Jon Fauer ASC www.fdtimes.com April 2011 Issue 41-42

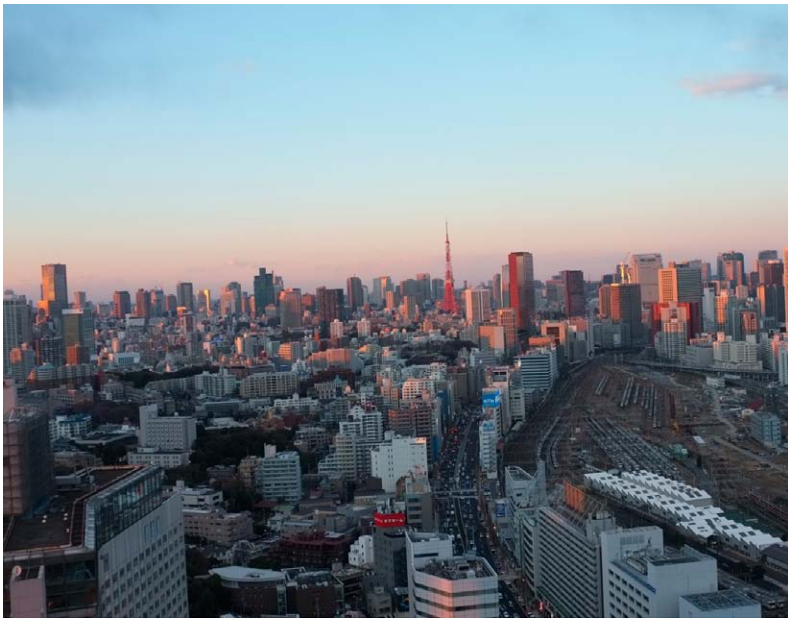
FILM AND DIGITAL TIMES

Journey to Japan

Fujifilm - Fujinon Optics

Factory Visit and 4K+ Zooms

Fujifilm - Optical Devices Division



Shuichi Yamataka, Senior Operations Manager of the Optical Devices Division, at right, and Atsushi Yamazaki, left at Fujifilm - Optical Devices Division in Saitama.

Looking out from my 36th floor hotel window, Tokyo at dawn looks like a timelapse shot. Atsushi Yamazaki is waiting for me in the lobby. We're on our way to Fujifilm - Optical Devices Division, where Fujinon lenses are made an hour northwest in the Tokyo suburb of Saitama.

Shuichi Yamataka, Senior Operations Manager of the Optical Devices Division, is my gracious host for a cinematographer's tour of the lens factory.

Fujifilm is a vast company with 74,216 employees working in 241 companies that fall into two divisions: Information and Imaging. The Information group includes medical systems, life sciences, high-performance materials, graphics, recording media, office-industry, and optical devices.

The Optical Devices Division manufactures Fujinon lenses for CCTV and security installations, industry, display equipment, cameras, optical instruments, and what we're here to see, cinema and TV.

Fuji Photo Film was founded in 1933. The first Fujica-6 still photography camera was made in 1948.

In 1957, the optical division became a separate business unit.

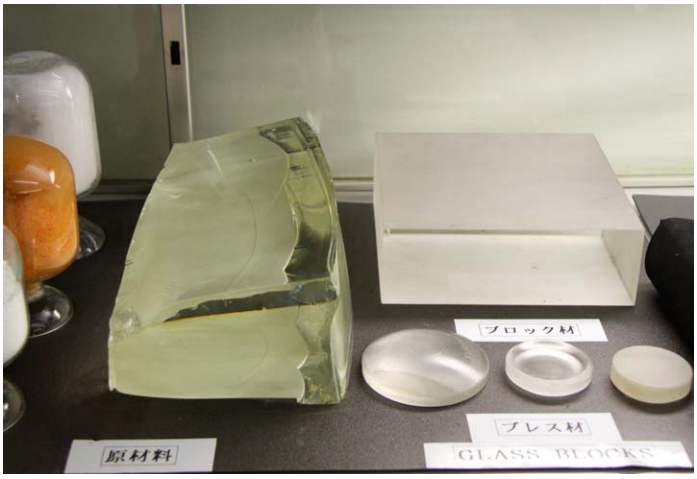
Fujinon Inc was established in New York in 1973 as a subsidiary company, followed by Fujinon Europe (1980), Fujinon Singapore (1991), Fujinon Australia (1992), Fujinon Hong Kong (1995) among others.

