar has designed and produced world-class projection lenses since 1978. Today, we offer an innovative series of HemiStar lenses ideal for small, medium and large planetariums, as well as simulation and immersive projection.

Our fisheye projection lenses have an almost infinite depth of focus, allowing them to maintain sharpness in a variety of settings.

We offer both single and multi-projector solutions for either 2K or 4K resolution.



Custom 4K Projection Lenses

Navitar offers custom projection lens solutions. Our design team of optical, mechanical and electrical engineers have years of experience and are ready to design and seamlessly integrate a custom projection lens into your system.



NuView® Replacement Lenses

NuView lenses replace the existing prime lens of your projector and allow you to use your projector in a variety of applications. NuView lenses are compatible with LCD, DLP, DILA and LCOS projectors.

Use a long throw lens to increase projection distance and move your projector farther from the screen. The zoom feature allows you to choose your projection distance and image size by simply rotating the lens. Use a wide angle lens in rear screen applications or to produce much larger images for front projection.



ScreenStar® Conversion Lenses

Navitar's ScreenStar conversion lenses are placed in front of your projector's standard lens to change image size or throw distance.

These lenses decrease the overall cost of installation by allowing you to reduce the number of projectors being used, or by selecting a lower cost, less featured projector.

ScreenStar lenses work with LCD, DLP, DILA and LCOS projectors.

For more information visit navitar.com



Online Resources

The Optical Wizard

With our patented online tool, the Optical Wizard, you can easily configure complete imaging solutions. The Wizard offers customized suggestions to suit your needs and budget.

www.opticalwizard.com

Digital Resources Library

Navitar offers a number of digital resources for your reference, including brochures and interactive catalogs.

www.navitar.com/support/resources/



How to Order



Call 585-359-4000 or call us toll-free at 800-828-6778.



Visit www.navitar.com for secure and simple online ordering, or email us at info@navitar.com.



Submit your purchase order by fax at 585-359-4999.



Navitar, Inc.

200 Commerce Drive | Rochester, NY 14623
585.359.4000 | 800.828.6778
info@navitar.com | www.navitar.com