The optical division became officially known worldwide as Fujinon in 2004. In 2010, it was absorbed back into the Fujifilm Corporation as Fujifilm - Optical Devices Division.

All this corporate history is making us hungry. We'll see how lenses are made here after lunch. So, we're off to the famous nearby shabu-shabu restaurant Kisoji. It's nothing like shabu-shabu in New York. The marbled beef is cut paper thin, and cooked only for a few seconds. Enoki mushrooms and fresh vegetables are set like a flower arrangement. Fugu, the prized puffer fish, is on the menu, but we're spared the agonizing choice of something twenty times more lethal than cyanide if improperly prepared and what I'm told is an almost religious experience when done right.

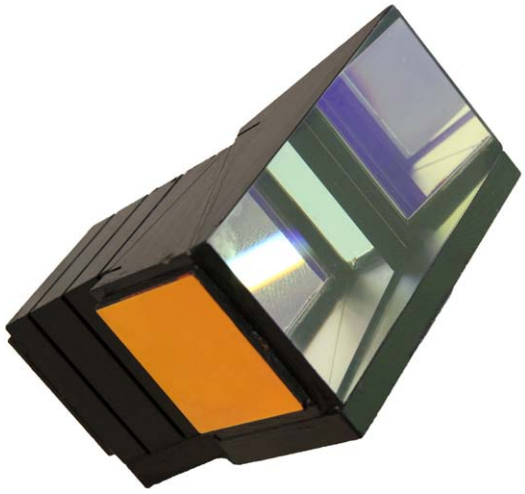
Fujifilm - Optical Devices Division

We get back to business in the large showroom of products. A massive block of glass guards the entrance, reminding anyone, lest they forget, that it all begins with glass.

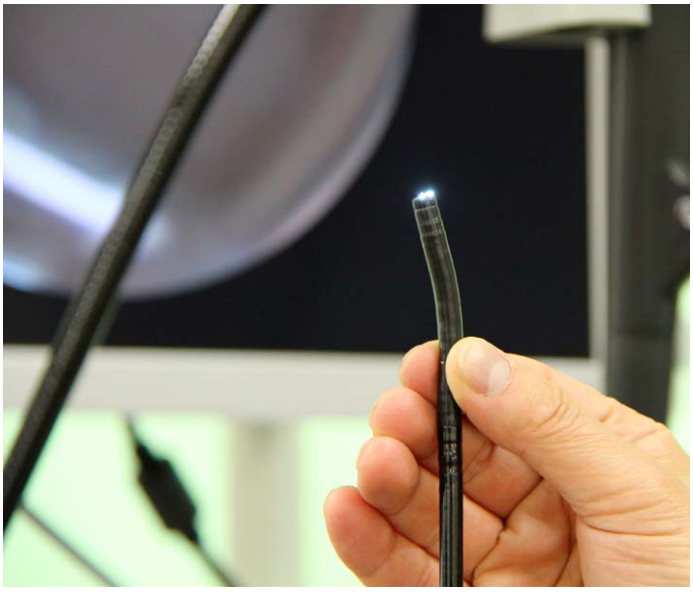


Lens elements are designed and created from a vast variety of glass "mixtures," whose mineral and chemical content determines refractive index, transmission, contrast, and resolution.

Fujinon makes one of the world's largest binoculars, 25 x 150, named in honor of astronomer Yuji Hyakutake.



Many of the world's prisms and sensor cover glasses for professional digital and video cameras are made by Fujifilm.



Fujinon Endoscopes were first introduced in 1971. The latest ones incorporate high power multiple source LED illumination and tiny articulating camera heads. 3D endoscopes are imminent.

Next time you're watching a 3D movie, the projection lenses may have been made here. This is an over-under lens array.

Fujinon Lenses

Happy customers. The showroom displays the autographed pictures of users like Rick McCallum, David Tattersal, BSC, and George Lucas (above, left to right, on *Star Wars*). McCallum, a producer who understands technology, wrote, "For *Star Wars Episode III Revenge of the Sith*, we were very impressed with the flexibility and responsiveness of the Fujinon engineering team. They designed and produced lenses with the exact specifications, focal lengths and overall features we requested. Fujinon truly understands the unique needs of digital cinematographers."

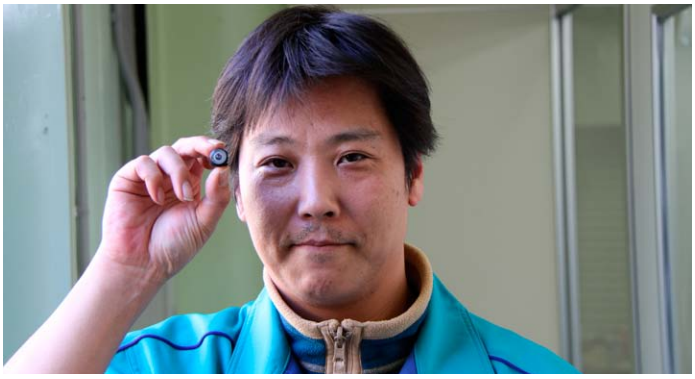
An instrument for checking flatness of optical surfaces: the Fujinon interferometer.

Do not try this at home, unless you have an abrasive water-jet cutter and advanced machine shop skills. I learned you have to cut the metal and optical elements separately, and then reassemble.

Above: Vince Pace, left, and James Cameron, right, on *Avatar* (photo: Mark Fellman). Vince Pace wrote, "Our main lenses were Fujinon 6.3-101 mm T2 zooms and specially developed 7-35 mm T1.8 short zooms. We didn't want to use primes; Fujinon stepped up to the plate. Jim wanted the flexibility and speed of using zooms."

The showroom displays one of almost every lens and camera made: ENG, a Super Fujica-6 still camera from 1955, H System lenses for Hasselblad.

Fujinon Lenses

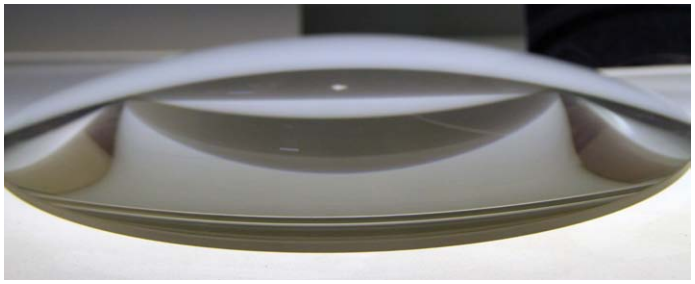


Making camera lenses begins with development and design. Let's imagine several years in the life of a Fujinon PL Premier. It begins with a concept: some years ago, someone has heard that 4K cameras are on the horizon. Marketing research determines how many to build, how much they might cost, what features to include. Designers, using the latest computer technology, simulate optical and mechanical parameters. Next, they determine types of glass, specifications of optics and mechanics, and even the machines required. Next comes manufacturing of optical and mechanical components, followed by assembly and ultimately testing, packing and shipping.

We go across the street to the massive main factory area. It's measured in acres. Of course, camera lenses are a small part of the optical devices business. It's the less glamorous non-showbiz business that occupies much of the space: mobile phone lenses, security (CCTV), optical instruments for measuring, optics for CD and DVD players, copying machines, and backup cameras for cars (bottom, left).

But I'm here for the glamor and excitement of showbiz lenses, and I'm very excited to meet a Fujifilm Lens Meister. A Lens Meister is exalted status, named in recognition of German optical history, and spoken in the same awed tones reserved for the artists, musicians and keepers of important intangible cultural properties in Japan known as Living National Treasures. Mr. Arai Masashi (above) is one of the lens meisters entrusted to create the latest Fujinon PL mount 35mm Premier Zoom Lenses.

Fujinon Lenses



Consumer camera lenses are often made with high-pressure molded plastic and glass elements, whose tolerances can be accurate to about 10 microns. Fujifilm is, I believe, the world's largest manufacturer of molded aspherical lenses.

Plastic lenses are injection molded under high heat and pressure. The plastic takes the shape of the mold, which has been machined to extremely tight tolerances. The machines are automated and unmanned, running in large 24/7 factories in Japan and abroad.

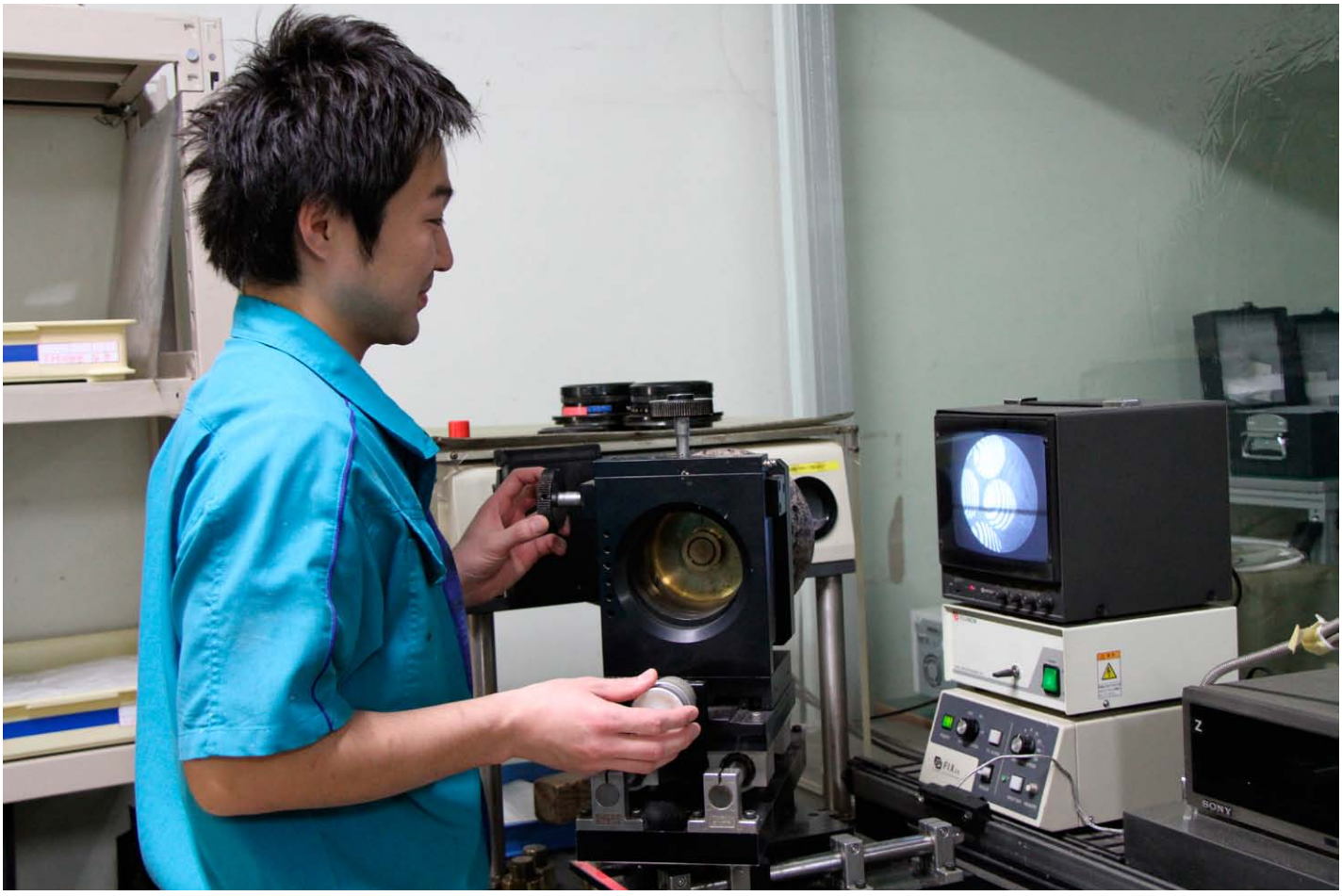
Molded aspherical glass elements are used in many optical devices and consumer cameras like the new Fujifilm FinePix X100. The raw glass is melted and pressed into a mold that is the accurate reverse shape of the continuously varying curvature that defines the aspheric lens.

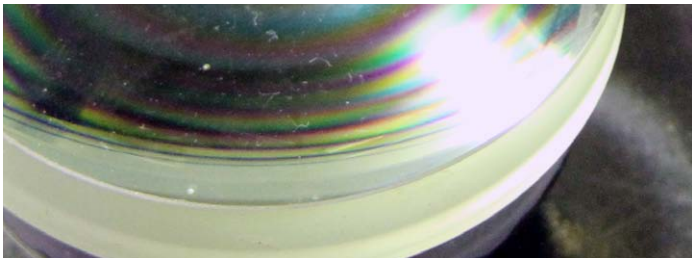
Motion picture lenses require even more accuracy, care and craftsmanship. The raw glass blanks must first be ground to rough dimensions, spherical or aspheric. Some of this work is done on new, automated polishing machines.

However, when it comes to high-end cinema optics, no matter where in the world you see lenses being built, it's all about the craftsmen and women and their human skills. It's still as much an art as it is a science. Lenses are roughed, polished, centered and edged using time-honored techniques that can only be learned through apprenticeship and years of experience. A skilled technician can often feel a miniscule imperfection even before a machine can detect it.

Polishing is accomplished by attaching the glass element to a kind of suction cup that spins it eccentrically against a disk. A slurry of increasingly fine abrasive material polishes the glass to shape. The glass that began its journey milky and cloudy now becomes increasingly clear.

Fujinon Lenses

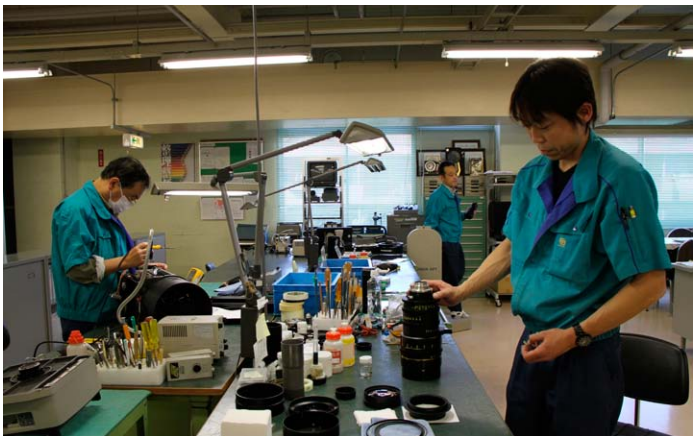


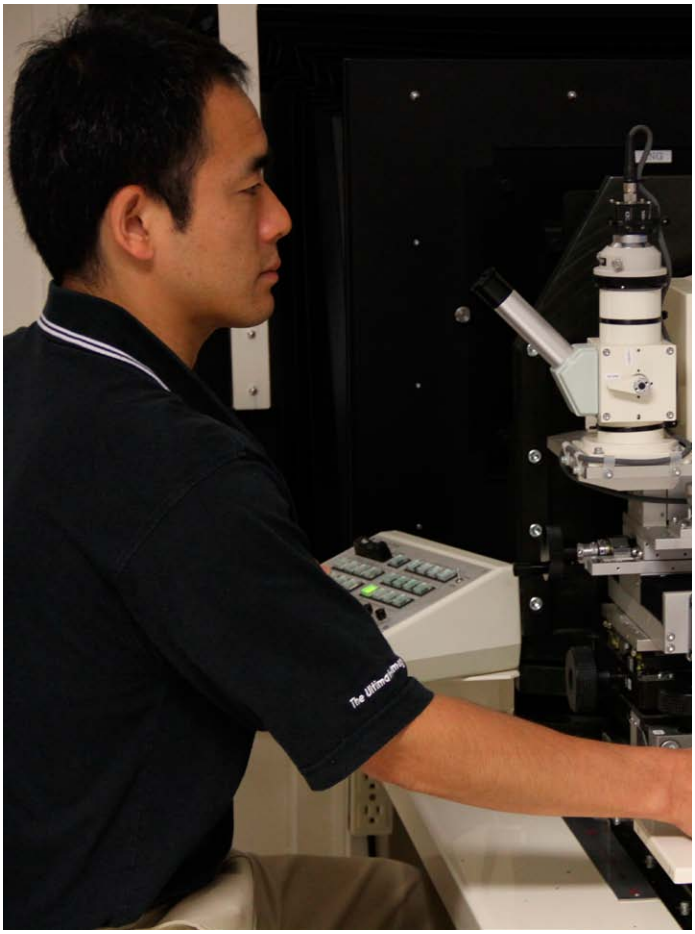


Great lenses require a great deal of measurement at every step of the way: testing for centering, alignment, and accuracy. After polishing, the elements are treated with proprietary coatings to reduce reflections and increase light transmission.

Next, they are assembled in the lens barrels, which are precision machined in-house to jaw-droppingly tight tolerances. As each element is carefully placed in the barrels, it is checked again.

Fujinon Lenses

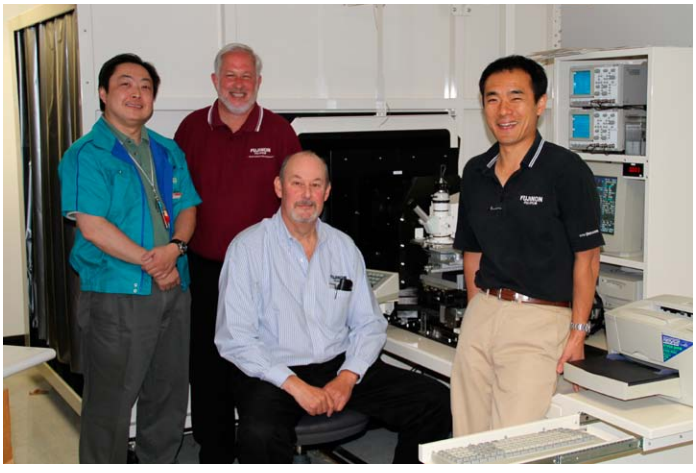




Above: Each lens is checked and double-checked on a custom Fujinon-built MTF projector. It rolls on rails to check almost every focus distance. Advanced computer readouts automatically display all critical lens parameters for the entire image area.

There are Fujinon service facilities worldwide. Here's the main service center in the factory (at left). It was good to see Mr. Junichi Aoki (bottom, left) and many familiar faces—technicians rotate from headquarters to work in the US and around the world.

Below: Fujinon factory lens service center in Wayne, NJ. Left to right: Eddie Lee, North America Service Manager; Gordon Tubbs, VP Broadcast and Communication Products; John Newton, Special Assistant to the President; Hideyuki Kasai, Engineering Manager (also at left).



Fujinon Premier 4K+ PL Zooms

Lens	14.5-45 mm T2.0	18-85 mm T2.0	24-180 mm T2.6	75-400 mm T2.8-T3.8
Zoom Ratio	3.1x	4.7x	7.5x	5.3x
Max Iris	T2.0	T2.0	T2.6	T2.8
Min Iris	T22 and Closed	T22 and Closed	T22 and Closed	T22 and Closed
Iris Blades	9	9	9	9
Close Focus (from image plane)	0.71 m / 2.3 ft	0.82 m / 2.7 ft	1.24 m / 4.1 ft	2 m / 6.6 ft
Size: Diameter x Length	136 x 310 mm	136 x 352 mm	136 x 405 mm	136 x 444 mm
Front Diameter	136 mm	136 mm	136 mm	136 mm
Weight	6.5 kg / 14.3 lbs	6.9 kg / 15.2 lbs	8.9 kg / 19.6 lbs	8.9 kg / 19.6 lbs
Focus Rotation (degrees)	280	280	280	280
Zoom Rotation	160	160	160	160
available with feet or meters focus scales				

There are currently four Fujinon Premier 4K+ PL Cine zoom lenses: 14.5-45 mm T2.0; 18-85 mm T2.0; 24-280 mm T2.6; and 75-400 mm T2.8-3.8 (T2.8 from 75-290; gradual ramp to 3.8 from 290-400 mm).

Identified by their gold band, Fujinon Premier PL lenses were originally going to be named Fujinon HK 4K zooms. The name "Premier" was chosen because these zooms go well beyond 4K.

Of the zoom lenses used in 3D productions, stereographers have told us that Fujinon Premier PL lenses consistently match each other to a superbly high level for focus, iris, zoom, color, contrast, and performance. This was clear at the factory. Each Premier lens was continuously "tweaked" at each step of manufacturing and testing: insuring that the focus scales, for example, of every lens matched every other lens.

The Premiers have a maximum aperture of T2.0 on the two widest zooms (14.5-45 mm and 18-85 mm). Shooting at T2.0 requires half as much light as T2.6, which could translate into the difference between using 5Ks instead of 10Ks.

With Fujinon Premiers, you enter the realm of exalted resolution, line-pairs, and MTF. These are among the sharpest zooms you'll see, with uniform MTF and illumination across the entire image area at all focal lengths. All four Fujinon Premier PL zooms have 136 mm front diameters. Focus, zoom, and iris gears are all in the same position—which speeds up lens changes, since follow focus accessories and lens motors can stay in the same position on the rods. Focus barrel rotation is a uniform 280 degrees on all four lenses. The Premier Zooms match color, performance and look of the top prime lenses used in the industry. The complete family of four Premier PL Series 4K+ Zooms will be at NAB booth C7525, and are ready to purchase or rent. (fujinon.com/digitalcinema)

Fujinon 2/3" C and E Series

C (Compact) Series Zooms

E Series Primes and Zooms

The new Fujinon PL Zooms join Fujinon's existing 2/3" 3-chip format high end zooms and primes for Digital Cinematography, the C series of compact zooms, (above, left group of 3), and the E series of Primes and Zooms, *(above, right)*.

Focal Length	**5mm**	**8mm**	**10mm**	**12mm**	**16mm**	**20mm**	**34mm**	**40mm**	**54mm**
E Series Prime: Name	HAeF5	HAeF8	HAeF10	HAeF12	HAeF16	HAeF20	HAeF34	HAeF40	HAeF54
T-No.	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6
Close Focus Limit	.5m/19.7"	4m/15.7"	.5m/19.7"	.4m/15.7"	.4m/15.7"	.5m/19.7"	.4m/15.7"	.5m/19.7"	.6m/23.6"
Angular field of view	7˚x56˚	61˚x37˚	51˚x30˚	43˚x25˚	33˚x19˚	26˚x15˚	16˚x9˚	13˚x7˚	10˚x5˚
Length	180.5mm	144mm	144mm	144mm	144mm	144mm	144mm	144mm	144mm
Weight	2.2kg/4.8lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb	1.6kg/3.5lb
Filter thread: M86x1	Focus Rotation: 280˚		Front Diameter: 95 mm		Iris Blades: 11				

Focal Length	**5-15mm (3x)**	**6-30mm (5x)**	**10-100mm (10x)**	**9.5-114mm (12x)**
E Series Zoom: Name	HAe3x5	HAe5x6	HAe10x10	HAe12x9.5
T-No.	1.6	1.8	1.8	1.6
Close Focus Limit from Image Plane	.56m / 22.08"	.56m / 22.08"	.94m / 36.96"	1.2m / 47.28"
Diameter x Length	128 x 287mm	128 x 277mm	128 x 302mm	156 x 433.5mm
Weight	5kg / 11lbs	4.7kg / 9.4lbs	5.8kg / 12.76lbs	10kg / 22lbs
Focus Rotation: 280˚	Iris Blades: 11			

Focal Length	**4.5-59mm (13x)**	**7.3-110mm (15x)**	**7.6-137mm (18x)**
C Series Zoom: Name	HAc13×4.5	HAc15×7.3	HAc18×7.6
Iris Blades	6	8	6
T-No.	2 - 2.9	2	1.9 - 2.6
Close Focus Limit from Image Plane	.59m / 22.23"	1.18m / 46.46"	.87m / 34.25"
Diameter x Length	95 x 238.5mm	110 x 287.3mm	85 x 204mm
Weight	1.7kg / 3.74lbs	2.9kg / 6.38lbs	1.6kg / 3.52lbs
Focus Rotation: 280˚			

Eyes on the Prize

Above: Point and shoot in the Paris (Louvre), Rome (Pantheon), Kumamoto (Castle)

Below: Magic hour in Tokyo: f/2.8 at 1/420 sec, 200 ISO. Fujifilm X100.

Fujifilm FinePix X100

At left: Mr. Shuichi Yamataka, Senior Operations Manager of Fujifilm - Optical Devices Division

Above and below: Fujifilm FinePix X100 camera

The point and shoot salute is the outstretched arm, a presbyopic squint at a tiny LCD screen, with a prayer to the gods of focus and image stabilization (opposite page).

Some day all viewfinders will be like the new Fujifilm FinePix X100 camera with its Hybrid Viewfinder. It combines an optical viewfinder, an electronic viewfinder, and a 2.8" LCD live-view capable screen. No more holding the camera at arm's length.

The optical rangefinder-style finder is bright and clear. The bright frame markings are digital displays, overlaid via prisms and mirrors–not etched onto glass like a rangefinder. The Hybrid Viewfinder can show frame markings and camera data. When you want to compare the optical view and the actual "shooting" view, flip the lever in front. It's a great tool at night or in dimly lit locations. It is also a wonderful way to review the shot.

In optical viewfinder (OVF) mode, the brightness of both the frame lines and text data is automatically adjusted according to the brightness of scene area. The displayed shooting data is constantly updated according to changes in shutter speed, exposure, sensitivity, and other settings, so your eye never has to leave the viewfinder. In electronic viewfinder (EVF) mode, you can preview the picture or play it back—the EVF finder has 1,440,000 pixels.

The FinePix X100 uses a custom designed APS-C CMOS sensor (12.3 megapixels) and fixed FUJINON 23mm f/2 prime lens. The X100 CMOS high-performance sensor was developed exclusively for this camera model. Optimization of the angle-of-incidence in conjunction with the specially developed lens maximizes efficiency, reduces shading, and minimizes refraction that can extend to the outer edges of the sensor. This gives you a sharp image with wonderful clarity. The ISO range is from 200 to 6400, but this can be expanded to include 100 and 12800. The camera feels like a classic rangefinder. There's no shutter lag. This camera has the highest resolution, sensitivity and dynamic range ever produced by a FinePix digital camera.

The FUJINON non-collapsible 23mm f/2 lens has 8 elements in 6 groups, including an aspherical glass molded lens. Having a non-collapsible lens is very helpful because not only is it compact, but it also eliminates the traditional tromboning of the lens when you turn the power on or off. You're ready to start taking pictures as soon as you turn it on. The fast f/2 lens is not only fast, but very, very sharp. The 9-bladed iris produces beautiful, circular bokehs. You can shoot in macro mode as close as 4 inches.

The FinePix X100 is beautifully crafted. The top and bottom surfaces are die-cast from magnesium alloy. The ergonomics are sensational. The camera is well balanced and solid. You don't have to drill down through a maze of menus to find what you need. Traditional controls give you immediate access to shutter speed, aperture, focus, exposure compensation, and OVF/EVF. Even better, the traditional manual dials lets you confirm the settings without turning on the power. Custom modes can also be accessed with a one-touch setting.

Shooting in RAW format is easy with just a press of the readily accessible RAW Button on the back of the camera. The built-in RAW Development function lets you process the RAW data in-camera using the camera's image quality settings. It's no surprise, coming from the same renowned company that makes Fujifilm still and motion picture film that Film Simulation Modes provide the distinctive look of Velvia, PROVIA and ASTIA color film emulsions, as well as Monochrome Mode that can be fine-tuned with R/Ye/G filter settings. There are separate adjustments for shadow tones and highlights to deal with high-contrast scenes.

Our eyes on the next prize would be reflex hybrid viewfinders for digital motion picture cameras as pioneered by the FinePix X100.

FUJINON

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Reprinted from the April 2011 NAB Edition Issue 41-42
Film and Digital Times